

P e l l F r i s c h m a n n

Foel Trawsnant Windfarm (Project Fox)

Specification and Schedule for Treatment of Mine
Workings

110636-PEF-XX-XX-RP-GE-00003

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1 Introduction

Eight wind turbines at the coordinates shown in Table 1.1 and associated access tracks and infrastructure are proposed at Foel Trawsnant to the south of Duffryn (Turbines T3, T4 and T7 have been removed from the current proposals).

The Pell Frischmann (PFC) Mining Risk Assessment (MRA) ref 110636-PEF-XX-XX-RP-GE-00002 included in Appendix B has highlighted the site lies within an area of extensive historical coal mining and has recommended that further Ground Investigation (GI) should be undertaken to investigate mine workings within the areas shown on drawings 110636-PEF-XX-XX-DR-GI-00001 to 110636-PEF-XX-XX-DR-GI-00009.

This document has been prepared to specify the treatment of abandoned mine workings by drilling and grouting to provide confidence in the performance of the ground below the level of the structures and access track foundations. Following the additional GI, this grouting specification will be revised.

The MRA and this Grouting Specification have been prepared as part of a submission to address Planning Condition 7 which states that:

“No development shall commence until a scheme has been submitted to and approved in writing by the Local Planning Authority detailing intrusive site investigations for the mine entries and shallow coal workings which shall include the following:

- a) the submission of a report of findings arising from both intrusive site investigations.*
- b) the submission of a layout plan which identifies appropriate zones of influence for the mine entries on site, and the definition of suitable 'no-build' zones.*
- c) the submission of a scheme of treatment for the mine entries on site for approval.*
- d) the submission of a scheme of remedial works for the shallow coal workings for an approval; and the scheme as approved, including any remedial works identified by the site investigations shall be undertaken in accordance with the approved details.”*

The submitted MRA provides the findings of the intrusive site investigations and therefore addresses the requirements of Condition 7(a). The drawings included in Appendix A, together with the supporting MRA narrative, identify the relevant zones of influence and associated no-build zones, and therefore address the requirements of Condition 7(b).

The MRA also provides recommendations for the treatment of mine entries and shallow coal workings. These recommendations address the substantive requirements of Conditions 7(c) and 7(d) by identifying the nature and scope of the treatment and remedial works required. The Grouting Specification along with the MRA and associated drawings sets out the detailed methodology, sequencing and implementation requirements for the treatment of mine workings and provides the information necessary to enable the Local Planning Authority to discharge Condition 7.

Table 1.1 Turbine Locations

Turbine Number	Easting	Northing
T1	283979, 193530	SS 83979 93530
T2	283853, 193719	SS 83853 93719
T3	Removed from design	
T4	Removed from design	
T5	283096, 194329	SS 83096 94329
T6	282868, 194591	SS 82868 94591

Turbine Number	Easting	Northing
T7	Removed from design	
T8	283996, 194025	SS 83996 94025
T9	283748, 194174	SS 83748 94174
T10	283726, 194429	SS 83726 94429
T11	283512, 194698	SS 83512 94698

2 General Information

'Employer' means Alerion Uk Ltd and includes the Employer's successors.

'Client' means Alerion Uk Ltd and includes the Client's successors yet to be appointed on a Design and Build contract.

'Designer' means Pell Frischmann or other Designer appointed from time to time by the Employer and notified in writing to the Contractor to act as Designer, for the purpose of the Contract in place of the said Pell Frischmann.

The 'Contractor' will be the successful tenderer (Grouting Contractor). The Contractor maybe required to act as 'Principal Contractor' depending on the sequencing of the works.

This specification is for the treatment of the abandoned Coal and fireclay workings situated below the proposed infrastructure to be constructed as part of the Foel Trawsnant Windfarm. This involves drilling and grouting ground treatment at proposed turbine and access track locations, to provide confidence in the performance of the ground below the level of the structures and access track foundations.

The Contractor is required to treat the ground, in the area indicated on the drawings listed in Section 2, such that future upward migration of any voids present is limited and any potential settlement of the infrastructure is minimised. During the grouting process, the Contractor's method of working should not give rise to any ground settlement or heave. Where the Contractor believes that the Specification compromises his best working practice or may lead to the above requirements not being met, then the Contractor shall inform the Designer in writing at the earliest opportunity so that the method of working can be reassessed.

Prior to commencement of the Works the Contractor shall produce a Method Statement or Method Statements to cover all aspects of the works and shall submit this/these to the Designer and Employer for approval.

A Design Risk Assessment is provided in Section 16.

The Client will provide the following:

- welfare facilities;
- access roads suitable for grout mixing plant, deliveries by bulk haulage, access to stockpiles and working area;
- a level hard surfaced compound to site the grout mixing area;
- a level working platform for the grouting rigs and ancillary plant.

The Contractor will provide the following:

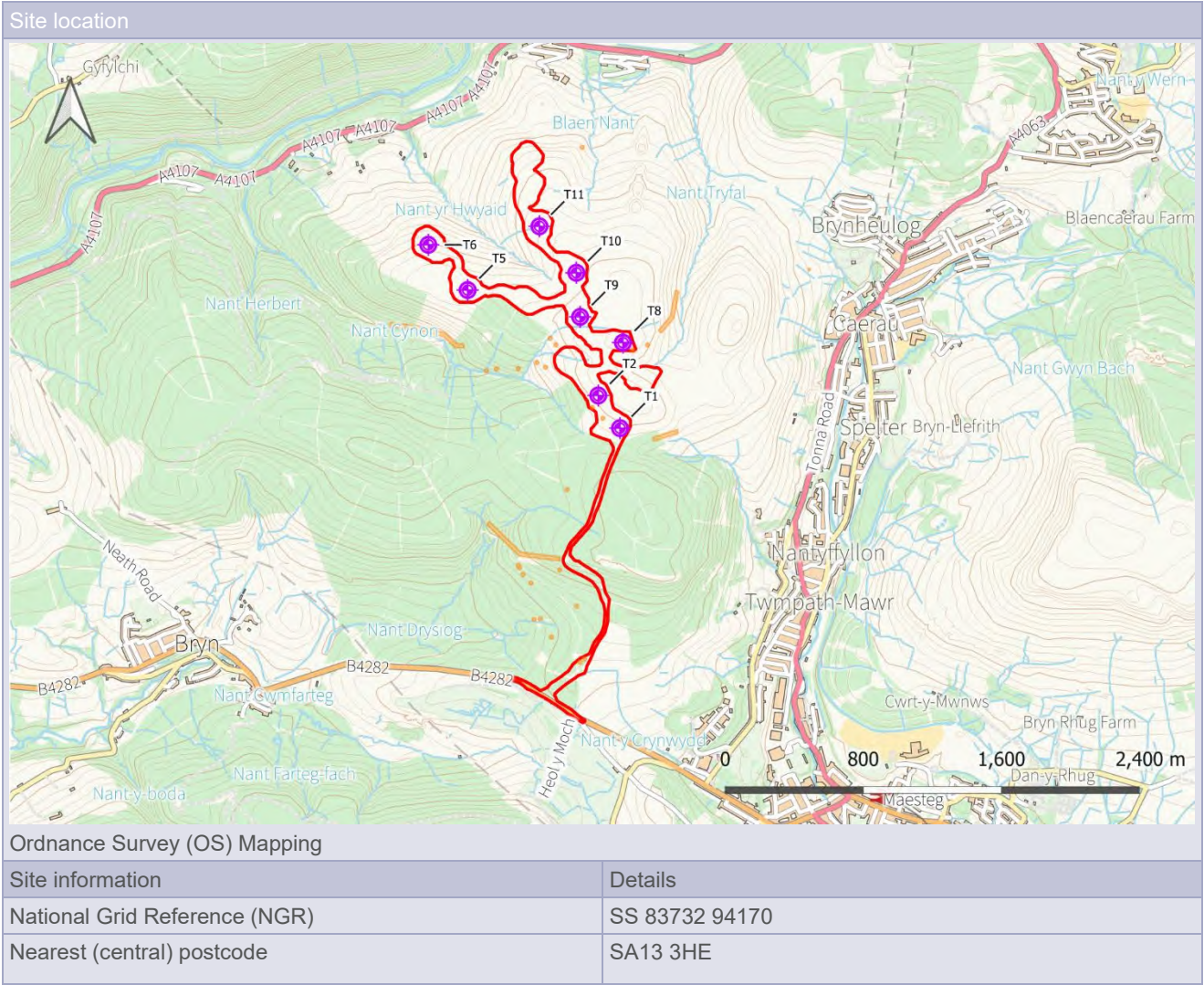
- an adequate water supply within pumpable distance of all grout mixing areas and drilling locations.

The Contractor should take note of the specific health and safety requirements regarding the requirements of the Mining Remediation Authority as detailed in Section 3.1.

2.1 Location

The site is located at Foel Trawsnant to the south of Duffryn, comprising the land between Cynonville and Nantyllyllon, approximately 2.3km north-west of Maesteg and is situated between 371m and 215mAOD. The National Grid reference of the approximate centre of the site is at 283732, 194170. The side boundary is shown in Figure 1 (in red).

Figure 1 Site Location Plan



3 Ground Conditions & Treatment Proposals

The ground conditions were established through the interpretation of historic and recent ground investigations. A summary of existing ground investigation and previous reporting is provided within the PFC Mining Risk Assessment Summary ref 110636-PEF-XX-XX-RP-GE-00002 included in Appendix B. The Intégral Géotechnique (Wales) Limited Factual Site Investigation Report and Interpretative Site Investigation Report produced in 2021, are presented in Appendix C for reference.

The on-line Geo-Index search-engine shows superficial deposits of Alluvium mapped to the east of the site and Till mapped to the east and south of the site, both predominantly at the base of the surrounding valleys. Glacial Till is indicated in the valley of the Nant yr Hywaid in the north-west of the site. A pocket of Peat is also mapped to the west of the main southern access track.

Bedrock across the main windfarm site is mapped as Sandstone of the Rhondda Member, mudstone, siltstone and sandstone of the Llynfi Member described by the BGS Lexicon as fluvial in origin. To the south of the windfarm site, along the access road, mudstone, siltstone and sandstone of the South Wales Upper and Middle Coal Measures Formation is mapped.

The Wernpistyll coal seam, Wernddu (No.2 Rhondda) coal seam, Field Vein coal seam and several thin coals are indicated to outcrop within the site. Strata dips of 12 degrees and 15 degrees towards the north-west are indicated within the vicinity of the site.

A fault transects the southern portion of the main site, trending largely west-north-west to east-south-east, crossing the area of former turbine positions Turbine 3 and Turbine 7. The Environmental Statement (Wood Environment and Infrastructure Solutions UK dated December 2018) indicates that the fault is known as the Jubilee Slide.

A summary of the anticipated geological succession, reproduced from the Walters UK Ltd Interpretive Site Investigation Report (2021) is given below in Table 3.1.

Table 3.1 Anticipated Geological Succession Summary

Geological unit	Horizon	Description
Quaternary	Glacial Till	Sands and gravels with varying matrix.
Carboniferous	Rhondda Member	Green-grey, lithic arenites ("Pennant sandstones") with thin mudstone/siltstone and seat earth interbeds and mainly thin coals.
Carboniferous	Llynfi Member	Green-grey and blue-grey, feldspathic, micaceous lithic arenites ("Pennant sandstone") with thin mudstone/siltstone and seat earth interbeds and mainly thin coals.

The site is in an area of known historical mining and there are recorded mine workings and mine shafts in the vicinity. The treatment of mining features, such as underground workings, collapsed ground, stowed waste, shafts, adits and the like, is likely to be required at the locations identified on the following drawings included in this report as Appendix A. Following revisions to the location of the Turbines and access roads, further ground investigation is required to inform the detailed grouting specification.

3.1 Turbine 1

There is a potential risk of unrecorded shallow mine workings associated with the Wernpistyll coal seam, and a relative lesser risk associated with the overlying Wernpistyll Rider (thin) coal seam. The 2025 proposed location has moved 21m closer to the worked area as per the historical abandoned mining map therefore ground investigation is required to confirm low risk of unrecorded workings. Four 30m boreholes shall be undertaken at the 2025 proposed location of T1. Intact coal was encountered during previous GI at the previous location of T1 however if evidence of workings is encountered, the ground should be treated in accordance with this specification.

3.2 Turbine 2 and access track between T1 and T2

A potential risk has been identified beneath the access track between turbines T1 and T2 in the south of the site associated with two adits where mine entry 008 (283193-008) is likely to be directly under the proposed access road between the two turbines.

Trial trenching of the adit portal entrance to 283193-008 and boreholes drilled along the proposed alignment to the access track will be undertaken to assess the potential for ground subsidence associated with adit 283193-008. Additional boreholes (30m bgl) will also be undertaken along the southern extent of the access roads between adit 283193-008 and T2.

T2 has been relocated 7m to the SE and as the strata dips to the NE, the workable coal seams at the new location to the SE are estimated to be at a shallower depth therefore a potential risk of ground subsidence associated with historic underground mine workings has been identified.

Considering the complex nature of the mine workings shown on the abandonment plan, at least two 30m boreholes (blue dots on Figure 7) will be undertaken at the current location to provide full coverage beneath the latest T2 location.

A mixture of intact coal and workings have previously been encountered in the area therefore it is likely workings will require treatment in accordance with this specification.

3.3 Turbine 8

A potential risk of ground subsidence associated with historic underground mine workings has been identified beneath T8 as the proposed location of T8 has been relocated 20m to the west of the existing ground investigation boreholes which were centred around a previous location.

Although the any potential workings will be deeper below the proposed T8 location they remain within influencing depth of the foundations therefore it is very likely the new location will also require treatment. Five additional boreholes will be undertaken to 30m depth to identify any shallow workings in the vicinity of T8 to understand the extent and thickness of the mine workings in this area and treatment/grouting of any encountered voids/workings will be undertaken in accordance with this specification.

3.4 Access track between T8 and T9

A potential risk has been identified beneath the access track between turbines T8 and T9 associated with the abandonment plans for the Foel-Y-Duffryn Colliery. Boreholes drilled along the proposed alignment to the access track will be undertaken to assess the potential for ground subsidence associated with collapse of potential workings. Any workings encountered beneath the access track will be treated in accordance with this specification.

3.5 Main Southern Access Road

A potential risk has been identified at the southern end of the main southern access track from the Golden Vein seam which is considered to be 1.33m thick. At the highest level of the workings beneath the access road (259mAOD), ground level is around 260mAOD, which coincides with adit number 283192-028 at around NGR SS837931. As ground level along the access road increases to the north, the workings dip or deepen towards the north-north west where they meet the main access track again at NGR SS836927 at which point the difference between the workings and existing ground level is approximately 197m and the risk of influence at the surface is negligible. The workings continue north along the main access track however, the seam dips north-northwest and ground levels increase to the north therefore the risk of ground subsidence arising from (recorded or unrecorded) mineworking beneath the main access track reduces from high to low over a short section of the southern end of the access road heading away from the adits.

Clay Seam workings (8371) cross the main access track at around NGR SS837927 at a level between 277 and 285mAOD with existing ground levels at approximately 320mAOD giving a potential depth to workings of 35m. The Clay Seam is considered to be around 0.66m thick and at a depth of more than 35m bgl is considered low risk.

Further workings in the Clay Vein are shown on abandonment plan SWR3762 however this plan contains no level information for the workings. The workings cross the main access track where existing ground levels are a minimum of around 300mAOD, potentially within 15m vertical separation from the workings, assuming similar levels taken from abandonment plan number 8371; however, in all likelihood the seam will dip to the northwest and be at much greater depth and is relatively low risk. Workings continue to cross the main access track further north however existing ground levels increase significantly to in excess of 340mAOD.

The White Seam is below the Clay Seam in the geological sequence and crosses the main access track at a level of approximately 297mAOD where ground levels are around 340mAOD giving a potential depth to workings of 40-45m which is considered to pose little risk to the access track.

Further workings are shown on abandonment plan SWR3764, again with no level information presented.

Ground levels where the workings cross the main access track are around 342.5mAOD. Assuming similar levels for workings for the White Vein (assumed White Seam) the potential depth to workings here is around 45.5m and considered low risk.

A potential risk has been identified associated with shaft and adit records for 283192-027 and 283192-028 respectively (shown in less detail in Figure 10). The workings associated with these mine entries head away from the access road at shallow depth but are indicated to cross back beneath the route of the road further north at significant depth such that they do not pose a risk.

Trial trenching of the adit portal entrance to 283192-028 will be undertaken with boreholes drilled along the proposed alignment immediately to the north of the adit on the main southern access track, to assess the potential for ground subsidence associated with adit 283192-028. Adit 283192-027 has been treated by collapsing and backfilling and no further treatment is proposed at this stage; however, this will need to be reassessed once the road alignment is fixed to confirm that the road crosses the already treated section of the adit. A similar approach to treatment of adit 283192-028 by collapse and backfill will be considered if it is found to run beneath the access track. Confirmation of this, or any further works required, would be submitted to the LPA for further consideration.

Any workings encountered beneath the access track will be treated in accordance with the grouting specification.

4 Scope of Grouting Works

4.1 General

The objective of the drilling and grouting is to stabilise / consolidate the mining features, to reduce construction risk and reduce the potential for total and differential settlement of the permanent works.

The Contractor will advise the Designer at any time if he considers that the proposed grouting is unlikely to accomplish the required consolidation due to, in their opinion, differing ground conditions from those anticipated, or for any other reason. The Contractor will satisfy themselves that the proposed grillage of holes will accomplish the required consolidation of fractured / voided / potentially worked ground at the spacing and area they deem appropriate for the works.

The areas shown on drawings 110636-PEF-XX-XX-D-G-0010 to 110636-PEF-XX-XX-D-G-0012 have been identified for further ground investigation to quantify the risk from former mine workings. Following the additional ground investigation, the drawings will be updated and grouting techniques adopted to infill voids.

This specification does not include any works related to the Made Ground or superficial deposits, such as investigation or ground treatment.

This specification does not include associated work, such as site clearance, ecological mitigations, utility diversion, surveying, monitoring, temporary works or traffic management, which are to be determined by the Employer.

The Contractor will carry out treatment of mining features as detailed in this specification and as appropriate for their scheme design.

All treatment of mining features will be undertaken following CIRIA guidance: Construction Over Abandoned Mine Workings (1984, SP32) and the Abandoned Mine Workings Manual (Sept 2019, C758D).

The Contractor will carry out any necessary liaison with third parties, such as the Mining Remediation Authority and Environment Agency and will gain all appropriate permissions and permits for the works and comply with their requirements.

Should the Contractor wish to utilise Pulverised Fuel Ash (PFA) they will undertake a risk assessment in accordance with the Environment Agency guidelines and BRE Building Technology Group publication 'Stabilising mine workings with PFA grouts', Environmental Code of Practice, 2nd edition 2009 and obtain approval from the Environment Agency. The Contractor is responsible for identifying the requirement (and obtaining if necessary) the proper consent under the Environmental Permitting Regulations (EPR) 2010 (Regulations 38 and 12).

Permission to enter or disturb Mining Remediation Authority assets is required. The Contractor will prepare and submit on behalf of the Employer all necessary applications and supporting documents.

The cost of the application(s) will be paid by the Contractor.

The works will be planned and supervised by the Contractor in accordance with the requirements of the Mining Remediation Authority and 'Guidance on managing the risk of hazardous gases when drilling or piling near coal'. Drill flush and requirements for monitoring for gases at locations / frequencies are to be determined by risk assessment and approved by the Mining Remediation Authority permitting process.

The Contractor will record and present information for validation of the treatment of the mine workings as stated within this Specification and provide Closure Summary Reports to the Mining Remediation Authority on completion of the works or as otherwise required to satisfy the requirements of the Mining Remediation Authority permit(s). Contractors method statements will be provided in advance of the works.

The Contractor will ensure that suitable screening / containment is provided around the works to reduce noise levels and prevent dust, arisings and flushing medium causing a nuisance, damage or safety concern to any adjacent properties, highway and public areas.

The Contractor's attention is drawn to the nearby water course/groundwater bodies and the need to prevent contamination thereto as a result of their operations.

The Contractor will provide CVs for all supervisory staff in advance of the works for approval by the Designer and Employer.

Site supervision provided by the Designer will be Senior Engineer / Engineer grade reporting to a Chartered Engineer (office based) all with experience of grouting works.

4.2 Mine Shafts and Adits

Mine entries/portal entrances are not considered to pose a risk to the proposed turbines; however, adit records 283193-007 and 283193-008 are located near to the proposed access track in the south of the turbine area and shaft and adit records for 283192-027 and 283192-028 respectively are located near the southern extents of the main southern access track.

Trial trenching will be undertaken of the adit portal entrance to 283193-008 and boreholes will be drilled along the proposed alignment to the access track to assess the potential for ground subsidence. Additional deep boreholes (30m bgl) will be undertaken along the southern extent of the access roads between adit 283193-008 and T2.

Trial trenching of the adit portal entrance to 283192-028 will be undertaken and boreholes will be drilled along the proposed alignment to the main southern access track immediately to the north of the adit to assess the potential for ground subsidence associated with shallow workings associated with the adit 283192-028. Adit 283192-027 has been treated by collapsing and backfilling and no further treatment is proposed at this stage; however, this may be reassessed once the road alignment is fixed. A similar approach will be taken for treatment of adit 283192-028 if it is found to extend or be within influencing distance of the access road.

Should a mineshaft be encountered this will be subject to stabilisation works / capping, which will be designed by the Contractor and submitted for approval by the Designer and the Mining Remediation Authority.

The drilling and grouting of features suspected as a mine shaft will be phased as follows;

- a. Investigative probing to identify perimeter of the mine shaft, elevation of the base of the mine shaft and qualitative indication of shaft infill material.
- b. Drilling and grouting of the mine shaft.
- c. Drilling and grouting under mine shaft cap and support zone, where required.
- d. Verification by pressure grouting and rotary rock coring.

Investigative probing to confirm the elevation of the base of shaft will;

- a. confirm at least 5m of hard strata prior to termination.
- b. include a downhole camera survey where significant voids are identified.

Drilling and grouting of the mineshaft will adopt the following sequence of works, assuming the mineshaft is infilled. Should major voids be identified the grouting operation will need adjusting in consultation with the Designer.

- a. Gravity grouting will commence within the mine shaft from the base upward.

- b. If grout has not appeared at the point of injection after 10 tonnes of grout materials have been placed, injection will be suspended for 12 hours and an additional 10 tonnes of material placed. If the hole is still accepting, after a further 12 hours delay sand will be added to the grout mix and an additional 10 tonnes of material will be placed, with additional sand content added to a further 10 tonnes if grout take continues.
- c. After gravity grouting, with nominal 10m borehole casing installed, the grout will be gradually pressurised to the limit detailed below.
- d. Three grout holes for pressure grouting (provisional number of holes; to be confirmed after mine shaft investigation) arranged equally around the centre hole within the shaft will be undertaken. Probe holes will terminate once 5m of hard strata has been proven. Pressure grouting will be undertaken from the base upwards. Grout pressures will be increased incrementally to the pressure limit at that depth. The drill string will be withdrawn by up to 6m and the procedure repeated up to the top of the shaft.
- e. A limiting grout pressure of 200kN/m², measured at the top of the probe hole, will be used below 40m depth, reducing when shallower than 40m depth by 5kN/m² per m of overburden assuming that the mineshaft is infilled.
- f. If pressure is not achieved or grout has not appeared at the point of injection after 10 tonnes of grout materials have been placed, injection will be suspended for 12hrs and an additional 10 tonne of material placed. If the hole is still accepting after this sand will be added to the grout mix.
- g. Four probe holes for pressure grouting arranged equally around and 1.5m outside the shaft (provisional number of holes; to be confirmed after mine shaft investigation) will be undertaken to prove the integrity of the support to the mine shaft cap and / or grouting of collapsed ground immediately adjacent to mine shaft. Holes will be drilled to 5m into sound rock beyond the mined seam.
- h. If significant voids are encountered at any stage of the grouting process, the voids will be filled with inert granular pea gravel and grouted. The Contractor submits the proposed grading of pea gravel to the Designer for approval.

The sequence of works described herein is on the basis that a temporary spanning platform is provided by the Contractor for probing, drilling and grouting works over the weak ground.

Based on the guidance on Table 14.3 of CIRIA C758D (Abandoned mine workings manual) the treatment options for medium situational risk areas will be considered with remedial options determined based on the proximity of the entry to turbines or associated infrastructure.

The mine shaft treatment will be designed in accordance with guidance within CIRIA SP32, industry best practice and the CIRIA report C758D. The Contractor will obtain approval from the Designer and the Mine Remediation Authority for the design of the mine shaft caps.

4.3 Mine Workings

The proposed ground investigation will investigate mine workings within the areas shown on drawings 110636-PEF-XX-XX-D-G-0010 to 110636-PEF-XX-XX-D-G-0012 which will inform a revision of this grouting specification.

Grouting works will be designed and carried out in a phased manner, with interpretation of the site records of each phase by the Contractor, with approval of the Designer on a daily basis, to determine the scope of subsequent phases of work and any adjustment to the depth and spacing of holes. This reflects the observational method described in BS EN 1997-1:2004+A1: 2003. The typical sequence of work will comprise:



Primary drilling and grouting will be carried out on a 6m offset grid.

Secondary grouting will be carried out in locations where the grout take in primary holes is one of the following, or as otherwise approved by the Designer:

- a. indicative of collapsed or infilled workings.
- b. more than 1.5 tonne/hole.
- c. more than two times that of the median grout take of primary holes in that area of the site.

Tertiary grouting will be carried out in locations where the grout take in secondary holes is one of the following, or as otherwise approved by the Designer:

- a. more than 1.0 tonne/hole.
- b. more than two times that of the median grout take of secondary grout holes in that area of the site.

The primary grouting proposals have been developed on the basis that the mine workings are infilled or collapsed, without the requirement for completion of perimeter grouting followed by infill grouting. Should site conditions dictate that perimeter grouting is required, revised grouting proposals will be developed by the Contractor for the approval of the Designer.

Where grout takes are significant, permeability testing by grout acceptance testing will be checked by drilling test holes in positions selected by the Designer and injecting grout at pressures appropriate to the depth, all in accordance with the requirements for infill grouting.

If the Designer considers that the quantities of grout accepted are excessive, further holes will be drilled and grouted at a spacing agreed with the Designer. After testing, holes will be completed in accordance with the requirements for grouting holes.

4.4 Safety

The Contractor is responsible for providing suitable working platforms from which to undertake the mining feature treatment.

5 Grouting Materials

5.1 General

The materials employed in the grout shall be as set out below.

5.2 Constituent Material for Grouting

Water to be used in grout shall be from the mains supply or other agreed source.

Cement shall be sulfate resistant Ordinary Portland Cement (OPC) complying with BS 4027.

PFA shall comply with BS EN 450-1 and be conditioned hopper ash, or dry powder ash, of a type suitable as a constituent for grout and obtained from an approved supplier.

Sand shall generally comply with BS 882, and be of a grading suitable for use in the Contractor's plant and approved by the Designer.

Pea gravel shall comply with BS 882, and be of grading approved by the Designer.

Thixotropic admixtures shall be bentonite or other admixture approved by the Designer.

6 Storage and Use of Materials

The Contractor shall ensure that all materials are stored and protected so as not to deteriorate, become damaged or contaminated, nor to hinder his works, nor to cause unnecessary disturbance to the site, nor cause nuisance on or away from the site of the works. Cement shall be kept in a dry location, and the sequence of deliveries recorded so that the cement can be used in rotation.

Unsuitable materials identified on site shall be marked in an obvious manner (until taken to a waste tip) to ensure they are not used.

Details of quantities of delivery of materials should be copied to the Designer.

7 Grouting Plant

Grout materials shall be introduced into the mixer via approved weight batching equipment. The grout mixer shall be capable of producing an intimate homogenous mix, all particles being thoroughly wetted without segregation occurring.

Provision shall be made for monitoring the quantity being delivered from the grouting plant. The Contractor shall supply details of the method of monitoring and calibration of equipment.

8 Grout Mix Requirements

8.1 General

Before work commences the Contractor will obtain approval from the Designer for the selection of grout mixes that the Contractor proposes to use based on availability of products that are likely to prove satisfactory for the conditions. The grout mix to be employed in the execution of the works may typically be as detailed below.

- Cement: PFA = 1:10 by weight.
- The minimum amount of water will be added to render it of a workable consistency, typically expected to be 0.4 water to solid ratio.
- High bleed grouts will be avoided and bleed capacity will be limited to 5% maximum. In the event of comparatively high grout takes then the ratio of PFA:cement may be varied and/or sand added, with a grading suitable for use in the Contractor's plant and complying with BS EN 12620.
- The grout should achieve a minimum cube strength of 2.5N/mm^2 at 28 days as detailed in Section 12.
- If any borehole takes a grout quantity of more than 10 tonnes then the grout mix is to be changed to 5:5:1 PFA:sand:cement (or as instructed by the Designer).
- The minimum cementitious content shall be 75kg/m^3 to allow for dilution effects in waterlogged workings.
- If open voids are encountered (defined by a gravity fall of more than 300mm during drilling) then instructions regarding the injection mix will be issued by the Designer.
- For large or interconnecting cavities exceeding 500mm high, pea gravel infilling shall be used to limit grout travel outwith the area of consolidation.

9 Grout Properties

Grout mixing and pumping plant will be such that the grout is thoroughly agitated and remains in an intimately mixed condition.

The pump will normally be a double acting long stroke reciprocating pump, or equivalent alternative. It will be capable of delivering the grout at pressures of 200 kN/m² and will be equipped with a pressure gauge at the top of the grout hole to register delivery pressure.

A triple outlet 'T' connection pile will be attached to the top of the drill string such that a free outlet is available to check the flow of grout.

Grout flow properties when measured on a "Colcrete" type flow meter should be between 300 and 600mm (12 – 24").

High bleed grouts shall be avoided. Bleed capacity shall be limited to 5% maximum, whenever possible.

10 Drilling Procedures

10.1 General

All probe holes will have unique identifiers to be agreed in writing with the Designer prior to commencing intrusive operations.

Setting out points are to be confirmed following completion of the ground investigation and updated topographical survey.

All drill holes, including any in which solid coal is proved, are to be used for the injection of grout. They shall be drilled by rotary or rotary percussive techniques down to a minimum of 3.0m below the pavement of the old workings or to the elevations which will be stated in Section 3 of the updated grouting specification, whichever is deeper. The drilling system, requirement for inclined holes and flushing medium to be used shall be agreed in writing with the Designer and defined in the Contractor's Method Statement.

The Contractor will be responsible for setting out the hole positions and recording National Grid coordinates and ground elevation ± 0.1 m of each probe hole. The permitted deviation for setting out holes will be 150mm on plan or subject to the written approval of the Designer.

The verticality and inclination of all drill holes shall be checked prior to commencement of drilling using an inclinometer against the drill rods. The holes shall be to an accuracy of $\pm 1^\circ$ from vertical measured by this method. This data should be plotted on a plan, which will be submitted digitally in pdf and native format to the Designer within a maximum of 2 working days.

The minimum diameter of holes for all holes shall be 50mm. When it is impracticable to drill at a constant diameter for the full depth, the diameter of the holes shall be increased in the upper lengths. The holes shall be suitably cased through any superficial deposits or made ground down to 1m below rockhead. If necessary the holes shall be kept open by means of a series of steel/alkathene tubes (tremie) or temporary casing placed to the bottom of the hole until grout injection into the workings is complete. The Contractor shall recover from all drilled holes all grout tubes, drill rods, casing or other equipment. No equipment shall be abandoned in a drilled hole without the written consent of the Designer.

Where drilling returns are 'lost' owing to the presence of loose ground, cavitated ground or water bearing strata, drilling shall proceed no deeper than 5 metres below the depth at which returns were lost. If after drilling the 5 metres without a reestablishment of the returns, the Designer shall either instruct the Contractor to terminate drilling at that position or to insert casing to such a depth that drilling returns are established. The method of recording grout take will be submitted by the Contractor for the written approval of the Designer.

Where multiple seams are to be treated, the uppermost seam shall be treated first, followed by each underlying seam in turn. Where the uppermost seam is encountered as intact coal (i.e. unworked), drilling shall continue until an old working is encountered in an underlying seam to be treated or to a maximum depth of 1.0m beneath the pavement of the deepest seam to be treated (should all seams be encountered intact).

Where a hole proves abortive because it becomes obstructed, or because of the failure to progress the hole, it shall be re-drilled at a larger diameter and re-cased, or a new hole drilled and cased.

Where the uppermost seam is encountered as an old working, the drilling shall terminate 1.0m below the pavement of the old working whereupon grouting will commence as outlined in Section 10. Following a period of at least 48 hours from completion of grouting the old working, drilling shall recommence at the position, through the grouted column, to the next underlying seam.

The grout hole spacing for the primary holes will be confirmed in the detailed grouting specification and dependant on location.

Grouting shall start from the deepest (i.e. down dip) working up to the shallowest holes. Where secondary holes are instructed they will be at 3m spacing. Tertiary holes will be at 1.5m spacing.

If crown holes or shafts are suspected to be present drilling and grouting may be instructed down to 1m centres. The Designer may alter (by written instruction) hole spacings during the course of the works, should the ground conditions dictate.

Upon completion of grouted areas, a number of pressure injection test holes will be drilled and grouted with the approval of the Designer to assess the adequacy of the works. Drilling will not take place that would intercept the pavement of the seam within 12 metres of grout that has been placed for less than 24 hours, except where grouting was only backfilling a solid hole.

11 Grouting Procedures

11.1 General

Subject to written instructions being received from the Designer grouting of holes shall proceed systematically from the deepest point of the workings.

11.2 Water Supply and Site Cleanliness

The Contractor is required to make provision for supply of water and other services required for grouting operations and to provide for the disposal of surplus grout and slurries produced in the cleansing plant and in any other part of the operation.

The Contractor shall keep the site clean and tidy at all times during the work and at the completion of the work.

The Contractor shall make provision to prevent any grout spillage or run off from the site by construction of a suitable sump or provide a portable collecting tank. The Contractor shall not contaminate or cause to be contaminated any watercourses or water supplies.

11.3 Site Procedure

Immediately prior to grouting each hole, the Contractor shall check that the tremie or temporary casing is unobstructed to the required depth to receive the tubing or pipe for grout.

Obstructions shall be dealt with as described in 'drilling procedures' above. Grout shall be tremied into position down each hole via a series of steel/alkathene tubes placed to the bottom of the hole, until grout appears at the surface, whereupon the tremie hose is withdrawn. In infill and attenuation curtain grout holes, the grout line at the surface is then attached to an approved T-connection with an attached pressure gauge fixed to the top of the drill hole. Provision shall be made for monitoring the quantity being delivered in the line.

The grout shall be injected at the approved rates until either a limiting pressure of 5kN/m² per metre of superficial (soil) overburden or a maximum of 200kN/m² is reached in boreholes or when grout appears from the mouth of the boreholes or from near the point of injection, when the hole shall be deemed complete.

If grout does not appear at the point of injection after 10 tonnes of grout materials have been placed, the grout tube or pipe shall be removed from the hole and injection suspended. After a period of at least 12h the grout mix shall be changed typically by addition of sand to create a 5:5:1 PFA (typically):sand:cement mix, as set out in Section 8.1, and up to a further 10 tonnes of materials shall be injected. If there is still no result, injection shall again be suspended for at least 12h and the process shall be repeated with further quantities of 10 tonnes. If the hole is still accepting grout after a total of 40 tonnes of materials have been injected without any sign of the hole being completed, the Contractor shall consult the Designer to determine whether the injection is to be continued or other measures are required

11.4 Escape of Grout and Ground Heave

The Contractor shall be held wholly responsible for ensuring the grout is not allowed to penetrate any nearby drains, sewers, culverts, service ducts and cellars, etc. The Contractor shall employ a site supervisor and shall regularly inspect all services in the vicinity of the site to ensure the absence of grout.

12 Grout Testing

12.1 Bulk Grouting

Before work commences the Contractor will obtain approval from the Designer to the selection of grout mixes that the Contractor proposes to use that are likely to prove satisfactory for the conditions. The Contractor will prepare cubes of an agreed size, representative of the mixes agreed and will test them by crushing at 14 and 28 days in accordance with BS 1881. Where time permits the results of the tests will be furnished to the Designer prior to commencement of grouting operations. The grout should achieve a minimum cube strength of 2.5N/mm^2 at 28 days.

The Contractor shall check the flowability of the grout on site during operations by means of the "Colcrete" type flow meter as outlined in Section 9. A minimum of two tests shall be undertaken every 24 hours and tests may also be undertaken at the Designer's discretion.

Bleed capacity readings shall be at hourly intervals from 2 hours, after monitoring starts for not less than 6 hours until settled conditions occur. One test shall be carried out for each batch. Bleed capacity should be measured in a clear plastic or glass graduated cylinder, which has an internal diameter not less than 50mm. After placing the grout, a cover should be placed over the cylinder to avoid evaporation.

For strength testing, the Contractor shall make sets of nine test cubes of an agreed size and taken from the grouting pipe, at surface positions, every 24 hours or as agreed with the Designer. The cubes shall be marked, handled, stored and tested by an approved independent testing laboratory in accordance with BS EN 12390-1 2000 and BS EN 12390-2: 2000 to confirm the projected 14 and 28-day strengths of the grout. Crushing strengths shall be not less than 2.5MN/m^2 at 28 days.

If the results of the tests indicate that a change of mix proportions is required, the Contractor shall agree such modifications as may be necessary with the Designer. The Contractor shall ensure further testing of the cubes is undertaken by an independent testing laboratory in accordance with BS EN 12390-1 2000 and BS EN 12390-2: 2000 to confirm the projected 3, 7 and 28-day strengths of the grout.

13 In Situ & Verification Testing

Permeability by grout acceptance testing shall be checked by drilling test holes in positions to be selected by the Designer and then injecting grout at pressures in accordance with the requirements for infill grouting and outlined in Sections 4.2 and 11.3. The injection pressure will require to be held for an appropriate period of time (approx. 5 mins). Appropriate casing, capable of sustaining the test pressures, should be used. If the Designer considers that the quantities of grout accepted are excessive, further holes shall be drilled and grouted.

The consolidated ground will be subject to verification testing by rotary coring and pressure grouting, carried out at such places and times during the contract as the Designer may direct, when the grout in the ground has achieved a minimum compressive strength of 1N/mm^2 .

A minimum of one core hole will be completed in each of the locations subject to grouting of mine workings. The core holes will comprise continuous rotary coring of minimum 100mm core diameter to a minimum of 5m below the base of the grouted ground. When the samples have been taken the hole will be filled up with grout injected in accordance with the requirements for infill grouting. The cores will be logged in accordance with BS EN ISO 14688, and BS EN ISO 14689.

Verification pressure grouting will be undertaken on completion of drilling and grouting, to be carried out in accordance with pressure grouting detailed above. This will include as a minimum one in the centre of each shaft and one for each turbine foundation grouted.

If the Designer considers that the quantities of grout accepted are excessive or the core hole logs indicate insufficient ground consolidation, further holes will be drilled and grouted. After testing, holes will be completed in accordance with the requirements of grouting infill holes.

14 Records

The Contractor shall prepare, and keep available for inspection on site, plans showing the positions of all holes. Records, in the form of cross sections through the rows of holes, to show the results of the Works (in particular the information in items 9, 10 and 14 to 21 inclusive of the Daily Drilling Records), together with the total amounts of grout injected shall also be maintained.

The plans and sections shall be updated daily in conformity with the Records noted below. On completion of the Works, the Contractor shall provide all records relevant to the works and their interpretation including fair copies of the plans and sections to the Designer.

As work proceeds, the Contractor shall maintain separate Daily Records for Drilling, Grouting and for Materials and Plant Received in a form to be approved by the Designer. The Daily Records signed by the Contractor's agent shall be submitted each following morning to the Designer for his agreement. The Contractor shall provide one copy of the agreed Record for the Designer's retention and keep a further copy available for inspection on site.

Daily Drilling Records shall be provided for each hole and contain the following information:

1. Job title and location
2. Hole reference number
3. Date
4. Contractor's name
5. Plant in use, crew members and hours worked
6. Method of boring or drilling, flushing medium and type of drill bit
7. Type, diameter and depth of casing used
8. Diameter and depth of hole at the beginning and end of each working day or shift
9. Grout returns to surface
10. Loss of any flushing medium during drilling
11. Standing time, with reason, or time lost overcoming obstructions
12. Details of underground services located
13. Details of any settlement or ground heave
14. Daily and cumulative length drilled
15. Depth to each major change of stratum
16. Description, with identification, of the stratum and whether it is intact or broken.
17. Depths at which groundwater is encountered (if apparent)
18. Depths at which any samples are taken
19. Details of any voids or suspended workings
20. Details of any emissions of gas, water etc
21. Depth of completed hole

Daily Grouting Records shall be provided for each hole and contain the following information:

1. Job title and location
2. Hole reference number
3. Date
4. Contractor's name
5. Plant in use, crew member and hours worked
6. Details of type of injection and grout-line dimensions (e.g. tremie injection through 25mm diameter line)
7. Type of grout mix and volumetric quantity injected
8. Grout pressures recorded, with the corresponding depths
9. Details of casing abandoned
10. Completion status of the grouting operation

The Daily Records of Materials and Plant Received shall show in particular that day's quantities by weight of each type of material and the cumulative quantities.

A Completion Report shall be completed by the Contractor as required by the Coal Authority permission to treat the workings.

Notwithstanding the information listed above, the Contractor shall provide any other information required by the Designer.

15 Services

The Contractor shall make his own enquiries with the statutory undertakers and public authorities and satisfy himself as to the exact position of such apparatus and the depth and size.

Any positions of services, mains, sewers, tunnels and pipelines supplied by the Employer are based on information extracted from the records of the relevant organisations and should be regarded as approximate only.

Service plans will be included within a revised version of this specification issued after completion of the ground investigation without prejudice for information purposes only, and will not form part of the Contract.

The Contractor shall state in the submitted Method Statement how they intend to undertake the works with regards to the presence of statutory services and adjacent infrastructure to prevent damage due to vibration or heave. Details of stand-off distances, changes in grouting pressure and any other relevant information shall be included.

Before any drilling works commence The Contractor will obtain a permit to break ground for each drill hole location from The Client.

16 Geotechnical Risk Register

A geotechnical risk register (Table 16.4) has been produced for the scheme in order to identify potential hazards, the likelihood of the hazard occurring, severity and risk rating. It is a very simple qualitative risk assessment and should not be viewed as definitive. This Risk Assessment reflects the current level of understanding of the geotechnical and geo-environmental aspects of the scheme and will be subject to revision. It is a generalised risk register that covers the main risks. Risk rating is defined in **Table 16.1**.

Table 16.1: Risk Classification

Low (1-8)	Ensure assumed control measures are maintained and reviewed, as necessary.
Medium (9-19)	Additional control measures needed to reduce risk rating to a level that is equivalent to a test of "reasonably required" for
High (20-25)	Activity not permitted. Hazard to be avoided or risk to be reduced to tolerable level.

Table 16.2: Risk classification and required action

Likelihood		Severity				
		1	2	3	4	5
		Minor	Moderate	Serious	Major	Catastrophic
1	Extremely unlikely	1	2	3	4	5
2	Unlikely	2	4	6	8	10
3	Likely	3	6	9	12	15
4	Extremely likely	4	8	12	16	20
5	Almost certain	5	10	15	20	25

Table 16.3: Potential severity of harm occurring

1	Minor	Minor damage or loss – (no human injury)
2	Moderate	Moderate damage or loss – (slight injury or illness)
3	Serious	Substantial damage or loss - (serious injury or illness)
4	Major	Major damage or loss – (fatal injury)
5	Catastrophic	Catastrophic loss or damage – (multiple fatalities)

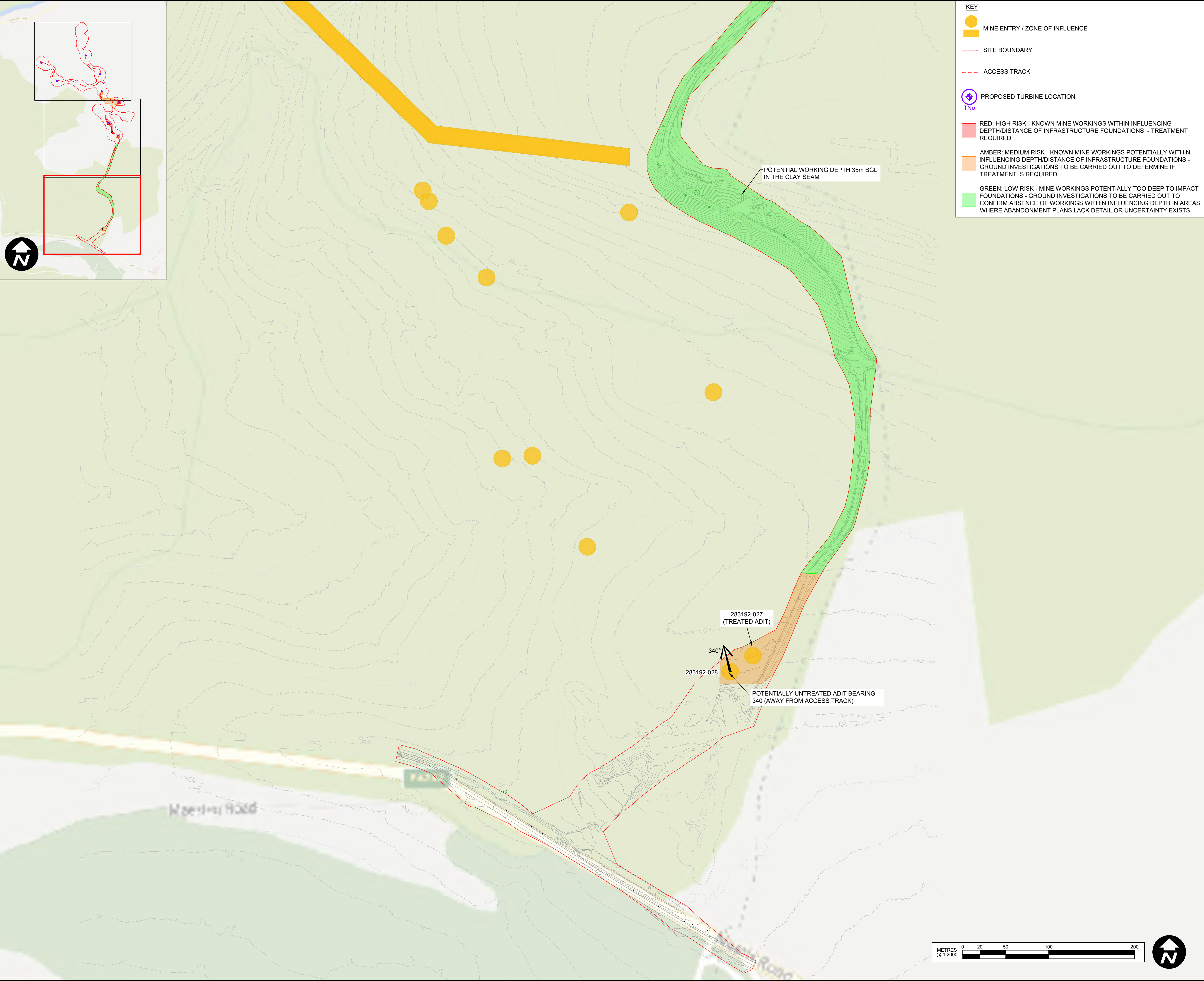
Table 16.4: Geotechnical Risk Register

Risk ID	Hazard	Consequence(s)	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Residual Risk
Ground gas migration	Displacement of gases from pressure grouting.	-Gas migrating into adjacent properties. -Gas migrating into other enclosed adjacent structures. -Health risk to occupants in adjacent properties. -Health risk posed to construction workers if working within adjacent excavations. -Explosion.	3	5	15	-Site in undeveloped area with no buildings or enclosed structures. -Grouting contractor to establish suitable methodology. -Agreement of methodology with Mining Remediation Authority. -Gas monitoring as required during and after grouting works.	1	5	5
Ground combustion	Coal Measures or associated colliery spoil.	-Ground gas combustion. -Generation of ground gas. -Combustion induced settlement. -Damage to overlying infrastructure.	3	4	12	-Obtain permit from Mining Remediation Authority. -Contractor to use suitable flush (water or vapour mist) when undertaking rotary drilling	2	4	8
Groundwater encountered.	Contaminated land and groundwater encountered.	-Health risk posed to construction workers. -Pathway creation of groundwater to surface water by displacement of groundwater during bulk infill of mine workings. -Delay in construction. -Cost of remediation.	4	3	12	-Appropriate PPE to be worn during construction. -Minimise excavation and soil arisings in design. -Produce appropriate methodology for safely containing, settling and treating (if required) groundwater prior to discharge and obtain consent to discharge prior to site works. -Off-site disposal to an appropriately licensed waste management facility.	2	3	6
Settlement	Underlying recorded/unrecorded workings.	-Collapse or settlement of underlying recorded/unrecorded workings. -The removal of underground commodities could affect the structural properties of the overlying bedrock which may cause subsidence related issues at surface. -The presence of mine entries and wells within 50m of the site and the potential for nearby adits to extend within influencing distance of the site.	5	5	25	-Adequate mining risk assessment undertaken to identify hazards relating to historic underground mining. -Ground investigation to be undertaken to identify areas at risk of collapse and settlement, and ground treatment to be undertaken.	1	5	5

Table 16.4: Geotechnical Risk Register

Risk ID	Hazard	Consequence(s)	Likelihood	Severity	Risk	Mitigation	Likelihood	Severity	Residual Risk
Unexploded Ordnance (UXO)	-UXO struck/encountered during intrusive works	-Detonation of ordnance resulting in injury or death. -Delay in construction.	2	5	10	-UXO risk identified as low within ZetixaUXO Unexploded Bomb Risk Map.	1	5	5

Appendix A Drawings



KEY

- MINE ENTRY / ZONE OF INFLUENCE
- SITE BOUNDARY
- ACCESS TRACK
- PROPOSED TURBINE LOCATION
- RED: HIGH RISK - KNOWN MINE WORKINGS WITHIN INFLUENCING DEPTH/DISTANCE OF INFRASTRUCTURE FOUNDATIONS - TREATMENT REQUIRED.
- AMBER: MEDIUM RISK - KNOWN MINE WORKINGS POTENTIALLY WITHIN INFLUENCING DEPTH/DISTANCE OF INFRASTRUCTURE FOUNDATIONS - GROUND INVESTIGATIONS TO BE CARRIED OUT TO DETERMINE IF TREATMENT IS REQUIRED.
- GREEN: LOW RISK - MINE WORKINGS POTENTIALLY TOO DEEP TO IMPACT FOUNDATIONS - GROUND INVESTIGATIONS TO BE CARRIED OUT TO CONFIRM ABSENCE OF WORKINGS WITHIN INFLUENCING DEPTH IN AREAS WHERE ABANDONMENT PLANS LACK DETAIL OR UNCERTAINTY EXISTS.

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- NOTES**
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 - ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE ENGINEER IMMEDIATELY.
 - ALL DIMENSIONS ARE IN MILLIMETRES - (mm)
ALL LEVELS ARE IN METRES - (m) AND ARE ABOVE ORDNANCE DATUM AT NEWLYN, CORNWALL UNLESS NOTED OTHERWISE.
 - NORTH SHOWN INDICATIVELY ONLY
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, DRAWINGS, DETAILS AND OTHER DESIGN INFORMATION.

- GROUTING NOTES:**
- PRIMARY DRILLING AND GROUTING WILL BE CARRIED OUT ON A 6M OFFSET GRID.
 - SECONDARY GROUTING WILL BE CARRIED OUT IN LOCATIONS WHERE THE GROUT TAKE IN PRIMARY HOLES IS ONE OF THE FOLLOWING, OR AS OTHERWISE APPROVED BY THE DESIGNER:
 - INDICATIVE OF COLLAPSED OR INFILLED WORKINGS.
 - MORE THAN 1.5 TONNE/HOLE.
 - MORE THAN TWO TIMES THAT OF THE MEDIAN GROUT TAKE OF PRIMARY HOLES IN THAT AREA OF THE SITE.
 - TERTIARY GROUTING WILL BE CARRIED OUT IN LOCATIONS WHERE THE GROUT TAKE IN SECONDARY HOLES IS ONE OF THE FOLLOWING, OR AS OTHERWISE APPROVED BY THE DESIGNER:
 - MORE THAN 1.0 TONNE/HOLE.
 - MORE THAN TWO TIMES THAT OF THE MEDIAN GROUT TAKE OF SECONDARY GROUT HOLES IN THAT AREA OF THE SITE.
 - THE PRIMARY GROUTING PROPOSALS HAVE BEEN DEVELOPED ON THE BASIS THAT THE MINE WORKINGS ARE INFILLED OR COLLAPSED, WITHOUT THE REQUIREMENT FOR COMPLETION OF PERIMETER GROUTING FOLLOWED BY INFILL GROUTING. SHOULD SITE CONDITIONS DICTATE THAT PERIMETER GROUTING IS REQUIRED, REVISED GROUTING PROPOSALS WILL BE DEVELOPED BY THE CONTRACTOR FOR THE APPROVAL OF THE DESIGNER.
 - WHERE GROUT TAKES ARE SIGNIFICANT, PERMEABILITY TESTING BY GROUT ACCEPTANCE TESTING WILL BE CHECKED BY DRILLING TEST HOLES IN POSITIONS SELECTED BY THE DESIGNER AND INJECTING GROUT AT PRESSURES APPROPRIATE TO THE DEPTH, ALL IN ACCORDANCE WITH THE REQUIREMENTS FOR INFILL GROUTING.
 - IF THE DESIGNER CONSIDERS THAT THE QUANTITIES OF GROUT ACCEPTED ARE EXCESSIVE, FURTHER HOLES WILL BE DRILLED AND GROUTED AT A SPACING AGREED WITH THE DESIGNER. AFTER TESTING, HOLES WILL BE COMPLETED IN ACCORDANCE WITH THE REQUIREMENTS FOR GROUTING HOLES.

REV	DESCRIPTION	DRN	DES	CHK	APP	DATE
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Architect/Client/Contractor

Alerion

Project

FOEL TRAWSNANT WINDFARM

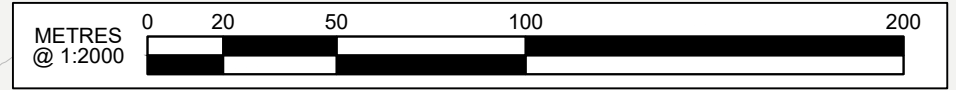
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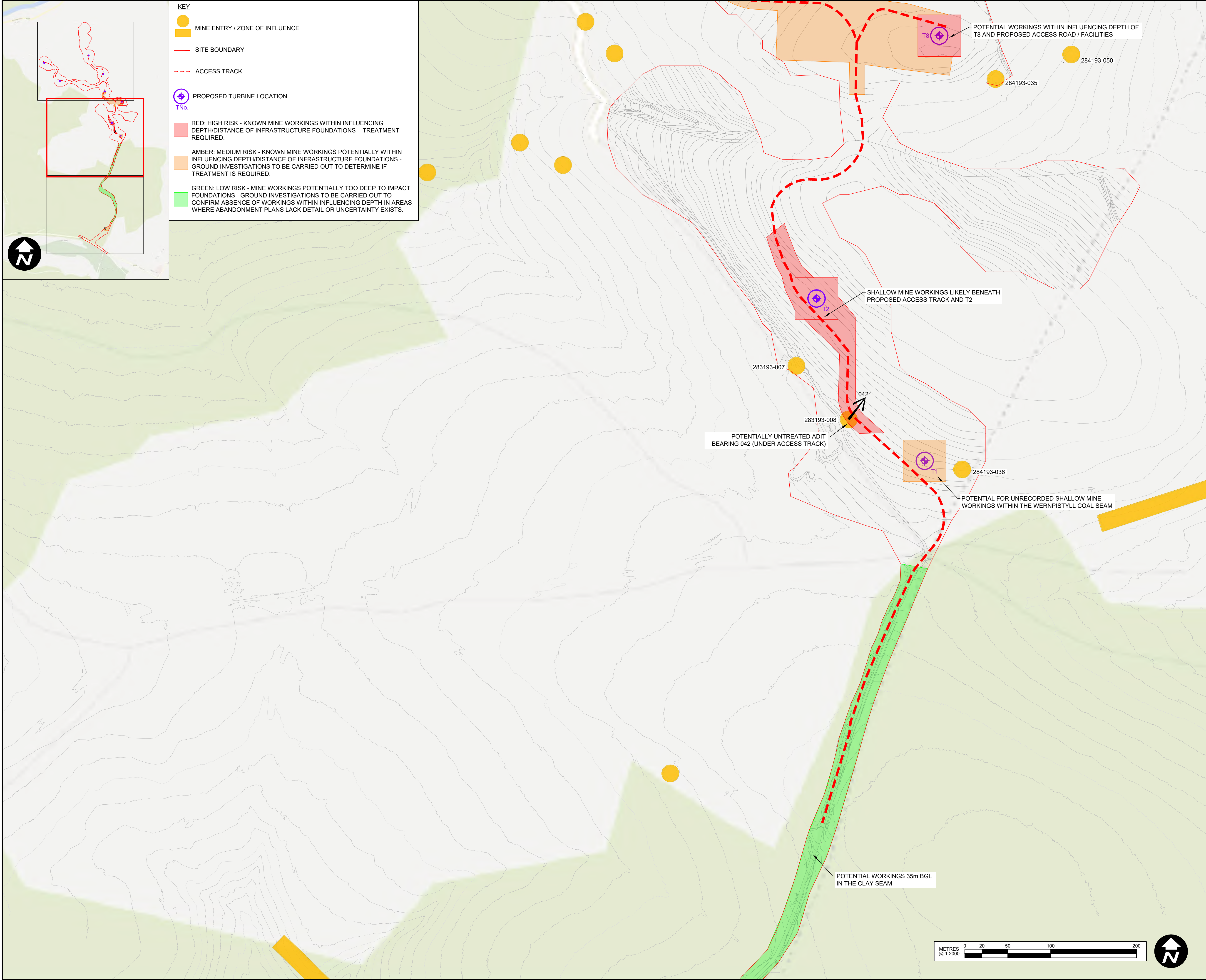
**GROUTING SPECIFICATION PLAN
SHEET 1 OF 3**

Drawing Status			
PRELIMINARY			
Drawn	Name T. CRAWFORD	Date 18/06/2026	Status Code S2
Designed	T. CRAWFORD	18/06/2026	Scale AS SHOWN @A1
Eng Chk	A. DOUGILL	18/06/2026	Revision
Approved	N. DEWELL	19/06/2026	P01

Drawing No.

110636-PEF-XX- XX - D - G - 0010





KEY

MINE ENTRY / ZONE OF INFLUENCE

SITE BOUNDARY

ACCESS TRACK

PROPOSED TURBINE LOCATION
TN_o.

RED: HIGH RISK - KNOWN MINE WORKINGS WITHIN INFLUENCING DEPTH/DISTANCE OF INFRASTRUCTURE FOUNDATIONS - TREATMENT REQUIRED.

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REV	DESCRIPTION	DRN	DES	CHK	APP	DATE
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Architect/Client/Contractor



Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUTING SPECIFICATION PLAN
SHEET 2 OF 3

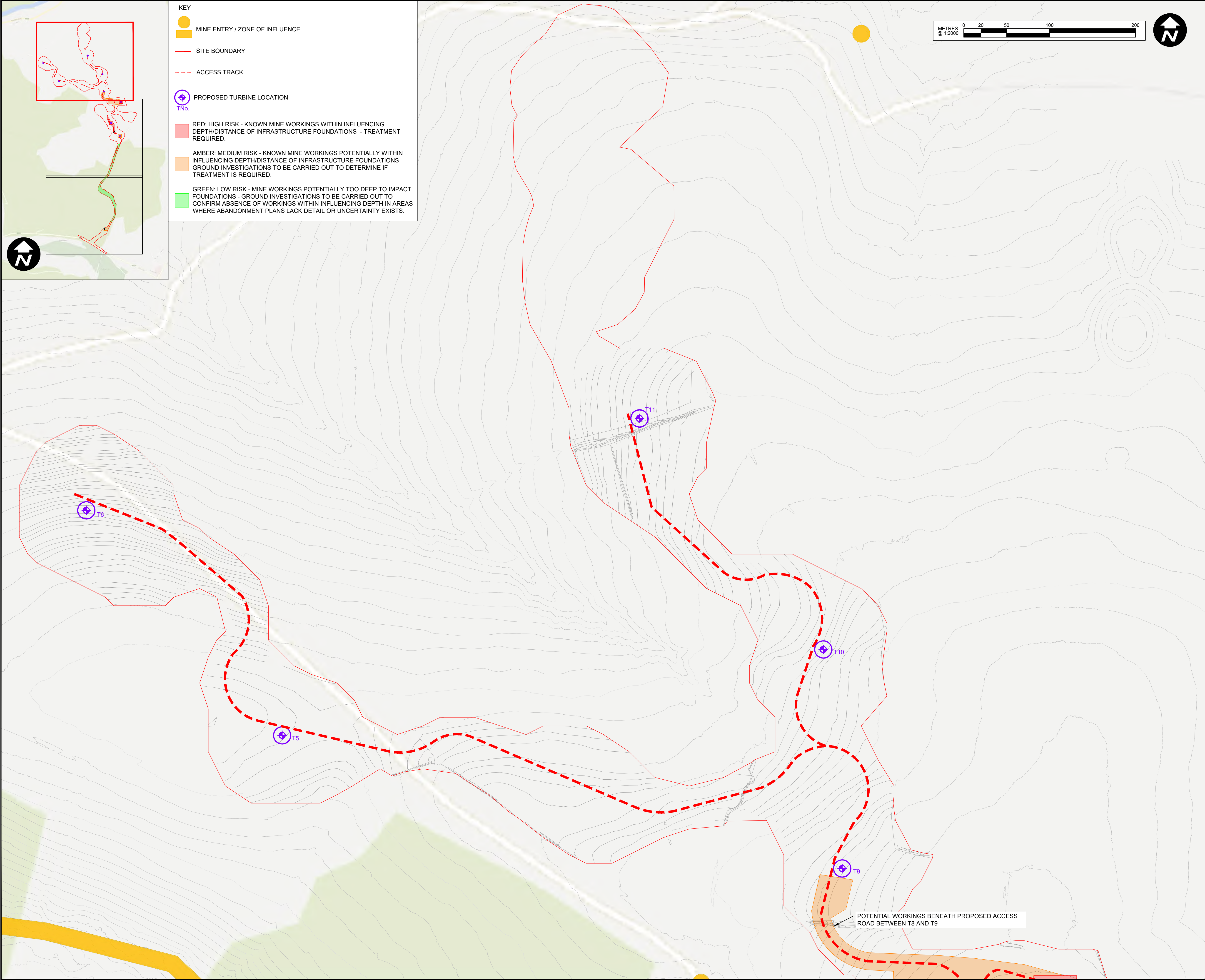
Drawing Status

PRELIMINARY

	Name	Date	Status Code
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Designed	T. CRAWFORD	18/06/2026	Scale
Eng Chk	A. DOUGILL	18/06/2026	AS SHOWN @A1
Approved	N. DEWELL	19/06/2026	Revision
			P01

Drawing No.

110636-PEF-XX- XX - D - G - 0011



KEY

MINE ENTRY / ZONE OF INFLUENCE

SITE BOUNDARY

ACCESS TRACK

PROPOSED TURBINE LOCATION

TNo.

RED: HIGH RISK - KNOWN MINE WORKINGS WITHIN INFLUENCING DEPTH/DISTANCE OF INFRASTRUCTURE FOUNDATIONS - TREATMENT REQUIRED.

AMBER: MEDIUM RISK - KNOWN MINE WORKINGS POTENTIALLY WITHIN INFLUENCING DEPTH/DISTANCE OF INFRASTRUCTURE FOUNDATIONS - GROUND INVESTIGATIONS TO BE CARRIED OUT TO DETERMINE IF TREATMENT IS REQUIRED.

GREEN: LOW RISK - MINE WORKINGS POTENTIALLY TOO DEEP TO IMPACT FOUNDATIONS - GROUND INVESTIGATIONS TO BE CARRIED OUT TO CONFIRM ABSENCE OF WORKINGS WITHIN INFLUENCING DEPTH IN AREAS WHERE ABANDONMENT PLANS LACK DETAIL OR UNCERTAINTY EXISTS.

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NOTES

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2. ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE ENGINEER IMMEDIATELY.

3. ALL DIMENSIONS ARE IN MILLIMETRES - (mm)
ALL LEVELS ARE IN METRES - (m) AND ARE ABOVE ORDNANCE DATUM AT NEWLYN, CORNWALL UNLESS NOTED OTHERWISE.

4. NORTH SHOWN INDICATIVELY ONLY

5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT; SPECIFICATIONS; DRAWINGS; DETAILS AND OTHER DESIGN INFORMATION.

GROUTING NOTES:

1. PRIMARY DRILLING AND GROUTING WILL BE CARRIED OUT ON A 6M OFFSET GRID.

2. SECONDARY GROUTING WILL BE CARRIED OUT IN LOCATIONS WHERE THE GROUT TAKE IN PRIMARY HOLES IS ONE OF THE FOLLOWING, OR AS OTHERWISE APPROVED BY THE DESIGNER:

2.1. INDICATIVE OF COLLAPSED OR INFILLED WORKINGS.

2.2. MORE THAN 1.5 TONNE/HOLE.

2.3. MORE THAN TWO TIMES THAT OF THE MEDIAN GROUT TAKE OF PRIMARY HOLES IN THAT AREA OF THE SITE.

3. TERTIARY GROUTING WILL BE CARRIED OUT IN LOCATIONS WHERE THE GROUT TAKE IN SECONDARY HOLES IS ONE OF THE FOLLOWING, OR AS OTHERWISE APPROVED BY THE DESIGNER:

3.1. MORE THAN 1.0 TONNE/HOLE.

3.2. MORE THAN TWO TIMES THAT OF THE MEDIAN GROUT TAKE OF SECONDARY GROUT HOLES IN THAT AREA OF THE SITE.

4. THE PRIMARY GROUTING PROPOSALS HAVE BEEN DEVELOPED ON THE BASIS THAT THE MINE WORKINGS ARE INFILLED OR COLLAPSED, WITHOUT THE REQUIREMENT FOR COMPLETION OF PERIMETER GROUTING FOLLOWED BY INFILL GROUTING. SHOULD SITE CONDITIONS DICTATE THAT PERIMETER GROUTING IS REQUIRED, REVISED GROUTING PROPOSALS WILL BE DEVELOPED BY THE CONTRACTOR FOR THE APPROVAL OF THE DESIGNER.

5. WHERE GROUT TAKES ARE SIGNIFICANT, PERMEABILITY TESTING BY GROUT ACCEPTANCE TESTING WILL BE CHECKED BY DRILLING TEST HOLES IN POSITIONS SELECTED BY THE DESIGNER AND INJECTING GROUT AT PRESSURES APPROPRIATE TO THE DEPTH. ALL IN ACCORDANCE WITH THE REQUIREMENTS FOR INFILL GROUTING.

6. IF THE DESIGNER CONSIDERS THAT THE QUANTITIES OF GROUT ACCEPTED ARE EXCESSIVE, FURTHER HOLES WILL BE DRILLED AND GROUTED AT A SPACING AGREED WITH THE DESIGNER. AFTER TESTING, HOLES WILL BE COMPLETED IN ACCORDANCE WITH THE REQUIREMENTS FOR GROUTING HOLES.

REV	DESCRIPTION	DRN	DES	CHK	APP	DATE
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Architect/Client/Contractor

Alerion

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUTING SPECIFICATION PLAN
SHEET 3 OF 3

Drawing Status

PRELIMINARY

	Name	Date	Status Code
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Designed	T. CRAWFORD	18/06/2026	Scale
Eng Chk	A. DOUGILL	18/06/2026	AS SHOWN @A1
Approved	N. DEWELL	19/06/2026	Revision
			P01

Drawing No.

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Appendix B Pell Frischmann Mining Risk Assessment

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FOEL TRAWSNANT WINDFARM (Project
Fox)

Mining Risk Assessment Summary

Planning Condition 7

Confidentiality						
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P02	S3	Revised for client comments	29/04/2024	A. Dougill	N R Dewell	N R Dewell
Ref. reference. Rev revision. Suit suitability.						

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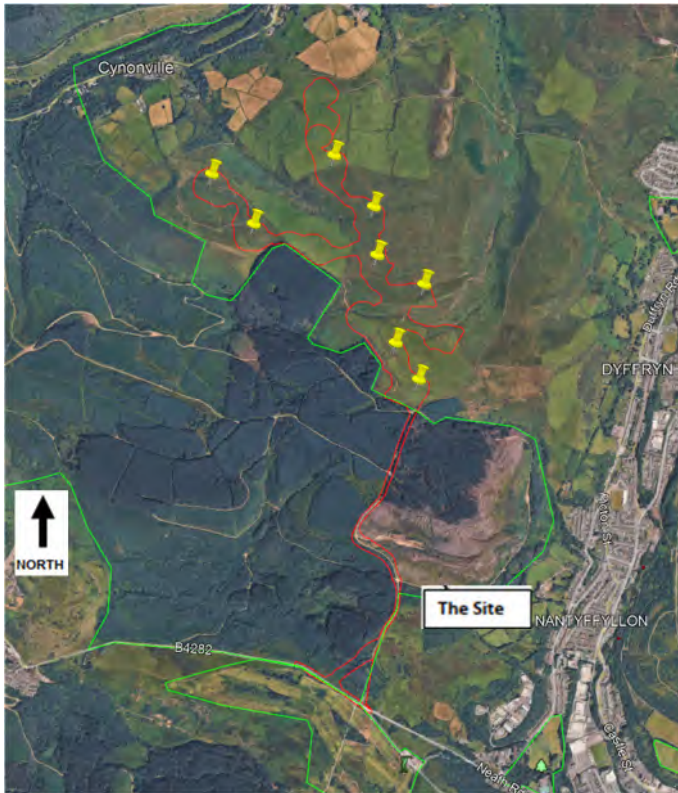
Appendix A Drawings

1 Introduction

1.1 Site location

The site is located at Foel Trawsnant to the south of Duffryn, comprising the land between Cynonville and Nantyffyllon, approximately 2.3km north-west of Maesteg and is situated between 251m and 371m AOD. The National Grid reference of the approximate centre of the site is at 283732, 194170. The current side boundary is shown in Figure 1 (in red).

Figure 1 Site Location Plan



1.2 Proposed Development

At the time of writing this report, the development was proposed to comprise 8 No. wind turbines spread across the site with an access road proposed to run between each turbine and between Turbine 1 (T1) and the B4282 Neath Road to the south. The turbines are understood to be a maximum height of 120m (top of blade). Access tracks are located throughout the site, with turbines and associated crane pads along the tracks and a large contractor compound and electrical substation located in the south of the site. Initially, eleven turbines were proposed, but turbines T3, T4 and T7 have since been removed from the project. Proposed wind turbine locations have also been revised from the initial locations proposed and assumed during the 2021 site investigation. The locations are shown in drawing ref 110636-PEF-XX-XX-D-G-0001 General Arrangement as shown in Appendix A. A summary of the changes is shown in Table 1.

Coordinates for all individual turbines are shown in Table 2 including those that have been descope. 110636-PEF-XX-XX-D-G-0001 General Arrangement in Appendix A shows the location of turbines on plan.

Table 1 Summary of Turbine Location Changes

Wind Turbine	Proposed location (February 2026) compared to factual location (Sept 2021)			Perpendicular distance from geophysics to proposed location	Change in distance to mine adits
T1	20m to E	8m to N	21.54m to NE	2.1m	14.3m closer to ME 284193-36
T2	3m to E	6m to S	6.71m to SE	8.6m	5.03m closer to ME 283193-007
T5	4m to E	2m to N	4.47m to NE	<i>Note 1</i>	<i>Note 2</i>
T6	10m to E	6m to S	11.66m to SE	<i>Note 1</i>	<i>Note 2</i>
T8	20m to W	2m to S	20.10m to SW	12.2m	12.6m farther from ME 284193-35
T9	11m to E	28m to S	30.08m to SE	18.5m	<i>Note 2</i>
T10	17m to E	17m to S	24.04m to SE	3.0m	<i>Note 2</i>
T11	9m to E	9m to S	12.73m to SE	<i>Note 1</i>	<i>Note 2</i>

Note 1: No geophysical survey completed at the location.

Note 2: No mining adits within 150m from the location.

Table 2 National Grid Reference Coordinates

Turbine Number	Easting	Northing	Grid Reference
T1	283979	193530	SS 83979 93530
T2	283853	193719	SS 83853 93719
T3 (removed)	283693	193910	SS 83693 93910
T4 (removed)	283428	194260	SS 83428 94260
T5	283096	194329	SS 83096 94329
T6	282868	194591	SS 82868 94591
T7 (removed)	284161	193808	SS 84161 93808
T8	283996	194025	SS 83996 94025
T9	283748	194174	SS 83748 94174
T10	283726	194429	SS 83726 94429
T11	283512	194698	SS 83512 94698

1.3 Scope of Works

Pell Frischmann initially produced a Gap Analysis Report in 2025 (ref. 110636-PEF-XX-XX-RP-GE-00001) which identified gaps in the existing mining risk assessments and ground investigation to satisfy the planning conditions below for the turbine locations which states as follows:

“No development shall commence until a scheme has been submitted to and approved in writing by the Local Planning Authority detailing intrusive site investigations for the mine entries and shallow coal workings which shall include the following:

- a) the submission of a report of findings arising from both intrusive site investigations.*
- b) the submission of a layout plan which identifies appropriate zones of influence for the mine entries on site, and the definition of suitable 'no-build' zones.*
- c) the submission of a scheme of treatment for the mine entries on site for approval.*
- d) the submission of a scheme of remedial works for the shallow coal workings for an approval; and the scheme as approved, including any remedial works identified by the site investigations shall be undertaken in accordance with the approved details.”*

Subsequently Pell Frischmann has been appointed to provide a summary of findings from both existing site investigation reports together with consideration of mining risk at revised turbine locations and along the main southern access track. The purpose of this report is to address Planning Condition 7a including the addition of

coal mining risk assessment of the main southern access track. Drawings provided in Appendix A are intended to address Planning Condition 7b; together with the risk assessment narrative within this report. Although recommendations for treatment of mine entries and workings are provided in this report, which in part address Planning Conditions 7c and 7d, a separate 'Specification and Schedule for Treatment of Mine Workings' will be provided to fully detail proposed works.

2 Existing Information

Table 3 lists the existing information that was consulted as part of this study.

Table 3 Summary of Existing Information

Title	Author	Date	Reference	Rev
CON29M Non-Residential Mining Report and Drawing	Mining Remediation Authority	February 2026	51003552596001	n/a
Mining Remediation Authority abandoned mines records	Mining Remediation Authority	February 2026	Various (see Table 7)	n/a
Foel Trawsnant Turbine Locations Comparison Plan	Alerion	8th July 2025	FoelTrawsnant_TurbineLocationsComparisonPlan_20250708	1
Figure 5.1 Site location Drawing	Wood	March 2022	n/a	n/a
Interpretative Site Investigation Report	Intégral Géotechnique (Wales) Limited	September 2021	12826/RAH/21/ISI	0
Factual Site Investigation Report	Intégral Géotechnique (Wales) Limited	September 2021	12826/RAH/21/FSI/RevA	A
CON29M Non-Residential Mining Report and Drawing	The Coal Authority	20th April 2018	51001821145001	n/a
Assessment of underground mine working activity and its potential impact upon the proposed Foel Trawsnant windfarm site	James Associates	June 2014	JA.PW.FT.01.14	n/a
Coal Authority abandoned mines record listing (appendix for above report)	The Coal Authority	24th September 2013	71000500709001	n/a

The Coal Authority has rebranded and is now the Mining Remediation Authority. Due to the collection of data during the name change, both names will be used interchangeably throughout this report.

2.1 Topography

The Intégral Géotechnique (Wales) Limited (IGL) Interpretative Site Investigation Report states the site is located at Foel Trawsnant and is situated between 371m and 215mAOD. The highest point on site is a peak in the south of the site with a trig point recorded at 369mAOD. The ground slopes down towards the southern boundary and also falls towards the north-west with the lowest topographic point located along the northern boundary. A steep valley is present trending south-east to north-west through the north-west of the site along the alignment of the Nant yr Hywaid.

A topographic survey has been provided by Alerion UK LTD (Foel Trawsnant Wind Farm 3D (Rev A)).

2.2 Geological Maps and Memoirs

The on-line Geo-Index search-engine shows superficial deposits of Alluvium mapped to the east of the site and Till mapped to the east and south of the site, both predominantly at the base of the surrounding valleys. Glacial Till is indicated in the valley of the Nant yr Hywaid in the north-west of the site. A pocket of Peat is also mapped to the west of the main southern access track.

Bedrock across the main windfarm site is mapped as Sandstone of the Rhondda Member, mudstone, siltstone and sandstone of the Llynfi Member described by the BGS Lexicon as fluvial in origin. To the south of the windfarm site, along the access road, mudstone, siltstone and sandstone of the South Wales Upper and Middle Coal Measures Formation is mapped.

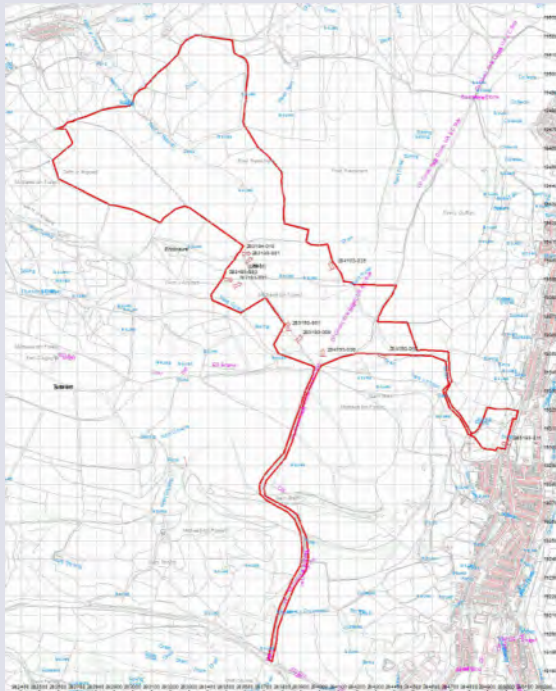
The Wernpistyll coal seam, Wernddu (No.2 Rhondda) coal seam, Field Vein coal seam and several thin coals are indicated to outcrop within the site. Strata dips of 12 degrees and 15 degrees towards the north-west are indicated within the vicinity of the site.

A fault transects the southern portion of the main site, trending largely west-north-west to east-south-east, crossing the area of former turbine positions Turbine 3 and Turbine 7. The Environmental Statement (Wood Environment and Infrastructure Solutions UK dated December 2018) indicates that the fault is known as the Jubilee Slide.

2.3 Non-Residential Coal Authority Mining Report

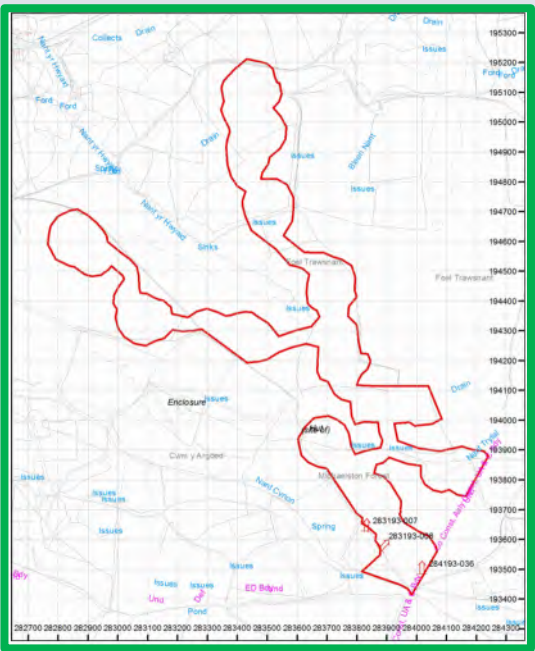
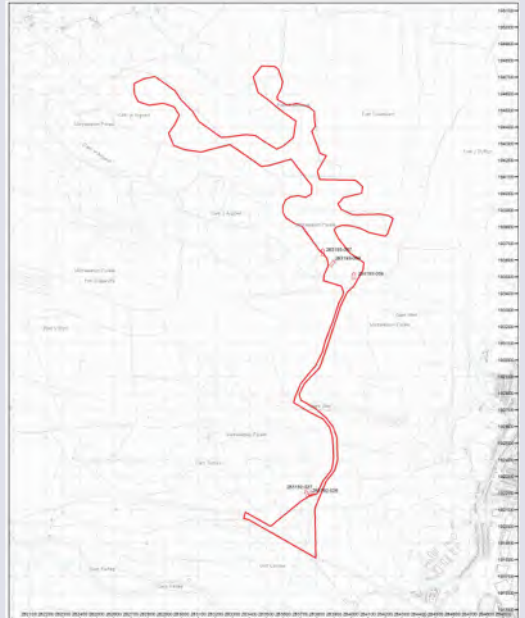
Three separate Non-Residential Coal Authority Mining Reports have been produced in 2013, 2018 and 2026 respectively. The 2026 report covers an updated and more targeted area and includes the main southern access track from the turbine area to the B4282 Neath Road to the south of the site. Key points from the three reports are summarised in Table 4 and Table 5.

Table 4 Summary of Existing Non-Residential Coal Authority Mining Reports (2013)

	2013
Coal Authority Reference	71000500709001
Site Boundary	
Past underground coal mining	Zone of influence from workings in 20 seams of coal at shallow to 790m depth and last worked in 1980. Zone of influence from workings in 1 seam of fireclay at shallow to 140m depth and last worked in 1862
Present underground coal mining	Not in the likely zone of influence of any present underground coal workings.
Future underground coal mining	Not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods. Is in an area for which 2 licences to remove or otherwise work coal using underground methods were granted in June 2011, October 1996. Not in an area that is likely to be affected at the surface from any planned future workings.
Mine Entries	Within, or within 20 metres of, the boundary of the property there are 10 mine entries.
Coal Mining geology	Not aware of any damage due to geological faults or other lines of weakness
Past opencast coal mining	Not within the boundary of an opencast site
Present opencast coal mining	Does not lie within 200 metres of the boundary of an opencast site

	2013
Coal Authority Reference	71000500709001
Future opencast coal mining	No licence requests outstanding or granted to remove coal by opencast methods within 800 metres of the boundary
Coal mining subsidence	Not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31st October 1994. No current Stop Notice delaying the start of remedial works or repairs to the property Not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991
Mine Gas	No record of a mine gas emission requiring action.
Hazards related to coal mining	The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures
Withdrawal of support	In an area for which notices of entitlement to withdraw support were published in 1945, 1946, 1948, 1954, 1956, 1975, 1977. Not in an area for which a notice has been given under section 41 of the Coal Industry Act 1994, revoking the entitlement to withdraw support.
Working facilities orders	The property is not in an area where an order has been made, under the provisions of the Mines Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.
Payments to owners of former copyhold land	The property is not in an area for which a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.
Cheshire Brine Subsidence Compensation Board	Lies outside the Cheshire Brine Compensation District.

Table 5 Summary of Existing Non-Residential Coal Authority Mining Reports (2018 & 2026)

	2018	2026
Coal Authority Reference	51001821145001	51003552596001
Site Boundary		
Past underground coal mining	In a surface area that could be affected by underground mining in 11 seams of coal at shallow to 780m depth and last worked in 1980.	The property is in a surface area that could be affected by underground mining in 17 seams of coal at shallow to 790m depth and last worked in 1980. The property is in a surface area that could be affected by underground mining in 1 seam of fireclay at shallow to 150m depth and last worked in 1862.

	2018	2026
Coal Authority Reference	51001821145001	51003552596001
Present underground coal mining	Not within a surface area that could be affected by present underground mining.	
Future underground coal mining		The property is not in an area where the Coal Authority has received an application for and is currently considering whether to grant a licence to remove or work coal by underground methods.
Mine Entries	Within, or within 20 metres of, the boundary of the property there are 3 mine entries.	Within, or within 20 metres of, the boundary of the property there are 5 mine entries.
Coal Mining geology	Not aware of any damage due to geological faults or other lines of weakness	
Past opencast coal mining	Not within the boundary of an opencast site	
Present opencast coal mining	Does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.	
Future opencast coal mining	No licence requests outstanding or granted to remove coal by opencast methods within 800 metres of the boundary.	
Coal mining subsidence	Not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31st October 1994. No current Stop Notice delaying the start of remedial works or repairs to the property. Not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991	
Mine Gas	No record of a mine gas emission requiring action.	
Hazards related to coal mining	The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.	
Withdrawal of support	In an area where notices to withdraw support were given in 1946, 1948, 1954, 1956 and 1975. Not in an area for which a notice has been given under section 41 of the Coal Industry Act 1994, revoking the entitlement to withdraw support.	The property is in an area where notices to withdraw support were given in 1946, 1948, 1954, 1956, 1975 and 1977. Not in an area where a notice has been given under section 41 of the Coal Industry Act 1994, cancelling the entitlement to withdraw support.
Working facilities orders	The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.	
Payments to owners of former copyhold land	The property is not in an area for which a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.	
Cheshire Brine Subsidence Compensation Board	Lies outside the Cheshire Brine Compensation District.	

2.4 James Associates Mineworking assessment (2014)

The James Associates Mineworking Assessment (2014) incorporates the following information:

- Published Geological Sheets Glamorgan XXV and XXVI
- The Geology of the South Wales Coalfield Part IV - The Country around Pontypridd and Maesteg. Memoir of the Geological Survey of Great Britain.

- Non-Residential Coal Authority Mining Report (ref: 71000500709001) dated 24 September 2013
- CIRA Report 'Construction over Abandoned Mine Workings - P R Healy, J M Head, 2002

Some of the relevant information from these reports are as follows:

- Turbine locations which could be affected by shallow (in this case <40m depth) abandoned Mine Workings are highlighted in 'red' in Table No. 1 (see
- Figure 2) and include Turbines T1, T2, T3, T4, T8, T9 and T10.
- Within the site area a fault is shown to lie within proximity to Turbines T3 and T7.
- It is not likely that any workings of significance will be present in seams other than Field Vein, Wernddu (No. 2 Rhondda), Wernpistyll Rider and Wernpistyll seams at shallow depth.
- The deeper level workings are at such a depth and age that there will be no further impacts associated with them.
- Figure 3 and Figure 4 shows the site plan with mining information overlaid. The proposed locations of the wind turbines shown on the two figures from 2014 have changed or have been removed from the current developmental scope at the time of writing this report.

Figure 2 Table summarising Abandoned Mine Working (James Associate, 2014)

TABLE NO. 1 - SUMMARY OF ABANDONED MINEWORKINGS
(Reference should be made to Drawing No. JA-146-001-005 for location details)

SEAM	INTERVAL BETWEEN SEAMS (M)	WORKED BENEATH SITE AREA	DATE OF WORKING	APPROXIMATE EXTRACTION THICKNESS (M)	APPROXIMATE DISTANCE TO SEAM BELOW TURBINE LOCATION (METRES)												
					T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13
No. 1 Rhondda	148	NO	N/W	N/A	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Field Vein		YES	1872-1967	25(5)10(25)22	0* ¹	20-25	10-20	10-20	60-70	70+	NP	20-25	15-20	10-20	60-70	70-80	80+
No. 2 Rhondda (Wernddu)	11	YES	1872-1967	71* ²	0-10	30-35	20-30	20-30	70-80	70+	NP	30-35	25-30	20-30	70-80	80-90	
Wernpistyll Rider	11	YES	1925-1959	50	10-20	40-45	30-40	30-40	80-90	80+	5-10	40-45	35-40	30-40	80-90	90-100	
Wernpistyll	<10	YES	1925-1959	55(5)40	20-30	50-60	40-50	40-50	90-100	90+	15-20	50-55	45-50	40-50	90-100	100-110	
Tormynydd	114	NO	1872-1957		135-145	165-175	155-165	155-165	205-215	205+	130-135	165-170	160-165	155-165	205-215	215-220	
Jonah	11	YES			145-155	175-185	165-175	165-175	215-225	215+	140-145	175-180	170-175	165-175	215-225	220-225	
White	5	YES	1912-1927		150-160	185-190	175-180	175-180	215-220	220+	145-150	180-195	175-180	175-180	225-230	225-230	
Clay	40	YES	1911	66	190-200	220-230	210-220	210-220	255-265	255+	185-190	220-225	215-220	210-220	255-265	265-270	
Black	80	YES	1872		270-280												
Golden	275	YES	1872-1931		IN EXCESS OF 200 METRES BELOW TURBINE LEVEL												
Cockshot		YES	1872														
Two Feet		YES															
Four Feet		YES	1966														
Six Feet		YES	1950-1977														
Upper Nine Feet		YES	1970														
Lower Nine Feet		YES	1977														
Five Feet		YES															

*¹ = At Surface

*² = Plus possibly 0.76m seatearth extraction

NP = Not Present N/A = Not applicable

N/W = Not Worked

53(10)50 = Coal (Dirt) Coal

T3 - Turbines located within the potential zone of effect associated with shallow level abandoned mineworkings

Figure 3 Windfarm Turbine and Coal Mine Drift Locations (2014)

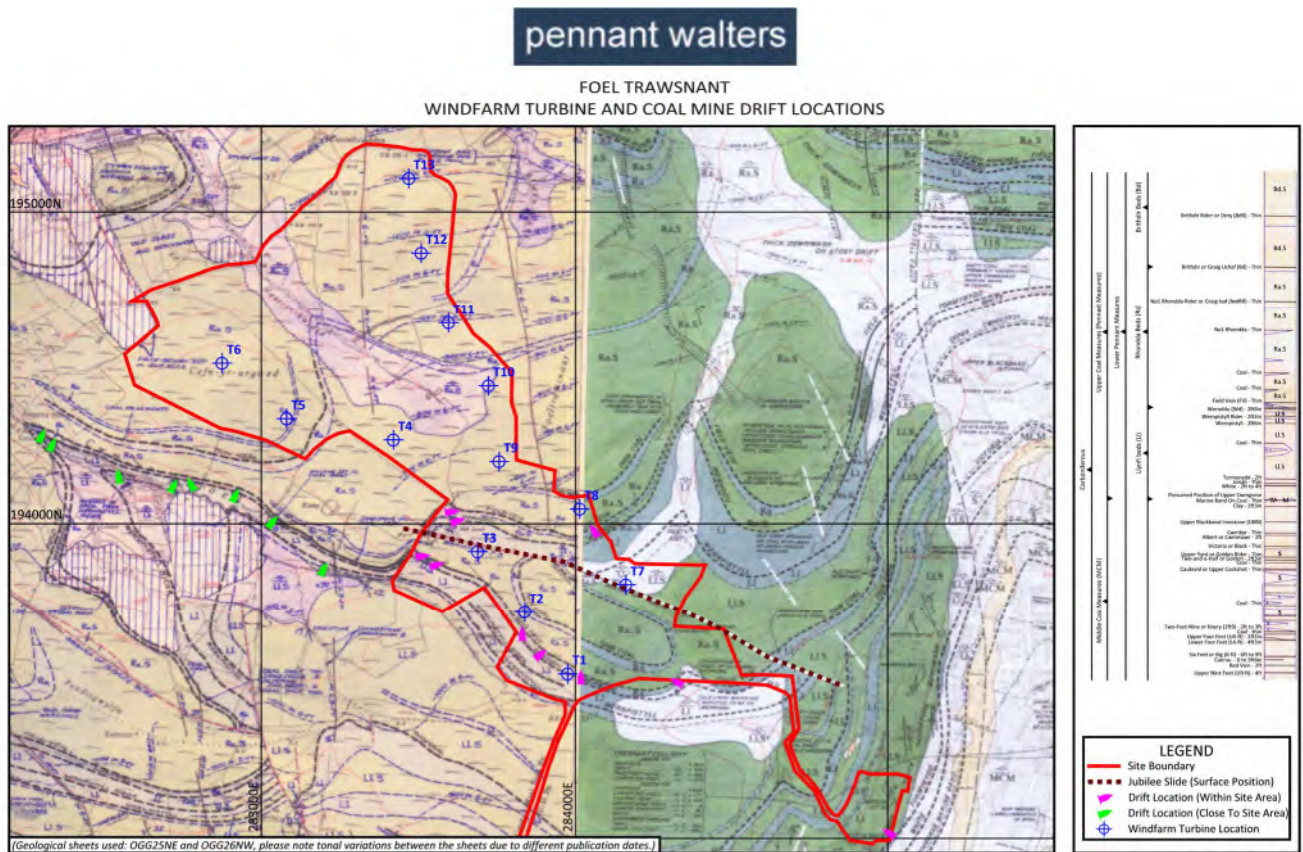
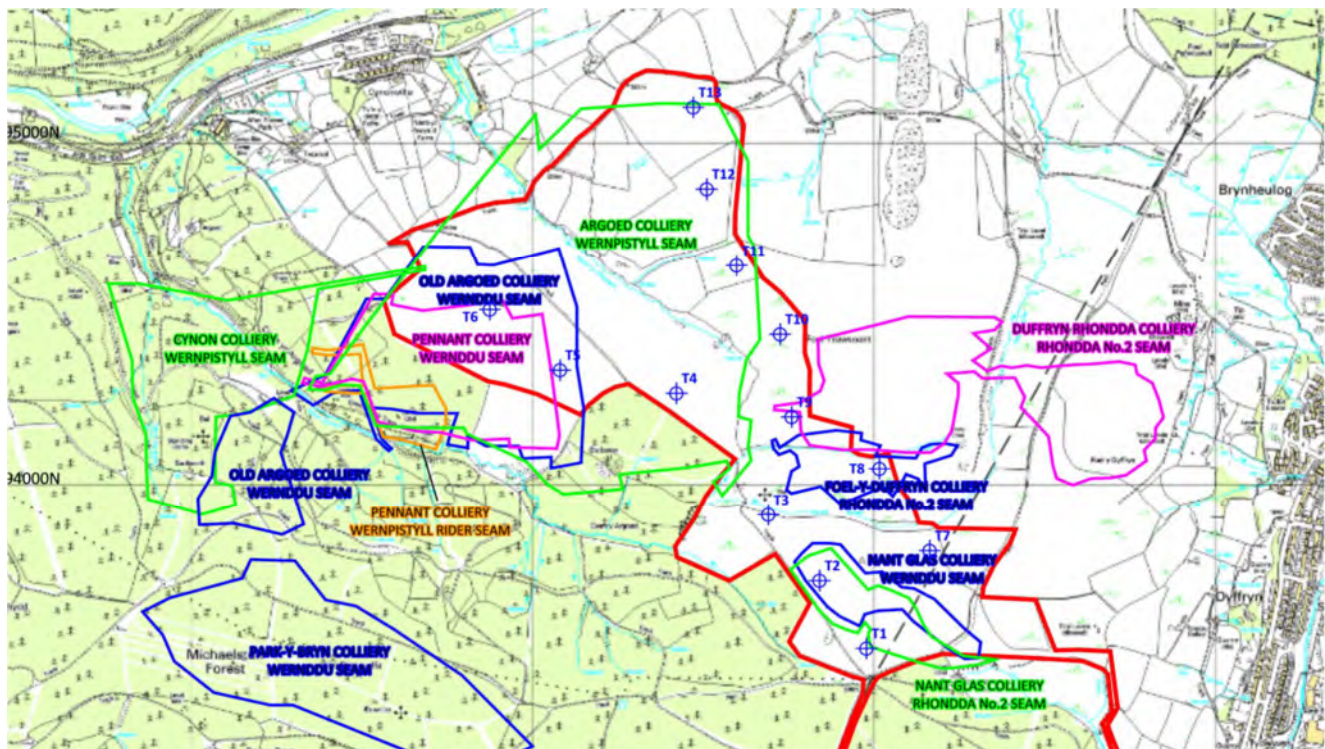


Figure 4 Old Workings Location Plan



2.5 Factual Site Investigation Report (Sep 2021, Integral Geotechnique)

The number of wind turbines considered in this report was consistent with the most recent proposals of eight turbines, reduced from the 13 considered in the 2014 report (T3, T4, T7, T12 and T13 were removed).

2.5.1 Geophysical Survey (March 2021, Terradat)

Initially a non-intrusive geophysical survey was undertaken at five of the eight proposed turbine locations (Turbines T1, T2, T8, T9 and T10 as shown in Figure 5). The survey took place on 24th and 25th March 2021. They were surveyed along a single profile line to record P-wave Seismic Refraction and S-wave Seismic Refraction. The Terradat's Geophysical Survey Report dated Apr 2021 is attached as Appendix A within the factual report. Other than estimated depths to bedrock below the turbines, no information is evident in the report pertinent to mine workings.

Figure 5 Geophysical survey locations at T1, T2, T8, T9 and T10

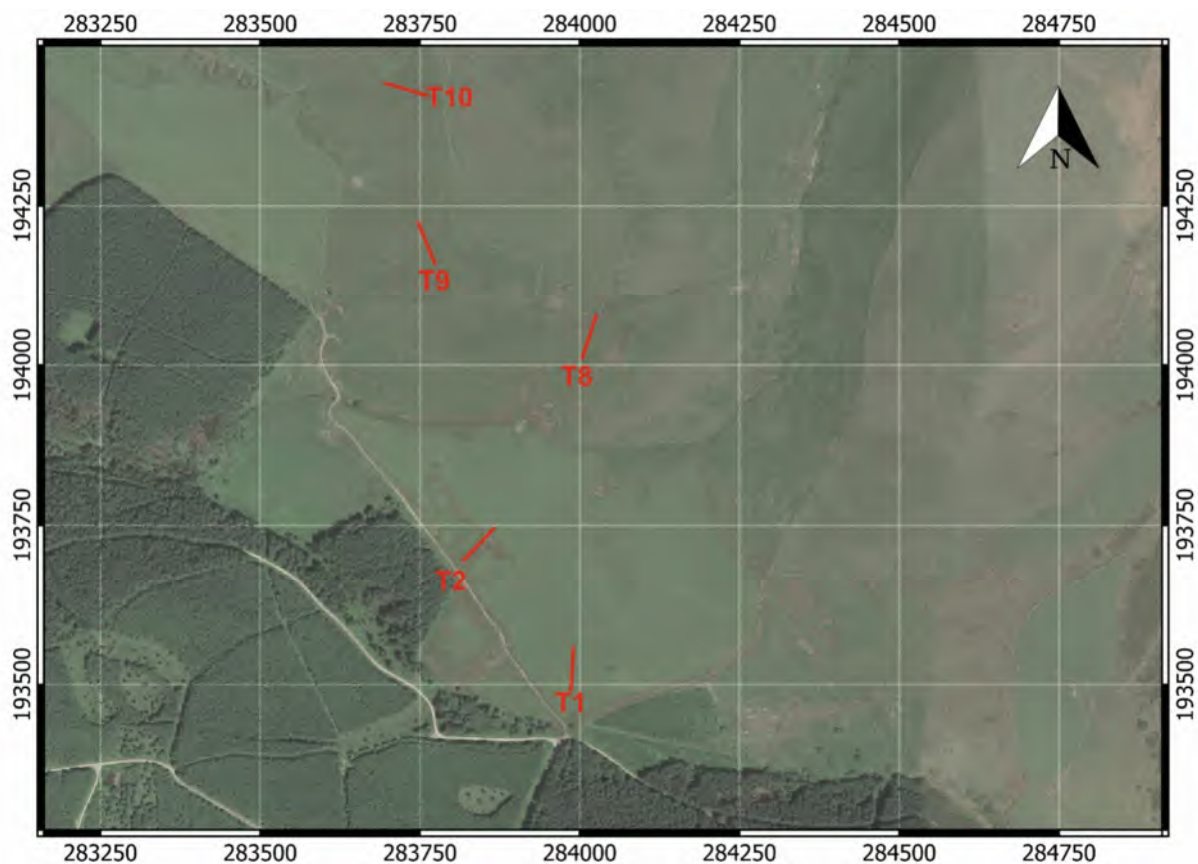


Table 6 Geophysical survey location details

Turbine ID	Start	End	Proposed wind turbine location (2025)
T1	283968.583 E 193492.174 N	283990.228 E 193557.123 N	283979 E 193530 N
T2	283818.341 E 193695.327 N	283865.695 E 193744.653 N	283853 E 193719 N
T8	284004.391 E 194011.402 N	284025.633 E 194077.073 N	283996 E 194025 N
T9	283773.575 E 194160.183 N	283747.778 E 194223.336 N	283748 E 194174 N
T10	283761.988 E 194421.583 N	283658.548 E 194451.848 N	283726 E 194429 N

2.6 Ground Investigation (2021, Integral Geotechnic)

Integral Geotechnic undertook the site investigation in 2021. Intrusive investigation (June/July 2021) included the following:

- 31No. Trial Pit Excavations (max depth of 4m bgl).
- 4No. Trial Trench Excavations (max depth 3.6m for 19 to 20m long) (T6, T10, Jubilee Slide, T1).
- 28No. Rotary Open Hole/Rotary Cored Boreholes (max depth 35m bgl) the drilling was commenced by dynamic sampling from ground level to rockhead (between 1.5m and 4.5mbgl), continued by rotary coring to depths of between 15mbgl and 21mbgl, followed on by rotary open hole drilling to 30/35mbgl. At turbine locations T1, T2, T8 and T9, four to six additional boreholes were undertaken around the perimeter of the proposed turbines.
- Sampling of soils and rock cores for laboratory geotechnical testing.

It should be noted that in the location of T2, the proposed turbine coordinate was amended during the intrusive works. It was moved approximately 28m northeast.

The following laboratory geotechnical testing was undertaken on soil samples collected from depths of between 0.4m and 1.8mbgl:

- 12No. Moisture Content
- 4No. Atterberg Limits
- 8No. Particle Size Distribution,
- 4No. Optimum Moisture Content and Maximum Dry Density relationship,
- 6No. pH and water-soluble sulphate

The following testing was undertaken on rock samples collected from depths of between 3.7m and 16.5mbgl:

- 15No. Point Load Tests (with axial and diametral tests on each sample)
- 2No. Uniaxial Compressive Strength (UCS) Tests

Photographs of site and trial pits are available in the report. The logs are AGS mark however AGS data has not been provided.

2.7 Geotechnical Interpretive Report (Sep 2021, Integral Geotechnique)

Following the factual investigation in June 2021, Integral Geotechnique produced an interpretive report which included the following sections:

- The Site (Section 2)
- Site History (Section 3)
- Preliminary Conceptual Site model (Section 5)
- Revised Conceptual Site Model (Section 9)
- Mining Risk Assessment (Section 9)
- Geotechnical Considerations (Section 10)
- Recommended Further Works (Section 11)
- Envirocheck Report (Appendix A)

The Mining Risk Assessment (Section 9 of the interpretive report) has been summarised and updated in Section 3 to include the most recent turbine locations and main southern access track.

3 Mining Risk Assessment

The following abandonment plans are referenced in this section of the report:

Table 7 Abandonment Plans Consulted

Abandonment Plan Number	Colliery	Affected Workings	Affected Features
8205	Duffryn Rhondda	Wernddu Seam	n/a
9094	Llew Howell & Company Limited Argded Collieries Pontrhydyfen	Wernddu & Wernpistyll Rider Seams	n/a – NW of site boundary
SWR794	Foel-Y-Duffryn	No. 2 Rhondda Seam	T8 and tracks between turbines
SWS1070	Nant Glas	No. 2 Rhondda Seam	T1, T2 and tracks between turbines
8371 (1 of 2)	Bryn Mercantile	White, Clay, Victoria & Jonah Seam	Main Southern Access Track
8371 (2 of 2)	Bryn Mercantile	White and Clay	
SWR3764	Unknown	White Vein	
SWR3762	Unknown	Clay Vein	
6847	Ton-Hir	Golden Vein	
SWR3763	Unknown (Partial Plan)	Unknown	Unknown

Strata within the vicinity of the site are indicated to dip between 12 degrees and 15 degrees towards the north-west. Table 8 provides more information on the conjectured sequence and thickness of the coal seams beneath the site; however, the site is split across two geological maps, which indicate local variations in the nature of the coal seams.

Table 8 Stratigraphic Summary of Coal Seams

Coal Seam	Thickness (26 NW / 25 NE)	Approximate vertical separation
Thin Coal	Thin	11m - 26m
Field Vein	Thin	5.5m – 11m
Wernddu (No.2 Rhondda)	2ft 6in / 9in 0.76/0.23	11m – 16m
Wernpistyll Rider	Thin	11m - 14m
Wernpistyll	Thin/2ft 6in Thin/0.76m	
A collection of thin coal seams greater than 25m below the Wernpistyll seam. Continued stratigraphic sequence with depth.		

*Wernddu and Field vein exist as either 2 leaves/seams on Glamorgan Sheet 26 NW, or a continuous seam (No. 2 Rhondda 3ft) on Glamorgan sheet 25 NE.

The following mine entries recorded within 20m of the planning boundary:

Table 9 Mine Entry Data

Mine Entry Reference	Treatment Details	Georeferenced Coordinates (E,N)	Adit Bearing
283192-027	Following a report of a surface collapse, the shaft was partially excavated and subsequently backfilled and mounded with imported clean stone and secured with timber post and rail fencing by the Coal Authority in 2019.	283774 192187	n/a

Mine Entry Reference	Treatment Details	Georeferenced Coordinates (E,N)	Adit Bearing
283193-007	No treatment details	283830, 193641	003
283192-028	No treatment details	283731 193163 (approximate)	340
283193-008	No treatment details	283891, 193578	042
284193-036	Adit sealed with compacted brick rubble and backfilled with soil. 4.3m square fence erected. (CCD/92/34).	284022, 193500	000
*284193-035	No treatment details	284064, 193968	338

*Mine entry ref: 284193-035 which is located just outside of the site boundary, to the south-east of proposed Turbine 8.

Workings at greater and varying depths are likely to be recorded in various coal seams beneath the site associated with the following collieries, which are known to have been mined beneath the site or within the surrounding area:

- Nant Glas Colliery
- Foel y Duffryn Colliery
- Duffryn Rhondda Colliery
- Old Argoed Colliery
- Pennant Colliery
- Cynon Colliery

Table 10 summarises the impact of the shallow coal mining on the proposed turbine locations from 2021, and the main southern access track. It should be noted that the turbines have since been moved between 5m and 30m from these locations.

Table 10 Summary of Mining impact on proposed turbine locations and Main Southern Access Track

Turbines	Notes
T1	The Wernpistyll coal seam would be estimated at some 24mbgl reducing to approximately 21m at the southern edge. Wernpistyll coal seam is generally either thin or 2ft 9inches in thickness. A potential risk of unrecorded shallow mine workings associated with the Wernpistyll coal seam, and a relative lesser risk associated with the overlying Wernpistyll Rider (thin) coal seam. A low risk of unrecorded crop workings associated with the No.2 Rhondda coal seam. Mine entry ref:284193-036 is shown approximately 67m east of Turbine 1. Due to its northerly azimuth and distance from the turbine, low risk from adit.
T2 (new location)	No.2 Rhondda coal seam is located at approximately 33mbgl (after correction). The Field Vein would be anticipated to overlie this coal seam and may be some 5.5m to 11m shallower or may also be present immediately overlying the No.2 Rhondda coal seam. Underlain by recorded workings at around 30mbgl within the No.2 Rhondda coal seam and may also be expected within the underlying fire clay and the overlying Field Vein. The Wernpistyll coal seam at greater depth. Therefore, both coal seams are outside the zone of concern. Mine entry ref: 283193-007 is shown approximately 75m south-south-west of Turbine 2, entering the conjectured No.2 Rhondda coal seam. The azimuth of the adit is shown towards the north, continuing via a roadway towards the north-east, almost immediately beneath Turbine 2. Low risk from Adit. Shallow mining risk remains.
T5, T6	A thin coal seam is conjectured to outcrop through the north-west of the site.

Turbines	Notes
	No.2 Rhondda are located at significant depths beneath the site, outside the zone of concern. Risk of unrecorded and recorded mineworking: not considered due to lack of economic viability.
T8	No.2 Rhondda coal seam is located approximately 18m to 20mbgl in the vicinity of Turbine 8 (after correction). Field vein may be some 1.5m to 11m shallower. Mine entry 284193-035 is located approximately 65m south-east of Turbine 8. Low risk from adit. Shallow mining risk remains .
T9, T10, T11	Below T9, the No.2 Rhondda coal seam is estimated to be at approximately 65mbgl and deeper below T10 and T11. The risk of ground subsidence arising from (recorded or unrecorded) mineworking beneath these turbines is low. Shallow mine working (field Vein) considered.
Main Southern Access Track	Golden vein workings decreasing in level to NW. Ground Level increases to the north. At highest level of workings (259mAOD), ground level is around 260mAOD, which coincides with adit number 283192-028 at around NGR SS837931. Workings proceed north-north west where they meet the main access track again at NGR SS836927 at which point the difference between the workings and existing ground level is approximately 197m. The Golden Vein is considered to be 1.33m thick. The workings continue north along the main access track however, the seam dips north-northwest and ground levels increase to the north therefore the risk of ground subsidence arising from (recorded or unrecorded) mineworking beneath the main access track is low. Clay Seam workings (8371) cross the main access track at around NGR SS837927 at a level between 277 and 285mAOD with existing ground levels at approximately 320mAOD giving a potential depth to workings of 35m. The Clay Seam is considered to be around 0.66m thick. Further workings in the Clay Vein are shown on abandonment plan SWR3762 however this plan contains no level information for the workings. The workings cross the main access track where existing ground levels are a minimum of around 300mAOD, potentially within 15m vertical separation from the workings, assuming similar levels taken from abandonment plan number 8371. Workings continue to cross the main access track further north however existing ground levels increase significantly to in excess of 340mAOD. The White Seam is below the Clay Seam in the geological sequence and crosses the main access track at a level of approximately 297mAOD where ground levels are around 340mAOD giving a potential depth to workings of 40-45m. Further workings are shown on abandonment plan SWR3764, again with no level information presented. Ground levels where the workings cross the main access track are around 342.5mAOD. Assuming similar levels for workings for the White Vein (assumed White Seam) the potential depth to workings here is around 45.5m. Mine workings appear to be too deep to be a risk. Adit at southern end of road high risk.

3.1.1 Fieldwork Interpretation

Table 11 summarises the encountered coal seams and potential mining features. Table 12 shows Mining Legacy Risk Table (after field work) for the turbine area. Table 13 shows Mining Legacy Risk Table for the main southern access track.

Table 11 Summary of Encountered Coal Seams and Potential Mining Features

Location	Coal Seam (mbgl)	Coal Seam Thickness (m)	Possible Mine Workings (mbgl)	Workings Thickness (m)
Turbine 1				
BHT1	1.6 – 1.9	0.3	N/A – Intact coal only	N/A
	5.6 – 6.0	0.4		
	17.0 – 17.3	0.3		
BHT1-A	3.8 – 4.3	0.5	N/A – Intact coal only	N/A
	9.2 – 10.0	0.8		

Location	Coal Seam (mbgl)	Coal Seam Thickness (m)	Possible Mine Workings (mbgl)	Workings Thickness (m)
	20.5 – 20.9	0.4		
BHT1-B	3.2 – 3.6	0.4	N/A – Intact coal only	N/A
	14.5 – 15.0	0.5		
BHT1-C	2.0 – 2.5	0.5	N/A – Intact coal only	N/A
	14.0 – 14.5	0.5		
BHT1-D	2.0 – 2.4	0.4	N/A – Intact coal only	N/A
	19.0 – 19.5	0.5		
<u>Turbine 2 (Revised Location)</u>				
BHT2	N/A – No Coal encountered	N/A	N/A	N/A
BHT2-A	N/A– No Coal encountered	N/A	N/A	N/A
BHT2-B	25.5 – 26.5	1.0	N/A – Intact coal only	N/A
BHT2-C	24.5 – 26.0	1.5	N/A – Intact coal only	N/A
<u>Turbine 2 (Original Location)</u>				
BHT202	18.0 – 18.8	0.8 (Very soft drill, possible coal)	15.2 – 18.0 No returns	2.8
			27.0 – 28.2 Soft drill	1.2
BHT202-D	14.0 – 15.0	1.0	21.8 – 22.1 Void	0.3
			(22.1 – 22.6 Normal drill)	(0.5)
			22.6 – 24.0 Backfilled workings	1.4
BHT202-E	14.5 – 15.8	1.3	23.3 – 24.0 Void	0.7
			24.0 – 24.5 Backfilled workings	0.5
<u>Turbine 8</u>				
BHT8	9.7 – 10.0	0.3	19.5 – 20.0 Broken Ground	0.5
			20.0 – 21.0 Void	1.0
			21.0 – 23.0 Very soft drill	2.0
BHT8-A	11.0 – 11.6	0.6	21.0 – 22.5 Void	1.5
			22.5 – 23.5 Backfilled workings	1.0
BHT8-B	8.4 – 9.6	1.2	N/A – Intact coal only	N/A
	19.5 – 20.0	0.5		
	21.4 – 22.2	0.8		
BHT8-C	6.5 – 7.5	1.0	N/A – Intact coal only	N/A
	16.7 – 17.7	1.0		
	19.0 – 19.4	0.4		
BHT8-D	– No Coal encountered	N/A	14.6 – 15.0 Void	0.4
			15.0 – 19.0 Broken ground and voids (no returns)	4.0
BHT8-E	10.5 – 11.0	0.5	N/A – Intact coal only	N/A

Location	Coal Seam (mbgl)	Coal Seam Thickness (m)	Possible Mine Workings (mbgl)	Workings Thickness (m)
	20.9 – 21.6	0.7		
	22.6 – 23.0	0.4		
BHT8-F	11.1 – 11.6	0.5	22.5 – 23.5 Void	1.0
			23.5 – 24.4 Soft drill	0.9
<u>Turbine 9</u>				
BHT9-D	13.8 – 14.1	0.3	N/A – Intact coal only	N/A

Table 12 Mining Legacy Risk Table for Turbines and Access Tracks

Coal Mining Issue	Yes	No	Risk Assessment	
			Rating	Comments
Underground coal mining (recorded at shallow depths)	X		High risk Turbines T2 and T8 Only	Recorded workings and roadways presented on the Coal Authority mine abandonment plans associated with the No.2 Rhondda coal seam (and underlying fireclay) in Turbines T2 and T8.
Underground coal mining (probable/unrecorded at shallow depths)	X		Medium risk Turbine 1	Workable coal seams encountered within boreholes beneath Turbine 1.
Mine entries (shafts)		X	Low risk	Three mine entries identified in the Coal Authority records – none are shafts.
Mine entries (adits)	X		Medium risk Access track/T2 crane pads only	Three mine entries on site and one just off site relate to adits. Adit locations are away from turbine locations (low risk). 283193-008 located immediately south-west of proposed access track (medium risk). Investigation recommended. 283193-007 located to the south-west of Turbine 2 crane pad and access road. Investigation recommended.
Coal mining geology (faults and fissures)		X	Low risk	Jubilee Slide underlies centre of the site. Trial trench(TT3) along the fault line does not indicate significant concerns with regard to ground conditions. Localised softer zone should be anticipated.
Record of past mine gas emissions or potential	X		Medium risk	None recorded on site. However, all mine workings pose a potential gas risk which should be considered in any future investigations and development.
Recorded coal mining surface hazard		X	Low risk	None recorded.
Surface mining (open cast workings)		X	Low risk	None recorded. Some potential for small scale crop/surface workings to exist in the southern portion of the site along coal seam outcrops, however the intrusive investigations did not encounter such workings at Turbine 1 or elsewhere.

Table 13 Mining Legacy Risk Table for Main Southern Access Track

Coal Mining Issue	Yes	No	Risk Assessment	
			Rating	Comments
Underground coal mining (recorded at shallow depths)		X	Low risk	Recorded workings and roadways presented on Mining Remediation Authority abandonment plans associated with adit number 283192-028 and the Golden Vein; however workings dip away from road and ground level for road rises above workings, so low risk. Clay Seam workings (8371) cross the main access track at around NGR SS837927 around 35mbgl within zone of influence of the surface. Further workings in the Clay Vein are shown on plan SWR3762, this plan contains no level information for the workings; however, based on other plans workings are likely to be between 35m and 45mbgl, with a seam thickness of 0.7m more than 7m of rock cover is present to mitigate the risk to the road and therefore not within zone of influence of the surface. The White Seam is below the Clay Seam in the generally geological sequence and crosses the main access track at a level of approximately 297mAOD where ground levels are around 340mAOD and therefore not within zone of influence of the surface.
Underground coal mining (probable/unrecorded at shallow depths)		X	Low risk	Ground investigation not undertaken along main southern access track to determine underground coal mining beyond abandonment plans received. However abandonment plans present for all of road alignment indicates works in workable seams are recorded.
Mine entries (shafts)		X	Low risk	Shaft 283192-027 identified in Mining Remediation Authority records. Following a report of a surface collapse, the shaft was partially excavated and subsequently backfilled and mounded with imported clean stone and secured with timber post and rail fencing by the Coal Authority in 2019.
Mine entries (adits)	X		High risk	Adit number 283192-028 associated with the Golden Vein meets the main southern access track at around NGR SS837931. Treatment details are unknown.
Coal mining geology (faults and fissures)		X	Low risk	Faults inferred 450m west and 490m east of access track.
Record of past mine gas emissions or potential	X		Medium risk	None recorded on site however all mine workings pose a potential gas risk which should be considered in any future investigations and developments.
Recorded coal mining surface hazard		X	Low risk	None recorded.
Surface mining (open cast workings)		X	Low risk	None recorded.

3.1.1.1 Risk from abandoned mine workings

- T1 old location is low mining risk as coal encountered as intact in borehole records. New location to be investigated.
- T2 original location at potential mining risk due to insufficient rock cover. T2 revised location at no significant risk as coal was either absent or encountered as intact in borehole records. To be reassessed after confirmation of foundation levels.
- T8 potential mining risk due to insufficient rock cover (10:1)
- Drilling and grouting remediation required at T8 and T2.

3.1.1.2 Risk from abandoned mine entries

The mine entries have not been physically or intrusively investigated as part of this report and previous ground investigations. The mine entries/portal entrances are not considered to pose a risk to the proposed turbines. However, adit records 283193-007 and 283193-008 are located near to the proposed access track in the south

of the turbine area and shaft and adit records for 283192-027 and 283192-028 respectively are located near the southern extents of the main southern access track. As such, it is recommended that further investigation is undertaken at these locations to confirm their locations and assess the potential impact to the access track between turbines by trenching. The supplementary proof drilling beneath Turbine 2 should also cover the area of the proposed access track and/or crane pad in this area which may also be affected by the underground roadway extending north from mine entry 283193-007. Where an adit entrance is located within influencing distance of the access tracks between turbines and the main southern access track (i.e. potentially at Adit 283193-008 and 283192-028) the adit entrance may need to be excavated out and reinstated.

Any intrusive activities, including site investigation boreholes and trial pits/trenches that disturb coal seams and/or adits and subsequent treatment of mine workings/mine entries for ground stability purposes require written permission from the Coal Authority.

4 Remedial Works Required

The following sections address further work required in relation to each of the planning conditions detailed in Section 1.3 and identify where gaps exist in the available information.

The 2021 report noted that mine entries/portal entrances were not considered to pose a risk to the proposed turbines; however, the report noted that several adits were located near to proposed access tracks and recommended that further intrusive work by trenching and borehole drilling would be required to determine if the adits posed a risk to access tracks and if treatment is required.

4.1 Turbine 1

The abandonment plans around T1 presented in Figure 6, and in greater detail on drawing 110636-PEF-XX-XX-D-G-0006 in Appendix A, show the proposed location for T1 (red circle) is closer to potential workings by approximately 21m compared with the previous T1 location (black circle).

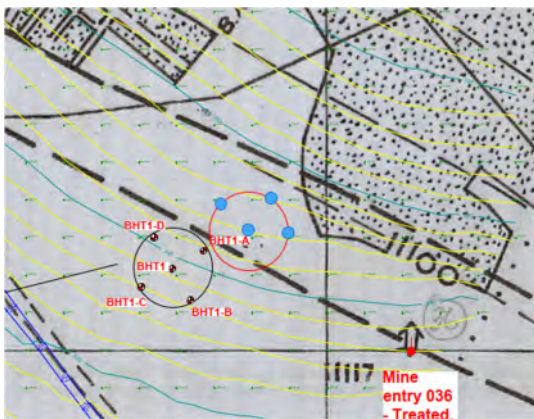


Figure 6 Relocation of T1 relating to underground working

Drawing 110636-PEF-XX-XX-D-G-0006 in Appendix A presents a cross section showing the current proposed location of Turbine 1 and the relative depth of coal seams beneath the previous T1 location encountered during previous ground investigation works. Although intact / unworked coal seams were encountered beneath the original T1 location, considering that the current location is closer to the Nant Glas Colliery where the uppermost of these seams is known to have been worked at least four 30m deep boreholes (blue dots on Figure 6) should be undertaken at the proposed location of T1 to confirm coal remains intact at the revised T1 location.

4.2 Turbine 2 and access track between T1 and T2

A potential risk has been identified beneath the access track between turbines T1 and T2 in the south of the site associated with two adits. Figure 8, and in greater detail on drawing 110636-PEF-XX-XX-D-G-0006 in Appendix A, suggests that mine entry 008 (283193-008) is directly under the proposed access road between the two turbines. The topography of the location also suggests a worked area which may be the mine entry. Trial trenching of the adit portal entrance to 283193-008 and boreholes drilled along the proposed alignment to the access track is recommended to assess the potential for ground subsidence associated with adit 283193-008. Additional deep boreholes (30m bgl) are required along the southern extent of the access roads between adit 283193-008 and T2 every 5m for the first 20m, every 10m for the next 60m and every 20m for the remaining distance. A higher frequency of boreholes shall be undertaken near the adit to locate and evaluate the backfill.

T2 has been relocated 7m to the SE as shown in Figure 7 and a potential risk of ground subsidence associated with historic underground mine workings has been identified. Drawing 110636-PEF-XX-XX-D-G-0009 in Appendix A presents a cross section showing the relative depth of worked coal seams beneath the previous T2

location and unworked coal seams close to the proposed T2 location at the time of the most recent ground investigation. Since the ground investigation T2 has been relocated 7m to the south east and as the strata dips to the north, the workable coal seams at the new location to the SE are estimated to be at a shallower depth. Considering the complex nature of the mine workings shown on the abandonment plan, at least two 30m boreholes (blue dots on Figure 7) should be undertaken at the current location to provide full coverage beneath the latest T2 location.

These works should also cover the area of the proposed access track and/or crane pad in this area which may also be affected by the underground roadway extending north from mine entry 283193-007 (Figure 7).

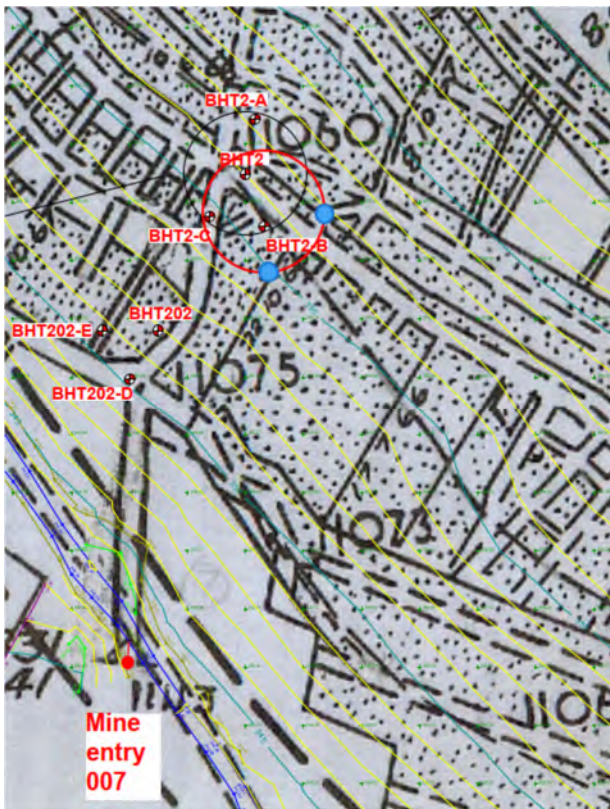


Figure 7 Relocation of T2 relating to underground working

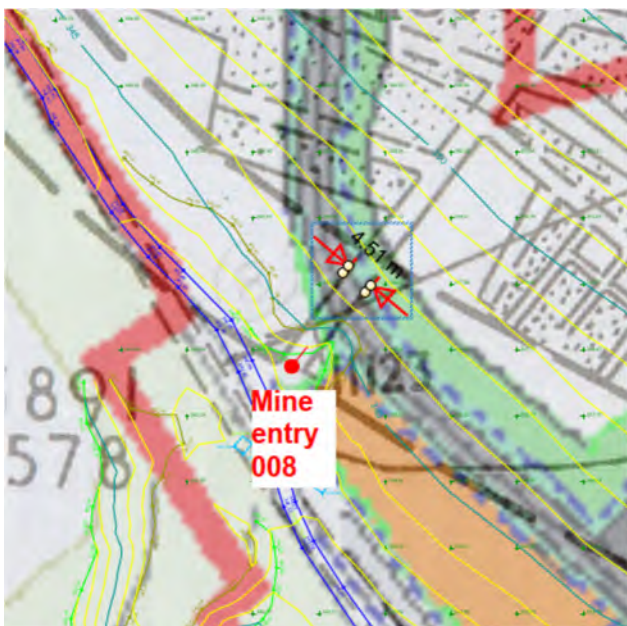


Figure 8 Mine Entry 008

4.3 Turbine 8

A potential risk of ground subsidence associated with historic underground mine workings has been identified beneath T8. The proposed location of T8 (red circle) has been relocated 20m to the west of the existing ground investigation boreholes which were centred around a previous location (black circle), as shown in Figure 9. Drawing 110636-PEF-XX-XX-D-G-0009 in Appendix A presents a cross section showing the relative depth of coal workings beneath the previous T8 location and although the any potential workings will be deeper below the proposed T8 location they remain within influencing depth of the foundations. As the previous mining risk assessment indicated that treatment was necessary and with reference to the abandonment plans for the area, it is very likely the new location will also require treatment. Therefore, five additional boreholes (blue dots on Figure 9) shall be undertaken to 30m deep to identify the shallow workings in the vicinity of T8 to understand the extent and thickness of the mine workings in this area and undertake treatment/grouting of any encountered voids/workings.

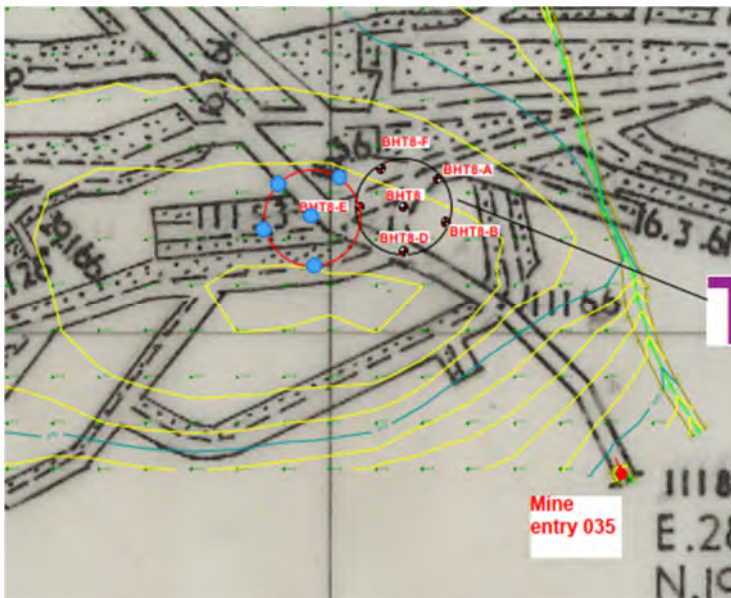


Figure 9 Relocation of T8 relating to underground working

4.4 Access track between T8 and T9

A potential risk has been identified beneath the access track between turbines T8 and T9 associated with the abandonment plans for the Foel-Y-Duffryn Colliery. Boreholes drilled along the proposed alignment to the access track are recommended to assess the potential for ground subsidence associated with collapse of potential workings.

4.5 Turbine 9

As T9 has been moved 30m SE of the previous ground investigation; however, as shown on the mine abandonment plan drawing (110636-PEF-XX-XX-D-G-0009 T9 in Appendix A) is outside the footprint of any recorded workings and as shown on constraints drawing (110636-PEF-XX-XX-D-G-0004 in Appendix A) is not located over any identified constraints. Five dynamic sample boreholes to bedrock, extended by rotary coring to prove a minimum of 5m of bedrock, are recommended for geotechnical design. Remedial works are not thought necessary.

4.6 Access Road

Drawing 110636-PEF-XX-XX-D-G-0005 shows the redline boundary of the main southern access track overlaid onto the abandonment plans and a potential risk has been identified associated with shaft and adit records for 283192-027 and 283192-028 respectively (shown in less detail in Figure 10). The workings associated with

these mine entries head away from the access road at shallow depth but are indicated to cross back beneath the route of the road at significant depth such that they do not pose a risk. There are also 'Old Workings' shown on the abandonment plans on drawing 110636-PEF-XX-XX-D-G-0005 which are not within influencing distance / depth of the road and do not require further investigation.

Trial trenching of the adit portal entrance to 283192-028 is recommended with boreholes drilled along the proposed alignment to the main southern access track, to assess the potential for ground subsidence associated with adit 283192-028. Adit 283192-027 has been treated by collapsing and backfilling and no further treatment is proposed at this stage; however, this will need to be reassessed once the road alignment is fixed to confirm that the road crosses the already treated section of the adit.



Figure 10 Approximate location of adit number 283192-028 and shaft 283192-027

4.7 Additional Recommendations

Further site investigation is also recommended at the proposed location for contractor compound, proposed track upgrades and the crane pad adjacent to T1.

A minimum two 30m boreholes are recommended at the proposed location of substation footprint, currently shown to be approximately 150m west of the proposed T8.

Further site investigation is recommended at the proposed crane pads associated with each turbine location.

The following recommendations are not necessary for the mining risk assessment but may be undertaken during the site investigations listed in the Section 4 if deemed advantageous in cost savings or operational requirements:

- A. Shallow investigations for the access roads and building sites to determine pavement foundation design and determine geotechnical parameters for temporary works design.
- B. Boreholes to provide geotechnical design parameters for the latest Turbine 9 location; being 30m SE of the previous ground investigation.
- C. Development of BIM modelling around turbines T2 and T8.

Recommended ground investigation works are summarised in Table 14 and the locations shown on drawings 110636-PEF-XX-XX-DR-GI-00001 to 110636-PEF-XX-XX-DR-GI-00009 (Appendix A). On completion of the ground investigation works a treatment scheme for shallow mine workings will be issued as a separate 'Specification and Schedule for Treatment of Mine Workings'.

Table 14 Proposed Exploratory Hole Schedule

Reference	Method of Investigation	Scheduled Depth (m bgl)	Easting (m)	Northing (m)	Comments
BH101	Rotary Borehole	10	283785.8928	192152.0942	Determine depth of and presence/likelihood of workings in No.2 Rhonda Seam, under access road.
BH102	Rotary Open Hole Borehole	10	283790.4764	192160.9893	
BH103	Rotary Open Hole Borehole	10	283795.0126	192169.8845	
BH104	Rotary Borehole	20	283804.1324	192187.6748	
BH105	Rotary Open Hole Borehole	25	283813.2523	192205.4651	
BH106	Rotary Open Hole Borehole	35	283829.3423	192243.1402	
BH107	Rotary Open Hole Borehole	35	283885.0780	192597.7190	Determine depth of and presence/ likelihood of workings within the Caly Seam, under access road.
BH108	Rotary Open Hole Borehole	35	283873.4675	192628.7495	
BH109	Rotary Open Hole Borehole	35	283850.6205	192652.4520	
BH110	Rotary Open Hole Borehole	30	283726.1700	192720.7450	Determine depth of and presence/likelihood of workings in White Seam, under access road.
BH111	Rotary Open Hole Borehole	30	283711.7520	192726.4940	
BH112	Rotary Open Hole Borehole	30	283701.0570	192737.0115	
BH113	Rotary Open Hole Borehole	30	283694.2540	192748.5990	
BH114	Rotary Open Hole Borehole	30	283675.4850	192763.1180	
BH115	Rotary Open Hole Borehole	30	283676.2060	192777.9555	
BH116	Rotary Open Hole Borehole	30	283676.7797	192792.7665	
BH117	Rotary Open Hole Borehole	30	283680.8620	192807.0440	
BH118	Rotary Open Hole Borehole	30	283711.1867	192866.1366	
BH119	Rotary Open Hole Borehole	30	283749.7745	192907.4787	
BH120	Rotary Open Hole Borehole	30	283779.4416	192941.4790	
BH121	Rotary Open Hole Borehole	30	283803.6109	192973.9048	
BH122	Rotary Open Hole Borehole	30	283818.7760	193012.8900	
BH123	Rotary Open Hole Borehole	30	283835.6162	193062.0396	
BH124	Rotary Open Hole Borehole	30	283852.5000	193114.2000	
BH125	Rotary Open Hole Borehole	30	283870.5221	193165.7530	

Reference	Method of Investigation	Scheduled Depth (m bgl)	Easting (m)	Northing (m)	Comments
BH126	Rotary Open Hole Borehole	30	283881.6442	193210.9313	
BH127	Rotary Open Hole Borehole	30	283898.4679	193255.0846	
BH128	Rotary Open Hole Borehole	30	283916.3505	193299.4559	
BH129	Rotary Open Hole Borehole	30	283933.5446	193344.6310	
BH130	Rotary Open Hole Borehole	30	283950.0301	193382.7674	
BHT1-E	Rotary Borehole	30	283979.4316	193529.9538	Confirm coal intact beneath new T1 location.
BHT1-F	Rotary Borehole	30	283976.0041	193539.8180	
BHT1-G	Rotary Borehole	30	283982.7820	193520.7428	
BHT1-H	Rotary Borehole	30	283988.8488	193533.0837	
BHT1-I	Rotary Borehole	30	283958.2516	193535.9895	
BHCC101	Dynamic Sample with Rotary follow on	8	283911.5710	193552.5800	Determine ground conditions at the location of the proposed contractor's compound. Prove minimum of 5m bedrock through rotary coring.
BHCC102	Dynamic Sample with Rotary follow on	8	283904.4762	193512.9269	
BHCC103	Dynamic Sample with Rotary follow on	8	283888.9150	193488.9228	
BHCC104	Dynamic Sample with Rotary follow on	8	283967.1020	193488.0580	
BHCC105	Dynamic Sample with Rotary follow on	8	283954.9760	193457.1660	
TPAD101	Machine Excavated Trial Trench	4.5	283886.8884	193578.7471	Trial trenching of the adit portal entrance to 283193-008
BHT2-E	Rotary Borehole	30	283862.9402	193720.6909	Provide full coverage beneath the latest T2 location
BHT2-G	Rotary Borehole	30	283855.1782	193708.6910	
BHCP201	Rotary Open Hole Borehole	30	283868.3286	193703.7758	Determine ground conditions at the location of the proposed crane pad
BHCP202	Rotary Borehole	30	283880.5773	193689.7473	
BH201	Rotary Open borehole	30	283892.8042	193588.0163	Assess the potential for ground subsidence associated with adit 283193-008 and evaluate the backfill and workings in the Nant Glas Colliery present at shallow depth along the line of the access road.
BH202	Rotary Open borehole	30	283889.6329	193595.2070	
BH203	Rotary Open borehole	30	283888.9979	193600.1101	

Reference	Method of Investigation	Scheduled Depth (m bgl)	Easting (m)	Northing (m)	Comments
BH204	Rotary Open borehole	30	283888.4807	193605.0833	
BH205	Rotary Open borehole	30	283888.7746	193615.0789	Assess the potential for ground subsidence associated with adit 283193-008 and workings in the Nant Glas Colliery present at shallow depth along the line of the access road.
BH206	Rotary Open borehole	30	283889.0832	193625.5772	
BH207	Rotary Open borehole	30	283889.3762	193635.5443	
BH208	Rotary Open borehole	30	283889.5793	193645.0682	
BH209	Rotary Open borehole	30	283890.0000	193656.0740	
BH210	Rotary Open borehole	30	283885.3668	193663.4960	
BH211	Rotary Open borehole	30	283872.8042	193679.0582	
BH212	Rotary Open borehole	30	283859.2142	193693.7080	
BH213	Rotary Open borehole	30	283845.6628	193708.4172	
BH214	Rotary Open borehole	30	283832.3401	193723.3355	
BH215	Rotary Open borehole	30	283823.9791	193741.2620	
BH216	Rotary Open borehole	30	283817.0317	193760.3534	
BH217	Rotary Open borehole	30	283809.3261	193778.5869	
BH218	Rotary Open borehole	30	283805.3127	193796.7822	
BH219	Rotary Open borehole	30	283900.6382	193950.3105	Determine likelihood of workings in Wernpistyll Rider Seam, under access road
BH220	Rotary Open borehole	30	283899.3430	193965.8170	
BH221	Rotary Open borehole	30	283900.9054	193989.8261	
BH222	Rotary Open borehole	30	283900.5598	194018.9147	
BH223	Rotary Open borehole	30	283892.2674	194036.9447	
BH224	Rotary Open borehole	30	283878.6207	194051.5656	
BH225	Rotary Open borehole	30	283861.4423	194061.8077	
BH226	Rotary Open borehole	30	283841.5420	194063.5984	
BH227	Rotary Open borehole	30	283821.6416	194065.3891	
BH228	Rotary Open borehole	30	283801.7412	194065.8767	

Reference	Method of Investigation	Scheduled Depth (m bgl)	Easting (m)	Northing (m)	Comments
BH229	Rotary Open borehole	30	283781.8409	194066.3644	
BH230	Rotary Open borehole	30	283909.0362	194034.9406	
BH231	Rotary Open borehole	30	283918.8872	194049.8218	
BH232	Rotary Open borehole	30	283929.8836	194055.5453	
BH233	Rotary Open borehole	30	283947.2947	194052.5691	
BH234	Rotary Open borehole	30	283964.2475	194046.8455	
BH235	Rotary Open borehole	30	283979.5967	194042.4956	
BH236	Rotary Open borehole	30	283730.0000	194102.0726	
BHT8-G	Rotary Borehole	30	283993.8532	194032.6845	Identify the shallow workings in the vicinity of T8 to understand the extent and thickness of the mine workings in this area
BHT8-H	Rotary Borehole	30	283995.9289	194024.7956	
BHT8-I	Rotary Borehole	30	283985.8562	194022.8911	
BHT8-J	Rotary Borehole	30	283998.1059	194015.2242	
BHT8-K	Rotary Borehole	30	283951.8685	194041.9661	
BHT8-L	Rotary Borehole	30	283977.4772	194035.8239	
BHT8-M	Rotary Borehole	30	283964.5596	194027.2378	
BHSS1	Rotary Borehole	40	283811.3752	194033.6018	Determine ground conditions at the location of the proposed substation
BHSS2	Rotary Borehole	40	283841.2534	194001.2589	
TPCC801	Machine Excavated Trial Pit	4.5	283842.3502	194035.5765	Determine ground conditions at the location of the proposed contractor's compound
TPCC802	Machine Excavated Trial Pit	4.5	283865.0615	194030.4737	
TPCC803	Machine Excavated Trial Pit	4.5	283880.2459	194005.4185	
TPCC804	Machine Excavated Trial Pit	4.5	283918.8343	193997.2814	
TPCC805	Machine Excavated Trial Pit	4.5	283937.8677	194027.4012	
TPCC806	Machine Excavated Trial Pit	4.5	283969.1602	194002.8925	
TPCC807	Machine Excavated Trial Pit	4.5	283996.0703	193985.2963	
BHT9-E	Dynamic Sample with Rotary follow on	8	283737.7220	194174.2546	

Reference	Method of Investigation	Scheduled Depth (m bgl)	Easting (m)	Northing (m)	Comments
BHT9-F	Dynamic Sample with Rotary follow on	8	283748.2309	194174.2338	Determine ground conditions at the location of the proposed contractor's compound. Prove minimum of 5m bedrock through rotary coring.
BHT9-G	Dynamic Sample with Rotary follow on	8	283758.0913	194174.1788	
BHT9-H	Dynamic Sample with Rotary follow on	8	283743.7813	194153.7312	
BHT9-I	Dynamic Sample with Rotary follow on	8	283738.5676	194132.5922	

5 Summary

This Mining Risk Assessment summarises the previous reports around mining risk and ground investigation. As the wind turbines have been relocated in the most recent proposal, and the main southern access road was added to the scope of works, the completeness of the new and existing information was assessed to fulfil the requirements for the planning condition numbers 7a and 7b but not 7c and 7d.

It is anticipated that grouting will be required at turbines T2 and T8 as a minimum together with the surrounding access tracks and proposed infrastructure. Additional exploratory holes are required to mitigate risks identified by the mining risk assessment for revised proposed turbine locations T1, T2, T8 and T9, sections of access track between turbines T1 and T2 and T8 and T9, adit 283193-008 and the main southern access track, as detailed in Section 4 and summarised in Table 14.

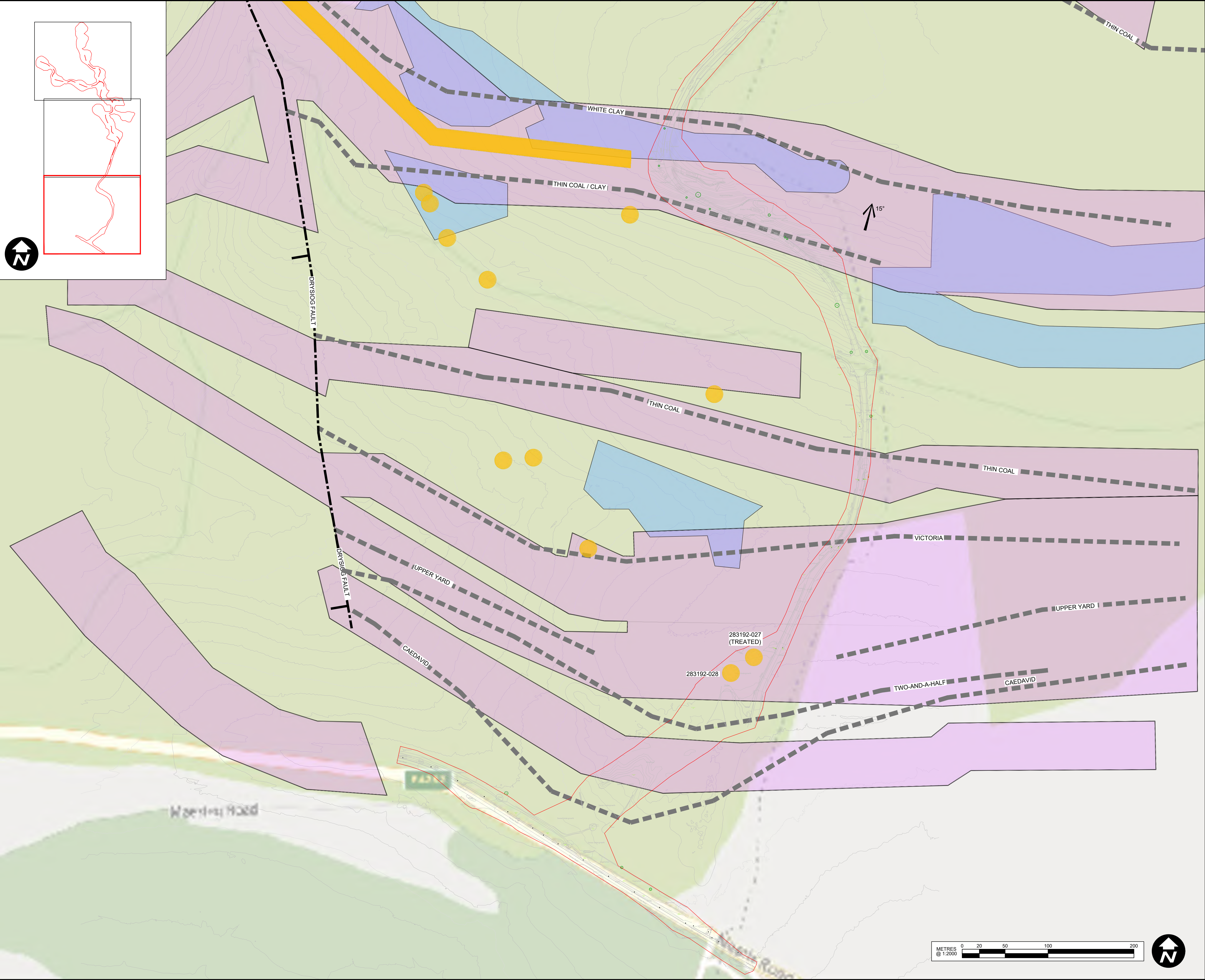
Proposed exploratory hole locations are shown on drawings 110636-PEF-XX-XX-DR-GI-00001 to 110636-PEF-XX-XX-DR-GI-00009 presented in Appendix A. A ground investigation specification will be issued separately for pricing by ground investigation contractors. On completion of the ground investigation a treatment scheme for shallow mine workings will be issued as a separate 'Specification and Schedule for Treatment of Mine Workings'.

Appendix A Drawings

110636-PEF-XX-XX-D-G-0001	General Arrangement
110636-PEF-XX-XX-D-G-0002	Existing /Geological Information and Constraints Plan Sheet 1 of 3
110636-PEF-XX-XX-D-G-0003	Existing /Geological Information and Constraints Plan Sheet 2 of 3
110636-PEF-XX-XX-D-G-0004	Existing /Geological Information and Constraints Plan Sheet 3 of 3
110636-PEF-XX-XX-D-G-0005	Mine Abandonment Plans Sheet 1 of 3
110636-PEF-XX-XX-D-G-0006	Mine Abandonment Plans Sheet 2 of 3
110636-PEF-XX-XX-D-G-0007	Mine Abandonment Plans Sheet 3 of 3
110636-PEF-XX-XX-D-G-0008	Existing Information and Geological Sections Sheet 1 of 2
110636-PEF-XX-XX-D-G-0009	Existing Information and Geological Sections Sheet 2 of 2
110636-PEF-XX-XX-DR-GI-00001	Ground Investigation Schedule Page 1 of 9
110636-PEF-XX-XX-DR-GI-00002	Ground Investigation Schedule Page 2 of 9
110636-PEF-XX-XX-DR-GI-00003	Ground Investigation Schedule Page 3 of 9
110636-PEF-XX-XX-DR-GI-00004	Ground Investigation Schedule Page 4 of 9
110636-PEF-XX-XX-DR-GI-00005	Ground Investigation Schedule Page 5 of 9
110636-PEF-XX-XX-DR-GI-00006	Ground Investigation Schedule Page 6 of 9
110636-PEF-XX-XX-DR-GI-00007	Ground Investigation Schedule Page 7 of 9
110636-PEF-XX-XX-DR-GI-00008	Ground Investigation Schedule Page 8 of 9
110636-PEF-XX-XX-DR-GI-00009	Ground Investigation Schedule Page 9 of 9



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- INFERRED FAULT (TICK ON DOWNTHROW SIDE)
- INCLINED STRATA, DIP IN DEGREES
- SITE BOUNDARY
- ACCESS TRACK
- PROPOSED TURBINE LOCATION WITH 21m DIA. BASE
- DESCOPED TURBINE LOCATION

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Project

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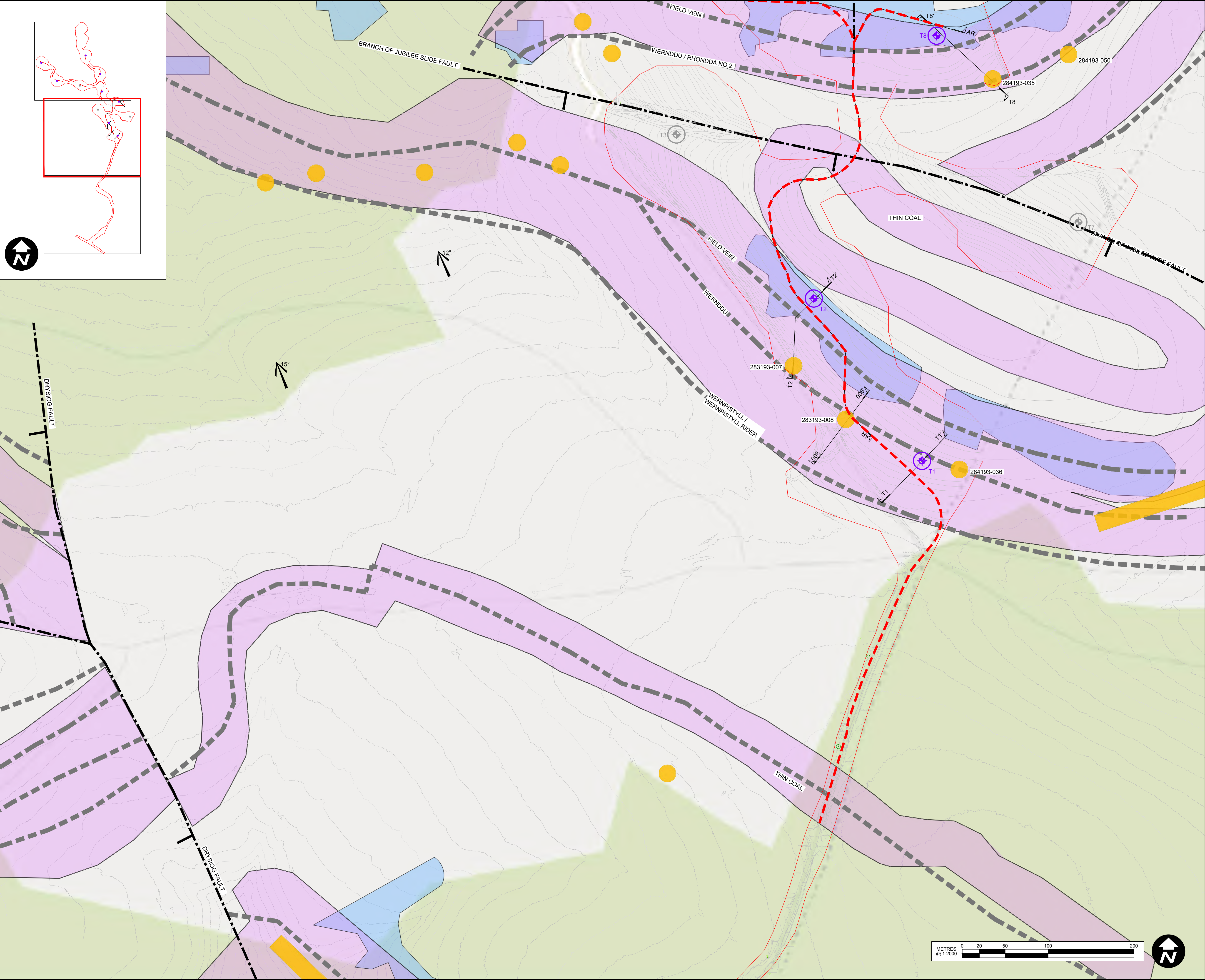
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EXISTING GEOLOGICAL INFORMATION & CONSTRAINTS SHEET 1 OF 3

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- INCLINED STRATA, DIP IN DEGREES
- SITE BOUNDARY
- ACCESS TRACK
- PROPOSED TURBINE LOCATION WITH 21m DIA. BASE
- DESCOPED TURBINE LOCATION

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EXISTING GEOLOGICAL
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SHEET 2 OF 3

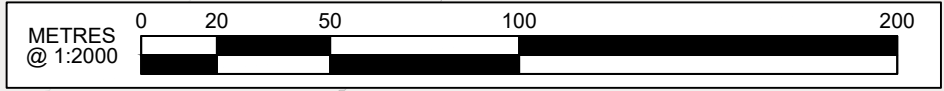
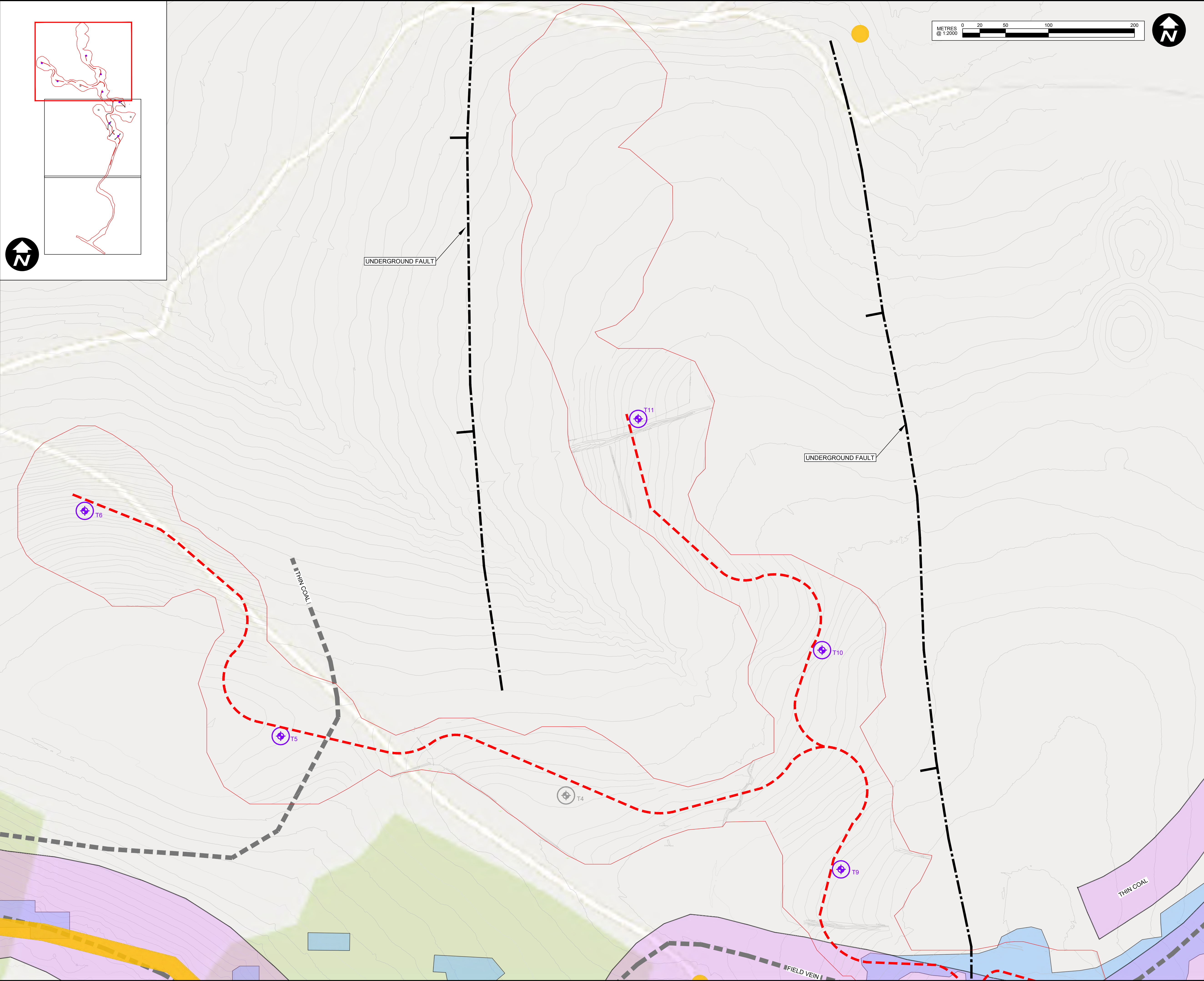
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- DESCOPED TURBINE LOCATION

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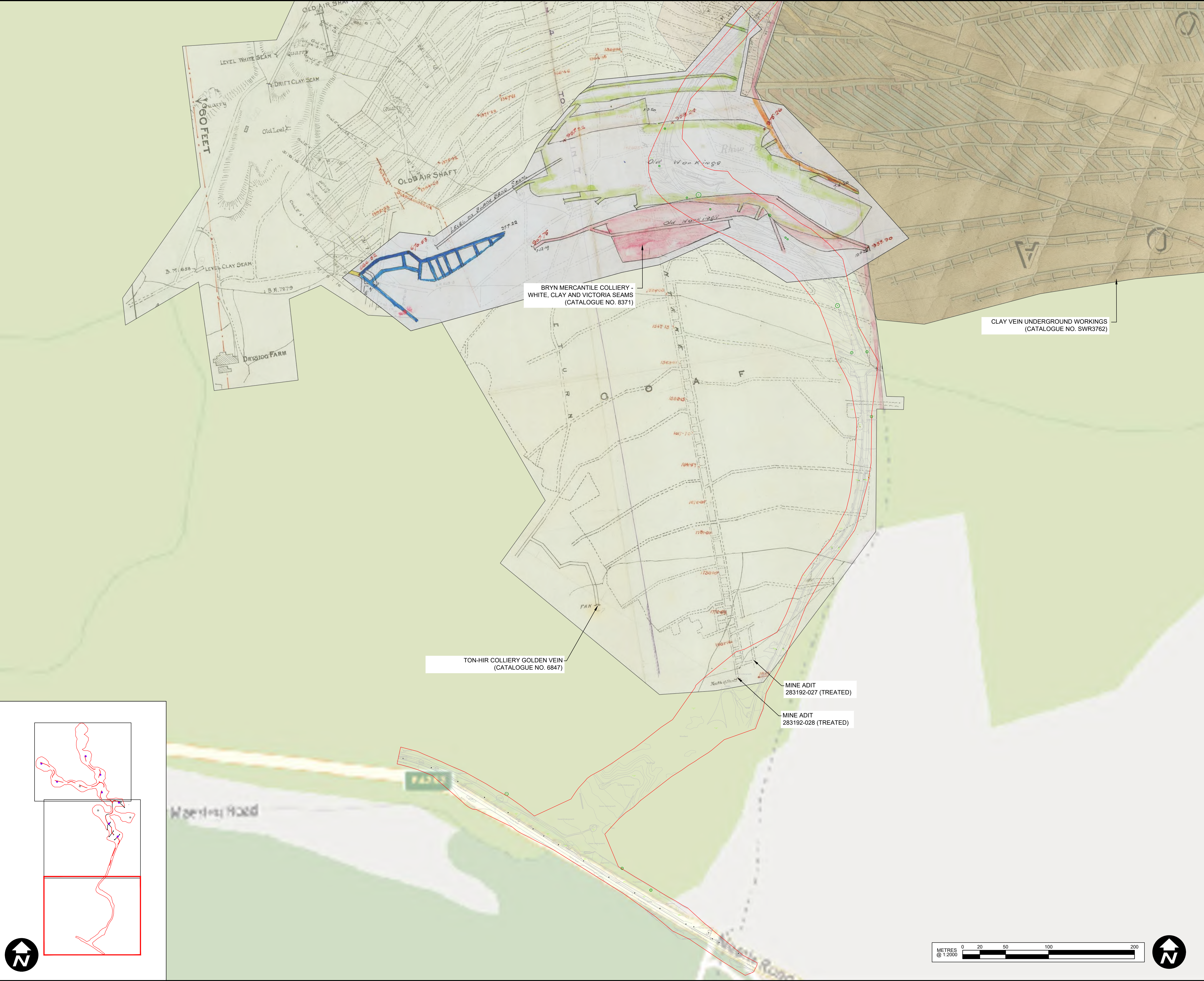
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MINE ABANDONMENT PLANS		
CATALOGUE NO.	SEAM NAME	RELATED MINE ENTRY
SW1070	NO.2 RHONDDA (WERNDDU)	283193-007
		283193-008
		283193-036
SWR794	NO.2 RHONDDA (WERNDDU)	283193-007
9094/ 1	NO.2 RHONDDA (WERNDDU)	
8205	NO.2 RHONDDA (WERNDDU)	
8371/ 1	LOWER PINCHIN (WHITE)	
SWR3764	LOWER PINCHIN (WHITE)	
SWR3763	UNNAMED SEAM	
SWR3762/ 2	HAFOD CLAY	
6847	GOLDEN VEIN	283192-028

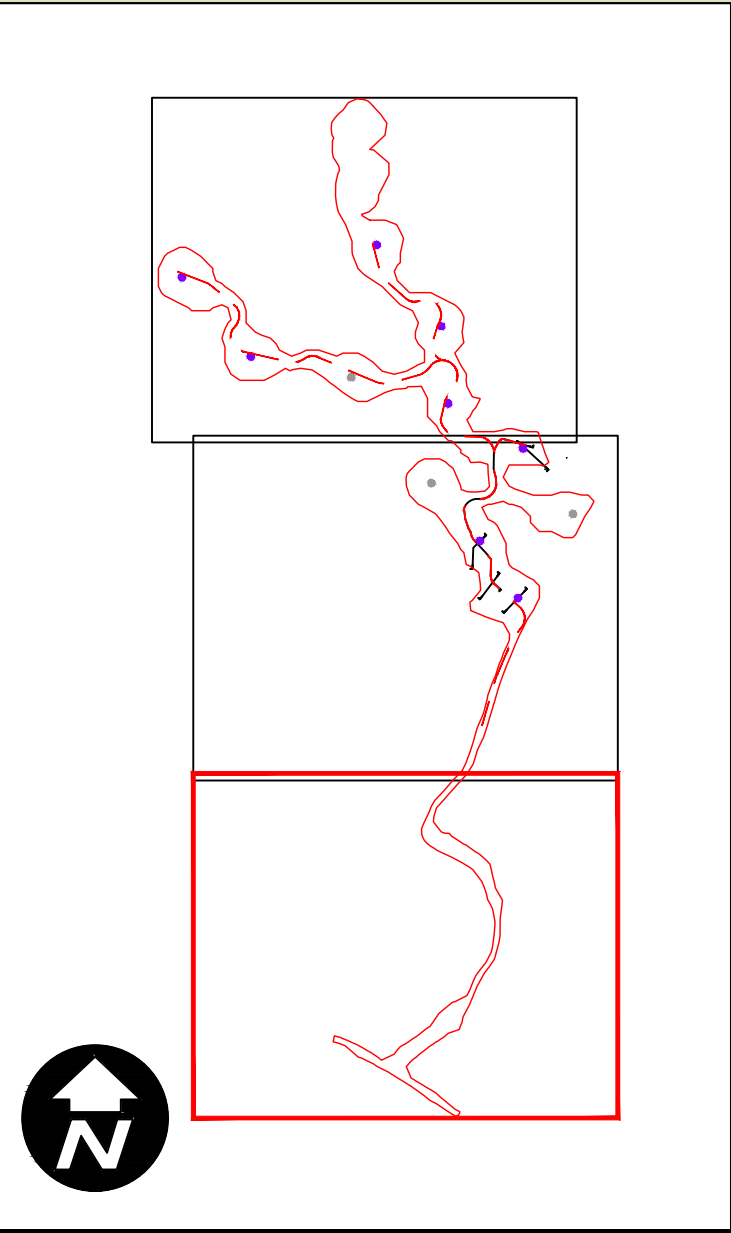
KEY

SITE BOUNDARY

PROPOSED ACCESS TRACK

PROPOSED TURBINE LOCATION WITH 21m DIA. BASE

DESCOPED TURBINE LOCATION



REV | DESCRIPTION | DRN | DES | CHK | APP | DATE

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Architect/Client/Contractor

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

MINE ABANDONMENT PLANS SHEET 1 OF 3

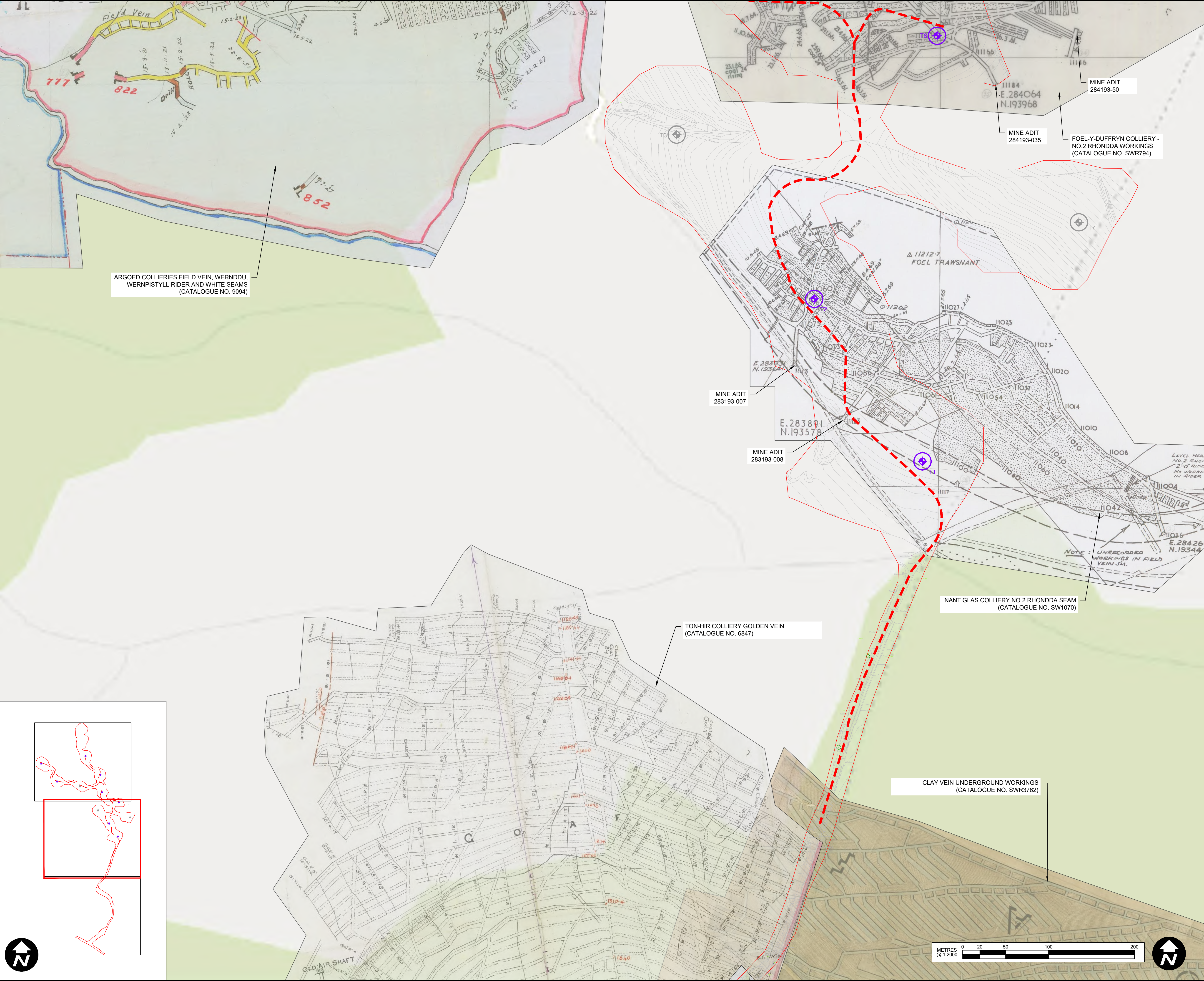
Drawing Status

PRELIMINARY

Drawn	Name	Date	Status Code
Designed	T. CRAWFORD	11/02/2026	S2
Eng Chk	T. CRAWFORD	11/02/2026	Scale
Approved	A. DOUGILL	05/03/2026	AS SHOWN @A1
			Revision
			P01

Drawing No.

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MINE ABANDONMENT PLANS		
CATALOGUE NO.	SEAM NAME	RELATED MINE ENTRY
SW1070	NO.2 RHONDDA (WERNDU)	283193-007 283193-008 283193-036
SWR794	NO.2 RHONDDA (WERNDU)	283193-007
9094/ 1	NO.2 RHONDDA (WERNDU)	
8205	NO.2 RHONDDA (WERNDU)	
8371/ 1	LOWER PINCHIN (WHITE)	
SWR3764	LOWER PINCHIN (WHITE)	
SWR3763	UNNAMED SEAM	
SWR3762/ 2	HAFOD CLAY	
6847	GOLDEN VEIN	283192-028

KEY

- SITE BOUNDARY
- PROPOSED ACCESS TRACK
- PROPOSED TURBINE LOCATION WITH 21m DIA. BASE
- DESCOPED TURBINE LOCATION

REV	DESCRIPTION	DRN	DES	CHK	APP	DATE
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Architect/Client/Contractor

Alerion

Project

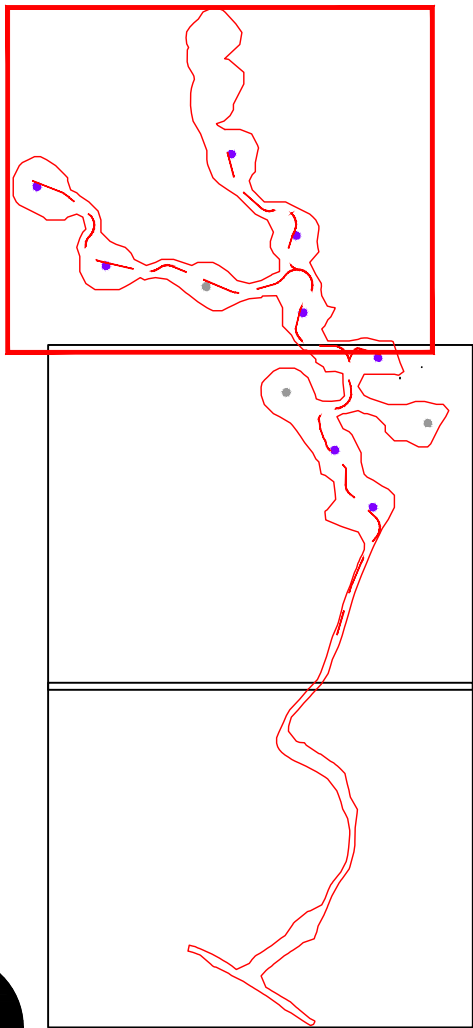
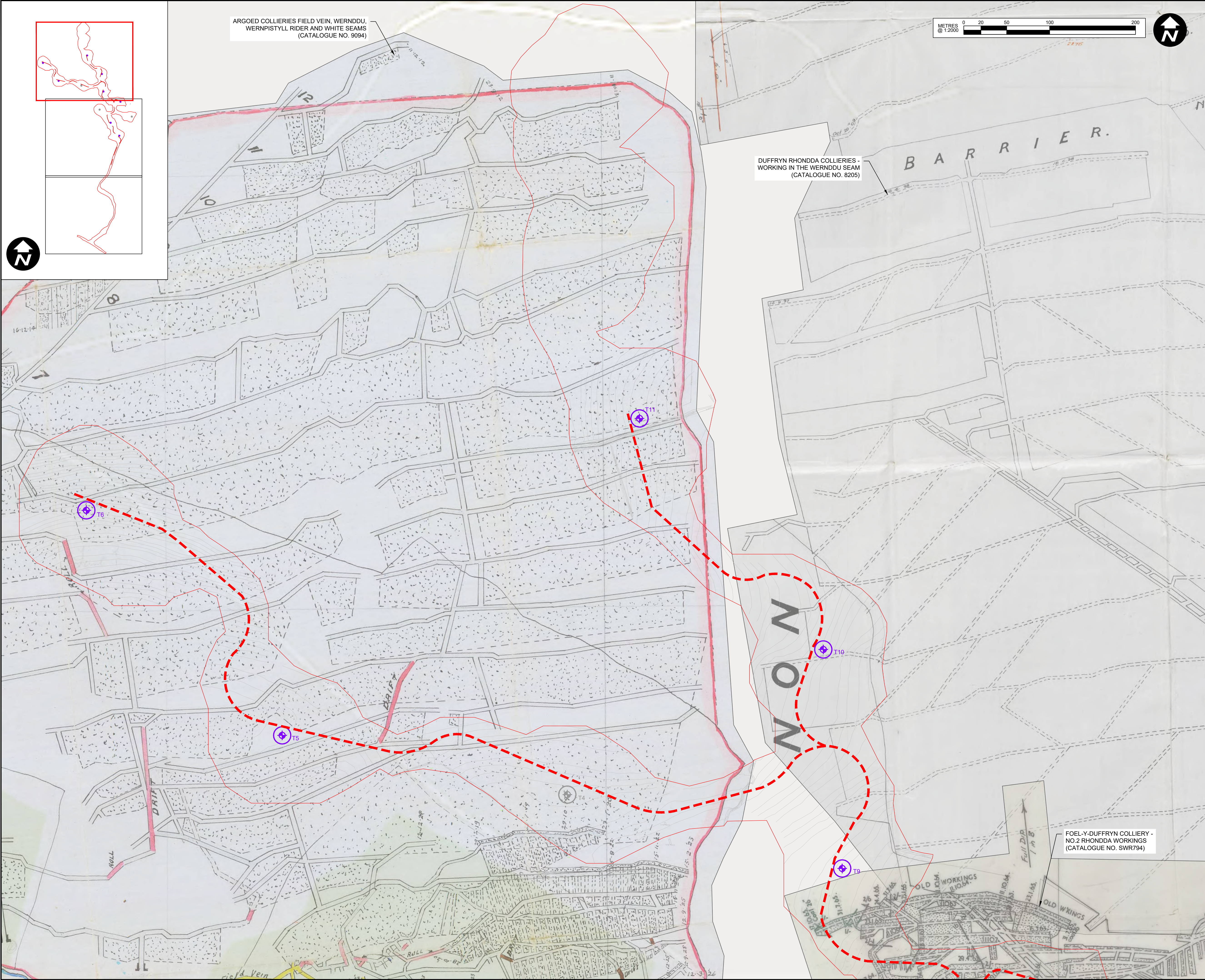
FOEL TRAWSNANT WINDFARM

Drawing Title

MINE ABANDONMENT PLANS SHEET 2 OF 3

Drawing Status			
PRELIMINARY			
	Name	Date	Status Code
Drawn	T. CRAWFORD	11/02/2026	S2
Designed	T. CRAWFORD	11/02/2026	Scale
Eng Chk	A. DOUGILL	05/03/2026	AS SHOWN @A1
Approved	----	----	Revision
			P01

Drawing No.
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MINE ABANDONMENT PLANS		
CATALOGUE NO.	SEAM NAME	RELATED MINE ENTRY
SW1070	NO.2 RHONDDA (WERNDDU)	283193-007 283193-008 283193-036
SWR794	NO.2 RHONDDA (WERNDDU)	283193-007
9094/ 1	NO.2 RHONDDA (WERNDDU)	
8205	NO.2 RHONDDA (WERNDDU)	
8371/ 1	LOWER PINCHIN (WHITE)	
SWR3764	LOWER PINCHIN (WHITE)	
SWR3763	UNNAMED SEAM	
SWR3762/ 2	HAFOD CLAY	
6847	GOLDEN VEIN	283192-028

KEY

— SITE BOUNDARY

- - - PROPOSED ACCESS TRACK

⊕
TNo. PROPOSED TURBINE LOCATION WITH 21m DIA. BASE

⊕
TNo. DESCOPED TURBINE LOCATION

REV	DESCRIPTION	DRN	DES	CHK	APP	DATE
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Project

FOEL TRAWSNANT WINDFARM

Drawing Title

MINE ABANDONMENT PLANS
SHEET 3 OF 3

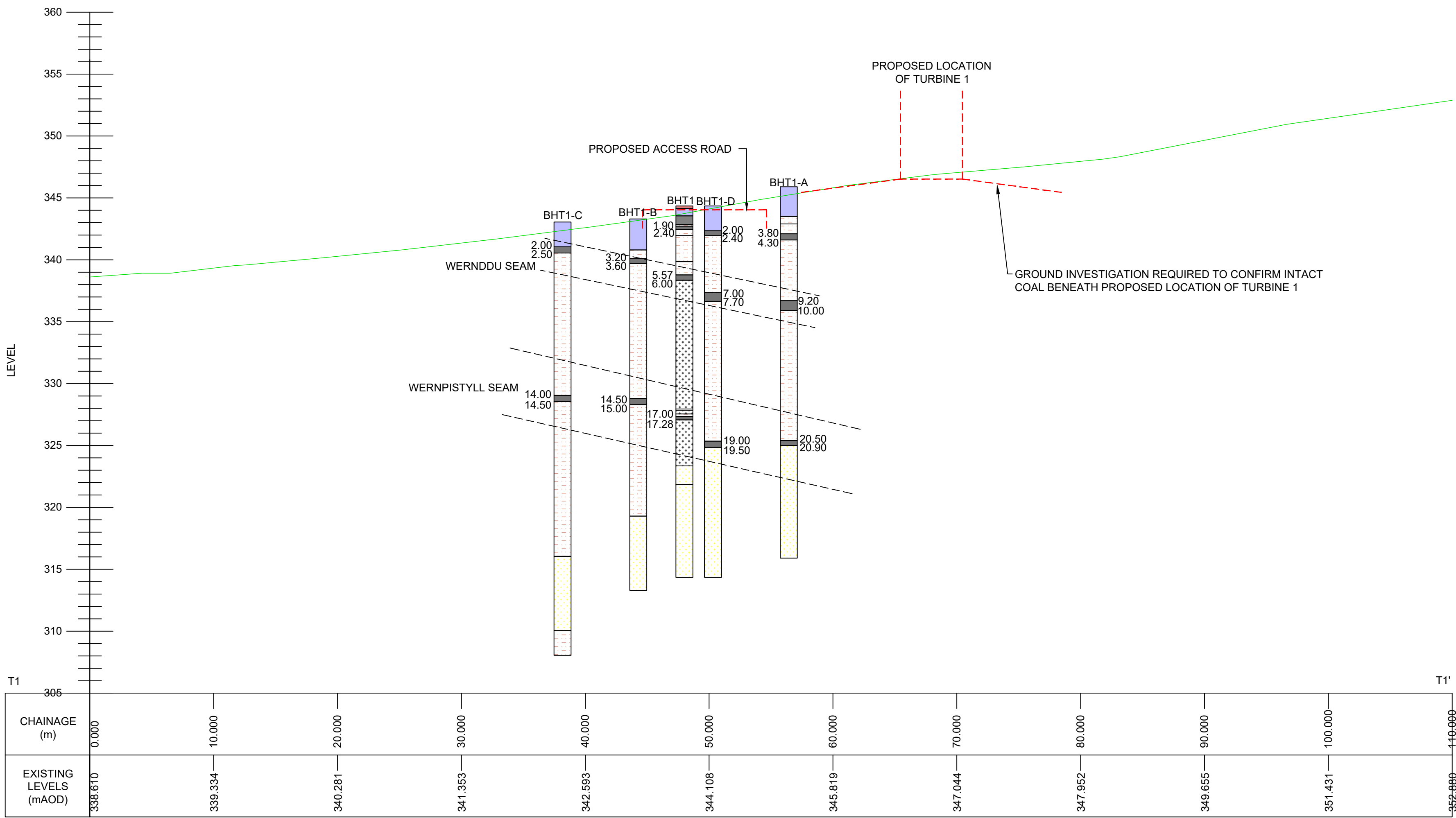
Drawing Status

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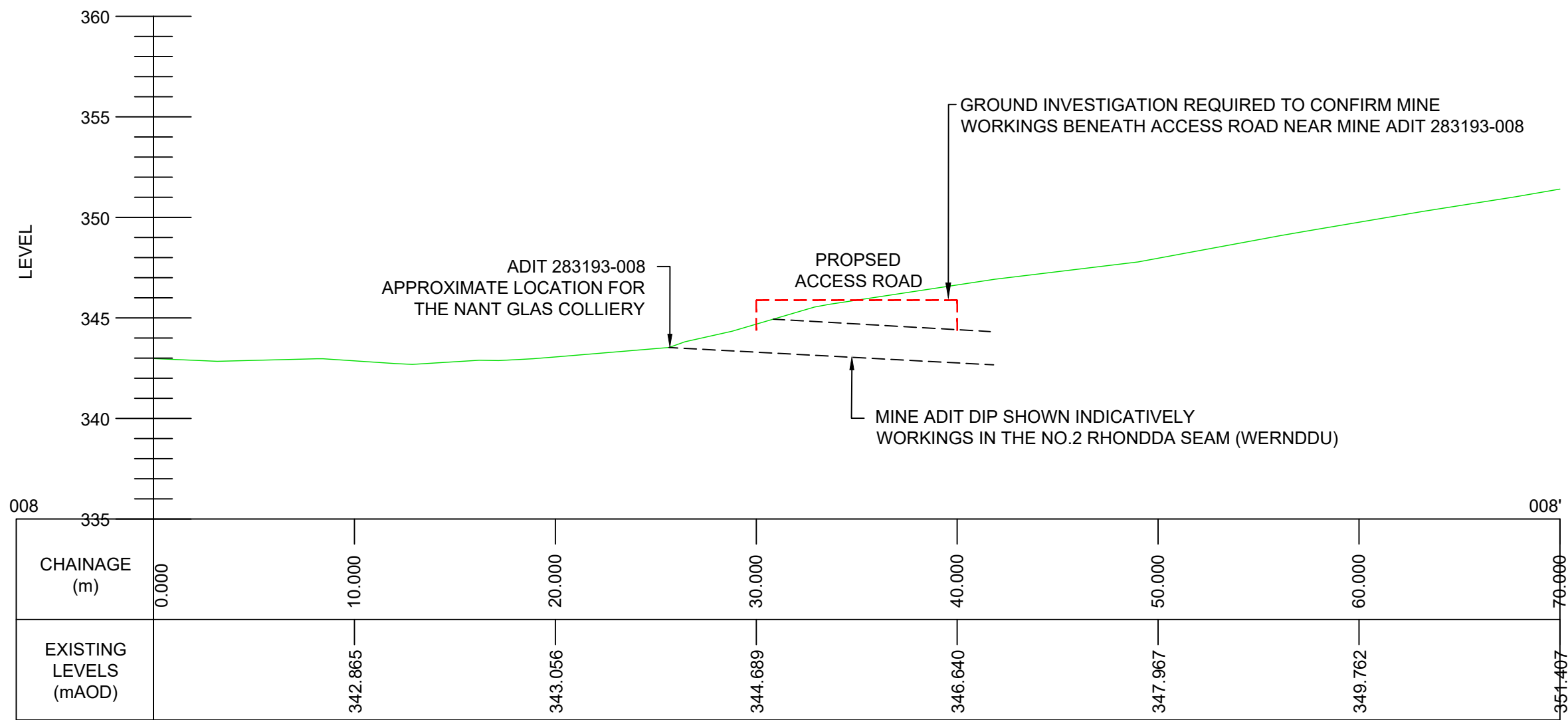
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Drawn	T. CRAWFORD	11/02/2026	S2
Designed	T. CRAWFORD	11/02/2026	Scale AS SHOWN @A1
Eng Chk	A. DOUGILL	05/03/2026	Revision
Approved	----	----	P01

Drawing No.

110636-PEF-XX- XX - D - G - 0007



T1 - T1': TURBINE 1 CROSS SECTION
SCALE: 1:250



008 - 008': MINE ADIT 283193-008 FOR WERNDDU (NO.2 RHONDDA) CROSS SECTION
SCALE: 1:250

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GEOLOGY KEY

- TOPSOIL
- COAL
- MUDSTONE
- SANDSTONE
- SILTSTONE
- GRANULAR TILL
- COHESIVE TILL
- VOID
- NO RECOVERY
- EXISTING GROUND LEVEL
- PROPOSED STRUCTURES

REV	DESCRIPTION	DRN	DES	CHK	APP	DATE
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Architect/Client/Contractor



Project

**FOEL TRAWSNANT
WINDFARM**

Drawing Title

**EXISTING INFORMATION
AND GEOLOGICAL SECTIONS
SHEET 1 OF 2**

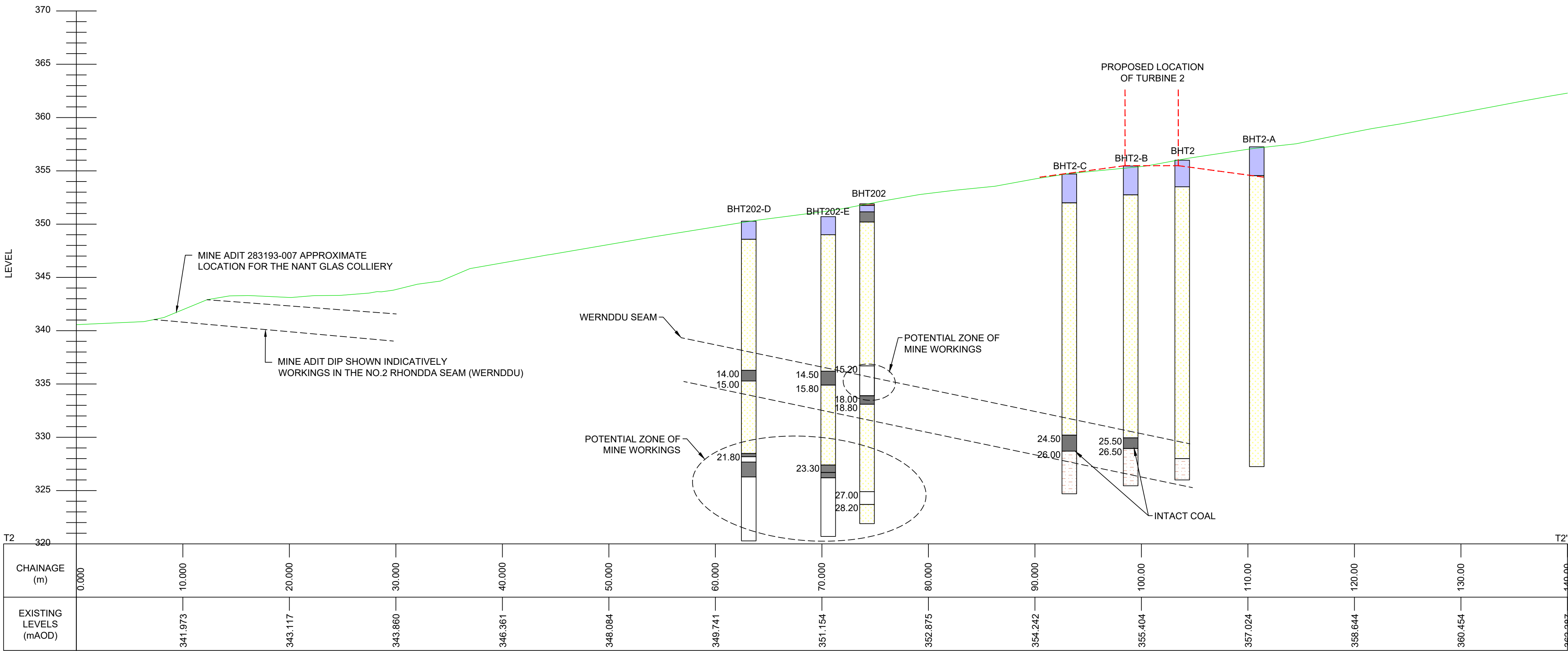
Drawing Status

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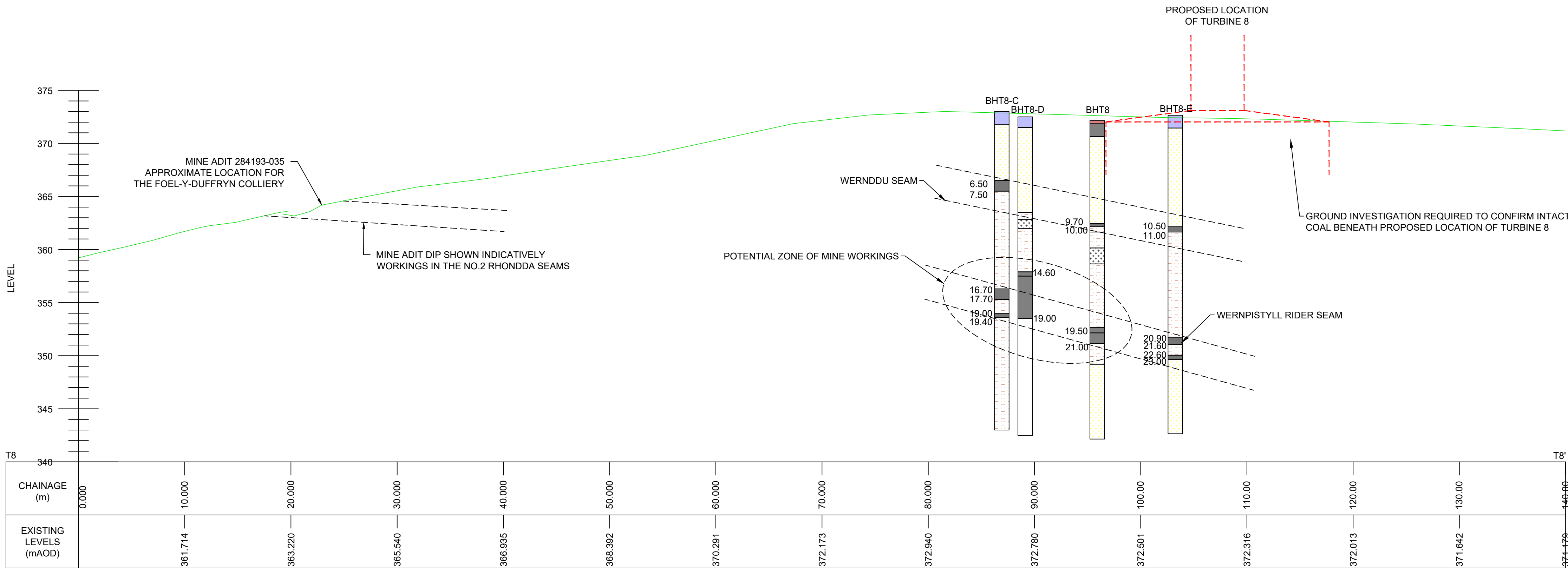
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Drawn	T. CRAWFORD	11/02/2026	S2
Designed	T. CRAWFORD	11/02/2026	Scale
Eng Chk	A. DOUGILL	05/03/2026	AS SHOWN @A1
Approved	----	----	Revision
			P01

Drawing No.

110636-PEF-XX- XX - D - G - 0008



T2 - T2': TURBINE 2 AND ADIT 283193-007 CROSS SECTION
SCALE: 1:250



T8-T8': TURBINE 8 AND ADIT 284193-035 CROSS SECTION
SCALE: 1:250

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GEOLOGY KEY

- TOPSOIL
- COAL
- MUDSTONE
- SANDSTONE
- SILTSTONE
- GRANULAR TILL
- COHESIVE TILL
- VOID
- NO RECOVERY

- EXISTING GROUND LEVEL
- PROPOSED STRUCTURES

REV	DESCRIPTION	DRN	DES	CHK	APP	DATE
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Project

FOEL TRAWSNANT
WINDFARM

Drawing Title

EXISTING INFORMATION
AND GEOLOGICAL SECTIONS
SHEET 2 OF 2

Drawing Status

PRELIMINARY

	Name	Date	Status Code
Drawn	T. CRAWFORD	11/02/2026	S2
Designed	T. CRAWFORD	11/02/2026	Scale
Eng Chk	A. DOUGILL	05/03/2026	AS SHOWN @A1
Approved	----	----	Revision
			P01

Drawing No.

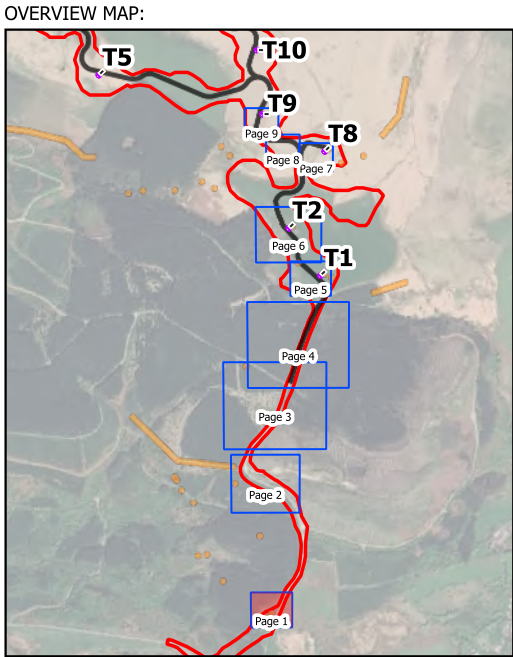
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 4. THE CONTRACTOR SHALL SUITABLY PROTECT PEDESTRIANS AND VEHICLES FROM THE WORKING AREA DURING THE WORKS.
 5. SETTING OUT SHALL BE CARRIED OUT IN ACCORDANCE WITH CONTRACT DOCUMENTS AND APPENDIX 1/12.

KEY

- Rotary Borehole
- Rotary Open Hole Borehole
- Site Boundary



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Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
PAGE 1 of 9

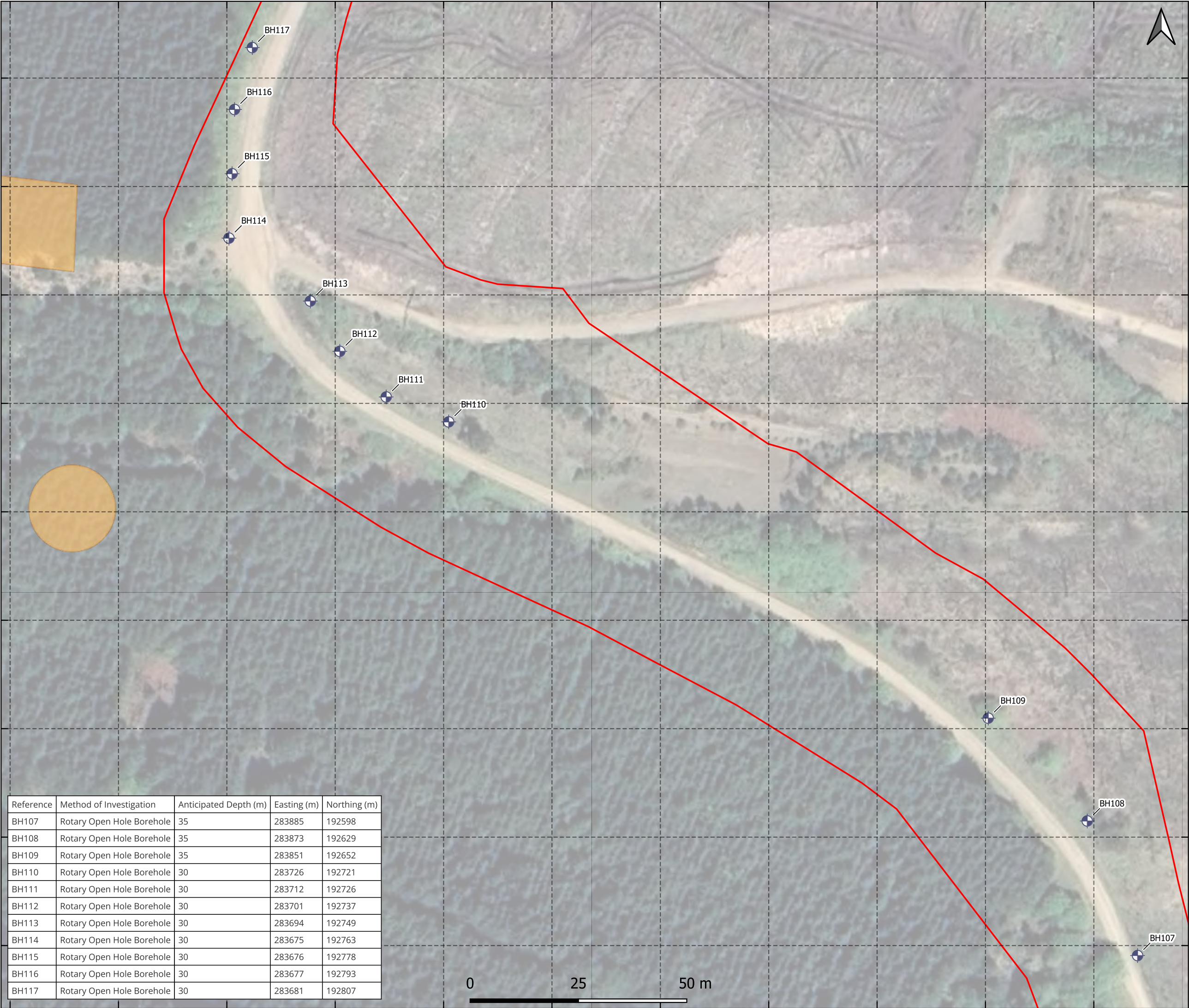
Drawing Status

FOR ISSUE

Drawn	Name	Date	Status Code
Designed	K. Jensen	29/04/2026	S4
Eng Chk	A. Dougill	29/04/2026	AS SHOWN
Approved	N. Dewell	29/04/2026	Revision P01

Drawing No.

110636-PEF-XX-XX-DR-GI-00001

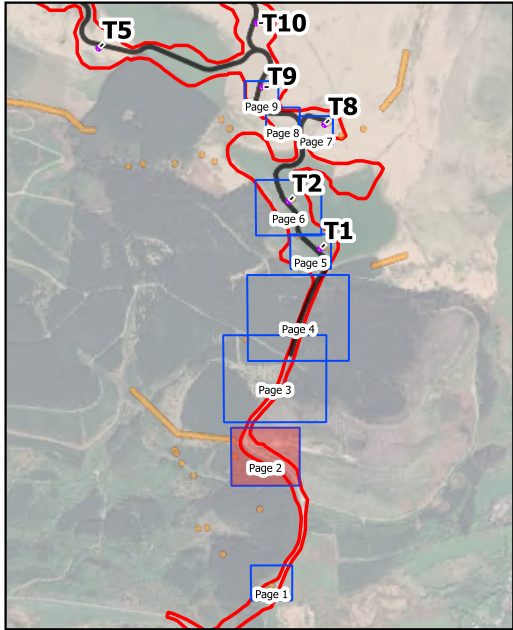


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 5. SETTING OUT SHALL BE CARRIED OUT IN ACCORDANCE WITH CONTRACT DOCUMENTS AND APPENDIX 1/12.

KEY

-  Rotary Open Hole Borehole
-  MINE ENTRY / ZONE OF INFLUENCE
-  Site Boundary

OVERVIEW MAP:



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Client

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
PAGE 2 of 9

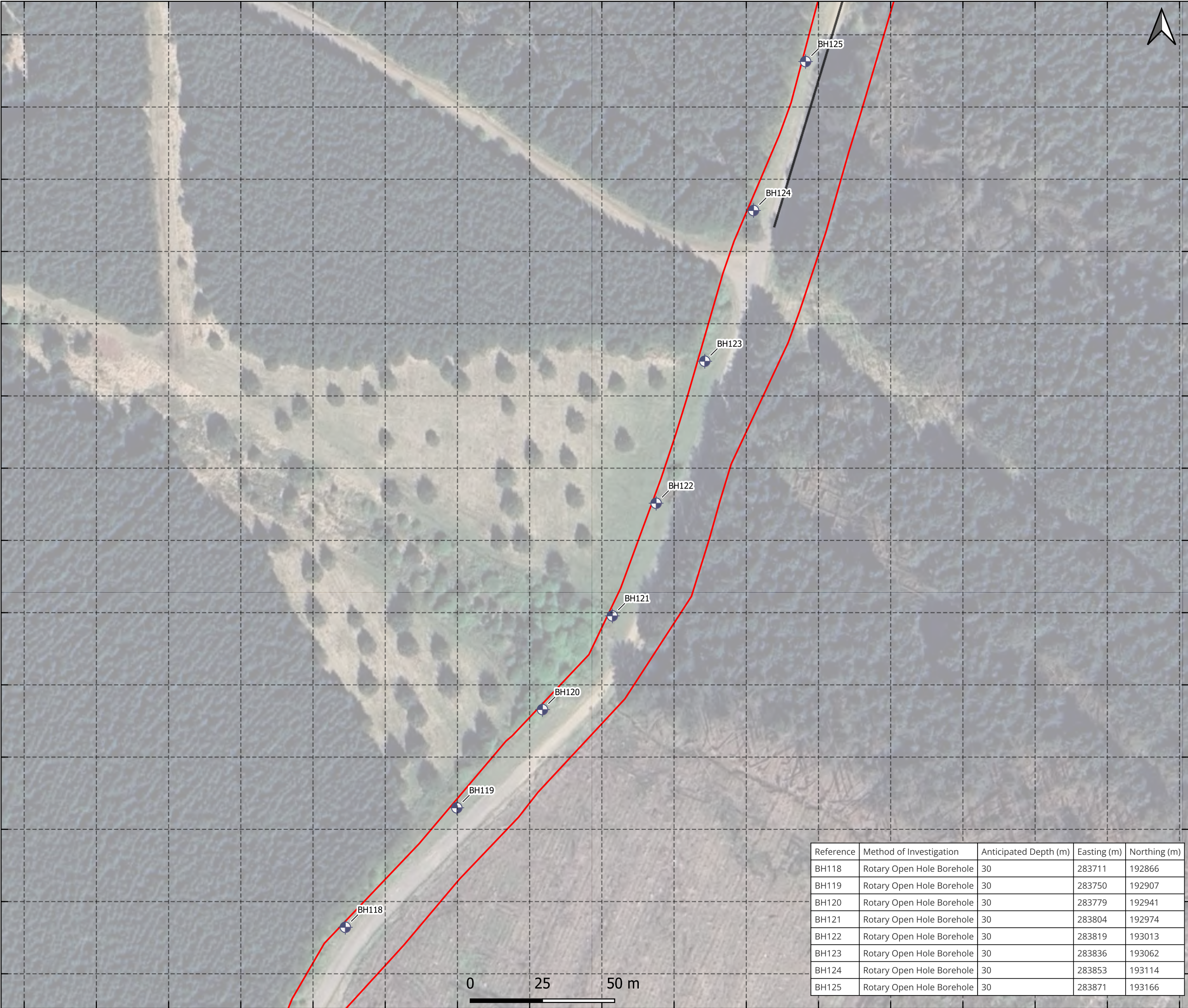
Drawing Status

FOR ISSUE

	Name	Date	Status Code
Drawn	K. Jensen	29/04/2026	S4
Designed	K. Jensen	29/04/2026	AS SHOWN
Eng Chk	A. Dougill	29/04/2026	Revision
Approved	N. Dewell	29/04/2026	P01

Drawing No.

110636-PEF-XX-XX-DR-GI-00002

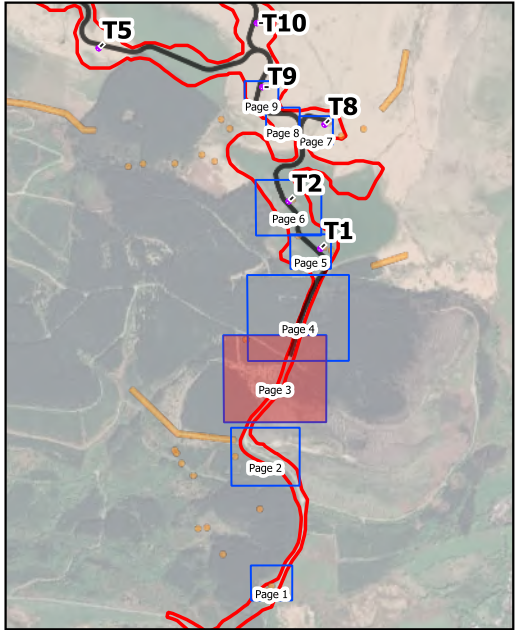


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 5. SETTING OUT SHALL BE CARRIED OUT IN ACCORDANCE WITH CONTRACT DOCUMENTS AND APPENDIX 1/12.

KEY

-  Rotary Open Hole Borehole
-  Site Boundary
-  Proposed Track

OVERVIEW MAP:



Pell Frischmann



Client

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
PAGE 3 of 9

Drawing Status

FOR ISSUE

	Name	Date	Status Code
Drawn	K. Jensen	29/04/2026	S4
Designed	K. Jensen	29/04/2026	AS SHOWN
Eng Chk	A. Dougill	29/04/2026	Revision
Approved	N. Dewell	29/04/2026	P01

Drawing No.

110636-PEF-XX-XX-DR-GI-00003

Reference	Method of Investigation	Anticipated Depth (m)	Easting (m)	Northing (m)
BH118	Rotary Open Hole Borehole	30	283711	192866
BH119	Rotary Open Hole Borehole	30	283750	192907
BH120	Rotary Open Hole Borehole	30	283779	192941
BH121	Rotary Open Hole Borehole	30	283804	192974
BH122	Rotary Open Hole Borehole	30	283819	193013
BH123	Rotary Open Hole Borehole	30	283836	193062
BH124	Rotary Open Hole Borehole	30	283853	193114
BH125	Rotary Open Hole Borehole	30	283871	193166

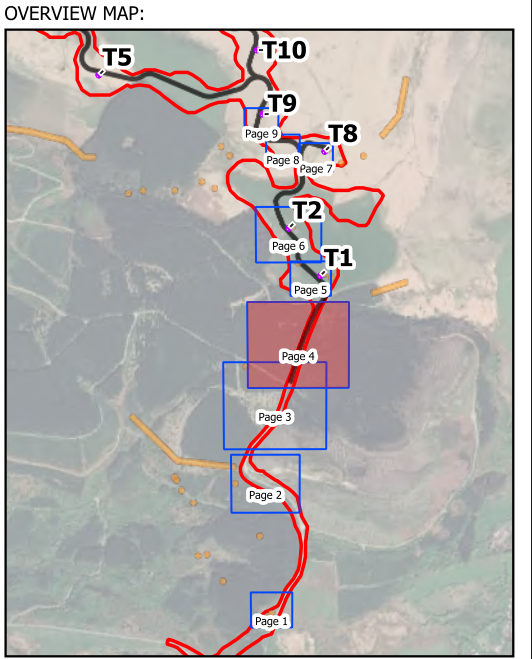


Reference	Method of Investigation	Anticipated Depth (m)	Easting (m)	Northing (m)
BH124	Rotary Open Hole Borehole	30	283853	193114
BH125	Rotary Open Hole Borehole	30	283871	193166
BH126	Rotary Open Hole Borehole	30	283882	193211
BH127	Rotary Open Hole Borehole	30	283898	193255
BH128	Rotary Open Hole Borehole	30	283916	193299
BH129	Rotary Open Hole Borehole	30	283934	193345
BH130	Rotary Open Hole Borehole	30	283950	193383

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 5. SETTING OUT SHALL BE CARRIED OUT IN ACCORDANCE WITH CONTRACT DOCUMENTS AND APPENDIX 1/12.

KEY

- Rotary Open Hole Borehole
- Site Boundary
- Proposed Track



Pell Frischmann

Client

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
PAGE 4 of 9

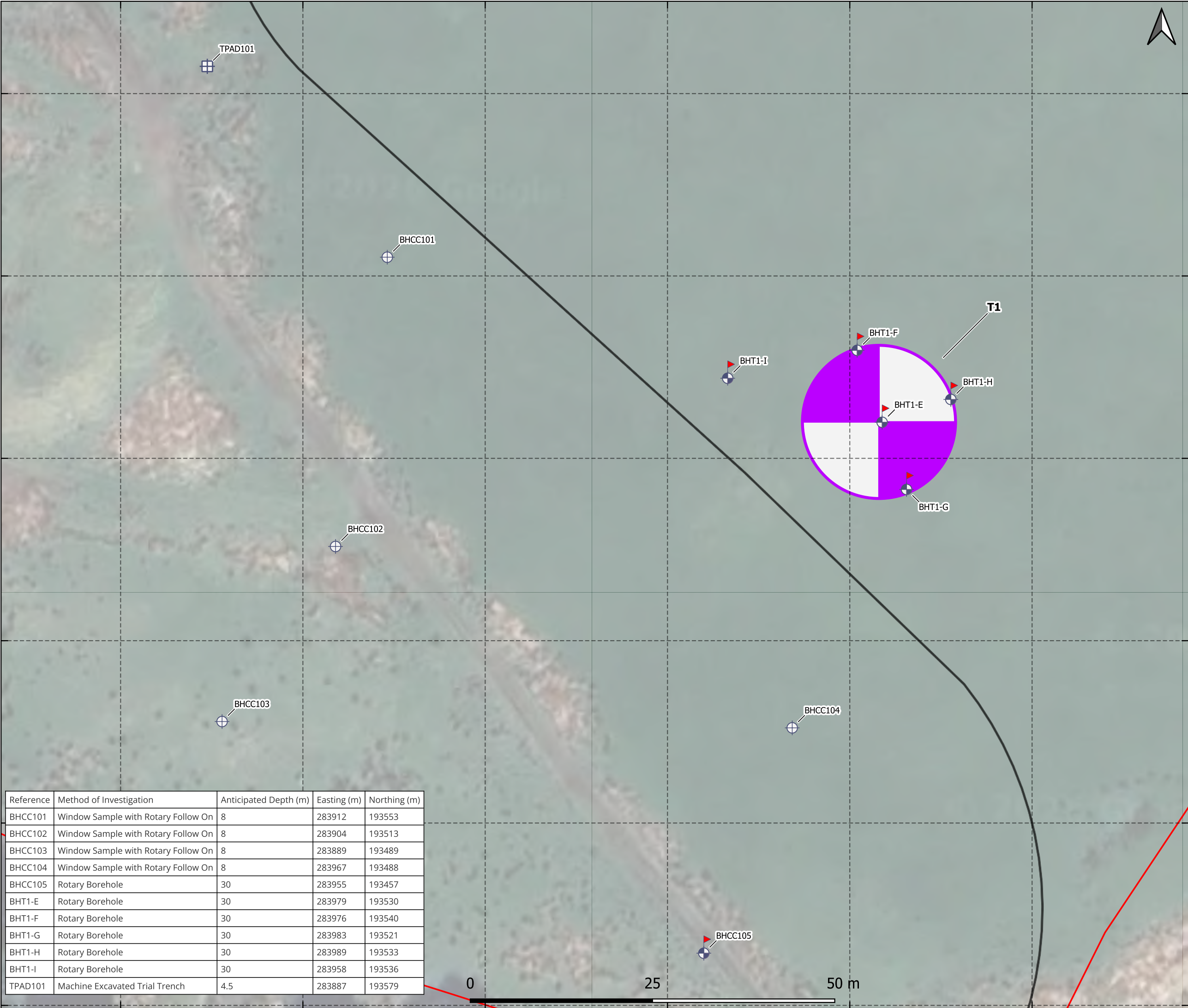
Drawing Status

FOR ISSUE

Drawn	K. Jensen	Date	29/04/2026	Status Code	S4
Designed	K. Jensen	Date	29/04/2026	Scale	AS SHOWN
Eng Chk	A. Dougill	Date	29/04/2026	Revision	P01
Approved	N. Dewell	Date	29/04/2026		

Drawing No.

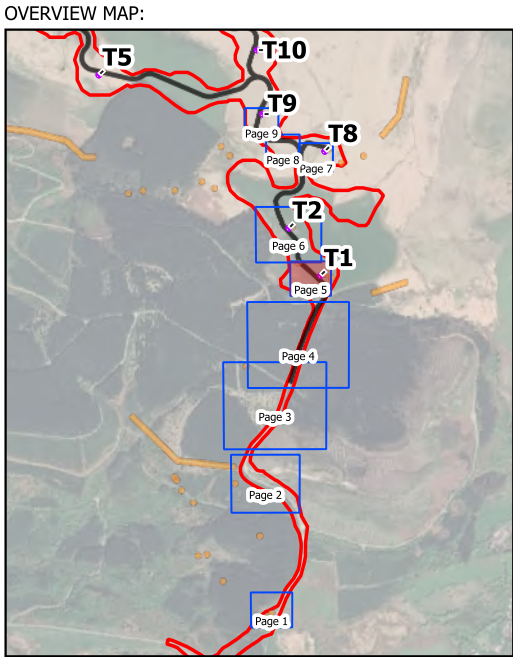
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KEY

- Machine Excavated Trial Trench
- Rotary Borehole
- Window Sample with Rotary Follow On
- PROPOSED TURBINE LOCATIONS
- Site Boundary
- Proposed Track



Pell Frischmann



Client

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
PAGE 5 of 9

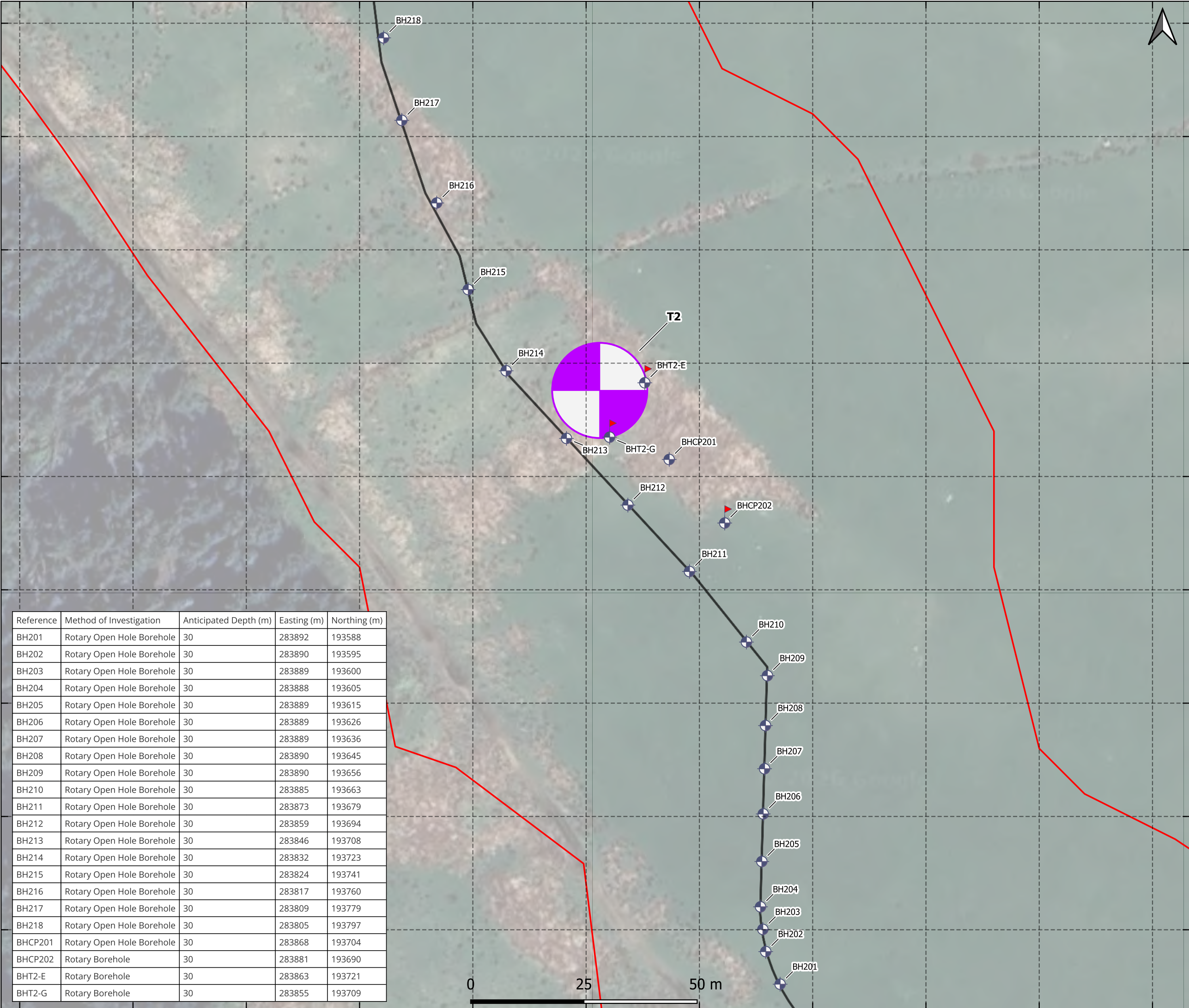
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Designed	K. Jensen	29/04/2026	Scale
Eng Chk	A. Dougill	29/04/2026	AS SHOWN
Approved	N. Dewell	29/04/2026	Revision
			P01

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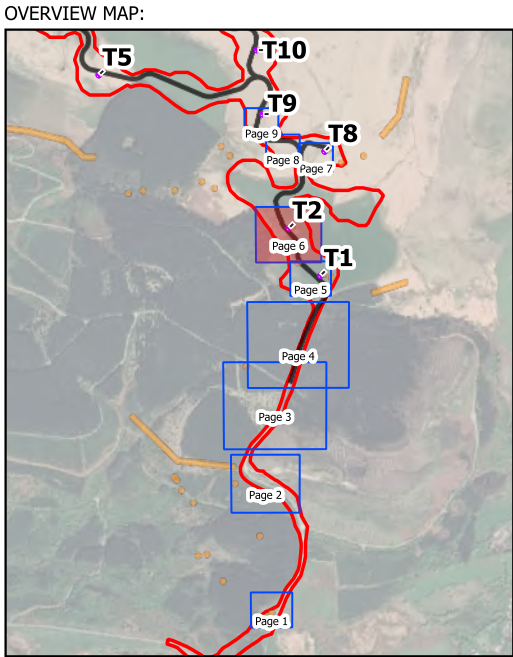


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BH202	Rotary Open Hole Borehole	30	283890	193595
BH203	Rotary Open Hole Borehole	30	283889	193600
BH204	Rotary Open Hole Borehole	30	283888	193605
BH205	Rotary Open Hole Borehole	30	283889	193615
BH206	Rotary Open Hole Borehole	30	283889	193626
BH207	Rotary Open Hole Borehole	30	283889	193636
BH208	Rotary Open Hole Borehole	30	283890	193645
BH209	Rotary Open Hole Borehole	30	283890	193656
BH210	Rotary Open Hole Borehole	30	283885	193663
BH211	Rotary Open Hole Borehole	30	283873	193679
BH212	Rotary Open Hole Borehole	30	283859	193694
BH213	Rotary Open Hole Borehole	30	283846	193708
BH214	Rotary Open Hole Borehole	30	283832	193723
BH215	Rotary Open Hole Borehole	30	283824	193741
BH216	Rotary Open Hole Borehole	30	283817	193760
BH217	Rotary Open Hole Borehole	30	283809	193779
BH218	Rotary Open Hole Borehole	30	283805	193797
BHCP201	Rotary Open Hole Borehole	30	283868	193704
BHCP202	Rotary Borehole	30	283881	193690
BHT2-E	Rotary Borehole	30	283863	193721
BHT2-G	Rotary Borehole	30	283855	193709

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 5. SETTING OUT SHALL BE CARRIED OUT IN ACCORDANCE WITH CONTRACT DOCUMENTS AND APPENDIX 1/12.

KEY

- Rotary Borehole
- Rotary Open Hole Borehole
- PROPOSED TURBINE LOCATIONS
- Site Boundary
- Proposed Track



Pell Frischmann

Client

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
PAGE 6 of 9

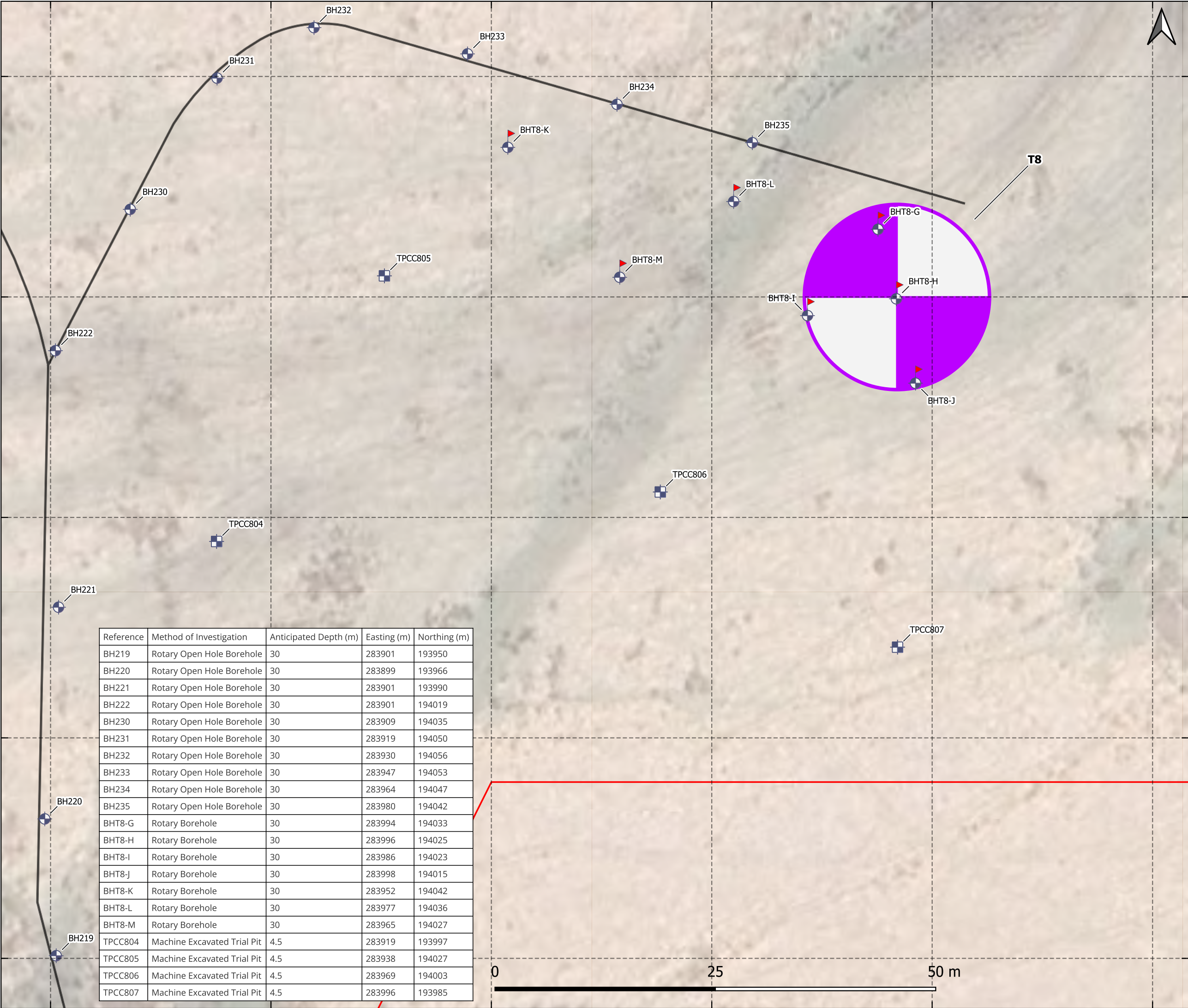
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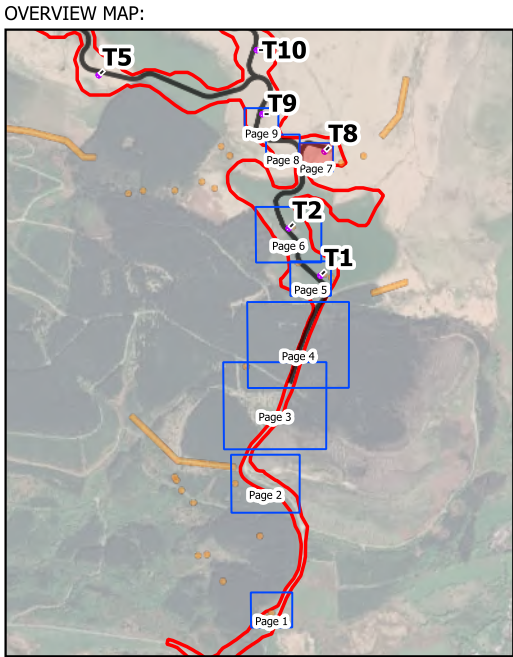


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BH221	Rotary Open Hole Borehole	30	283901	193990
BH222	Rotary Open Hole Borehole	30	283901	194019
BH230	Rotary Open Hole Borehole	30	283909	194035
BH231	Rotary Open Hole Borehole	30	283919	194050
BH232	Rotary Open Hole Borehole	30	283930	194056
BH233	Rotary Open Hole Borehole	30	283947	194053
BH234	Rotary Open Hole Borehole	30	283964	194047
BH235	Rotary Open Hole Borehole	30	283980	194042
BHT8-G	Rotary Borehole	30	283994	194033
BHT8-H	Rotary Borehole	30	283996	194025
BHT8-I	Rotary Borehole	30	283986	194023
BHT8-J	Rotary Borehole	30	283998	194015
BHT8-K	Rotary Borehole	30	283952	194042
BHT8-L	Rotary Borehole	30	283977	194036
BHT8-M	Rotary Borehole	30	283965	194027
TPCC804	Machine Excavated Trial Pit	4.5	283919	193997
TPCC805	Machine Excavated Trial Pit	4.5	283938	194027
TPCC806	Machine Excavated Trial Pit	4.5	283969	194003
TPCC807	Machine Excavated Trial Pit	4.5	283996	193985

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KEY

- Machine Excavated Trial Pit
- Rotary Borehole
- Rotary Open Hole Borehole
- PROPOSED TURBINE LOCATIONS
- Site Boundary
- Proposed Track



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Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
PAGE 7 of 9

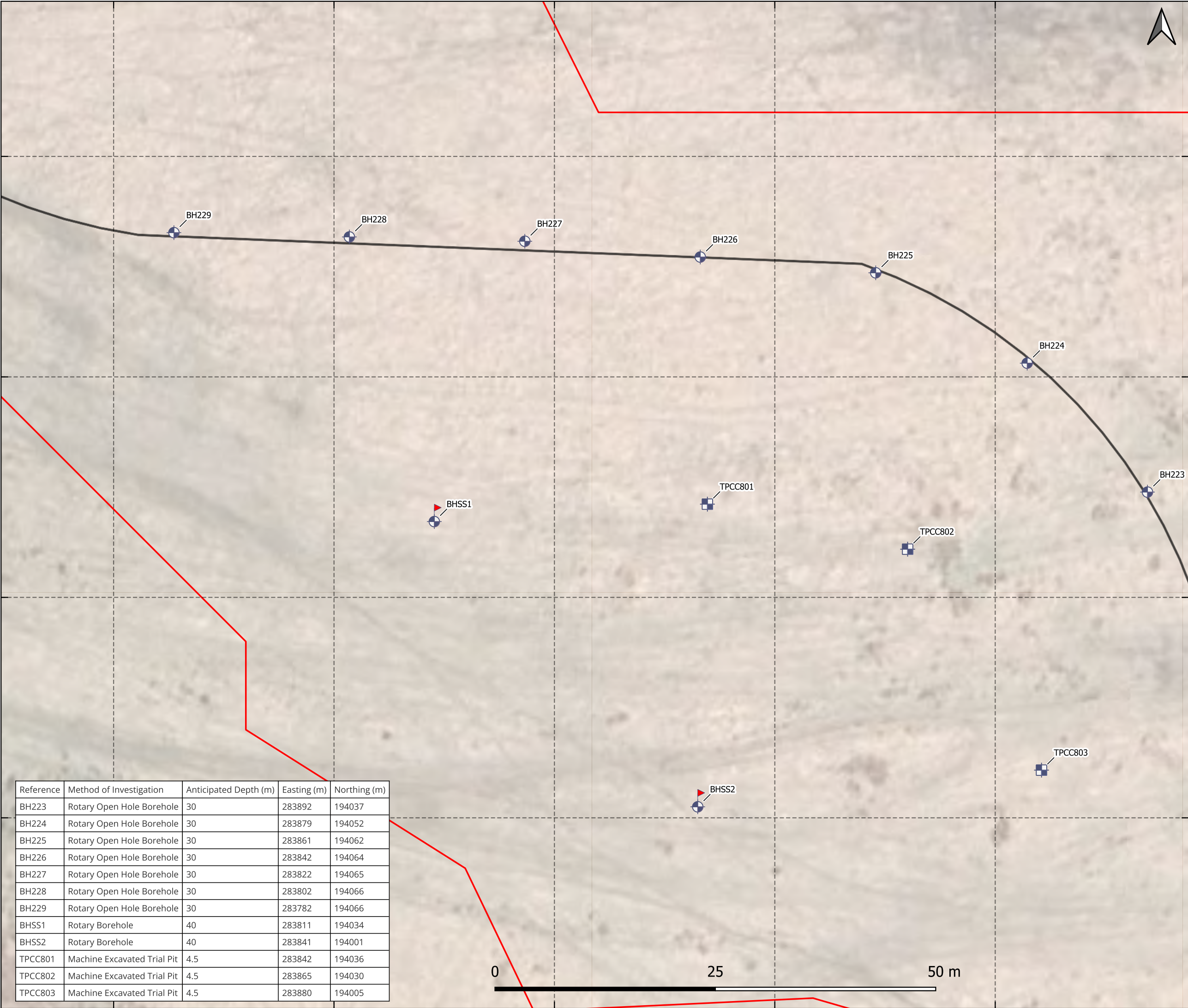
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	N. Dewell	29/04/2026	P01

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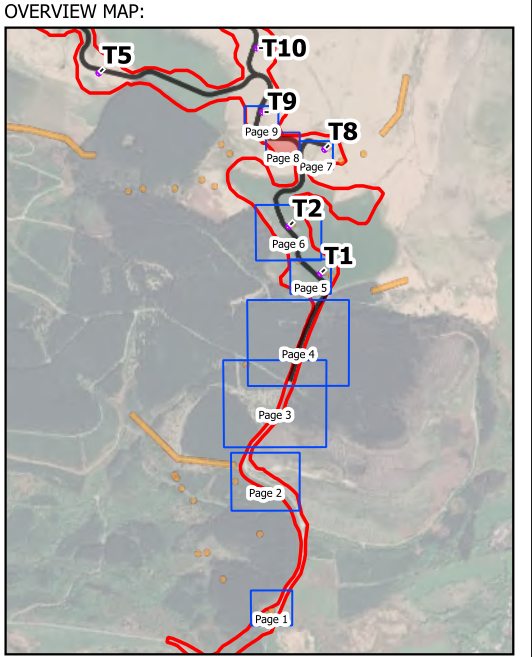
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BH225	Rotary Open Hole Borehole	30	283861	194062
BH226	Rotary Open Hole Borehole	30	283842	194064
BH227	Rotary Open Hole Borehole	30	283822	194065
BH228	Rotary Open Hole Borehole	30	283802	194066
BH229	Rotary Open Hole Borehole	30	283782	194066
BHSS1	Rotary Borehole	40	283811	194034
BHSS2	Rotary Borehole	40	283841	194001
TPCC801	Machine Excavated Trial Pit	4.5	283842	194036
TPCC802	Machine Excavated Trial Pit	4.5	283865	194030
TPCC803	Machine Excavated Trial Pit	4.5	283880	194005

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- KEY
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Client

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
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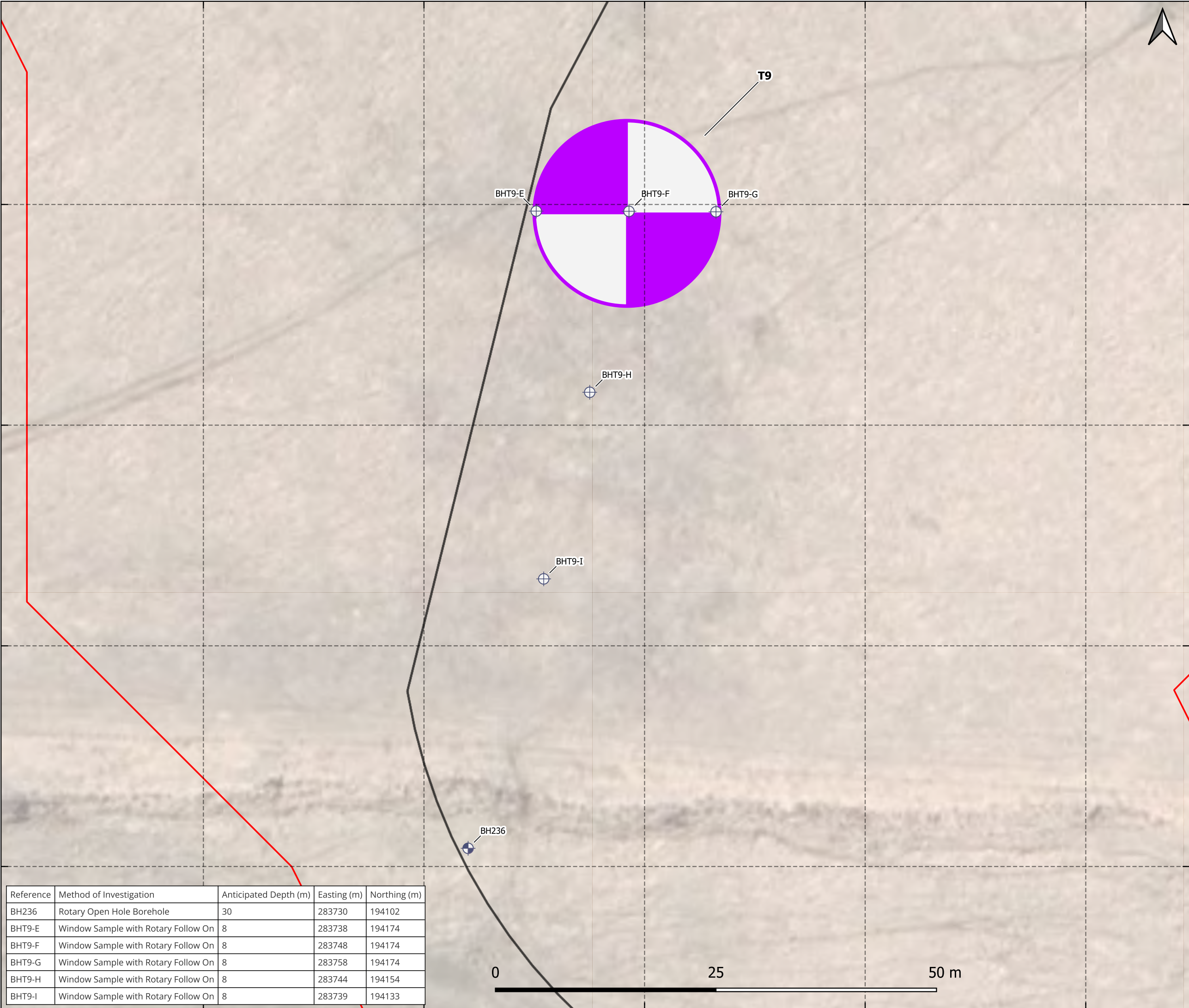
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Approved	N. Dewell	29/04/2026	P01

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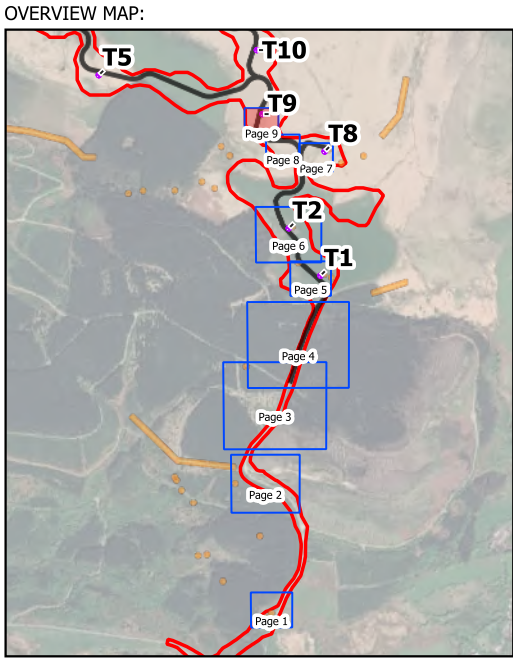
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KEY

- Rotary Open Hole Borehole
- Window Sample with Rotary Follow On
- PROPOSED TURBINE LOCATIONS
- Site Boundary
- Proposed Track



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Client

Project

FOEL TRAWSNANT WINDFARM

Drawing Title

GROUND INVESTIGATION SCHEDULE
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Drawing Status

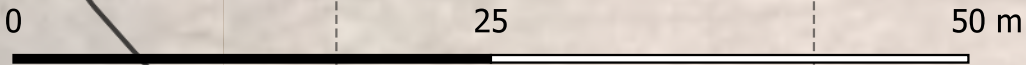
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Approved	N. Dewell	29/04/2026	Revision
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			P01

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Reference	Method of Investigation	Anticipated Depth (m)	Easting (m)	Northing (m)
BH236	Rotary Open Hole Borehole	30	283730	194102
BHT9-E	Window Sample with Rotary Follow On	8	283738	194174
BHT9-F	Window Sample with Rotary Follow On	8	283748	194174
BHT9-G	Window Sample with Rotary Follow On	8	283758	194174
BHT9-H	Window Sample with Rotary Follow On	8	283744	194154
BHT9-I	Window Sample with Rotary Follow On	8	283739	194133



Appendix C Intégral Géotechnique Reports

Intégral Géotechnique (Wales) Limited, 12826/RAH/21/FSI, Factual Site Investigation Report

Intégral Géotechnique (Wales) Limited, 12826/RAH/21/ISI, Interpretative Site Investigation Report

Walters UK Ltd

FOEL TRAWSNANT WINDFARM

Site Investigation Report

12826/RAH/21/ISI

CLIENT: Walters UK Ltd

PROJECT: Foel Trawsnant Windfarm

TITLE: Interpretative Site Investigation Report

JOB NO: 12826

DOCUMENT REF: 12826/RAH/21/ISI

Revision	Purpose Description	Originated	Reviewed	Authorised	Date
0	Final	RAH	RB	HP	Sept' 2021

Geotechnical Engineers:

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1.0 INTRODUCTION

1.1 GENERAL

Walters UK Ltd are proposing to develop a site at Foel Trawsnant, Maesteg for commercial end use, comprising a windfarm.

Intégral Géotechnique (Wales) Limited have been appointed as the Geotechnical Engineers to undertake a site investigation to enable a geotechnical and geoenvironmental appraisal of the site and provide a basis for design.

This report presents the findings of the preliminary site investigation and gives geotechnical recommendations for the design aspect of the project.

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1.2 PROPOSED DEVELOPMENT

The new development is proposed to comprise 8No. wind turbines spread across the site area. Reference has been made to Figure 5.2 of the Environmental Statement by Wood Environment and Infrastructure Solutions UK, which also details the typical specification of the turbines, understood to be a maximum height of 120m (top of blade). The figure indicates access tracks through the site, with turbines and associated crane pads along the tracks and a large contractors compound and electrical substation located in the south of the site.

Initially, eleven turbines were proposed, but turbines T3, T4 and T7 have since been removed from the project.

The following outlines the GPS coordinates of the proposed turbines. As the design phase progresses, these positions may be micrositied, but is understood that they will remain largely in the vicinity of the locations below.

1.2 PROPOSED DEVELOPMENT (CONTINUED)

Table 1: GPS Coordinates		
Turbine No.	Easting, Northing	Grid Reference
T1	283959, 193522	SS 83959 93522
T2	283850, 193725	SS 83850 93725
T3 (removed)	283693, 193910	SS 83693 93910
T4 (removed)	283428, 194260	SS 83428 94260
T5	283092, 194327	SS 83092 94327
T6	282858, 194597	SS 82858 94597
T7 (removed)	284161, 193808	SS 84161 93808
T8	284016, 194027	SS 84016 94027
T9	283737, 194202	SS 83737 94202
T10	283709, 194446	SS 83709 94446
T11	283503, 194707	SS 83503 94707

The position of Turbine T2 was amended during the site investigation, previously located at national grid reference 283835,193698.

1.3 SCOPE OF WORKS

The work instructed included a desk study of available information and interpretative reporting of the factual site investigation data provided to Pennant Walters (FOELT) Ltd.

The desk study comprised a review of information provided to us from the client including:

- A Coal Authority Mining Report
- Chapter 12 of an Environmental Statement by Wood Environment and Infrastructure Solutions UK, dated December 2018 including;
 - Appendix 12B - A Coal Authority Report and Ground Stability Report
 - Appendix 12C - A Peat Study

In addition, the geological maps by the British Geological Survey have been reviewed, as well as Coal Authority Data via the interactive web viewer.

The desk study information was used to make an initial assessment of the site and to design an investigation to be carried out by Intégral Géotechnique. The preliminary site investigation was designed in accordance with BS5930:2015+A1:2020, the Code of Practice for Site Investigations, BS10175:2011+A2:2017, the code of practice for investigation of potentially contaminated sites, and 'Development of Land Affected by Contamination: A Guide for Developers' prepared by Welsh Local Government Association (WLGA)/Natural Resources Wales (NRW) Land Contamination Working Group, 2017.

1.3 SCOPE OF WORKS (CONTINUED)

The site investigation was completed in two phases as follows:

Initially a non-intrusive geophysical survey was undertaken in March 2021. Five of the eight proposed turbine locations (Turbines T1, T2, T8, T9 and T10) were surveyed along a single profile line to record P-wave Seismic Refraction and S-wave Seismic Refraction.

Following this an intrusive investigation comprising the following was undertaken in June through to July 2021 comprising:

- 31No. Trial Pit Excavations,
- 4No. Trial Trench Excavations,
- 28No. Rotary Open Hole/Rotary Cored Boreholes,
- Sampling of soils and rock cores for laboratory geotechnical testing.

The factual site investigation data was provided as a Factual Report to Pennant Walters (FOELT) Ltd and used within this interpretative report.

1.4 LIMITATIONS

This document is intended to be a working document for further development in discussion with all concerned including the Local Planning Authority, and Natural Resources Wales, as appropriate.

“Contamination” is taken throughout the report to mean the “presence of one or more potentially harmful substances as a result of human activity”. The use of the term in this way does not imply that harm is being or might be caused by the contamination. It should be noted that “contamination” can have different meanings under different regulatory regimes, for example, planning, building control and Part IIA of the Environmental Protection Act 1990. Naturally elevated concentrations of potentially harmful substances may also be of concern and the significance of any that have been found is also evaluated in this report.

It is important to recognise that there may be areas of contamination that have not been found, or that contaminants are present at concentrations above those that have been found. It is also important to recognise that contamination may be localised and that no investigation, however comprehensive, is capable of finding such occurrences other than by chance.

It should also be noted that vertical and lateral changes in ground conditions may be present between exploratory hole locations.

2.0 THE SITE

2.1 SITE LOCATION AND DESCRIPTION

The site is located at Foel Trawsnant to the south of Duffryn, comprising the land between Cynonville and Nantyffyllon, approximately 2.3km north-west of Maesteg. The national grid reference of the approximate centre of the site is at 283732, 194170. See Figure 1 Site Location Plan.

The site is irregular in shape and the full site boundary, hereby referred to as the planning site boundary, occupies an area of approximately 111 hectares. A smaller site boundary, hereby referred to as the development site boundary, refers to a smaller area, also irregular in shape, comprising the proposed development area. The boundaries of the site are generally defined by vacant land to the north, east, south and west with areas of woodland present to the south-west. A site plan is presented in Figure 2.

The site is situated on sloping ground with a maximum elevation of 371mAOD in the south of the site falling to approximately 215m along the north-west boundary. The site rises from the southern boundary to the maximum height (Trig point - Foel Trawsnant) in the southern portion of the site. A steep valley is present trending south-east to north-west through the north-west of the site along the alignment of the Nant yr Hywaid.

The site generally comprises vacant land, with various fence lines present as well as drains and minor watercourses. Localised areas of reeds and rushes are present and the grass/vegetation varies across the fields, but is generally short. Towards the north-east the ground surface is hummocky and comprises grassland. Areas of woodland are present adjacent to the site, but not located within the site boundary.

Several public footpaths are known to cross the site.

The site is accessed from the south via an approximately 1.6km long gravel track from Neath Road.

Site Walkover

A site walkover was undertaken in March 2021. A selection of site photographs are included in Appendix A. A summary of the findings and condition of the site are detailed below.

In the southern part of the of the site, the ground was grass covered with localised reeds and rushes. An abundance of reeds were present in the vicinity of proposed Turbine 2 and the ground was peaty in this area and locally saturated underfoot.

2.1 SITE LOCATION AND DESCRIPTION (CONTINUED)

A large depression was present to the east of proposed Turbine 1, approximately 18m long and 8m wide, with abundant reeds within the area of hollow ground.

An access track was present from the southern corner of the site transecting the west of the site in a north-westerly direction. To the west of the proposed Turbine 1, a large pile of tipped/stockpiled material was present immediately west of the track. The pile was estimated at circa 40m long, up to 20m wide and up to 5m high. Bricks, metal fragments/rods and concrete cobbles and boulders were observed within, and in the immediate vicinity of the stockpile. Two large concrete slabs were also noted in the track at this location. It is considered likely that these features are associated with historic mining. With the exception of these findings, potential features representing historic mine entries were not observed in this area.

Moving further north, no notable features were observed. The grass changes to more acidic grassland to the north of the field boundary transecting through the southern third of the site (east-west). In the vicinity of proposed Turbine 8, localised reeds were present and there was evidence of recent burning of vegetation. Approximately 90m south-east of proposed Turbine 8, a 3m diameter depression was noted, up to approximately 1.6m below the surrounding ground level. Timber fragments/posts were observed within the feature and a small opening within the depression measured a further 1.2m deeper. Further south-west a large concrete slab feature was present as well as a small mound of stockpiled/tipped materials including bricks and concrete fragments. It is considered likely that these observations relate to a mine entry in the area, and consideration is given to the depression feature corresponding with mine entry ref: 284193-035. The on-site coordinates of the feature were 284063, 193970.

In the vicinity of proposed turbine locations 9, 10 and 11, no notable features were observed. The area was covered by acidic grass and drains/ditches were generally present along field boundaries. A more formalised ravine/drain feature was present along the northern field boundary in the vicinity of Turbine 11 trending east to west to join the Nant yr Hywaid. The drains and ravine were dry at the time of the investigation. A small pond was present in the south-west corner of the field containing proposed Turbine 9.

In the north-west of the site, proposed Turbine locations 5 and 6 are located within a grass covered field with localised rushes. A pond was located to the north-west of proposed Turbine 5. No notable features were observed in this field.

2.1 SITE LOCATION AND DESCRIPTION (CONTINUED)

A steep valley feature highlights the alignment of the Nant yr Hywaid in the north-west of the site. The sides were more sheer closer to the watercourse and vegetated. The ground was grass covered to the west and comprised more acidic grassland on the east side. Occasional drains were noted leading down to the valley and two areas of possible historic slope failure were present near to the issues of the watercourse. The bottom of the valley was not inspected, but the watercourse appeared to be dry at the time of the investigation.

2.2 SITE OPERATIONS

The site is currently vacant. Several informal tracks cross through the site with two public footpaths including the St Lltyd's Walk along the western boundary and a walkway in the north-west.

2.3 SURROUNDING LAND USE

The surrounding land is generally vacant land with localised areas of woodland. Further afield, Cynonville, Duffryn and Nantyllon are located to the north-west, north and south-east respectively.

2.4 AVAILABLE SITE INVESTIGATION DATA

Chapter 12 of an Environmental Statement completed by Wood Environment and Infrastructure Solutions UK dated December 2018 has been reviewed as part of this report. We have also been provided with Appendix 12B, A Coal Authority Report and Ground Stability Report and Appendix 12C, A Peat Study.

There is no other investigation data for the site to our knowledge.

3.0 SITE HISTORY

An Envirocheck Report has been obtained for the site, based around a central point of 283620, 194240, included in Appendix B. Reference has been made to the historic maps included within the Envirocheck Report and the following provides a summary.

The earliest available map from 1884 indicates that the site comprised undeveloped land with the Nant yr Hwyaidd transecting through the north-west as present and several minor watercourses/drains shown in the centre of the site. An unknown feature was shown (off site) to the east of proposed Turbine T8. The text is not clear but appears to be labelled as a level. A trial level is shown along an access track through the south of the site and another trial level is shown off-site further south. A camp was shown to the south-west of the site on the edge of a forest area.

On the 1900 map a second trial level was shown to the south-west of the access track, off-site. Duffryn Rhondda colliery was shown to the east of the site.

On the 1921 map, no notable changes were depicted with the exception of two cutting/quarry features along the alignment of the Nant yr Hwyaidd, close to the source. Duffryn Rhondda colliery was labelled as disused.

A hut was shown on the 1964 map onwards, indicated to the north-west of the trig point, close to the access track.

The 2006 map shows a mound immediately south of the access track in the southern part of the site.

The most recent map (2021) shows the site as undeveloped land, with localised water features including small ponds in the north-western field and in the south-western corner of the central L-shaped field. A mast is shown close to the centre of the site.

4.0 SITE ENVIRONMENTAL SETTING

An Envirocheck Report has been obtained for the site, based around a central point of 283620, 194240, included in Appendix B. The following section has been completed with reference to the Envirocheck Report alongside Chapter 12 of the Environmental Statement (completed by Wood Environment and Infrastructure Solutions UK dated December 2018) with associated Appendices (12B, A Coal Authority Report and Ground Stability Report and Appendix 12C, A Peat Study).

4.1 PHYSICAL SETTING

The site is located at Foel Trawsnant and is situated between 371m and 215mAOD. The highest point on site is a peak in the south of the site with a trig point recorded at 369mAOD. The ground slopes down towards the southern boundary and also falls towards the north-west with the lowest topographic point located along the northern boundary. A steep valley is present trending south-east to north-west through the north-west of the site along the alignment of the Nant yr Hywaid.

4.2 GEOLOGY

Reference to the BGS 1:50,000 scale geological maps (solid and drift) indicates that the site is predominantly underlain by bedrock of the Rhondda Member of the Carboniferous period. These rocks generally comprise sandstones. Localised areas of the site are also underlain by the Llynfi Member comprising Carboniferous interbedded mudstones, siltstones and sandstones. The Wernpistyll coal seam, Wernddu (No.2 Rhondda) coal seam, Field Vein coal seam and several thin coals are indicated to outcrop within the site. Strata dips of 14 degrees and 15 degrees towards the north-west are indicated within the vicinity of the site.

The geological maps indicate a negligible superficial cover would be anticipated overlying the bedrock, with an area of Glacial Till indicated in the valley of the Nant yr Hywaid in the north-west of the site only, and no superficial deposits recorded elsewhere on-site.

Based on the site history made ground would not be anticipated beneath the site, with the exception of localised areas of reworked materials associated with regrading or made ground along tracks and within field gateways.

A fault transects the southern portion of the site, trending largely west-north-west to east-south-east crossing the area of former turbine positions Turbine 3 and Turbine 7. The Environmental Statement indicates that the fault is known as the Jubilee Slide.

4.2 GEOLOGY (CONTINUED)

A summary of the anticipated geological succession is given below in Table 2.

Table 2 : Summary of Anticipated Site Geology		
Geological unit	Horizon	Description
Quaternary	Glacial Till	Sands and gravels with varying matrix
Carboniferous	Rhondda Member	Green-grey, lithic arenites ("Pennant sandstones") with thin mudstone/siltstone and seatearth interbeds and mainly thin coals.
Carboniferous	Llynfi Member	Green-grey and blue-grey, feldspathic, micaceous lithic arenites ("Pennant sandstone") with thin mudstone/siltstone and seatearth interbeds and mainly thin coals.

4.3 COAL AUTHORITY MINING REPORT

An assessment of previous underground mineworkings activity and its potential impact upon the proposed Foel Trawsnant Windfarm Site was completed by James Associates in June 2014 and included within Appendix B of the Environmental Statement by Wood Environmental and Infrastructure Solutions UK. A Coal Mining Report was obtained from the Coal Authority as part of the report. It should be noted that for the Environmental Statement the planning boundary covered a larger area than the current site boundary including a larger area to the south-east which is no longer part of the site boundary.

A Coal Authority Mining Report was obtained as part of the Environmental Statement and is included in Appendix C.

The Coal Authority report states that the development area is within the likely zone of influence from workings in 11 seams of coal at shallow to 780m depth.

The report states that the site is not in the likely zone of influence of any present underground coal workings.

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

The Coal Authority states that it is not aware of any damage due to geological faults or other lines of weakness affected by coal mining.

4.3 COAL AUTHORITY MINING REPORT (CONTINUED)

The Coal Authority mining report identified 3 mine entries within 20m of the site boundary.

The following details the mine entries recorded within 20m of the planning boundary:

- 283193-008. No treatment details.
- 284193-036. Adit sealed with compacted brick rubble and backfilled with soil. 4.3m square fence erected. (CCD/92/34).
- 283193-007. No treatment details.

In addition to the above listed mine entries, the available information also identified the presence of mine entry ref: 284193-035, located just offsite, some 65m south-east of Turbine 8.

Additional adits may be present within the site which are not recorded.

Opencast workings

No surface opencast mineworkings for coal or any other minerals are recorded to have been undertaken in the application area.

Underground workings

The area has been subjected to historic mineral extraction of coal, fireclay and ironstone, with records extending back to the 1800's. There is also the potential for unrecorded workings which pre-date this period.

Other features

The Jubilee Slide transects the southern portion of the site, in close proximity to former Turbine T3 and T7.

The James Associates report states that the fault is part of a system of arcuate normal faults which extend in a broadly east / west direction and are traceable over a distance in excess of 12 miles. The displacement direction of the faulting is generally towards the south. The hade (i.e. angle between fault plane and vertical) of the faults can be highly variable from 45° to a much lower inclination.

4.4 HYDROLOGY AND HYDROGEOLOGY

The Nant yr Hywaid issues in the approximate centre of the site and flows towards the north-west through the site. The watercourse is not located within the actual development site boundary, but within the planning boundary.

4.4 HYDROLOGY AND HYDROGEOLOGY (CONTINUED)

In the south of the site several minor watercourses are present. Close to the centre of the site a watercourse flows from east to west through the site and continues into the forest to the west to join Nant Cynon. Further south, two sets of issues are shown, one continues as a minor watercourse towards the west and is culverted beneath the track (via a large plastic pipe within a stone and gabion wall) to continue west, and the other flows towards the east to join the Nant Tryfal.

Natural Resources Wales classify the bedrock beneath the site as a Secondary A Aquifer and the site is not located within a source protection zone.

4.5 OTHER ENVIRONMENTAL ISSUES

The Envirocheck Report identifies four points of interest to the north-east of the site, located between 612m and 943m from the centre point and off-site. These points relate to refuse tips/heaps associated with coal tip stockpiles and are not considered to be of concern to the site or proposed development.

The Envirocheck Report has identified five points of potentially infilled land (non-water) within 1000m of the site, four to the south-west and one to the north of the site. Reference to the historic maps indicates that these features are generally associated with infilled coal levels or old trial levels, with the exception of the entry located 418m south-west of the centre point which is positioned in the vicinity of a historic camp (later labelled enclosure). The potentially infilled land entries are not considered to be of concern or relevant to the site due to their location off-site.

4.6 PEAT SURVEY

A peat study was completed by Walters (UK) Ltd in 2014 as part of the Environmental Statement. The survey identified the presence of site-wide peat encountered from ground level, but generally less than 0.3m in thickness with less than 0.1m thicknesses encountered in large areas across the north and north-west.

Localised areas of peat between 0.7m and 0.8m in thickness were recorded, however the survey identified the deeper pockets to be limited and generally associated with the source of the Nant yr Hywaid in the north-west.

Accordingly, the report states that use of floating access tracks are not considered necessary.

4.6 PEAT SURVEY (CONTINUED)

Following the peat characterisation fieldwork a number of items of proposed infrastructure were moved or micrositied to avoid the deeper areas of peat within the site as follows:

- Construction compound 1 – location and geometry adapted to avoid band of deeper peat (albeit still shallow) lying adjacent to the southern boundary of the site and to minimise hydrological impacts in this area.
- Turbine 7 – moved west to avoid deep peat.
 - This location has been more recently removed from the scheme.
- Turbine 8, construction compound 2 and substation – Moved south to avoid deeper pocket of peat to the north.
- Access track between Turbines 4 and 10 – access track moved further south to maximise the separation between the construction works and the deeper peat pockets.

5.0 PRELIMINARY CONCEPTUAL SITE MODEL

5.1 RISK ASSESSMENT FRAMEWORK

In order to be consistent with current UK government policies and legislation, it is necessary to identify, assess, estimate, evaluate, and take appropriate action to deal with land contamination, in accordance with the procedures specified in the Environment Agency guidance Land Contamination Risk Management (LCRM) published in October 2020. This replaces the now withdrawn 'Model Procedures for the Management of Land Contamination CLR-11' (Environment Agency 2004).

The risk assessment process is designed to provide a reasoned, structured and pragmatic mechanism for the identification of any potential human health and controlled waters risks associated with land contamination and where necessary to develop a robust remediation strategy to ensure protection of the sensitive receptors (human health of future residents, controlled waters, etc).

In accordance with LCRM, the term 'land contamination' is defined as:

- All land affected by contamination – land that might have contamination present which may, or may or may not, meet the statutory definition of contaminated land,
- Land determined as contaminated land under Part 2A of the Environmental Protection Act 1990.

LCRM provides a tiered approach to risk assessment, comprising a preliminary risk assessment (including the development of an initial conceptual site model), a generic quantitative risk assessment and a detailed quantitative risk assessment. For each tier of risk assessment, the following steps must be followed:

1. Identify the hazard - establish contaminant sources,
2. Assess the hazard – use a source-pathway-receptor linkage approach to determine if there is potential for unacceptable risk,
3. Estimate the risk – predict what degree of harm or pollution may result and how likely it is to occur, and
4. Evaluate the risk – decide whether a risk is unacceptable.

LCRM also provides definitions of the following terms:

- Hazard – a property or situation that in particular circumstances could lead to harm or pollution,

5.1 RISK ASSESSMENT FRAMEWORK (CONTINUED)

- Risk – a combination of the probability, or frequency of occurrence of a defined hazard and the magnitude of the consequences of the occurrence,
- Risk assessment – the formal process of identifying, assessing and evaluating the health and environmental risks that may be associated with a hazard,
- Risk management – the formal process to identify, assess and determine the risks, and to select and take action to mitigate them.

The three essential elements to any risk are defined by LCRM as follows:

- A contaminant, or pollutant, that is in, on, or under the land and that has the potential to cause harm, or pollution (Source)
- A route by which a receptor is, or could be affected by a contaminant (Pathway)
- A receptor, i.e. something that could be adversely affected by a contaminant, for example a person, controlled waters, an organism, an ecosystem, or Part 2A receptors such as buildings, crops or animals (Receptor).

In order for there to be a potential risk, all three of the above elements must be present. If there is a source of contamination and a receptor (for example a resident or site user), then there is only a potential risk if there is a pathway linking the two. Such an active pathway is known as a relevant pollutant linkage. It is possible for the same contaminant to be linked to a receptor via a number of pathways, and hence it is important that all relevant pollutant linkages, to both human health and controlled waters, are separately identified on a site in order that a comprehensive conceptual model can be formed and ultimately a robust remediation strategy designed.

Current practice during Generic Quantitative Risk Assessment of land affected by contamination is to use generic soil screening values based on the appropriate proposed end use. These usually comprise risk based Soil Guideline values (SGVs) or Generic Assessment Criteria (GACs) derived by the Environment Agency's Contaminated Land Exposure Assessment Model (CLEA). The SGVs and the supporting technical guidance were developed in order to assist in the assessment of long term risk to human health from the exposure to contaminated soils.

Revised Statutory Guidance, published in 2012, to support Part 2A of the Environmental Protection Act 1990, introduced a new four category system for classifying land under Part 2A. Category 1 includes land where the level of risk is clearly unacceptable and Category 4 includes land where the level of risk posed is considered to be acceptably low. Under Part 2A, land would be determined as contaminated if it falls within Categories 1 or 2.

5.1 RISK ASSESSMENT FRAMEWORK (CONTINUED)

The revised Part 2A Statutory Guidance was accompanied by an Impact Assessment that identified a role for new 'Category 4 Screening Levels' (C4SLs) that would provide a simple test for determining when land is suitable for use and definitely not contaminated land. A Policy Companion Document including the C4SLs was published in March 2014 (England) and May 2014 (Wales).

The C4SLs have been based on the CLEA methodology and derived using the CLEA model, with modified toxicological and exposure parameters. To date, C4SLs have been released for six substances (arsenic, cadmium, chromium (VI), lead, benzo(a)pyrene and benzene).

The C4SLs have been derived on the assumption that where they exist, they will be used as generic screening criteria within generic quantitative risk assessment.

Following publication of the C4SLs, Land Quality Management (LQM), in conjunction with the Chartered Institute for Environmental Health (CIEH) released Suitable 4 Use Levels (S4ULs) in January 2015.

The S4ULs have been derived in accordance with UK legislation, and using a modified version of the Environment Agency's CLEA software. As such, the S4ULs are based on the concept of minimal or tolerable risk as described in Human Health Toxicological Assessment of Contaminants in Soil (Science Report SR2, Environment Agency 2009a).

S4ULs have been derived for a wider number of substances.

In addition to the existing SGVs, C4SLs and S4ULs, Atkins ATRISK^{soil} also provide a set of Soil Screening Values. These are currently intended to be used in conjunction with SGVs, although they intend to update these values in line with the C4SLs in due course.

We have reviewed all sets of values and intend to use the most appropriate assessment criteria as Tier 1 screening values in the first instance. Where a published S4UL is available, and considered appropriate, this will be used in the first instance.

5.2 CONCEPTUAL MODEL FRAMEWORK

The preliminary stage of the risk assessment process is to develop and define a conceptual site model, based on the desk study and any existing site investigation data. This is used to establish any potential contaminant sources, identify existing and future receptors and assess if there are any potentially active pathways by which a potential risk may be present.

5.2 CONCEPTUAL MODEL FRAMEWORK (CONTINUED)

The preliminary conceptual site model will be developed and refined as site specific data is gathered, such as actual ground conditions and chemical data, resulting in a more robust conceptual understanding of the site.

5.3 CRITICAL SENSITIVE RECEPTOR – HUMAN HEALTH

The proposed redevelopment of the site is for a commercial end use. Therefore, the critical sensitive receptor from a human health perspective is an on-site commercial receptor.

In accordance with S4UL/C4SL and CLEA guidance for a standard commercial scenario, the critical sensitive receptor for a commercial end use risk assessment is a female adult, with exposure from 16 to 65 years.

The standard commercial end-use conceptual model defined by S4UL/C4SL and CLEA is assumed to be suitable for the purposes of this assessment.

5.4 CRITICAL SENSITIVE RECEPTOR – CONTROLLED WATERS

Based on the proposed redevelopment of the site for a commercial end use, and the findings of the desk study, the critical sensitive receptor from a controlled water perspective is groundwater within the Rhondda Member and Llynfi Member.

By considering groundwater as the critical sensitive receptor for controlled waters, the groundwater/hydrogeological risk assessment will also be protective of the various surface water features and drains which flow through the site and therefore also the Nant yr Hywaid, Nant Cynon and Nant Tryfal into which the minor surface water features flow into.

5.5 POTENTIAL CONTAMINANT SOURCES

Review of the desk study information indicates that the site has historically comprised vacant land, thus is therefore considered to be a greenfield site. Review of the coal mining data indicates that the site has been subjected to historic underground workings in several seams of coal, but the historic maps and records do not indicate that the site has been worked from surface level.

Accordingly, based on the absence of historic land uses or neighbouring site uses, the risk of contamination is considered to be low with negligible sources of potential contamination to the site.

5.5 POTENTIAL CONTAMINANT SOURCES (CONTINUED)

Consideration is given to the following contaminants which may be associated with any localised made ground which is used along tracks and within gateways or any other localised made ground. The following contaminants are also considered relevant to the potential unrecorded presence of historic tips from coal mining activities.

- Metals, semi-metals, and inorganics within any made ground;
- Polyaromatic hydrocarbons (PAH) within any made ground;
- Asbestos within any made ground

The potential for ground gas migration arising from backfilled historic mineworkings has been considered, however, the nature of the proposed development indicates that the risk to site end users is low, owing to the open air environment of the development. As such, this has been removed from the conceptual site model.

5.6 POTENTIAL EXPOSURE PATHWAYS

Potential exposure pathways for the critical receptors (both human health and controlled waters) are listed below:

- Dermal contact with soil and/or soil derived dust;
- Ingestion of soil;
- Inhalation of soil derived dust;
- Inhalation of vapours – indoor and outdoor air;
- Leaching of contaminants from made ground to groundwater; and
- Transportation of contaminants within groundwater.

In addition, the following exposure pathways have also been considered:

- Ground gas generation and migration; and
- Building materials durability.

5.7 SUMMARY OF CONCEPTUAL EXPOSURE MODEL

A preliminary conceptual exposure model has been developed for the site. This is based on the findings of the desk study, historical review and site walk over and includes all potential sources, pathways and receptors that may be present on site. Those that have been identified as being potentially active require further investigation in the form of sampling and testing of soils and/or groundwater, followed by appropriate risk assessment.

5.7 SUMMARY OF CONCEPTUAL EXPOSURE MODEL (CONTINUED)

The preliminary conceptual exposure model will be reviewed and refined following the completion of the site works and any relevant laboratory testing.

The preliminary conceptual exposure model is presented below in Table 3.

Table 3: Preliminary Conceptual Exposure Model				
Source		Receptor	Pathway	Potentially Active Pathway?
Origin	Contaminant			
Made Ground of unknown origin placed along tracks/gateways (if encountered)	Metals, semi-metals, non-metals, PAH, asbestos	Commercial – human health	Dermal Contact with made ground/dust	✓
			Ingestion of soil	✓
			Inhalation of dust	✓
			Inhalation of vapours – indoor/outdoor	✓
	Metals, semi-metals, inorganics, PAH	Groundwater quality	Leaching from made ground	✓
	Metals, semi-metals, inorganics, PAH	Surface water quality	Transportation within groundwater	✓
Made Ground of unknown origin and natural ground	pH and water soluble sulphate	Building Materials Durability	Direct contact	✓
Ground Gas – organic, gas producing materials	Methane, carbon dioxide	Human health	Accumulation of gases in confined spaces, and/or migration off site, leading to asphyxiation, or risk of explosion	✓/✗

6.0 THE SITE INVESTIGATION

6.1 FIELDWORKS

Geophysical Investigation

A geophysical survey was undertaken in March 2021 which comprised surveys at five of the eight proposed turbine locations (Turbines T1, T2, T8, T9 and T10). The work was designed to provide initial information on estimated depth to bedrock and characteristics of the underlying strata using P-wave (V_p) and S-wave (V_s) seismic velocities. Seismic data was acquired along single profile lines to check for lateral homogeneity.

- P-wave Seismic Refraction – to provide seismic velocity (P-wave) sections along the selected profile lines.
- S-wave Seismic Refraction – to provide seismic velocity (S-wave) sections along the selected profile lines.

The work is described in Terradat's Geophysical Survey Report ref: 7299, dated April 2021 and is presented in Appendix D.

Intrusive Investigation

An intrusive site investigation was designed in accordance with BS5930:2015+A1:2020, the Code of Practice for Site Investigations, BS10175:2011+A2:2017, the Code of Practice for Investigation of Potentially Contaminated Sites, and 'Development of Land Affected by Contamination: A Guide for Developers' prepared by Welsh Local Government Association (WLGA)/Natural Resources Wales (NRW) Land Contamination Working Group, 2017.

An intrusive site investigation comprising 31No. trial pits, 4No. trial trenches and 28No. rotary drilled boreholes, was carried out during June and July 2021.

The trial pits were excavated across the proposed development areas, including at the proposed turbine locations, associated compounds and crane pads as well as along the proposed access roads.

The trial trenches were undertaken across proposed turbine footprints where there was the potential for a disparity in ground conditions beneath the turbine area as a result of either sloping ground (with a notable change in ground level), or the potential for shallow coal seams. A trial trench (TT3) was also undertaken near to the centre of the site in the vicinity of the geological Jubilee Slide Faultline in order to note any change in ground conditions in this area associated with the fault displacement.

6.1 FIELDWORKS (CONTINUED)

The trial pits were excavated using a 14 tonne tracked excavator to a maximum depth of 4.0m below existing ground level. The purpose of the trial pits was to confirm the nature of the shallow ground conditions and obtain representative samples for laboratory geotechnical testing. A photographic record of each trial pit was taken and the photos are included in Appendix G.

The trial trenches were also excavated using a 14 tonne tracked excavator to a maximum depth of 3.6mbgl. Trenches TT1, TT2 and TT4 were 19 to 20m long, completed along the diameter of proposed turbines T6, T10 and T1 respectively. Trench TT3 was undertaken near to the centre of the site, perpendicular to the alignment of the Jubilee Slide, to a total length of 15m.

The rotary drilled boreholes were located at the proposed turbine locations, drilled to a maximum depth of 35m below existing ground level, and typically drilled to 30mbgl. The purpose of the boreholes was to prove the deeper ground conditions and characterise the rock mass, with particular interest in the presence of any coal seams and/or any associated shallow mineworkings.

A rotary borehole was undertaken at the centre point of the eight proposed turbines. In these locations, the drilling was commenced by dynamic sampling from ground level to rockhead (between 1.5m and 4.5mbgl), continued by rotary coring to depths of between 15mbgl and 21mbgl, followed on by rotary open hole drilling to 30/35mbgl.

At turbine locations T1, T2, T8 and T9, four to six additional boreholes were undertaken around the perimeter of the proposed turbines, with sections of rotary coring undertaken in BHT8-D and BHT2 only (between 9m to 15mbgl).

It should be noted that in the location of Turbine 2, the proposed turbine coordinate was amended during the intrusive works. As such, three boreholes were undertaken in the vicinity of the former coordinate (BHT202, BHT202-D and BHT202-E) and four boreholes were undertaken in the location of the amended coordinate (BHT2, BHT2-A, BHT2-B and BHT2-C).

Representative soil and rock samples were taken from the trial pits and rotary boreholes for laboratory geotechnical testing and placed in the appropriate sample containers deemed suitable for the analysis required. Strict protocols were adopted during this process to limit the cross contamination of samples.

6.1 FIELDWORKS (CONTINUED)

The fieldworks were supervised by a qualified Geotechnical Engineer from Intégral Géotechnique (Wales) Limited who also logged the trial pits and prepared their detailed engineering logs in accordance with the requirements of BS5930:2015+A1:2020. The engineering logs provide descriptions of the materials encountered in accordance with BSEN ISO 14688-1 (2002) and 14689-1 (2003) for soils and rocks respectively.

The approximate locations of the trial pits, trial trenches and rotary open hole boreholes are shown on Figure 2. Figures 3A, 3B and 3C depict the locations on the topographical survey in more detail. The trial pit logs are presented in Appendix E and the trial pit photographs are presented in Appendix G. The trial trench sections are shown in Appendix F. The rotary borehole logs are presented in Appendix H. Rotary core photographs are included in Appendix I.

6.2 LABORATORY GEOTECHNICAL TESTING

Representative soil samples obtained from the trial pits and rotary boreholes were sent to the UKAS accredited laboratories of Apex Testing Solutions.

The following testing was undertaken on soil samples collected from depths of between 0.4m and 1.8mbgl:

- 12No. Moisture Content
- 4No. Atterberg Limits
- 8No. Particle Size Distribution,
- 4No. Optimum Moisture Content and Maximum Dry Density relationship,
- 6No. pH and water soluble sulphate

A copy of the soil geotechnical test results is presented in Appendix J.

The following testing was undertaken on rock samples collected from depths of between 3.7m and 16.5mbgl:

- 15No. Point Load Tests (with axial and diametral tests on each sample)
- 2No. Uniaxial Compressive Strength (UCS) Tests

A copy of the rock geotechnical test results is presented in Appendix K.

7.0 GROUND CONDITIONS

7.1 GEOPHYSICAL SURVEY

The geophysical survey provided an indicative profile of the ground conditions underlying five of the eight proposed turbines. The compressive P-wave velocities showed a general 4 layer ground model, with local variations observed in T1. The shear S-wave velocities also provide a general 4-layer ground model, becoming increasingly more competent with depth to reach moderately strong bedrock.

The S-wave data is generally more sensitive than the P-wave velocity and is less affected by the groundwater table, therefore S-wave data can be used to depict approximate depths at which the ground increases in strength and refine the P-wave profiles alongside. Accordingly, the geophysical survey has been able to approximate between sediments and 'bedrock' or cemented material.

Table 4 provides a brief summary of the approximate ground conditions encountered at the site, based on the results of the geophysical survey.

Table 4: Summary of Geophysical Ground Conditions		
Depth (mbgl)		Indicative stratum description
From	To	
GL	0.5m – 1.0m, locally up to 2.0m	Unconsolidated very soft/soft soils
0.5m – 1.0m	3.5m – 4.0m 12.0m – 15.0m	Stiff/compacted sediments ...Becoming stiff soils or weak/soft rock (Encountered in T1 only)
0.5m – 1.0m	3.0m – 6.0m, locally up to 8.0m in T2	Stiff to very stiff/very dense soils or soft/weak rock
3.0m – 6.0m (up to 12m to 15.0m in T1)	>7.0m / >26.0m	Moderately strong bedrock

Based on the above, the geophysical survey indicates a gradational weathering profile with depth, with the potential for soils of relative competence below between approximately 0.5m and 2.0mbgl, becoming moderately strong bedrock from around 4.0m to 6.0m, locally deeper.

7.2 INTRUSIVE INVESTIGATION

Following the geophysical investigation, an intrusive site investigation was carried out to provide a detailed insight into both the shallow and deeper ground conditions underlying the site. The following sections form a summary of the strata encountered.

The intrusive investigation found that the thicknesses of near surface soils/compacted sediments (of either glacial till or weathered bedrock) were generally slightly less than expected based on the geophysical investigation. In general, soft compressible soils were recorded to a maximum depth of approximately 1.3mbgl, with more competent gravel/gravel and cobbles or firm to stiff clays of either glacial till or highly/moderately weathered bedrock below the softer soils (where present). Weathered sandstone or mudstone bedrock which was more intact, was encountered from depths of between approximately 1.0m and 3.2mbgl, but was locally not encountered within the excavated depths in select locations in the north of the site (TT1 – Turbine 6 and TP13 – Turbine 10).

7.2.1 TOPSOIL

Within all trial pits and trial trenches, topsoil was typically recorded to depths of between 0.2m and 0.4m below existing ground level with an area of thicker peat observed in the vicinity of Turbine 2 to 0.6mbgl. The topsoil generally comprised a peaty silty clay with roots and rootlets, locally sandy and frequently graded into a lighter grey brown clay with depth due to acidic staining/leaching from the peat content.

Made ground was not encountered within any of the trial pits.

7.2.2 GLACIAL TILL

Superficial deposits of glacial till were encountered in the majority of the trial pits and trial trenches, to variable depths below existing ground level. The glacial till soils were recorded to the greatest depths in the vicinity of Turbine 6 in the north-west and Turbine 10 in the north-east of the site. TT1 was the only location where the glacial till deposits were not penetrated, although in TT2 it was noted that the (localised) interpreted transition from glacial till to gravels of weathered bedrock was difficult to depict and may indicate a continuation of the glacial till materials.

In general, a thin veneer of firm to stiff, orange brown slightly gravelly to gravelly, sandy to very sandy silt/clay, bordering on sand was encountered immediately beneath the topsoil. Gravel comprises sub-rounded to angular sandstone. This layer was recorded to depths of between 0.4m and 0.9mbgl and generally graded into sand with depth.

7.2.2 GLACIAL TILL (CONTINUED)

In several locations, typically in the central portion of the site (at the topographic high), the near surface superficial layer was recorded as soft to firm. In locations TP24, TP25 and TP26 in the vicinity of Turbine 2, the near surface layer was highly compressible, described as damp to wet and ranging between very soft and soft. This is likely to be associated with the presence of abundant rushes/reeds seen at surface level in this area and similar ground conditions should be anticipated in areas with abundant rushes.

Underlying the veneer of orange brown deposits, medium dense brown/light brown/grey brown sandy gravel with cobbles was typically observed. Gravel and cobbles were noted to be sub-angular to angular, which alongside the absence of structure in the trial pits suggests that the materials are superficial.

With depth, the gravels may represent either glacial till deposits or highly weathered bedrock, with no obvious differentiation between the two.

7.2.3 WEATHERED BEDROCK

The site is predominantly underlain by sandstone of the Rhondda Member, with localised areas of the site underlain by the Llynfi Member comprising sandstones, siltstones and mudstones in the southern portion of the site only. During the investigation the difference between the two geological members was not very discernible, however the presence of mudstones and siltstones alongside sandstones in the southern portion of the site and in the vicinity of the Jubilee Slide Faultline indicates that these occurrences may represent the Llynfi Member.

Weathered bedrock was typically encountered as sandstone within the majority of trial pits and trial trenches, with mudstone bedrock more frequently encountered in the southern portion of the site only.

Within the trial pits, weathered sandstone generally comprised a highly weathered sandstone layer of sandy gravels, becoming gravel and cobbles with depth, grading into less weathered sandstone bedrock. Gravel and cobbles were typically angular and tabular and/or blocky. This highly weathered zone was recorded to depths of approximately 1.0m and greater than 3.2mbgl.

Sandstone bedrock ranges between extremely weak to strong within the trial pits and trial trenches, and within the boreholes it was found to be of similar strengths, but locally very strong. The rock mass is typically fine to medium grained, locally coarse grained, and largely grey, but generally weathered to brown.

7.2.3 WEATHERED BEDROCK (CONTINUED)

Discontinuities were variable, ranging between extremely closely spaced to medium spaced, however in general two discontinuity sets were identified as (1) sub-horizontal bedding planes and (2) more irregular fractures.

Weathered mudstone was encountered within trial pits/trenches TP24, TP25, TP26, TP29, TP30, TP31, TT3 and TT4 only, located in the southeast part of the site. In general, the weathering profile of the mudstone comprised clay with lithorelicts of mudstone grading into mudstone gravel, becoming extremely weak to very weak, extremely to very closely spaced fractured mudstone with depth. The near surface weathered mudstone in locations TP26 and TP27 was noted to be soft to firm clay down to depths of 1.3m and 0.4mbgl respectively.

Weathered mudstones and siltstones were also encountered within several of the boreholes, with discontinuity sets largely as observed within the sandstone, with rock strengths ranging between extremely weak to weak.

Coal deposits were observed within four trial pits/trenches only (TP25, TP29, TT3 and TT4). Coal seams were recorded within several boreholes, with multiple seams frequently recorded in each borehole. The coal seams were encountered within boreholes in the vicinity of Turbine 1, Turbine 2, Turbine 8 and a single thin seam was recorded around Turbine 9.

The shallow coal deposits were observed as weathered coal comprising gravelly sand or sandy gravel, where gravel comprised angular fragments of coal. With depth in the deeper boreholes, coal seams were either recorded by the drillers during open hole drilling methods or within the recovered cores during coring sections.

Coal seams ranged between 0.3m and 1.2m thick, thickest in BHT202-E. Further detail on the coal findings is included in Section 9.0 alongside a discussion on the associated mining risks at the site.

7.2.4 GROUNDWATER

A number of surface water drainage features and minor watercourses are present in the southern portion of the site as well as the Nant yr Hywaid stream in the north west, located outside of the development boundary but within the planning boundary.

In general, the trial pits and trial trenches remained dry during excavation, with groundwater ingress/seepages only locally recorded as follows:

7.2.4 GROUNDWATER (CONTINUED)

In TP25, medium groundwater ingress entered the trial pit from the upslope (north) end of the trial pit, at approximately 2.4m to 2.6mbgl at the base of the coal layer and was ponding in the base of the excavation.

In TP26 a slight water seepage was encountered at 1.4mbgl within the weathered mudstone.

No significant water strikes were recorded within the boreholes during the investigation with the exception of water strikes within BHT1 at 6.0m and 18.0mbgl, BHT1-B at 17.0mbgl and BHT1-C at 21mbgl.

7.2.5 LABORATORY GEOTECHNICAL TEST RESULTS

Samples of soils and rock cores were scheduled for geotechnical testing to inform on the volume change potential of the soils, the class of materials and suitability for re-use as engineered fill, the strength of the weathered bedrock and the suitable concrete classification requirements at the site.

Atterberg Test Results

Four samples of near surface glacial till soils collected from depths of between 0.4m and 0.6mbgl were subjected to Atterberg Limits in order to inform on the volume change potential of the materials. During the investigation, the soils were described as variable consistency sandy gravelly silts or clays and locally sand dominant.

The test results indicate that the sample from TP04 at 0.4m was identified as a slightly gravelly sandy silt which exhibited a plasticity index of 11%. 71% of the material passed through the 0.425mm sieve, therefore this information indicates that the material is classed as a non-shrinkable silt with a modified plasticity index of 0.78%.

The sample collected from TP24 at 0.6m was identified as a sandy clay which exhibited a plasticity index of 17%. 100% of the material passed through the 0.425mm sieve, therefore this information indicates that the material comprises a low volume change potential clay with a modified plasticity index of 17%.

The samples collected from TP02 at 0.5m and TP14 at 0.6m were identified as gravelly sands with 42% and 59% of the samples passing through the 0.425mm sieve, and testing indicating that the soils were non-plastic.

7.2.5 LABORATORY GEOTECHNICAL TEST RESULTS (CONTINUED)

As the intrusive investigation identified, it is therefore considered likely that the near surface shallow glacial till layer is likely to comprise variable material which ranges between sand, silt and clay with varying gravel content.

Particle Size Distribution and Optimum Moisture Compaction

The geotechnical test results on representative bulk samples are included in Appendix J. Table 5 summarises the sample proportions and measured moisture content of the materials, as well as providing the class of materials in accordance with the Specification for Highways Works (SHW) Series 600.

The samples of near surface glacial till deposits were identified to comprise a combination of Class 2C and Class 1A/1B materials.

The samples of granular glacial till deposits and granular weathered bedrock, which were typically described as sand gravel or gravel and cobbles in the field, are classified as Class 1A/1B materials.

The weathered bedrock materials, comprising either sandstone or mudstone in-situ, and excavated as gravel/gravel and cobbles, have been classified as Class 1A/1B materials.

The dry density/moisture content relationship analysis indicates that in general, the natural moisture content of the materials is acceptable in order to achieve 95% of the maximum dry density of the materials. Where optimum moisture content analysis was not completed on specific samples, the results of representative samples of a similar nature have been adopted to provide the suitable moisture content range. The sample of glacial till from TP08 at 0.4m to 0.65m was the only sample outside of the 95% compaction moisture range, with the natural moisture content of 22% exceeding the upper threshold of 17.2%.

Table 5: Summary of Particle Size Distribution and Optimum Moisture Compaction Test Results

Location	Depth (m)	Stratum	Sample Proportions (%)		Class (SHW Series 600)	Uniformity Coefficient	Received Moisture Content	Maximum Dry Density (Mg/m3)	OMC (to achieve 100% dry density)	OMC range (to achieve 95% dry density)
TP02	0.8 - 1.2	Medium dense very clayey/silty sandy GRAVEL of sandstone. (Glacial Till/Highly Weathered Bedrock)	Cobbles and Boulders	5	1A/1B	416.7	10.1	2.03	10.7	8% - 12.5%
			Gravel	64						
			Sand	16						
			Silt/Clay	14						
TP08	0.4 - 0.65	Firm to stiff orange brown sandy gravelly silty CLAY with low to medium cobble content. (Glacial Till)	Cobbles and Boulders	11	2C	116.7	22	1.83	13.9	8.5%-17.2%
			Gravel	36						
			Sand	35						
			Silt/Clay	18						
TP10	0.8 - 0.9	Medium dense brown silty very sandy GRAVEL of fine to coarse sub-angular to angular sandstone with low to medium cobble content. (Glacial Till/Highly weathered bedrock)	Cobbles and Boulders	0	2C	50	12.2	-	10.7* (TP02)	8% - 12.5%
			Gravel	43						
			Sand	40						
			Silt/Clay	17						
TP13	0.5 - 0.8	Firm to stiff, orange brown and grey brown sandy gravelly silty CLAY. (Glacial Till)	Cobbles and Boulders	0	2C	50	13.2	-	13.9* (TP08)	8.5%-17.2%
			Gravel	44						
			Sand	36						
			Silt/Clay	20						
TP17	1.0 - 1.4	Medium dense to dense light brown slightly sandy GRAVEL and COBBLES of sub-angular to angular sandstone. (Weathered Bedrock)	Cobbles and Boulders	22	1A/1B	216.7	7.5	-	8.8* (TT1)	4.5%-13%
			Gravel	44						
			Sand	22						
			Silt/Clay	12						
TP19	0.8 - 1.0	Medium dense light brown silty sandy GRAVEL of fine to coarse sub-angular to angular sandstone. (Weathered bedrock)	Cobbles and Boulders	9	1A/1B	208.4	8.7	-	10.7* (TP02)	8% - 12.5%
			Gravel	64						
			Sand	16						
			Silt/Clay	11						

Table 5: Summary of Particle Size Distribution and Optimum Moisture Compaction Test Results

Location	Depth (m)	Stratum	Sample Proportions (%)		Class (SHW Series 600)	Uniformity Coefficient	Received Moisture Content	Maximum Dry Density (Mg/m ³)	OMC (to achieve 100%)	OMC range (to achieve 95% dry density)
TP27	1.6 - 1.8	Extremely weak becoming very weak, very closely to closely fractured MUDSTONE. (Weathered bedrock)	Cobbles and Boulders	4	1A/1B	240	10.4	1.98	12.4	10%-17%
			Gravel	81						
			Sand	8						
			Silt/Clay	7						
TT1	1.2 - 1.5	Medium dense light brown silty/clayey very sandy GRAVEL of fine to coarse sub-rounded to angular sandstone with medium cobble content. (Glacial Till)	Cobbles and Boulders	9	2C or 1B	175	9.8	2.06	8.8	4.5%-13%
			Gravel	45						
			Sand	31						
			Silt/Clay	15						

7.2.5 LABORATORY GEOTECHNICAL TEST RESULTS (CONTINUED)

Point Load Testing and Uniaxial Compressive (UCS) Strength Testing

The point load and UCS test results are included within Appendix K. Point load tests were undertaken on a range of rock core samples collected from varying depths. The conversion factor of the point load test correlates well with the UCS tests completed.

A summary of the rock testing is included in Table 6. The sandstone bedrock typically ranges between weak and strong, with very weak and very strong results also recorded. The siltstones/mudstones are relatively weaker, described as extremely weak to weak.

Table 6: Summary of Point Load and UCS testing on Rock Cores							
Borehole	Depth (m)	Point Load Index Is(50)		UCS (Mpa)	Rock Type	Inferred UCS* (Mpa)	Indicative unconfined strength
		Diametral (Mpa)	Axial (Mpa)				
BHT1	7.5	0.07	0.39		Siltstone/mudstone	1.47 8.19	Very weak Weak
BHT1	16	0.05	1.7		Siltstone	1.05 35.7	Very weak Medium strong
BHT2	13.15	0.25	2.06		Sandstone	5.25 43.26	Weak Medium strong
BHT5	8.7	2.71	4.73		Sandstone	56.91 99.33	Strong Strong
BHT5	9.3 - 9.5			71.5	Sandstone		Strong
BHT5	9.8	0.14	3.24		Sandstone	2.94 68.04	Very weak Strong
BHT5	14.7	0.94	3.29		Sandstone	19.74 69.09	Weak Strong
BHT6	5.15	0.4	6.17		Sandstone	8.4 129.57	Weak Very strong
BHT6	12.1	7.58	6.28		Sandstone	159.18 131.88	Very strong Very strong
BHT8	3.7 - 4.0			47.2	Sandstone		Medium strong
BHT8	3.7	0.61	1.35		Sandstone	12.81 28.35	Weak Medium strong
BHT8	12.5	0.34	0.58		Siltstone	7.14 12.18	Weak Weak
BHT8D	11.1	0.11	0.03		Siltstone/mudstone	2.31 0.63	Very weak Extremely weak
BHT9	7.6	0.43	1.01		Sandstone	9.03 21.21	Weak Weak
BHT9	8.8	0.87	1.31		Sandstone	18.27 27.51	Weak Medium strong

Table 6: Summary of Point Load and UCS testing on Rock Cores							
Borehole	Depth (m)	Point Load Index Is(50)		UCS (Mpa)	Rock Type	Inferred UCS* (Mpa)	Indicative unconfined strength
		Diametral (Mpa)	Axial (Mpa)				
BHT11	8.1	0.07	0.39		Sandstone	1.47 8.19	Very weak Weak
BHT11	12	0.05	1.7		Sandstone	1.05 35.7	Very weak Medium strong
* Inferred UCS where $UCS=21 \times \text{Point Load Index (ISRM, 1985)}$. A typical conversion factor of 24 is considered appropriate for sandstones of the South Wales Coal Measures, therefore the above conversions should be considered an estimate. Point Load Index (Is) has also been related to UCS by a conversion factor of between 15 and 29 for a variety of rock types (Broch and Franklin, 1972; Bieniawski, 1974, 1975; Forster, 1983; Chau and Wong, 1996) and for sedimentary rocks as a factor of 16 (Read et al., 1980).							

8.0 REVISED CONCEPTUAL MODEL

The preliminary conceptual exposure model has been reviewed and revised to reflect the findings of the site investigation. Pathways identified as a relevant pollutant linkage require appropriate risk assessment or mitigation measures.

Table 7: Revised Conceptual Exposure Model

Source		Receptor	Pathway	Preliminary Active Pathway? (see Sect. 5.8)	Relevant Pollutant Linkage	Justification/ Mitigation
Origin	Contaminant					
Made Ground of unknown origin placed along tracks/gateways (if encountered)	Metals, semi-metals, non-metals, PAH, asbestos	Commercial – human health	Dermal Contact with made ground/dust	✓	×	Made ground was not encountered during the intrusive investigation
			Ingestion of soil	✓	×	
			Inhalation of dust	✓	×	
			Inhalation of vapours – indoor/outdoor	✓	×	
	Metals, semi-metals, inorganics, PAH	Groundwater quality	Leaching from made ground	✓	×	
	Metals, semi-metals, inorganics, PAH	Surface water quality	Transportation within groundwater	✓	×	
Made Ground of unknown origin and natural ground	pH and water soluble sulphate	Building Materials Durability	Direct contact	✓	✓	Building materials will be in contact with natural ground. Risk Assess See Section 10.6
Ground Gas – organic, gas producing materials	Methane, carbon dioxide	Human health	Accumulation of gases in confined spaces, and/or migration off site, leading to asphyxiation, or risk of explosion	✓/×	×	Localised peat present in small quantities, however this will be removed during site strip. Negligible risk to site end use from mineworkings

9.0 MINING RISK ASSESSMENT

9.1 BACKGROUND

9.1.1 BGS Data

Reference to the BGS 1:50,000 scale geological maps (solid and drift) indicates that the site is predominantly underlain by bedrock of the Rhondda Member of the Carboniferous period. These rocks generally comprise sandstones. Localised areas of the site are also underlain by the Llynfi Member comprising Carboniferous interbedded mudstones, siltstones and sandstones.

The county geological maps have also been obtained for the site which include more detail on the presence of coal seams beneath the site. Reference to the Glamorgan sheet 25 NE and Glamorgan sheet 26 NW indicates that the Wernpistyll coal seam Wernpistyll Rider coal seam, Wernddu (No.2 Rhondda) coal seam, Field Vein coal seam and several thin coals are indicated to outcrop within the site. Strata dips of 12 degrees and 15 degrees towards the north-west are indicated within the vicinity of the site.

Table 8 provides more information on the conjectured sequence and thickness of the coal seams beneath the site, however the site is split across two geological maps, which indicate local variations in the nature of the coal seams. Therefore, this should be regarded a best estimate.

Table 8: Stratigraphic Summary of Coal Seams		
Coal Seam	Thickness (26 NW / 25 NE)	Approximate vertical separation
Thin Coal	<i>Thin</i>	11m – 26m
Field Vein	<i>Thin</i>	
Wernddu	<i>2ft 6in / 9in</i>	5.5m – 11m
(No.2 Rhondda)*	0.76m / 0.23m	11m – 16m
Wernpistyll Rider	<i>Thin</i>	
Wernpistyll	<i>Thin / 2ft 6in</i> Thin / 0.76m	11m – 14m
A collection of thin coal seams greater than 25m below the Wernpistyll seam. Continued stratigraphic sequence with depth.		

*Wernddu and Field vein exist as either 2 leaves/seams on Glamorgan Sheet 26 NW, or a continuous seam (No. 2 Rhondda 3ft) on Glamorgan sheet 25 NE.

9.1 BACKGROUND (CONTINUED)

The geological maps indicate that a negligible superficial cover would be anticipated overlying the bedrock, with an area of Glacial Till indicated in the valley of the Nant yr Hywaid in the north-west of the site only, and no superficial deposits recorded elsewhere on-site.

A fault transects the southern portion of the site, trending largely west-north-west to east-south-east crossing the area of former turbine positions Turbine 3 and Turbine 7. The geological map indicates that this is a branch of the Jubilee Slide and that it is downthrowing to the south.

9.1.2 Coal Authority Data

A Coal Authority Mining Report has been obtained for the site, due to its location in an area with potential risk of past mining and a copy is included in Appendix C.

The Coal Authority report states that *“the development area is within the likely zone of influence from workings in 11 seams of coal at shallow to 780m depth.”*

The report states that the site is not in the likely zone of influence of any present underground coal workings.

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

The Coal Authority states that it is not aware of any damage due to geological faults or other lines of weakness affected by coal mining.

The Coal Authority mining report identified 3 mine entries within 20m of the site boundary.

The following details the mine entries recorded within 20m of the planning boundary:

- 283193-008. No treatment details.
- 284193-036. Adit sealed with compacted brick rubble and backfilled with soil. 4.3m square fence erected. (CCD/92/34).
- 283193-007. No treatment details.

Abandonment Plans and Mine Entry Datasheets

Following the identification of historic coal mine workings beneath the site, the relevant mine entry datasheets and abandonment plans were obtained from the Coal Authority.

9.1 BACKGROUND (CONTINUED)

Mine entry data sheets were obtained for the following which were included within the Coal Authority Report:

- 283193-008. No treatment details.
- 284193-036. Adit sealed with compacted brick rubble and backfilled with soil. 4.3m square fence erected. (CCD/92/34).
- 283193-007. No treatment details.

In addition, the formerly obtained Coal Authority report for the planning boundary identified the presence of mine entry ref: 284193-035 Which is located just outside of the site boundary, to the south-east of proposed Turbine 8. Accordingly, the datasheets for this record were also obtained for completeness.

The mine entry datasheets are included in Appendix C with the Coal Authority Report.

Following review of the data sheets, two abandonment plans, relating to records of workings within the No.2 Rhondda were obtained from the Coal Authority, references below:

- Ab plan SWR794 (Foel Duffryn Colliery)
- Ab plan SWS1070 (Nant Glas Colliery)

Several abandonment plan overlays are included as follows:

- Figure 4A Abandonment Plan Overlay – Turbine 1
- Figure 4B Abandonment Plan Overlay – Turbine 2
- Figure 4C Abandonment Plan Overlay – Turbine 8
- Figure 4D Abandonment Plan and Proposed Layout Overlay – Access Road

Abandonment plan SWS1070 indicates that the No.2 Rhondda has been extensively worked beneath the southern portion of the site, including beneath Turbine 2. A seam section sketch shows a layer of clift, underlain by a 27inch coal seam underlain by fireclay.

Abandonment plan SWR794 indicates that the No.2 Rhondda has been extensively worked beneath the central portion of the site, including beneath Turbine 8. A seam section sketch shows a layer of shale, underlain by a 26inch coal seam underlain by fireclay. The plan indicates that the strata dip at 1 in 3 (18 degrees) towards the north. The plan also shows that workings in the No.2 Rhondda coal seam continued towards the north associated with Duffryn Rhondda colliery.

9.1 BACKGROUND (CONTINUED)

Georeferencing exercise

To provide confidence in the Coal Authority data obtained the positions of the mine entry locations were more accurately positioned during review of the abandonment plans and historical maps.

The geofixed locations of the mine entries are shown on Figures 4a – 4d and summarised below in Table 9.

Table 9: Mine Entry Data		
Mine entry reference	Treatment details	Georeferenced Coordinates (E,N)
284193-035	No treatment details.	284064,193968
284193-036	Adit sealed with compacted brick rubble and backfilled with soil. 4.3m square fence erected. (CCD/92/34).	284022,193500
283193-007	No treatment details.	283830,193641
283193-008	No treatment details.	283891,193578

9.1.3 Preliminary Risk Assessment

The geological map indicates the conjectural outcrop of various coal seams through the site, with the presence of a fault line known as the Jubilee Slide trending east to west through the site causing the repetition of the coal seam sequence in the north and south of the site.

Accordingly, it is considered that the site is underlain by the following coal seams listed in stratigraphic order:

- Thin coal
- Field Vein
- No.2 Rhondda (Wernddu)
- Wernpistyll Rider
- Wernpistyll
- Thin coals at greater depth

9.1 BACKGROUND (CONTINUED)

The Coal Authority report indicates that eleven coal seams have been worked beneath the site at shallow to 780m depth. Review of the information gathered indicates that the shallow workings are likely to relate to recorded workings within the No.2 Rhondda coal seam. The records of workings at greater depths are likely to be in various coal seams at varying depths beneath the site, associated with the following collieries which are known to have mined beneath the site or surrounding area:

- Nant Glas Colliery
- Foel y Duffryn Colliery
- Duffryn Rhondda Colliery
- Old Argoed Colliery
- Pennant Colliery
- Cynon Colliery

For ease of reference, the proposed turbine locations have been assessed on a case by case basis, and the following provides a summary of the risk assessment for each.

Turbine 1 (283959,193522)

The geological maps and abandonment plans indicate that the No.2 Rhondda coal seam is conjectured to outcrop immediately north-east of Turbine 1, with the overlying Field Vein indicated to outcrop approximately 25m beyond (north-east).

The abandonment plan indicates an extensive network of recorded mineworkings within the No.2 Rhondda coal seam to the north of Turbine 1 (T1). However, the abandonment plan does not indicate any recorded workings within the No.2 Rhondda beneath T1, due to the location of the outcrop being upgradient of the turbine. Based on this information, any unrecorded workings within the No.2 Rhondda within the vicinity of T1 are likely to be worked from surface level (i.e. to the north of T1), if present at all.

The Wernpistyll coal seam is conjectured to outcrop approximately 60m south-west of Turbine 1, with the Wernpistyll rider coal seam likely to overlie this seam. Accordingly, based on the topography of the area, and assuming no superficial cover, the Wernpistyll coal seam would be estimated some 24mbgl beneath Turbine 1, reducing to approximately 21m at the southern edge. The geological maps indicate that the Wernpistyll coal seam is generally either thin or 2ft 9inches in thickness.

Reference to the available information included within the James Associates Ground Stability Report indicates that abandonment plans were not available for the Wernpistyll coal seam in this area, indicating that there are no recorded workings within the Wernpistyll coal seam in this area.

9.1 BACKGROUND (CONTINUED)

However, the potential for unrecorded workings cannot be discounted.

As such, the preliminary risk assessment indicates a potential risk of unrecorded shallow mineworkings associated with the Wernpistyll coal seam beneath Turbine 1, and a relative lesser risk associated with the overlying Wernpistyll Rider (thin) coal seam.

A low risk of unrecorded crop workings may also be anticipated beneath the Turbine 1 area, associated with the No.2 Rhondda coal seam.

Mine entry ref:284193-036 is shown approximately 67m east of Turbine 1, entering into the conjectured No.2 Rhondda coal seam. Due to its northerly azimuth and distance from the turbine, the adit is not considered to pose a ground stability risk to Turbine 1.

Turbine 2 (283850, 193725)

The geological maps and abandonment plans indicate that the Field Vein coal seam is conjectured to outcrop approximately 50m south-west of Turbine 2 (T2), with the underlying No.2 Rhondda coal seam indicated to outcrop approximately 24m beyond (south-west). In addition to the conjectured outcrops, the abandonment plan indicates a network of recorded mineworkings beneath Turbine 2 and the surrounding area, which includes seam levels to provide confidence in the depths to the workings below ground level.

Correction of the abandonment plan seam level with the existing topography indicates that the No.2 Rhondda coal seam is located approximately 33mbgl. The Field Vein would be anticipated to overlie this coal seam and may be some 5.5m to 11m shallower or may also be present immediately overlying the No.2 Rhondda coal seam.

As such, Turbine 2 is indicated to be underlain by recorded workings at around 30mbgl within the No.2 Rhondda coal seam, and may also be expected within the underlying fire clay and the overlying Field Vein.

Based on the seam level depths of the No. 2 Rhondda coal seam, the Wernpistyll rider coal seam would be anticipated at greater than 30mbgl, with the Wernpistyll coal seam at greater depth. Therefore, both of these coal seams are considered to be outside the zone of concern.

Mine entry ref: 283193-007 is shown approximately 75m south-south-west of Turbine 2, entering into the conjectured No.2 Rhondda coal seam. The azimuth of the adit is shown towards the north, continuing via a roadway towards the north-east, almost immediately beneath Turbine 2.

9.1 BACKGROUND (CONTINUED)

Accordingly, this information indicates that the risk of ground subsidence at Turbine 2 associated with the adit entry (portal entrance) is considered to be low, however the risk of ground subsidence from shallow workings remains.

The previous location of Turbine 2 was approximately 30m south-west of Turbine 2. Correction of the abandonment plan seam level with the existing topography indicates that the No.2 Rhondda coal seam is located approximately 24.5mbgl below the former Turbine 2 coordinate. The Field Vein would be anticipated to overlie this coal seam and may be some 5.5m to 11m shallower or may also be present immediately overlying the No.2 Rhondda coal seam.

Turbine 8 (284016,194027)

The geological maps and abandonment plans indicate that the Field Vein coal seam is conjectured to outcrop approximately 59m south-east of Turbine 8, with the underlying No.2 Rhondda coal seam indicated to outcrop approximately 100m from Turbine 8. In addition to the conjectured outcrops, the abandonment plan indicates a network of recorded mineworkings beneath Turbine 8 and the surrounding area, which includes seam levels to provide confidence in the depths to the workings below ground level.

Correction of the abandonment plan seam level with the existing topography indicates that the No.2 Rhondda coal seam is located approximately 18m to 20mbgl in the vicinity of Turbine 8. The Field Vein would be anticipated to overlie this coal seam and may be some 1.5m to 11m shallower or may also be present immediately overlying the No.2 Rhondda coal seam.

As such, Turbine 2 is indicated to be underlain by recorded workings at around 30mbgl within the No.2 Rhondda coal seam, and may also be expected within the underlying fire clay and the overlying Field Vein.

The geological map does not show a conjectured outcrop of the Wernpistyll Rider to the north of the Jubilee Slide. The Wernpistyll coal seam is indicated to the east of Turbine 8 (north of the Jubilee Slide), therefore it would be prudent to consider the presence of both the Wernpistyll and Wernpistyll Rider coal seams at around circa 30mbgl in the area of Turbine 8.

Mine entry 284193-035 is located approximately 65m south-east of Turbine 8. The adit is shown to continue towards the north-west (curved pathway), via a roadway almost immediately beneath Turbine 8.

9.1 BACKGROUND (CONTINUED)

Accordingly, this information indicates that the risk of ground subsidence at Turbine 8 associated with the adit entry is considered to be low, however the risk of ground subsidence from shallow working remains.

Turbines 9, 10 and 11

Review of the seam levels and indicated strata dips on abandonment plan SWR794 indicates that moving north from Turbine 8, the Field Vein and No.2 Rhondda coal seams are located at greater depths in the north-eastern portion of the site. Beneath Turbine 9, the No.2 Rhondda coal seam is estimated to be at approximately 65mbgl, and at much greater depths below Turbines 10 and 11 further north. As such, the risk of ground subsidence arising from (recorded or unrecorded) mineworkings beneath these turbines is considered to be low.

Beneath Turbine 9, the potential for the Field Vein at shallower depth is considered.

Turbines 5 and 6

Review of the geological map indicates that a thin coal seam is conjectured to outcrop through the north-west of the site, with no other coal seams shown in the area. The background information suggests that the workable coal seams in the area, notably the No.2 Rhondda, are located at significant depths beneath the site, outside the zone of concern.

As such, Turbines T5 and T6 may be underlain by a thin coal seam at shallow depth, but neither location is likely to encounter thick coal seams. It would have been unlikely to be economically viable to mine thin coal seams of this nature, therefore these are not considered to be at risk of unrecorded mineworkings. As such, Turbines T5 and T6 are not considered to be at risk of ground subsidence from unrecorded or recorded shallow mineworkings.

9.1.4 *Proposed Investigation*

Due to the presence of recorded workings at potentially shallow depths beneath the site, an intrusive investigation was recommended to determine the depth to any workings and the thickness of rock cover. Coal mining at depths shallower than nominally 30m beneath ground level can pose constraints to development in the form of ground stability at the surface. The magnitude of this effect depends upon the exact depth to any workings, the thickness of competent rock cover and the extraction thickness of any coal mine workings.

9.1 BACKGROUND (CONTINUED)

As such, due to the uncertainty over unrecorded shallow mine workings in the area combined with the identification of recorded workings beneath Turbines T2 and T8 within the site, the risk of ground movement as a result of past coal mining was considered to be uncertain and rotary drilled boreholes were drilled as part of the intrusive site investigation.

9.2 FIELDWORK

28 rotary drilled boreholes were drilled on-site in June and July 2021 to profile the depth to rockhead and identify the presence and nature of any shallow coal seams, or associated mining-related broken ground/voids.

The rotary drilled boreholes were located at the proposed turbine locations, drilled to a maximum depth of 35m below existing ground level, but typically drilled to 30mbgl. A rotary borehole was undertaken at the centre point of the eight proposed turbines. In these locations, the drilling was commenced by dynamic sampling from ground level to rockhead (between 1.5m and 4.5mbgl), continued by rotary coring to depths of between 15mbgl and 21mbgl, followed on by rotary open hole drilling to 30/35mbgl.

At turbine locations T1, T2, T8 and T9 where a potential risk from shallow recorded and/or unrecorded workings has been identified, between four to six additional boreholes were undertaken around the perimeter of the proposed turbines, with sections of rotary coring undertaken in BHT8-D and BHT2 only (between 9m to 15mbgl).

It should be noted that in the location of Turbine 2, the proposed turbine coordinate was amended during the intrusive works. As such, three boreholes were undertaken in the vicinity of the former coordinate (BHT202, BHT202-D and BHT202-E) and four boreholes were undertaken in the location of the amended coordinate (BHT2, BHT2-A, BHT2-B and BHT2-C).

Rockhead was encountered at depths of between 1.5m and 4.5mbgl in all of the boreholes, described as sandstone or mudstone/siltstone bedrock. Superficial deposits of glacial till were encountered overlying the bedrock. The superficial deposits were thickest in BHT10, encountered down to 4.2mbgl, overlying a thin zone of highly weathered sandstone before grading into sandstone bedrock. Similarly, in BHT6, superficial deposits were recorded to 2.6mbgl, underlain by broken sandstone to 3.7mbgl.

9.2 FIELDWORK (CONTINUED)

During the investigation, coal was not encountered within boreholes BHT5, BHT6, BHT9, BHTA, BHTB, BHTC, BHT10 and BHT11, which are the boreholes in the vicinity of Turbines T5, T6, T9, T10 and T11. A thin coal seam was encountered at 13.8mbgl (0.3m thick) in BHT9-D (at turbine T9) only. These findings accord with the preliminary risk assessment (Section 9.1.3 above) and confirm that the potential risk of ground subsidence beneath these turbines is negligible.

Table 10 below summarises the occurrence of encountered coal seams and/or backfilled workings, broken ground or voids:

Table 10: Summary of Encountered Coal Seams and Potential Mining Features				
Location	Coal Seam (mbgl)	Coal Seam Thickness (m)	Possible mineworkings (mbgl)	Workings Thickness (m)
<u>Turbine 1</u>				
BHT1	1.6 – 1.9	0.3	N/A – Intact coal only	N/A
	5.6 – 6.0	0.4		
	17.0 – 17.3	0.3		
BHT1-A	3.8 – 4.3	0.5	N/A – Intact coal only	N/A
	9.2 – 10.0	0.8		
	20.5 – 20.9	0.4		
BHT1-B	3.2 – 3.6	0.4	N/A – Intact coal only	N/A
	14.5 – 15.0	0.5		
BHT1-C	2.0 – 2.5	0.5	N/A – Intact coal only	N/A
	14.0 – 14.5	0.5		
BHT1-D	2.0 – 2.4	0.4	N/A – Intact coal only	N/A
	19.0 – 19.5	0.5		
<u>Turbine 2 (Revised Location)</u>				
BHT2	N/A – No Coal encountered	N/A	N/A	N/A
BHT2-A	N/A– No Coal encountered	N/A	N/A	N/A
BHT2-B	25.5 – 26.5	1.0	N/A – Intact coal only	N/A
BHT2-C	24.5 – 26.0	1.5	N/A – Intact coal only	N/A
<u>Turbine 2 (Original Location)</u>				
BHT202	18.0 – 18.8	0.8 (Very soft drill, possible coal)	15.2 – 18.0 No returns 27.0 – 28.2 Soft drill	2.8 1.2
BHT202-D	14.0 – 15.0	1.0	21.8 – 22.1 Void (22.1 – 22.6 Normal drill) 22.6 – 24.0 Backfilled workings	0.3 (0.5) 1.4

9.2 FIELDWORK (CONTINUED)

Table 10: Summary of Encountered Coal Seams and Potential Mining Features				
Location	Coal Seam (mbgl)	Coal Seam Thickness (m)	Possible mineworkings (mbgl)	Workings Thickness (m)
BHT202-E	14.5 – 15.8	1.3	23.3 – 24.0 Void 24.0 – 24.5 Backfilled workings	0.7 0.5
<u>Turbine 8</u>				
BHT8	9.7 – 10.0	0.3	19.5 – 20.0 Broken Ground 20.0 – 21.0 Void 21.0 – 23.0 Very soft drill	0.5 1.0 2.0
BHT8-A	11.0 – 11.6	0.6	21.0 – 22.5 Void 22.5 – 23.5 Backfilled workings	1.5 1.0
BHT8-B	8.4 – 9.6 19.5 – 20.0 21.4 – 22.2	1.2 0.5 0.8	N/A – Intact coal only	N/A
BHT8-C	6.5 – 7.5 16.7 – 17.7 19.0 – 19.4	1.0 1.0 0.4	N/A – Intact coal only	N/A
BHT8-D	– No Coal encountered	N/A	14.6 – 15.0 Void 15.0 – 19.0 Broken ground and voids (no returns)	0.4 4.0
BHT8-E	10.5 – 11.0 20.9 – 21.6 22.6 – 23.0	0.5 0.7 0.4	N/A – Intact coal only	N/A
BHT8-F	11.1 – 11.6	0.5	22.5 – 23.5 Void 23.5 – 24.4 Soft drill	1.0 0.9
<u>Turbine 9</u>				
BHT9-D	13.8 – 14.1	0.3	N/A – Intact coal only	N/A

9.3 RISKS FROM MINING LEGACY

The review of the available information coupled with the recent drilling works identified the following site-specific coal mining legacy risks to the site, see below Table 11.

A summary of the risk posed by these features is summarised in the sections below, along with comments on each specific coal mining issue.

9.3 RISKS FROM MINING LEGACY

Table 11: Mining Legacy Risk Table				
Coal Mining Issue	Yes	No	Risk Assessment	
			Rating	Comments
Underground coal mining (recorded at shallow depths)	X		High risk <i>Turbines T2 and T8 Only</i>	Recorded workings and roadways presented on the Coal Authority mine abandonment plans associated with the No.2 Rhondda coal seam (and underlying fireclay) in Turbines T2 and T8.
Underground coal mining (probable/unrecorded at shallow depths)	X		Medium risk <i>Turbine 1</i>	Workable coal seams encountered within boreholes beneath Turbine 1.
Mine entries (shafts)		X	Low risk	Three mine entries identified in the Coal Authority records – none are shafts.
Mine entries (adits)	X		Medium risk <i>Access track/T2 crane pads only</i>	Three mine entries on site and one just off site relate to adits. Adit locations are away from turbine locations (low risk). 283193-008 located immediately south-west of proposed access track (medium risk). Investigation recommended. 283193-007 located to the south-west of Turbine 2 crane pad and access road. Investigation recommended.
Coal mining geology (faults and fissures)		X	Low risk	Jubilee Slide underlies centre of the site. Trial trench (TT3) along the fault line does not indicate significant concerns with regard to ground conditions. Localised softer zone should be anticipated.
Record of past mine gas emissions or potential	X		Medium risk	None recorded on site. However, all mine workings pose a potential gas risk which should be considered in any future investigations and development.
Recorded coal mining surface hazard		X	Low risk	None recorded.
Surface mining (opencast workings)		X	Low risk	None recorded. Some potential for small scale crop/surface workings to exist in the southern portion of the site along coal seam outcrops, however the intrusive investigations did not encounter such workings at Turbine 1 or elsewhere.

9.4 RISKS FROM ABANDONED MINE WORKINGS

Coal mining at depths shallower than 30m beneath ground level can pose constraints to development in the form of ground stability at the surface. The magnitude of this effect depends upon the exact depth of any workings, the thickness of competent rock cover and the extraction thickness of any workings.

The drilling works undertaken at the proposed location of Turbine 8 has identified the presence of shallow mine workings at variable depths and thicknesses, between 14.6 and 24.4mbgl. The voids or broken ground generally ranged between 0.4m and 1.0m in thickness, however in borehole BHT8, 2.0m of very soft drill was recorded from 21.0mbgl and in borehole BHT8, 4.0m of “broken ground and voids” was recorded from 15.0mbgl.

The drilling works undertaken at the proposed location of Turbines T1 and T2 did not encounter any voids or backfilled workings, however at Turbine 1, either 2 or 3 coal seams were recorded in succession within each borehole, a maximum of 0.5m in thickness and at Turbine 2, intact coal was recorded in boreholes BHT2-B and BHT2-B at a maximum of 1.5m thickness.

In addition, drilling at the former/original coordinate of Turbine 2 (boreholes BH202, BH202-D and BH202-E), encountered voids and backfilled workings of a maximum thickness of 1.4m with a 2.8m thick section of no returns in borehole BHT202 also considered likely to be backfilled workings.

To ensure that properties/buildings constructed over mine workings are not affected by subsidence associated with past mining, a rock cover of typically ten times the maximum void thickness of the workings is generally required.

The overlying bedrock above any voids or poor drilling conditions such as backfilled workings generally comprises a combination of mudstone and sandstone.

Garrard and Taylor (1988) presented the results of a study of abandoned workings found at British opencast sites and concluded, by a combination of theoretical and empirical analysis, that the upper limit of migration was controlled by the formation of stable arches, not choking by bulked collapse debris. Height of migration was generally limited to less than $3W$, where W is the width of the void. It would be comforting if a deterministic upper bound to crownhole formation could be derived. However, there will be cases where no stable arch can form, e.g. in shattered or faulted zones with groundwater ingress and where no bulking occurs. Further, in these cases washing away of collapse debris by water moving through the mine, or by slipping to a greater depth down steeply inclined workings, may occur. The height of migration in these worst cases is indeterminate and could greatly exceed the limits derived from deterministic models.

9.4 RISKS FROM ABANDONED MINE WORKINGS (CONTINUED)

It follows that there is no 'safe limit', merely a decreasing probability of subsidence as cover to workings increases. In practice, for gently dipping strata in South Wales the effective upper bound of migration of crown holes appears to be in the range 6T to 8T, where T is the height of the original void. However, in more than 75% of cases, the height of void migration was less than 2T.

Drift deposits also appear to have a mitigating effect on the process. Very few examples of crown holing in South Wales have been found where the chimney has migrated up through more than 5.0m of drift cover.

Based on the above a potential mining risk has been identified at Turbine T8. Although to a lesser extent, a potential mining risk has also been identified at Turbine T2

At Turbine 8, rockhead was encountered at depths of between 1.0m and 1.5m below existing ground level. Based on the 10:1 ratio for the thickness of rock cover to void height required to prevent subsidence migrating up from workings to the surface as previously discussed and based on the backfilled workings encountered within the boreholes, there is insufficient rock cover. It should be noted that the thickness of the backfilled workings encountered indicates that some migration of the workings towards the surface may have taken place.

At Turbine 2, the investigation was initiated at the original location, centred on borehole BHT202, and subsequently moved further north-east to the revised location, centred on borehole BHT2.

Within BHT202, BHT202-D and BHT202-E rockhead was encountered at 1.7m in all locations. Voids and backfilled workings were also encountered within BH202-D and BH202-E, and a section of no returns and a section of very soft and soft drill recorded in BHT202. These sections of voids/backfilled workings and/or soft drill were encountered from as shallow as 15.2mbgl and 21.8mbgl, which indicates that the rock cover is likely to be insufficient at this location.

At the amended Turbine 2 location, within boreholes BHT-2, BHT2-A, BHT2-B and BHT2-C, rockhead was encountered from depths of between 2.5m and 2.7m in all locations. No voids or backfilled workings were encountered within any of the boreholes, however coal was recorded from 25.5m to 25.6m in BHT2-B and from 24.5m to 26.0mbgl in BHT2-C, which are considered likely to be the No.2 Rhondda coal seam.

9.4 RISKS FROM ABANDONED MINE WORKINGS (CONTINUED)

The voids/backfilled workings encountered at the original T2 location can be extrapolated from the borehole BHT202 locations towards the north-east, which suggest that the sections of poor ground would be at around 26.9m and 37.9mbgl when adopting a 15 degree strata dip. These depths do not indicate a significant risk. Similarly, if the coal seams encountered within locations BHT2-B and BHT2-C have been worked, there is likely to be enough overlying rock cover to satisfy the potential risk. Nonetheless, it is considered that the overall risk to the proposed Turbine 2 location remains somewhat uncertain, requiring some further investigation. It should be noted that the risk should be further reviewed once the foundation depths of the turbine have been confirmed, as the requirement to over-excavate to formation level may indicate a slightly reduced rock cover.

At Turbine 1, three coal seams were encountered within boreholes BHT1 and BHT1-A, and in all other locations (BHT1-B, BHT1-C, BHT1D) two coal seams were recorded. The seams were intact and generally between 0.3m and 0.5m thick, with a relatively thicker seam observed from 9.2m to 10.0mbgl in BHT1-A (0.8m). The shallowest seam(s) between 1.6m and 10.0mbgl are considered to be of negligible concern, owing to the fact that they are situated at depths considered too shallow to have been worked by underground methods. The deepest coal seam recorded in the boreholes was between 0.3m and 0.5m thick and recorded between 14.0m and 20.9mbgl. The thickness of the coal seams alongside the absence of backfilled workings or voids in any of the boreholes indicates that the risk at Turbine 1 is considered to be low.

Further north of Turbine 1, the available abandonment plan for the No.2 Rhondda coal seam indicates that recorded workings are present beneath this area of the site, some 22m north-east of the site. This should be considered during any proposals to microsite Turbine 1.

Given the presence of shallow mine workings and the insufficient rock cover identified in select locations (T2 and T8), it is recommended that a drilling and grouting exercise is undertaken below any proposed structures and critical infrastructure, to stabilise the mine workings identified. External hard finished areas may also require protection, either by drilling and grouting works or the introduction of geo-grid reinforcement to the engineering make up as stated in CIRIA C758D Abandoned Mine Working Manual.

9.5 RISKS FROM ABANDONED MINE ENTRIES

The presence of mine entries recorded by the Coal Authority may have the potential to cause localised instability.

9.5 RISKS FROM ABANDONED MINE ENTRIES (CONTINUED)

Until recently, mine entries were rarely treated on abandonment to any significant engineering standard. They were typically loosely backfilled, or inferior capping was constructed over them. With time, backfills may settle and caps fail, resulting in significant ground loss. Therefore, if a mine entry lies partially or wholly within the site, or within a 20m buffer zone, drawn outside the site boundary, then its potential effect should be considered in the site development.

Mine entries have been recorded beneath the site and the four locations are depicted on Figures 4a – 4d. A geofixing exercise was completed using a combination of the existing topography, available historical maps and available abandonment plans in order to position the adits with reasonable accuracy.

The mine entries have not been investigated as part of this investigation.

The mine entries/portal entrances are not considered to pose a risk to the proposed turbines. However, adit records 283193-007 and 283193-008 are located near to the proposed access track in the south. As such, it is recommended that further investigation is undertaken at these locations in order to confirm their locations and assess the potential impact to the access track.

Trenching should be undertaken at the portal entrance to 283193-008, and stitch drilling may be required along the proposed alignment of the access track further-north east.

The supplementary proof drilling beneath Turbine 2 should also cover the area of the proposed access track and/or crane pad in this area which may also be affected by the underground roadway extending north from mine entry 283193-007.

Where an adit entrance is located within influencing distance of the access track (i.e. potentially at Adit 283193-008) the adit entrance may need to be excavated out and reinstated.

The development site lies within a historical mining area and therefore there is a residual risk of unrecorded mine entries to be present on site. All site operatives should be made aware of this potential risk and a watching brief should be maintained during site works.

9.6 COAL MINING GEOLOGY (FAULTS AND FISSURES)

A fault known as (a branch of) the Jubilee Slide transects through the centre of the site.

9.6 COAL MINING GEOLOGY (FAULTS AND FISSURES) (CONTINUED)

Trial trench 3 (TT3) targeted this fault displacement and the ground conditions highlighted a zone of irregular gravel and evidence of structural impact (folding) to the mudstone bedrock. An approximate 0.3m thick plane was depicted in the trial trench, and during excavation, this section of the trench was noted to be easier to dig, and described as a soft zone.

The conjectural alignment of the fault can be seen from ground level, evidenced by a slight channel at grass level with localised reeds/rushes along the alignment.

The fault presents a low risk to the development site. Any soft materials/soft zones associated with the fault that are encountered during the construction of the access track will need to be removed and consideration may need to be given to the inclusion of geogrid reinforcement within the access track construction.

9.7 RECORD OF PAST OR POTENTIAL MINE GAS EMISSIONS

There are no past gas emissions recorded at the site or in the surrounding area. It should be noted that coal seams and general workings pose a potential gas risk which should be considered.

At a development site with shallow workings, probable shallow workings, or pathway features such as mine entries and geological disturbance on or nearby the site, the Coal Authority recommends that a gas risk assessment is undertaken.

Gas monitoring was undertaken during the drilling of the rotary boreholes, and significant levels of carbon dioxide, methane or carbon monoxide were not recorded during the investigation.

No coal seams identified as underlying the site are recorded as being prone to spontaneous combustion.

9.8 RECORDED COAL MINING SURFACE HAZARD

None recorded.

9.9 SURFACE MINING (OPENCAST WORKINGS)

No opencast workings for coal have been recorded.

9.9 SURFACE MINING (OPENCAST WORKINGS) (CONTINUED)

The potential for local crop workings in the south of the site along the conjectured outcrops of the Field Vein/No.2 Rhondda and Wernpistyll coal seams has been considered. However, evidence of this was not noted during the trial pit investigation, which included excavation into very shallow coal in these parts of the site.

9.10 DEVELOPMENT PLAN

Based on the site investigation works to date, the rotary open hole boreholes undertaken at Turbines T2 and T8, indicate that the area is underlain by underground mineworkings. It is proposed that proof drilling and grouting stabilisation works are undertaken at Turbine 8, and that proof drilling to further assess the risk of ground subsidence is undertaken at Turbine 2.

The investigation in the vicinity of Turbine 1 indicates a low risk of ground subsidence beneath this part of the site, based on the absence of any underground workings and the presence of thin intact coal seams recorded during drilling

It should be noted that the intrusive investigation works to determine the presence of shallow coal seams and shallow workings has been focused on the Turbine coordinates provided at the start of this report, and as shown in Figures 3A, 3B and 3C.

Mine entries/adits are present in the south of the site and may present a potential risk to the proposed access tracks, such as localised ground instability. Further investigation works to locate and assess the mine entries will be required and is recommended in the vicinity of 283193-008. It is considered that further investigation of the underground roadway associated with adit 283193-007 will be covered by the supplemental proof drilling of Turbine 2.

9.11 DEVELOPMENT PRECAUTIONS

Site Investigation and/or Remediation

Due to the presence of mine workings at shallow depths beneath Turbine T8, drilling and grouting stabilisation works should be undertaken.

It is also recommended that further investigation is undertaken in the vicinity of Turbine T2, following the identification of voids and backfilled workings to the south-west of the proposed turbine at the original T2 location, and recorded coal seams at circa 24m and 25mbgl beneath the proposed/revised turbine location.

9.11 DEVELOPMENT PRECAUTIONS (CONTINUED)

Proof drilling should be undertaken at the site of the turbine, to confirm whether sufficient rock cover is present in order to negate the risk of void migration associated with workings of the No.2 Rhondda coal seam to migrate to the surface.

Mine entry 283193-008 is located in the south of the site in the vicinity of the proposed access track. It is recommended that these entries are located and investigated to confirm their location and current state. Where the adit entrance is within influencing distance of the access track, the adit entrance may need to be excavated and backfilled.

The occurrence of unrecorded mine entries beneath the site cannot be discounted and consequently a watching brief should be maintained throughout the site works to identify this risk. All site operatives should be made aware of this potential risk.

Coal Authority Permit

Any intrusive activities, including site investigation boreholes and trial pits/trenches that disturb coal seams and/or adits and subsequent treatment of mine workings/mine entries for ground stability purposes require written permission from the Coal Authority.

10.0 GEOTECHNICAL CONSIDERATIONS

The following section is based on the detailed design included within Enercon foundation data sheet ref: E-115 EP3 E3-ST-87-FB-C-01 and the Turbine coordinates listed in Section 1.2. If the development proposals or foundation design are amended, then the following section should be reviewed and revised to reflect the up to date information.

10.1 ENGINEERING PROPERTIES

Using the data from the geophysical survey, the general engineering properties of the strata underlying the turbine locations has been estimated based on the P-wave velocities and S-wave velocities.

Strata grouping

In the first instance, the ground conditions have been grouped to allow assessment of the engineering behaviour of particular geological layers beneath the turbines. The shallowest layer, P1 and S1, have not been analysed due to the unconsolidated and likely compressible nature of the materials based on the velocities observed during the fieldwork. The intrusive investigation indicates that this layer is an unsuitable bearing stratum, with variability in consistency (soft to stiff).

Accordingly, at each location an Upper Layer and Lower Layer have been defined, as summarised below in Table 12.

Table 12: Summary of Geological Layers								
Turbine	Layer	Approximate Top Depth (mbgl)	Average depth of layer (mbgl) (Approximated)	Stratum (Terradat description)	V _p	V _s	V _p	V _s
					P wave velocity (m/s) Min	S wave velocity (m/s) Min	P wave velocity (m/s) Max	S wave velocity (m/s) Max
1	Upper Layer	1.0	2.5	P2a/S2	660	280	670	310
2	Upper Layer	1.0	3.0	P2b/S3	1090	420	1530	540
8	Upper Layer	2.0	3.5	P2b/S3	1010	540	1040	560
9	Upper Layer	1.0	3.0	P2b/S3	1010	410	1100	500
10	Upper Layer	1.0	2.5	P2a/ S2	460	300	670	320
1	Lower Layer	4.0	7.0	P3/S3	1430	720	1450	790
2	Lower Layer	3.5	7.0	P4/S4	1820	920	2050	1120

10.1 ENGINEERING PROPERTIES (CONTINUED)

Table 12: Summary of Geological Layers								
8	Lower Layer	6.0	7.0	P4/S4	1960	920	2030	1120
9	Lower Layer	5.0	7.0	P4/S4	2420	1150	2480	1270
10	Lower Layer	5.0	7.0	P4/S4	2900	990	3030	1290

Material Properties***Density and Strength of Rock Material***

Soil densities have been estimated for each layer based on shear wave velocities and depth, by first calculating unit weight and then converting to bulk density accounting for acceleration due to gravity. By adopting the minimum shear wave velocities as a most stringent estimate, the results indicate densities of between 2.0kN/m³ and 2.2kN/m³ for the upper layer and between 2.3kN/m³ and 2.5kN/m³ for the lower layer.

Accordingly, a conservative density of 2.0kN/m³ has been assumed for the upper layer (stiff/dense soils or weathered rock), and 2.4kN/m³ has been assumed for the lower layer (very dense soil/soft/weak rock or moderately strong bedrock).

Uniaxial Compressive Strength tests and point load tests completed on the weathered bedrock indicates a minimum compressive strength of 1.05MPa, and maximum compressive strength of 639MPa, with an average of 40MPa when including axial and diametral tests results.

The mudstone/siltstone bands were relatively weaker in nature with a minimum compressive strength of 0.63MPa and a maximum compressive strength of 71MPa, averaging 35.7MPa, these results include both axial and diametral tests.

A site wide UCS value is not considered appropriate for the bedrock underlying the site due to the variability. Accordingly, a range of UCS values of 1MPa to 2MPa is considered appropriate for the mudstone/siltstone bedrock and a representative UCS value of 40MPa is considered appropriate for the sandstone bedrock, based on the average.

10.1 ENGINEERING PROPERTIES (CONTINUED)

Mass Properties

Poisson's Ratio

Poisson's ratio has been estimated for the upper and lower layers beneath the proposed turbines using the relationship between the P-wave and S-wave velocities, including the minimum and maximum results. An average Poisson's ratio has been adopted for the purpose of further assessment, which suggests representative values of between 0.22 and 0.41 for the upper layers and between 0.30 and 0.41 for the lower layers.

Rock Quality Designation (RQD) and Fracture Index

Core recovery parameters such as RQD and fracture index can provide an indication of the general condition of the bedrock, providing a best estimate of its state in-situ and therefore its likely engineering behaviour. Full copies of the rotary borehole logs are included within Appendix H which also includes the Total Core Recovery (TCR) and Solid Core Recovery (SCR).

RQD and FI profiles have been included in Appendix L to show the variation of the rock condition with depth.

Elastic Moduli

The geophysical survey has provided a basis for the assessment of rock strength/soil competence, density and Poisson's Ratio. From this the soil/rock stiffness has been assessed, and subsequently, the stiffness properties derived from a dynamic viewpoint.

Several methods have been undertaken in order to cross check and provide confidence in the calculated moduli, therefore the analysis is considered to be well-rounded and representative. Furthermore, in general the most conservative moduli have been adopted in order to ensure that the resultant stiffness parameters are also conservative.

Elastic (Young's) deformation modulus has been calculated for the soils/rock underlying the turbines using the density of the materials and the compressional P-wave_(min) and shear S-wave_(min) velocities and is summarised below:

10.1 ENGINEERING PROPERTIES (CONTINUED)

Table 13: Youngs Modulus			
Turbine	E (GPa)	E (MPa)	Average* (MPa)
Upper Layer (P2a or P2b / S2 or S3)			
1	0.44	438	924
2	1.07	1070	
8	1.69	1689	
9	1.01	1007	
10	0.41	414	
Lower Layer (P3 or P4 / S3 or S4)			
1	3.15	3151	5901
2	5.34	5340	
8	5.46	5462	
9	8.80	8801	
10	6.75	6752	

**Approach with caution due to variability of layers, layer-specific values are considered more appropriate.*

Shear Moduli

The small strain shear modulus has been calculated for the soil/rocks underlying the turbines by using Poisson's Ratio and Young's modulus and is summarised below:

Table 14: Shear Modulus			
Turbine	G (GPa)	G (MPa)	Average* (MPa)
Upper Layer (P2a or P2b / S2 or S3)			
1	0.038	38.31	49
2	0.061	61.02	
8	0.062	61.88	
9	0.057	56.67	
10	0.027	27.25	
Lower Layer (P3 or P4 / S3 or S4)			
1	0.085	84.97	118
2	0.105	105.12	
8	0.111	110.74	
9	0.145	145.05	
10	0.144	143.95	

**Approach with caution due to variability of layers, layer-specific values are considered more appropriate.*

10.1 ENGINEERING PROPERTIES (CONTINUED)

Static Moduli

Using the general rule of thumb that G_{ss} is approximately equal to five times G_{ls} , these results indicate that the large strain (static) shear modulus of the upper layers ranges between 5MPa and 12MPa and the large strain (static) shear modulus of the lower layers range between 17MPa and 29MPa.

10.2 TURBINE FOUNDATIONS

The proposed scheme comprises the construction of eight wind turbines, with associated infrastructure works. Reference has been made to an Enercon foundation data sheet ref: E-115 EP3 E3-ST-87-FB-C-01, however it is understood that the foundation specification may change. Nonetheless, the report outlines indicative minimum engineering parameters listed below, which are likely to change if the foundation design is amended.

Soil Bearing Pressure	212kN/m ²
Settlement (within 25 years)	≤3mm/m
Rotational Stiffness (Tower and Foundation)	100,000 MNm/rad
Rotational Stiffness (Total System)	12,500MNm/rad

The proposed foundation size is a circular base, 21m in diameter.

Foundations are expected to impose relatively uniform bearing under non-operating conditions and significantly eccentric loading under operating conditions.

As discussed above, if the proposed turbine type/supplier is to change, the above criteria are also likely to change, and the following sections would need to be reviewed and revised accordingly.

10.3 ROTATIONAL STIFFNESS

The turbine manufacturers have derived their requirement from a need to ensure that in dynamic conditions the turbine does not resonate at the same frequency or mode as the ground. Hence the minimum stiffness is designed to be sufficient such that the frequency of response is always exceeded by that of the foundation. As a rule of thumb the stiffness should be at least 10% greater than the system frequency.

The geophysical data yields information on the stiffness of the soil mass.

10.3 ROTATIONAL STIFFNESS (CONTINUED)

The Minimum Rotational Stiffness is a foundation characteristic derived from the overall proportions of the structure in relation to the ground properties. The rotational stiffness has been assessed for a base diameter of 21m (radius 10.5m) and a range of Shear Moduli and Poisson's Ratio values derived from the geophysical data. The results should be regarded as preliminary and would need to be amended to apply to alternative foundation design.

The Turbine manufacturers specification indicates the following requirements:

Rotational Stiffness ($K\phi_{\text{dyn}}$) (Tower and Foundation) – 100,000 MNm/rad

Rotational Stiffness ($K\phi_{\text{stat}}$) (Total System) – 12,500MNm/rad

Table 15: ($K\phi$) Dynamic stiffness/stiffness of constant rotation (Tower and Foundation)				
Turbine	Average Poisson ratio	Radius m	Shear Modulus MN/m²	Stiffness for constant rotation ($K\phi$) dyn MN/rad
Upper Layer (P2a or P2b / S2 or S3)				
1	0.38	10.5	38.3	189,712
2	0.41	10.5	61.0	319,032
8	0.30	10.5	61.9	271,822
9	0.38	10.5	56.7	283,085
10	0.22	10.5	27.2	108,116
Lower Layer (P3 or P4 / S3 or S4)				
1	0.31	10.5	85.0	379,599
2	0.30	10.5	105.1	461,051
8	0.32	10.5	110.7	500,550
9	0.34	10.5	145.0	675,713
10	0.41	10.5	144.0	753,267

10.3 ROTATIONAL STIFFNESS (CONTINUED)

Table 16: (Kϕ) Dynamic stiffness/stiffness of constant rotation (Total System)				
Turbine	Average Poisson ratio	Radius m	Shear Modulus MN/m²	Stiffness for constant rotation (Kϕ) stat MNm/rad
Upper Layer (P2a or P2b / S2 or S3)				
1	0.38	10.5	7.7	37,942
2	0.41	10.5	12.2	113,019
8	0.30	10.5	12.4	114,606
9	0.38	10.5	11.3	104,961
10	0.22	10.5	5.4	50,470
Lower Layer (P3 or P4 / S3 or S4)				
1	0.31	10.5	17.0	157,389
2	0.30	10.5	21.0	194,694
8	0.32	10.5	22.1	205,107
9	0.34	10.5	29.0	268,655
10	0.41	10.5	28.8	266,628

As such, the calculated stiffness of constant rotation values are in excess of the minimum requirements and are also over 10% greater than the requirements.

10.4 BEARING CAPACITY OF SHALLOW FOUNDATIONS

It is understood that foundation design for the scheme is under review, and at this stage, the indicative proposals are to excavate to a minimum of 2m beneath the underside of the proposed turbine foundation/base and place a minimum thickness of 1.5m to 2m of 6N structural fill in compacted layers beneath the base of the foundation. The excavation depth to reduced formation level will depend on the topography of the ground beneath the turbine, with a steeper topographic gradient indicating the requirement for over-excavation on the upslope side of the turbine in order to provide a level bearing stratum.

These proposals typically place the foundation reduced formation level (bottom of 6N fill layer) within competent soils of either glacial till or weathered bedrock, generally comprising sandy gravels or sandy gravel and cobbles. The over-excavation depths may penetrate the intact weathered bedrock comprising extremely weak to very weak mudstone or very weak to strong sandstones. At this stage, the above listed strata are considered to be suitable for the required loading of up to 212kNm² outlined in the design specification.

10.4 BEARING CAPACITY OF SHALLOW FOUNDATIONS (CONTINUED)

In select locations, excavation to the nominally 1.5m to 2.0m below underside of turbine foundation/base will expose firm to stiff gravelly clays of weathered mudstone or coal deposits, which are considered unsuitable bearing strata. In these instances, over excavation to reach weathered mudstone or sandstone should be undertaken and any weak soils, including weathered coal layers removed from beneath and within influencing distance of the turbine base/foundation.

The ground conditions indicate an angle of shearing resistance ranging between 29° and 35°.

Any poor ground (as detailed above) should be removed and replaced with engineered fill. This would be supported by appropriate inspections undertaken to verify formations.

The foundation should penetrate the foundation stratum by a minimum of 200mm.

It is recommended that a turbine specific foundation review is carried out once development proposals and engineering levels are confirmed/evolved.

10.5 SETTLEMENT OF SHALLOW FOUNDATIONS

The turbine foundations are proposed to be founded a minimum of 1.5m to 2m below existing ground level, or locally deeper. The bases will be underlain by a minimum of 1.5m to 2.0m of 6N structural fill, placed in compacted layers over the bearing strata. Therefore, the settlement characteristics of the turbine base will be influenced by formation weathering and the site preparation undertaken.

The assessment of the potential settlement effects has been broken down into various components and the appraisal of each is set out below. In the assessment a base diameter of 21m has been assumed, which satisfies the allowable bearing pressures and the rotational stiffness constraints and requirements.

Settlement due to Applied Loads

A detailed settlement assessment has not been completed at this stage of the investigation due to the evolving nature of the project. The following information should be regarded as preliminary and should be refined once the turbine locations have been confirmed, engineering/formation levels have been confirmed and the thickness of 6N fill beneath the base of the turbine has been confirmed.

10.5 SETTLEMENT OF SHALLOW FOUNDATIONS (CONTINUED)

Most settlement occurs during and soon after structural load application. Further movement then occurs gradually and is known as long term creep settlement. The materials encountered are not expected to behave with any time–dependant characteristics given the low level of any applied stresses.

Hence all the movement is expected to be elastic in nature. Allowances should be made for the effects of fluctuating loads and longer term effects for a period of 30 years.

Potential settlement caused by the proposed wind turbine structure should be considered using simple elastic theory using a linear elastic soil under an applied vertical load for peak operational load conditions.

Detailed design indicates that the proposed turbine loadings will generate an estimated peak stress of 212kN/m².

Careful and selective site preparation will be essential to minimise in-built effects. Experience would suggest that much of any future settlement would be a direct result of ground disturbance in preparing formations and hence the need for careful preparation cannot be understated. The materials will be both above the influence zone of the groundwater fluctuations and below the seasonal effect of the surface conditions. Hence this should not be a contributory factor and earthworks specifications should ensure this. This will be managed at excavation and inspection stage.

The limiting criterion is a relative deflection criterion of 3mm in 1m. For this size of base, the maximum permitted differential settlement is 63mm. Based on the geophysical traversing which showed minor variations in strata thicknesses and character across the structure and similar observations of rock quality in the boreholes, differential settlement is not considered a significant concern at this stage, but will need to be confirmed by detailed assessment once engineering levels are confirmed.

10.6 BUILDINGS AND MATERIALS DURABILITY RISK ASSESSMENT

A summary of the laboratory test results for the chemicals water soluble sulphate and pH, which may adversely affect the durability of building materials, is presented in Appendix J.

The following assessments are based upon site wide assessment of the strata encountered beneath the site.

10.6 BUILDINGS AND MATERIALS DURABILITY RISK ASSESSMENT (CONTINUED)

Typically, the materials are sub-divided according to the stratum (e.g. glacial till and weathered mudstone or sandstone), however in this instance, the comparatively similar test results indicate that the materials can be characterised as a whole.

In accordance with BRE Digest SD1:2005 and adopting the assessment procedure specified therein for greenfield sites, the laboratory test results for the glacial till soils and weathered bedrock indicate a characteristic value (taking the mean of the three highest results) for water soluble sulphate of 56mg/l.

Using Table C2 of BRE Digest SD1:2005, this characteristic value corresponds to Design Sulphate Class DS-1.

The groundwater regime of the site has been assessed as 'mobile' and a characteristic pH value (adopting the lowest of the test results) of 4.76 has been determined. The Design Sulphate Class has been modified to give a site ACEC class of AC-1z for the glacial till and weathered bedrock.

10.7 SUMMARY RECOMMENDATIONS FOR TURBINE FOUNDATIONS

Foundations

The results of the site investigation, desk study and research and analysis demonstrate that gravity base foundations are considered feasible for all turbines, provided the turbine formations are prepared with care, and no significant changes in ground conditions are encountered at formation level from those encountered during the site investigation works.

A reduced formation level of typically 2m below existing ground level, on either medium dense to dense glacial till, or highly weathered bedrock, could be adopted, with the use of over-excavation to suitably competent soils or bedrock where required, or over excavation associated with sloping ground. The ground is proposed to be raised from reduced formation level with 6N structural fill.

Ground Improvement and Site Preparation

All vegetation from the areas of the turbines and associated infrastructure works should be stripped off and removed from site. The majority of the spoil (excluding topsoil and peat) resulting from excavations should be generally suitable (subject to selection and processing as required) for reuse as engineered fill beneath crane platforms and roads.

10.7 SUMMARY RECOMMENDATIONS FOR TURBINE FOUNDATIONS (CONTINUED)

Geotechnical testing in the form of particle size distribution tests and optimum moisture compaction testing has been completed on representative samples of the likely site-won fill (natural arisings), and all results are discussed in Section 7.2 and included in Appendix J.

The exposed formation should be checked and any areas of loose/soft material removed from beneath turbine foundation areas. This should include any coal deposits and conditions such as those encountered within TP26 where groundwater ingress was encountered at the base of the coal layer.

The reduced formation should be inspected for evidence of faulting, intense structural fracturing or fissures, coal seams, seatearths etc. Appropriate treatment may be needed to address local concerns regarding the rock mass integrity.

If required, micro-siting to a suitable location should be considered.

Local improvement works of sub-formations will comprise removal of loose rock, removal of seatearths or coal, local replacement of fracture zones or coal outcrops. The reduced formation level should be brought back up to the required level with structural Class 6N materials.

Site preparation generally should ensure that the turbine base is placed within 'undisturbed' ground in granular glacial till, or granular weathered sandstone or weathered mudstone or competent bedrock. Uniformity of formation subgrade is essential to minimise the risk of hard spots and subsequent differential settlement. Also, uniformity of any up filling of engineered fill should be maintained as much as possible to minimise the risk of hard spots and subsequent differential settlement.

Fill materials should be placed in layers and well compacted in accordance with Department of Transport (DTp) Specification for Highway Works. The final depth of excavation should be to the satisfaction of the Engineer.

The placement of the structural fill should be undertaken under geotechnical engineering supervision and selected fill materials will require adequate physical testing (plate load/dynamic probing/sand replacement) in order to establish compaction levels and to provide suitable validation reports.

All working areas and sub formations should be laid to a fall and have adequate grips and drains to prevent ponding of water and any deterioration of the formations prior to placement of stone or concrete base.

10.7 SUMMARY RECOMMENDATIONS FOR TURBINE FOUNDATIONS (CONTINUED)

The above should be reviewed on a turbine specific basis once engineering levels are confirmed.

10.8 SUBSTATION AND CONTRACTORS COMPOUND

Development proposals indicate a substation and contractors' compound in the centre of the site to the west of Turbine 8. In this area of the site, the ground conditions comprised glacial till deposits down to depths of between 0.5m and 1.2mbgl, overlying granular soils (gravel or gravel and cobbles) of highly weathered sandstone bedrock.

Foundation design proposals are not known for the proposed structures at this stage. Based on the above findings, it is considered that the new buildings/structures can be founded on traditional concrete strip/trench fill foundations, pad foundations or raft foundations. It is recommended that foundations are placed within, and bearing onto (medium dense) sandy gravels or gravel and cobbles.

For strip/trench fill or pad foundations an allowable bearing pressure of 100kN/m² is suitable for foundations placed within the granular weathered bedrock listed above. At this intensity of loading, the total settlements should not exceed 25mm, and any angular distortions caused by differential movements should be less than 1:750.

Laboratory Atterberg Limits have been determined for near surface cohesive soils, indicating they either have a low volume change potential or are classified as non-shrinkable in accordance with NHBC Chapter 4.2. Accordingly, the foundation formations should be kept to a minimum depth of 0.75m below finished ground levels in order to protect them from the effects of frost heave and/or thermal shrinkage.

Foundations should penetrate the founding horizon by a minimum of 200mm.

The above recommendations indicate typical foundation depths generally between 0.75m and 1.4mbgl.

Footings should fully penetrate any soft compressible soils or made ground, if present.

Ideally, footings should be founded on similar strata throughout to reduce the risk of differential settlement. Any foundation bearing on a combination of differing bearing strata (such as spanning granular and cohesive soils) should be reinforced with top and bottom mesh reinforcement across the change in strata. This should be avoided where possible due to the difference in in-situ competence of the strata.

10.8 SUBSTATION AND CONTRACTORS COMPOUND (CONTINUED)

Suspended floor slab(s) are recommended for the site due to the heave potential of the low volume change potential shallow soils. All foundations should be designed for low shrinkability free influence criteria in accordance with NHBC guidelines.

If it is proposed to adopt raft foundations, The ground conditions indicate that following topsoil strip, rafts can be placed onto the soft to firm and firm gravelly sandy clay/silts.

It is recommended that beneath the raft foundations there should be a suitably thick layer of well compacted imported granular fill throughout the plan area of the building. Department of Transport Type 1 Sub-base, or similar approved, could be used and should be compacted in layers in accordance with current DTp Specification for Highway Works. Prior to placement of the granular layer, the exposed formation should be well proof rolled and any soft spots locally removed and replaced with well compacted granular fill.

Subject to the results of confirmatory plate load testing on prepared formations, the proposed rafts should be designed to an allowable maximum bearing pressure of 50kN/m², with an average pressure of less than 30kN/m². At this intensity of loading, the total settlements should not exceed 25mm and any angular distortions caused by differential movements should be less than 1:750.

10.9 ACCESS ROADS AND CRANE PADS

For access roads and crane pad formations within the granular natural soils, California Bearing Ratio (CBR) values in excess of 5% are likely to be achievable. Where more cohesive materials were encountered, CBR values of 2-3% should be expected.

If CBR values of greater than 5% are required then it may be appropriate to over-excavate to reach granular glacial till deposits or stiff gravelly clays. In areas such as those in the vicinity of Turbine 2 (TP24, TP25 and TP26) soft compressible materials were encountered to between 1.1m and 1.3m below existing ground level. In addition, thicker peat was recorded from ground level in TP25, to 0.6mbgl.

These conditions indicate the requirement for formation level to be deepened in this area of the site, or for alternative road construction proposals such as floating roads. Floating road construction should be considered in areas where CBRs are less than or equal to 1% at formation level.

10.9 ACCESS ROADS AND CRANE PADS (CONTINUED)

In general, a 450mm thick capping layer, overlying a medium strength geotextile membrane and capped with 150mm of suitable imported crushed stone, is considered a suitable construction for the proposed roads and crane pads. This excludes the ground conditions detailed above and any areas with thicker soft deposits at surface level. In these areas road construction thicknesses may need to be increased and consideration should be given to the inclusion of basal geogrid reinforcement.

Road formations should be regarded as frost susceptible. It will be necessary to ensure this performance, and hence contingencies should be allowed for the removal of any soft spots/areas and their replacement with well compacted granular fill materials.

These should be placed in well compacted layers, in accordance with Department of Transport (DTp) Specification for Highway Works.

It should be noted that the CBR tests should be carried out in order to confirm the above assumptions. Allowances should be made for undertaking field CBR tests. Depending on the outcome of such field tests, the above recommendations may need to be revised and, if necessary, amended.

10.10 OTHER DESIGN ISSUES

Assessment of Seismicity Issues

A brief review of the published information highlighted the potential for earthquakes in the South Wales area. A paper by Musson entitled "Seismicity And Earthquake Hazard In The UK highlighted the areas of highest hazard parallel to the areas where earthquakes have been most common in the past, but particularly those places where repeated earthquake activity has been highly localised.

This localisation has a pronounced effect on the hazard calculations compared to areas where the seismicity, while high, is more diffuse and less repetitive.

The zones where hazard is higher than average, encompass the Western Highlands of Scotland, an arcuate zone running from Carlisle to Pembroke, Northwest Wales and Western Cornwall.

The places in the UK with lowest seismic hazard are Northern Ireland (especially the western counties) and outlying parts of Scotland, including the Orkneys and Outer Hebrides.

10.10 OTHER DESIGN ISSUES (CONTINUED)

The actual values of hazard are not particularly high, since the predicted intensity for the higher zones is only 6 EMS. In other words, even in areas of relatively high exposure to earthquakes in the UK, if a facility has a life of 50 years there is only a 10% chance that it will experience shaking equivalent to intensity 6.

Recent activity indicates some potential for seismic events, but these are commonly at some depth. Where events have occurred there is no recorded surface fault or feature which corresponds to this plane of movement. Therefore, the turbine locations are unlikely to be directly affected by seismic activity.

Potential Influence of Seismic Events on Project Construction

The potential risks that seismic events can affect the project construction can be separated into direct and indirect effects.

Direct effects would include:

- Fault movement and ground rupture;
- Vibration forces on fixed assets;
- Ground liquefaction.

Whilst there are a number of major fault systems in the area there are no known recorded instances of fault rupture at surface since the seismic activity is generally at moderate depths. Therefore, fault zones are not considered to be of concern but should be avoided.

The nature of the ground conditions generally precludes liquefaction effects, and hence the project works are not considered at risk of ground disturbance from the low intensity seismic events that are generally experienced in this area.

All fixed assets and structures associated with the scheme should be designed to accommodate acceleration forces in accordance with the Codes of Practice.

Indirect effects would include ground disturbance from lateral flow of landslip materials. However, there are no recorded instances of landslip activity arising from seismic activity in this area.

Ground Instability

With regard to ground instability, the following issues have been considered:

10.10 OTHER DESIGN ISSUES (CONTINUED)

Mining

The Coal Authority Mining Report, and the ground conditions encountered within the trial pits/trenches and deep rotary boreholes indicate the potential for mining related ground instability associated with historic underground mineworkings within the No.2 Rhondda coal seam and potentially the overlying field vein. The seam outcrops, abandonment plans and the drilling works indicate that the risk of subsidence is limited to the location of proposed Turbines T2 and T8, with further investigation recommended in these areas.

It is recommended that proof drilling is undertaken at Turbine 8, to understand the requirement for any grouting works to deal with the voids recorded within several boreholes at this location.

It is also recommended that proof drilling is undertaken within the vicinity of Turbine 2, in order to confirm the risk of ground subsidence arising from workings within the No.2 Rhondda coal seam and overlying Field vein.

The intrusive investigation and review of the background information indicates that the risk of ground subsidence beneath proposed Turbine 1 is considered to be low. All coal seams encountered within the boreholes were in-tact and typically between 0.3m and 0.5m thick (0.8m thick on one occasion only).

A risk from historic mining has also been identified along the access track between Turbine 1 and Turbine 2, associated with the recorded mine entries along this section. The mouth of mine entry 008 is recorded immediately south-west of the proposed access track and mine entry 007 is located some 40m south-west of the access track/crane pad at Turbine 2.

Accordingly, once the route of the access road has been confirmed, it is recommended that further investigation is undertaken at the portal entrance of adit 283193-008 and/or beneath the proposed access road in the sections likely to be affected by underground workings.

Slopes

The South Wales Landslip register data indicates that the site is located within the Afan Valley, and that the closest recorded landslip is slip number 21 (code AA), on the south side of the valley, located to the north-west of the site along the western bank of Nant yr Hwyaidd stream (grid reference SS 829 949). The slip was recorded as dormant in the 1980 catalogue.

10.10 OTHER DESIGN ISSUES (CONTINUED)

Accordingly, the available information indicates that there are no active or dormant landslips within the area of the site that would present a potential risk to the proposed development.

Excavations

The potential for ground instability within excavations as part of the temporary works is considered to be low. Excavations will be within medium dense superficial deposits, which increase in density with depth, grading into weathered bedrock at shallow depth. In addition, the sides of excavations should be battered back to typically 30 degrees as part of the temporary works. Consideration will need to be given to temporary support of deeper excavations in the up-slope part of the turbine base.

Based on the assessments of coal mining risk, the South Wales landslip register data, and seismicity issues, it is considered that there will be no significant risk posed to the proposed development as a result of land instability issues.

Excavations and Formations

Shallow excavations in the glacial till and uppermost weathered rock up to at least 1.5m depth should be possible with normal soil excavating machinery. However, allowances should be made for the use of pneumatic breaker attachments, or similar tools, for the excavation of deeper bedrock. The degree of rock mass jointing is variable. The sandstone is known and observed locally to be tabular and ideal for walling and hence it is envisaged that a combination of ripping and pneumatic hammer loosening will be required.

Temporary excavations in peat will not stand unsupported at gradients in excess of 1v:4h. All other temporary excavation slopes should stand unsupported in the short term at gradients of 1v:2h.

It is possible that groundwater will be encountered in excavations. It is anticipated that these can be kept dry by pumping from a conveniently located sump. Groundwater was encountered within TP25 and TP26 only at approximately 2.0m and 1.4mbgl respectively.

Formations in the cohesive glacial till and the weathered mudstone bedrock will be highly susceptible to deterioration due to site traffic and weather and should be protected immediately on exposure with 150mm of granular material or 75mm of lean mix concrete. The excavated rock materials may breakdown under traffic and compaction, then becoming frost susceptible.

11.0 RECOMMENDED FURTHER WORKS

The detailed coal mining risk assessment has identified a potential risk of ground subsidence associated with historic underground mineworkings beneath Turbines T2 and T8. In addition, a potential risk has also been identified beneath the access track in the south of the site, associated with two adits. Accordingly, the following is recommended:

- Proof drilling in the vicinity of Turbine 2 in order to further confirm the potential risk.
 - These works should also cover the area of the proposed access track and/or crane pad in this area which may also be affected by the underground roadway extending north from mine entry 283193-007.
- Proof drilling in the vicinity of Turbine 8 in order to understand the extent and thickness of the mineworkings in this area and undertake treatment/grouting of any encountered voids/workings.
- Trial trenching of the adit portal entrance to 283193-008 and stich drilling along the proposed alignment to the access track, to assess the potential for ground subsidence associated with adit 283193-008.

Further site investigation works comprising a geophysical survey should be carried out at turbines T5, T6 and T11 in order to derive the P and S wave velocities of the underlying strata and confirm the design parameters.

APPENDIX A

SITE PHOTOGRAPHS

Turbine 1 and Turbine 2



West of T1, looking north towards Trig point (Foel Trawsnant).



Looking south towards T1 with access track beyond.



T2 area looking south-west.



T2 area, looking south-east.

Site Photographs

12826: Foel Trawsnant Windfarm

Intégral
Géotechnique

Intégral House
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Castlegate Business Park
Caerphilly
CF83 2AX
Tel: 029 2080 7991

Features south of Turbines 1 and 2.



Mound of stockpiled material south of track between T1 and T2.

Site Photographs

12826: Foel Trawsnant Windfarm

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Turbines 5 and 6



Looking north-west from south-eastern corner of T5 and T6 field.



T5 area, looking north-west.



Pond north-west of T5.



T6 area, looking east.

Site Photographs

12826: Foel Trawsnant Windfarm

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Turbine 8



T8 area looking north-east.



T8 area looking west.



Gate in the approximate centre of the site, south of T8 and compound. Looking north.

Site Photographs

12826: Foel Trawsant Windfarm

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Features south of Turbine 8



Depression with abundant rushes and timber - Suspected mine shaft.



Site Photographs

12826: Foel Trawsnant Windfarm

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Suspected Jubilee Shaft Alignment



Looking west.



Looking east.

Site

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Turbine 9



Looking north.



Pond in south-west corner of field.



Looking north-east.



Looking west.

Site Photographs

12826: Foel Trawsnant Windfarm

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Turbine 10



Looking north-west.



Looking north.

Site Photographs

12826: Foel Trawsnant Windfarm

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Turbine 11



South of fenceline, looking west.



South of fenceline, looking east.



South of fence, looking north towards T11 location.
Ravine located immediately beyond fenceline.

Site Photographs

12826: Foel Trawsnant Windfarm

Intégral
Géotechnique

Intégral House
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Castlegate Business Park
Caerphilly
CF83 2AX
Tel: 029 2080 7991

Nant yr Hwyaidd



Looking south-east.



Looking north-west.

Site Photographs

12826: Foel Trawsnant Windfarm

Intégral
Géotechnique

Intégral House
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APPENDIX B

ENVIROCHECK REPORT

Envirocheck[®] Report:

Datasheet

Order Details:

Order Number:

279012478_1_1

Customer Reference:

12826/RAH

National Grid Reference:

283620, 194240

Slice:

A

Site Area (Ha):

0.01

Search Buffer (m):

1000

Site Details:

Foel Trawsnant Windfarm

Client Details:

MR H Pritchard
Integral Geotechnique
Integral House
7 Beddau Way
Castlegate Business Park
Caerphilly
CF83 2AX

Report Section	Page Number
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Waste	8
Hazardous Substances	-
Geological	9
Industrial Land Use	14
Sensitive Land Use	15
Data Currency	16
Data Suppliers	21
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Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination. For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency/Natural Resources Wales and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client. In this datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

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Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
BGS Groundwater Flooding Susceptibility	pg 1	Yes		Yes	n/a
Contaminated Land Register Entries and Notices					
Discharge Consents					
Prosecutions Relating to Controlled Waters			n/a	n/a	n/a
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls					
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 1		Yes		
Pollution Incidents to Controlled Waters					
Prosecutions Relating to Authorised Processes					
Registered Radioactive Substances					
River Quality					
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points					
Substantiated Pollution Incident Register					
Water Abstractions					
Water Industry Act Referrals					
Groundwater Vulnerability Map	pg 1	Yes	n/a	n/a	n/a
Bedrock Aquifer Designations	pg 1	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
OS Water Network Lines	pg 1		4	12	35

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Waste					
BGS Recorded Landfill Sites					
Historical Landfill Sites					
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)					
Local Authority Landfill Coverage		1	n/a	n/a	n/a
Local Authority Recorded Landfill Sites					
Potentially Infilled Land (Non-Water)	pg 8			1	4
Potentially Infilled Land (Water)					
Registered Landfill Sites					
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites					
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Geological					
BGS 1:625,000 Solid Geology	pg 9	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 9	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 11		1	2	5
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
CBSCB Compensation District			n/a	n/a	n/a
Coal Mining Affected Areas	pg 12	Yes	n/a	n/a	n/a
Mining Instability	pg 12	Yes	n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 12	Yes		n/a	n/a
Potential for Compressible Ground Stability Hazards				n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 12	Yes	Yes	n/a	n/a
Potential for Running Sand Ground Stability Hazards	pg 12		Yes	n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 13		Yes	n/a	n/a
Radon Potential - Radon Affected Areas			n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries					
Fuel Station Entries					
Points of Interest - Commercial Services					
Points of Interest - Education and Health					
Points of Interest - Manufacturing and Production					
Points of Interest - Public Infrastructure	pg 14				4
Points of Interest - Recreational and Environmental					
Gas Pipelines					
Underground Electrical Cables					

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Ancient Woodland					
Areas of Adopted Green Belt					
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks	pg 15		1		
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones					
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					
World Heritage Sites					

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A13NE (NE)	0	1	283620 194240
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A13NW (NW)	341	1	283400 194500
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A13NW (NW)	412	1	283350 194550
	BGS Groundwater Flooding Susceptibility Flooding Type: Potential for Groundwater Flooding of Property Situated Below Ground Level	A13NW (NW)	446	1	283300 194550
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A8NW (S)	457	1	283500 193800
	BGS Groundwater Flooding Susceptibility Flooding Type: Potential for Groundwater Flooding of Property Situated Below Ground Level	A8NW (SW)	475	1	283350 193850
	BGS Groundwater Flooding Susceptibility Flooding Type: Limited Potential for Groundwater Flooding to Occur	A18SW (NW)	482	1	283300 194600
	Nearest Surface Water Feature	A13SW (S)	121	-	283605 194120
	Groundwater Vulnerability Map Combined Classification: Secondary Bedrock Aquifer - Medium Vulnerability Combined Vulnerability: Medium Combined Aquifer: Productive Bedrock Aquifer, No Superficial Aquifer Pollutant Speed: Low Bedrock Flow: Well Connected Fractures Dilution: >550 mm/year Baseflow Index: <40% Superficial Patchiness: <90% Superficial Thickness: <3m Superficial Recharge: No Data	A13NE (NE)	0	2	283620 194240
	Bedrock Aquifer Designations Aquifer Designation: Secondary Aquifer - A	A13NE (NE)	0	2	283620 194240
	Superficial Aquifer Designations No Data Available				
	Extreme Flooding from Rivers or Sea without Defences None				
	Flooding from Rivers or Sea without Defences None				
	Areas Benefiting from Flood Defences None				
	Flood Water Storage Areas None				
	Flood Defences None				
1	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 377.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SE (S)	141	3	283657 194104

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
2	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 607.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant yr Hwyaidd Catchment Name: Afan Primacy: 1	A13NW (N)	142	3	283593 194379
3	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 8.4 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SE (S)	148	3	283628 194092
4	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 197.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SE (S)	152	3	283621 194088
5	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 132.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SW (S)	285	3	283596 193956
6	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 8.8 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SW (S)	293	3	283619 193947
7	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 188.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SE (S)	295	3	283628 193946
8	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 158.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SW (S)	322	3	283499 193943
9	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 250.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A13SW (SW)	350	3	283312 194074
10	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 34.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A14SW (SE)	411	3	283997 194077

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
11	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 4.6 Watercourse Level: Underground Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A14SW (E)	440	3	284030 194082
12	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 194.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A14SW (E)	444	3	284034 194082
13	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 225.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A18SW (N)	446	3	283479 194662
14	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 260.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Tryfal Catchment Name: Afan Primacy: 1	A13SE (SE)	471	3	283950 193905
15	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 216.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A8NW (SW)	473	3	283419 193812
16	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 195.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A8NW (S)	473	3	283464 193794
17	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 85.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A8NW (S)	521	3	283576 193722
18	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 99.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A7NE (SW)	564	3	283214 193850
19	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 72.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18SE (N)	570	3	283807 194779

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
20	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 52.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A8NE (S)	582	3	283631 193658
21	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 231.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A8NE (S)	585	3	283629 193656
22	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 359.2 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant yr Hwyaidd Catchment Name: Afan Primacy: 1	A17SE (NW)	617	3	283177 194668
23	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 210.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	631	3	283119 193857
24	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 93.2 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A7NE (SW)	631	3	283119 193857
25	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 3.4 Watercourse Level: Underground Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18SE (N)	637	3	283806 194849
26	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 60.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18SE (N)	641	3	283806 194852
27	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 222.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A18SE (N)	654	3	283694 194889
28	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 554.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A12SE (SW)	668	3	283015 193959

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
29	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 1366.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Tryfal Catchment Name: Afan Primacy: 1	A9NW (SE)	676	3	284196 193886
30	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 12.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A7NE (SW)	682	3	283035 193891
31	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 277.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	682	3	283035 193891
32	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 104.0 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	687	3	283025 193898
33	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 176.1 Watercourse Level: On ground surface Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18SE (N)	697	3	283823 194906
34	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 229.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	740	3	283162 193660
35	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 83.6 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	740	3	283162 193660
36	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 217.2 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A8SW (S)	750	3	283403 193523
37	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 177.5 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	759	3	283217 193598

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
38	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 75.2 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A17NE (NW)	763	3	283282 194923
39	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 72.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	768	3	282986 193807
40	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 53.3 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A7NE (SW)	768	3	282986 193807
41	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 2.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A8SE (S)	773	3	283778 193484
42	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 1.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A8SE (S)	773	3	283778 193484
43	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 4.0 Watercourse Level: Underground Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18NE (N)	859	3	283860 195064
44	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 12.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18NE (N)	863	3	283861 195068
45	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 5.5 Watercourse Level: Underground Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18NE (N)	873	3	283857 195079
46	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 262.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Blaen Nant Catchment Name: Afan Primacy: 1	A18NE (N)	876	3	283854 195084

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
47	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 13.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant yr Hwyaidd Catchment Name: Afan Primacy: 1	A17SE (NW)	894	3	282979 194863
48	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 23.4 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A17SE (NW)	897	3	282965 194852
49	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 363.8 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant yr Hwyaidd Catchment Name: Afan Primacy: 1	A17SE (NW)	906	3	282973 194874
50	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 305.9 Watercourse Level: On ground surface Permanent: True Watercourse Name: Not Supplied Catchment Name: Afan Primacy: 1	A12SW (W)	949	3	282684 194085
51	OS Water Network Lines Watercourse Form: Inland river Watercourse Length: 72.7 Watercourse Level: On ground surface Permanent: True Watercourse Name: Nant Cynon Catchment Name: Afan Primacy: 1	A12SW (W)	960	3	282670 194105

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Local Authority Landfill Coverage Name: Neath Port Talbot County Borough Council - Has supplied landfill data		0	4	283620 194240
	Local Authority Landfill Coverage Name: Bridgend County Borough Council - Has supplied landfill data		728	5	284251 193878
52	Potentially Infilled Land (Non-Water) Bearing Ref: SW Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1990	A12SE (SW)	418	-	283255 194038
53	Potentially Infilled Land (Non-Water) Bearing Ref: W Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1990	A12SE (W)	599	-	283065 194016
54	Potentially Infilled Land (Non-Water) Bearing Ref: W Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1990	A12SW (W)	792	-	282839 194112
55	Potentially Infilled Land (Non-Water) Bearing Ref: W Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1990	A12SW (W)	827	-	282801 194125
56	Potentially Infilled Land (Non-Water) Bearing Ref: N Use: Unknown Filled Ground (Pit, quarry etc) Date of Mapping: 1988	A18NE (N)	962	-	283813 195182

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS 1:625,000 Solid Geology Description: South Wales Upper Coal Measures Formation	A13NE (NE)	0	1	283620 194240
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 25 - 35 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <100 mg/kg Nickel Concentration: 15 - 30 mg/kg	A13NE (NE)	0	1	283620 194240
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 35 - 45 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <100 mg/kg Nickel Concentration: 15 - 30 mg/kg	A13NW (N)	74	1	283593 194309
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 35 - 45 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <100 mg/kg Nickel Concentration: 30 - 45 mg/kg	A13SW (S)	215	1	283594 194027
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 35 - 45 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <100 mg/kg Nickel Concentration: 30 - 45 mg/kg	A8NW (S)	379	1	283492 193884
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 35 - 45 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <100 mg/kg Nickel Concentration: 15 - 30 mg/kg	A9NW (SE)	503	1	283971 193881
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 35 - 45 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <100 mg/kg Nickel Concentration: 15 - 30 mg/kg	A7NE (SW)	536	1	283269 193835

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 25 - 35 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 60 - 90 mg/kg Concentration: Lead Concentration: <100 mg/kg Nickel: 15 - 30 mg/kg Concentration:	A12SE (SW)	674	1	283002 193973
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 35 - 45 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 60 - 90 mg/kg Concentration: Lead Concentration: <100 mg/kg Nickel: 30 - 45 mg/kg Concentration:	A14SE (E)	846	1	284431 194000
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 35 - 45 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 60 - 90 mg/kg Concentration: Lead Concentration: <100 mg/kg Nickel: 15 - 30 mg/kg Concentration:	A14NE (E)	865	1	284427 194549
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 25 - 35 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 60 - 90 mg/kg Concentration: Lead Concentration: <100 mg/kg Nickel: 15 - 30 mg/kg Concentration:	A7NW (SW)	900	1	282842 193789
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 35 - 45 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 60 - 90 mg/kg Concentration: Lead Concentration: <100 mg/kg Nickel: 30 - 45 mg/kg Concentration:	A8SW (S)	903	1	283363 193375
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 35 - 45 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 60 - 90 mg/kg Concentration: Lead Concentration: <100 mg/kg Nickel: 15 - 30 mg/kg Concentration:	A9SW (SE)	973	1	284149 193424

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
57	BGS Recorded Mineral Sites Site Name: Foel Trawsnant Location: Dyffryn, Neath, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156479 Type: Underground Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Llynfi Member Commodity: Coal - Deep Positional Accuracy: Located by supplier to within 10m	A13SE (S)	247	1	283622 193994
58	BGS Recorded Mineral Sites Site Name: Foel Trawsnant Location: Dyffryn, Neath, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156480 Type: Underground Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rhondda Member Commodity: Coal - Deep Positional Accuracy: Located by supplier to within 10m	A8NW (S)	370	1	283498 193891
59	BGS Recorded Mineral Sites Site Name: Foel Trawsnant Location: Dyffryn, Neath, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156498 Type: Underground Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Llynfi Member Commodity: Coal - Deep Positional Accuracy: Located by supplier to within 10m	A8NW (S)	385	1	283554 193861
60	BGS Recorded Mineral Sites Site Name: Argoed Colliery Location: Dyffryn, Neath, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156482 Type: Underground Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rhondda Member Commodity: Coal - Deep Positional Accuracy: Located by supplier to within 10m	A12SE (W)	603	1	283059 194019
61	BGS Recorded Mineral Sites Site Name: Argoed Colliery Location: Dyffryn, Neath, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156481 Type: Underground Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rhondda Member Commodity: Coal - Deep Positional Accuracy: Located by supplier to within 10m	A12SW (W)	836	1	282792 194132
62	BGS Recorded Mineral Sites Site Name: Lluest Location: Duffryn, Maesteg, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156747 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rhondda Member Commodity: Sandstone Positional Accuracy: Located by supplier to within 10m	A19SE (NE)	905	1	284398 194701

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
63	BGS Recorded Mineral Sites Site Name: Lluest Location: Duffryn, Maesteg, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156837 Type: Underground Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rhondda Member Commodity: Coal - Deep Positional Accuracy: Located by supplier to within 10m	A19SE (NE)	956	1	284409 194779
64	BGS Recorded Mineral Sites Site Name: Blaen Nant Location: Duffryn, Neath, West Glamorgan Source: British Geological Survey, National Geoscience Information Service Reference: 156526 Type: Underground Status: Ceased Operator: Unknown Operator Operator Location: Not Supplied Periodic Type: Carboniferous Geology: Rhondda Member Commodity: Coal - Deep Positional Accuracy: Located by supplier to within 10m	A18NE (N)	961	1	283812 195181
	BGS Measured Urban Soil Chemistry No data available				
	BGS Urban Soil Chemistry Averages No data available				
	Coal Mining Affected Areas Description: In an area which may be affected by coal mining activity. It is recommended that a coal mining report is obtained from the Coal Authority. Contact details are included in the Useful Contacts section of this report.	A13NE (NE)	0	6	283620 194240
	Mining Instability Mining Evidence: Inconclusive Coal Mining Source: Ove Arup & Partners Boundary Quality: As Supplied	A13NE (NE)	0	-	283620 194240
	Non Coal Mining Areas of Great Britain No Hazard				
	Potential for Collapsible Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240
	Potential for Compressible Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240
	Potential for Ground Dissolution Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240
	Potential for Landslide Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240
	Potential for Landslide Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13NW (N)	74	1	283593 194309
	Potential for Landslide Ground Stability Hazards Hazard Potential: Moderate Source: British Geological Survey, National Geoscience Information Service	A13NW (N)	155	1	283586 194390
	Potential for Landslide Ground Stability Hazards Hazard Potential: Moderate Source: British Geological Survey, National Geoscience Information Service	A13SW (S)	215	1	283594 194027
	Potential for Running Sand Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240
	Potential for Running Sand Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NW (N)	74	1	283593 194309

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NW (N)	74	1	283593 194309
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13SW (S)	215	1	283594 194027
	Radon Potential - Radon Affected Areas Affected Area: The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level). Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240
	Radon Potential - Radon Protection Measures Protection Measure: No radon protective measures are necessary in the construction of new dwellings or extensions Source: British Geological Survey, National Geoscience Information Service	A13NE (NE)	0	1	283620 194240

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
65	Points of Interest - Public Infrastructure Name: Heap (Dis) Location: SA13 Category: Infrastructure and Facilities Class Code: Refuse Disposal Facilities Positional Accuracy: Positioned to an adjacent address or location	A19SW (NE)	612	7	284069 194655
66	Points of Interest - Public Infrastructure Name: Refuse Tip (Disused) Location: SA13 Category: Infrastructure and Facilities Class Code: Refuse Disposal Facilities Positional Accuracy: Positioned to an adjacent address or location	A19SW (NE)	801	7	284088 194889
66	Points of Interest - Public Infrastructure Name: Heap (Dis) Location: SA13 Category: Infrastructure and Facilities Class Code: Refuse Disposal Facilities Positional Accuracy: Positioned to an adjacent address or location	A19NW (NE)	829	7	284090 194922
67	Points of Interest - Public Infrastructure Name: Refuse Tip (Disused) Location: SA13 Category: Infrastructure and Facilities Class Code: Refuse Disposal Facilities Positional Accuracy: Positioned to an adjacent address or location	A19NW (NE)	943	7	284113 195043

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
68	Forest Parks Name: Not Given Multiple Area: N Area (m2): 8226578 Source: Forestry Commission	A13SW (SW)	233	8	283490 194047

Agency & Hydrological	Version	Update Cycle
Contaminated Land Register Entries and Notices Bridgend County Borough Council - Environmental Health Department Natural Resources Wales Neath Port Talbot County Borough Council - Environmental Health Department	January 2020 June 2020 March 2015	Annual Rolling Update Annually Annual Rolling Update
Discharge Consents Environment Agency - Welsh Region Natural Resources Wales	August 2014 December 2020	Quarterly Quarterly
Enforcement and Prohibition Notices Environment Agency - Welsh Region	March 2013	Annual Rolling Update
Integrated Pollution Controls Environment Agency - Welsh Region	October 2008	Variable
Integrated Pollution Prevention And Control Natural Resources Wales Environment Agency - Welsh Region	February 2021 January 2021	Quarterly Quarterly
Local Authority Integrated Pollution Prevention And Control Neath Port Talbot County Borough Council - Environmental Health Department Bridgend County Borough Council - Environmental Health Department	August 2012 July 2015	Variable Variable
Local Authority Pollution Prevention and Controls Bridgend County Borough Council - Environmental Health Department Neath Port Talbot County Borough Council - Environmental Health Department	July 2015 March 2014	Not Applicable Annual Rolling Update
Local Authority Pollution Prevention and Control Enforcements Bridgend County Borough Council - Environmental Health Department Neath Port Talbot County Borough Council - Environmental Health Department	July 2015 March 2014	Variable Variable
Nearest Surface Water Feature Ordnance Survey	January 2021	
Pollution Incidents to Controlled Waters Environment Agency - Welsh Region	December 1998	Not Applicable
Prosecutions Relating to Authorised Processes Environment Agency - Welsh Region Natural Resources Wales	March 2013 March 2013	Annual Rolling Update Annual Rolling Update
Prosecutions Relating to Controlled Waters Environment Agency - Welsh Region Natural Resources Wales	March 2013 March 2013	Annual Rolling Update Annual Rolling Update
Registered Radioactive Substances Natural Resources Wales Environment Agency - Welsh Region	January 2015 June 2016	Annually
Substantiated Pollution Incident Register Environment Agency Wales - South West Area Natural Resources Wales	January 2021 January 2021	Quarterly Quarterly
Water Abstractions Natural Resources Wales Environment Agency - Welsh Region	February 2021 January 2021	Quarterly Quarterly
Water Industry Act Referrals Natural Resources Wales Environment Agency - Welsh Region	December 2021 October 2017	Quarterly Quarterly
Groundwater Vulnerability Map Natural Resources Wales	June 2018	As notified
Bedrock Aquifer Designations Natural Resources Wales	January 2018	Annually
Superficial Aquifer Designations Natural Resources Wales	January 2018	Annually

Agency & Hydrological	Version	Update Cycle
Source Protection Zones Natural Resources Wales	November 2016	Annual Rolling Update
Extreme Flooding from Rivers or Sea without Defences Natural Resources Wales	August 2018	Quarterly
Flooding from Rivers or Sea without Defences Natural Resources Wales	September 2020	Quarterly
Areas Benefiting from Flood Defences Natural Resources Wales	November 2019	Quarterly
Flood Water Storage Areas Natural Resources Wales	August 2019	Quarterly
Flood Defences Natural Resources Wales	November 2019	Quarterly
OS Water Network Lines Ordnance Survey	September 2020	Quarterly
Surface Water 1 in 30 year Flood Extent Natural Resources Wales	October 2013	Annually
Surface Water 1 in 100 year Flood Extent Natural Resources Wales	October 2013	Annually
Surface Water 1 in 1000 year Flood Extent Natural Resources Wales	October 2013	Annually
Surface Water Suitability Natural Resources Wales	October 2013	Annually
BGS Groundwater Flooding Susceptibility British Geological Survey - National Geoscience Information Service	May 2013	Annually

Waste	Version	Update Cycle
BGS Recorded Landfill Sites British Geological Survey - National Geoscience Information Service	June 1996	Not Applicable
Historical Landfill Sites Natural Resources Wales	July 2017	Quarterly
Integrated Pollution Control Registered Waste Sites Environment Agency - Welsh Region	October 2008	Not Applicable
Licensed Waste Management Facilities (Landfill Boundaries) Environment Agency Wales - South West Area Natural Resources Wales	January 2021 January 2021	Quarterly Quarterly
Licensed Waste Management Facilities (Locations) Environment Agency Wales - South West Area Natural Resources Wales	April 2021 January 2021	Quarterly Quarterly
Local Authority Landfill Coverage Bridgend County Borough Council Neath Port Talbot County Borough Council - Environmental Health Department	May 2000 May 2000	Not Applicable Not Applicable
Local Authority Recorded Landfill Sites Bridgend County Borough Council Neath Port Talbot County Borough Council - Environmental Health Department	May 2000 September 2003	Not Applicable Not Applicable
Potentially Infilled Land (Non-Water) Landmark Information Group Limited	December 1999	Not Applicable
Potentially Infilled Land (Water) Landmark Information Group Limited	December 1999	Not Applicable
Registered Landfill Sites Environment Agency Wales - South West Area	March 2003	Not Applicable
Registered Waste Transfer Sites Environment Agency Wales - South West Area	March 2003	Not Applicable
Registered Waste Treatment or Disposal Sites Environment Agency Wales - South West Area	March 2003	Not Applicable
Hazardous Substances	Version	Update Cycle
Control of Major Accident Hazards Sites (COMAH) Health and Safety Executive	April 2018	Bi-Annually
Explosive Sites Health and Safety Executive	March 2017	Annually
Notification of Installations Handling Hazardous Substances (NIHHS) Health and Safety Executive	November 2000	Not Applicable
Planning Hazardous Substance Enforcements Bridgend County Borough Council - Planning Department Neath Port Talbot County Borough Council - Planning Department	February 2016 October 2015	Variable Variable
Planning Hazardous Substance Consents Bridgend County Borough Council - Planning Department Neath Port Talbot County Borough Council - Planning Department	February 2016 October 2015	Variable Variable

Geological	Version	Update Cycle
BGS 1:625,000 Solid Geology British Geological Survey - National Geoscience Information Service	January 2009	Not Applicable
BGS Estimated Soil Chemistry British Geological Survey - National Geoscience Information Service	October 2015	Annually
BGS Recorded Mineral Sites British Geological Survey - National Geoscience Information Service	November 2020	Bi-Annually
CBSCB Compensation District Cheshire Brine Subsidence Compensation Board (CBSCB)	August 2011	Not Applicable
Coal Mining Affected Areas The Coal Authority - Property Searches	March 2014	Annual Rolling Update
Mining Instability Ove Arup & Partners	October 2000	Not Applicable
Non Coal Mining Areas of Great Britain British Geological Survey - National Geoscience Information Service	May 2015	Not Applicable
Potential for Collapsible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	April 2020	Annually
Potential for Compressible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2019	Annually
Potential for Ground Dissolution Stability Hazards British Geological Survey - National Geoscience Information Service	January 2019	Annually
Potential for Landslide Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2019	Annually
Potential for Running Sand Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2019	Annually
Potential for Shrinking or Swelling Clay Ground Stability Hazards British Geological Survey - National Geoscience Information Service	January 2019	Annually
Radon Potential - Radon Affected Areas British Geological Survey - National Geoscience Information Service	July 2011	Annually
Radon Potential - Radon Protection Measures British Geological Survey - National Geoscience Information Service	July 2011	Annually
Industrial Land Use	Version	Update Cycle
Contemporary Trade Directory Entries Thomson Directories	April 2021	Quarterly
Fuel Station Entries Catalist Ltd - Experian	February 2021	Quarterly
Gas Pipelines National Grid	January 2021	
Points of Interest - Commercial Services PointX	March 2021	Quarterly
Points of Interest - Education and Health PointX	March 2021	Quarterly
Points of Interest - Manufacturing and Production PointX	March 2021	Quarterly
Points of Interest - Public Infrastructure PointX	March 2021	Quarterly
Points of Interest - Recreational and Environmental PointX	March 2021	Quarterly
Underground Electrical Cables National Grid	April 2021	

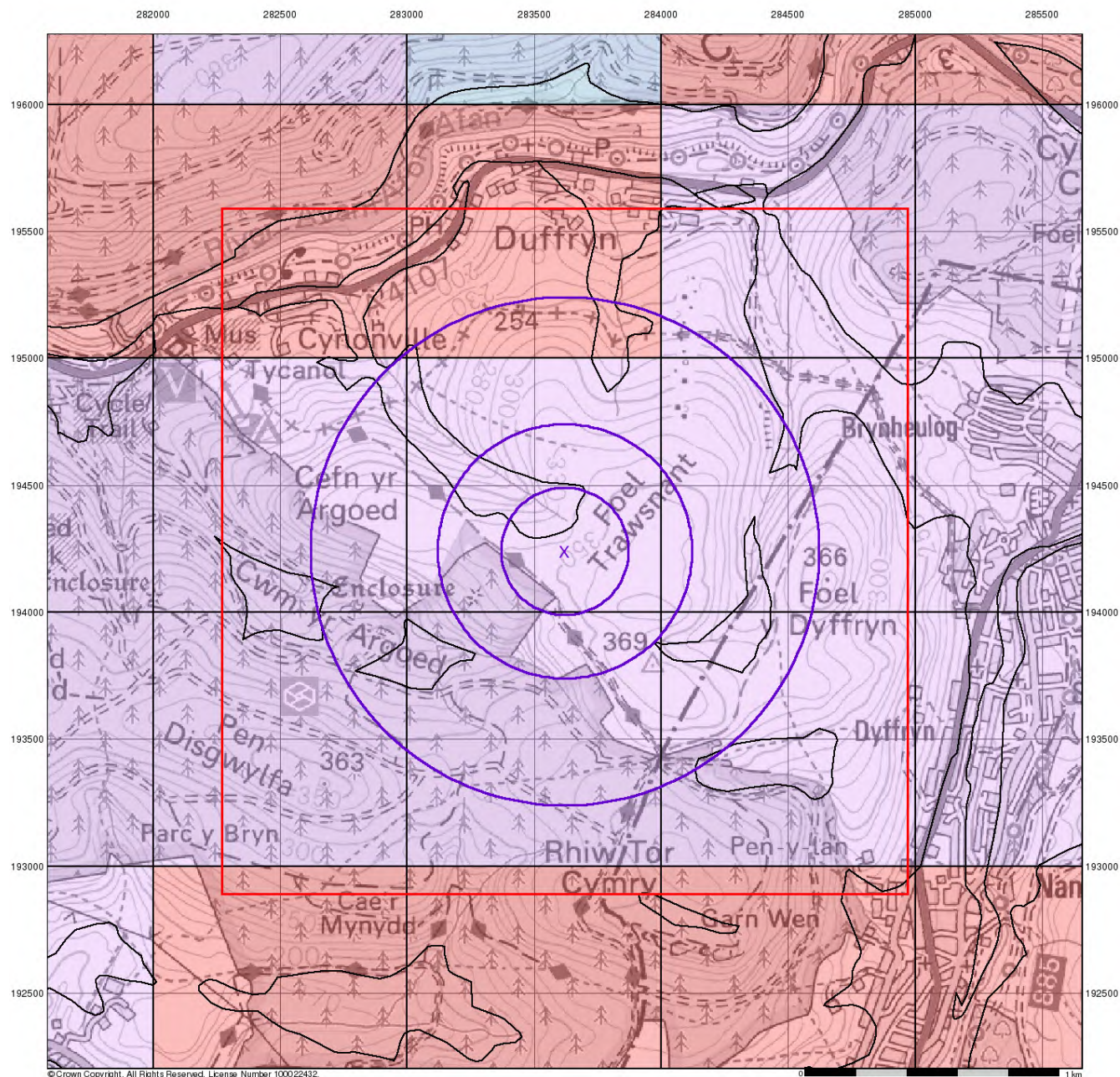
Sensitive Land Use	Version	Update Cycle
Ancient Woodland Natural Resources Wales	August 2018	Bi-Annually
Areas of Adopted Green Belt Bridgend County Borough Council Neath Port Talbot County Borough Council - Planning Services	June 2020 June 2020	As notified As notified
Areas of Unadopted Green Belt Bridgend County Borough Council Neath Port Talbot County Borough Council - Planning Services	June 2020 June 2020	As notified As notified
Areas of Outstanding Natural Beauty Natural Resources Wales	June 2019	Bi-Annually
Environmentally Sensitive Areas The National Assembly for Wales - GI Services (Department of Planning & Countryside)	January 2017	
Forest Parks Forestry Commission	April 1997	Not Applicable
Local Nature Reserves Bridgend County Borough Council Neath Port Talbot County Borough Council	August 2018 August 2018	Bi-Annually Bi-Annually
Marine Nature Reserves Natural Resources Wales	August 2018	Bi-Annually
National Nature Reserves Natural Resources Wales	June 2019	Bi-Annually
National Parks Natural Resources Wales	August 2018	Annually
Nitrate Vulnerable Zones Natural Resources Wales The National Assembly for Wales - GI Services (Department of Planning & Countryside)	July 2019 October 2005	Bi-Annually
Ramsar Sites Natural Resources Wales	July 2019	Bi-Annually
Sites of Special Scientific Interest Natural Resources Wales	March 2020	Bi-Annually
Special Areas of Conservation Natural Resources Wales	August 2020	Bi-Annually
Special Protection Areas Natural Resources Wales	August 2018	Bi-Annually

A selection of organisations who provide data within this report

Data Supplier	Data Supplier Logo
Ordnance Survey	
Environment Agency	
Scottish Environment Protection Agency	
The Coal Authority	
British Geological Survey	 British Geological Survey NATURAL ENVIRONMENT RESEARCH COUNCIL
Centre for Ecology and Hydrology	 Centre for Ecology & Hydrology NATURAL ENVIRONMENT RESEARCH COUNCIL
Natural Resources Wales	
Scottish Natural Heritage	
Natural England	
Public Health England	
Ove Arup	
Stantec UK Ltd	

Contact	Name and Address	Contact Details
1	British Geological Survey - Enquiry Service British Geological Survey, Environmental Science Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG	Telephone: 0115 936 3143 Fax: 0115 936 3276 Email: enquiries@bgs.ac.uk Website: www.bgs.ac.uk
2	Natural Resources Wales Ty Cambria, 29 Newport Road, Cardiff, CF24 0TP	Telephone: 0300 065 3000 Email: enquiries@naturalresourceswales.gov.uk
3	Ordnance Survey Adanac Drive, Southampton, Hampshire, SO16 0AS	Telephone: 03456 05 05 05 Email: customerservices@ordnancesurvey.co.uk Website: www.ordnancesurvey.gov.uk
4	Neath Port Talbot County Borough Council - Environmental Health Department Room 322, Neath Civic Centre, Neath, West Glamorgan, SA11 3QZ	Telephone: 01639 763333 Fax: 01693 763444 Website: www.neath-porttalbot.gov.uk
5	Bridgend County Borough Council PO Box 4, Civic Offices, Angel Street, Bridgend, Mid Glamorgan, CF31 1LX	Telephone: 01656 643643 Fax: 01656 668126 Website: www.bridgend.gov.uk
6	The Coal Authority - Property Searches 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG	Telephone: 0345 762 6848 Fax: 01623 637 338 Email: groundstability@coal.gov.uk Website: www2.groundstability.com
7	PointX 7 Abbey Court, Eagle Way, Sowton, Exeter, Devon, EX2 7HY	Website: www.pointx.co.uk
8	Forestry Commission 231 Corstorphine Road, Edinburgh, Midlothian, EH12 7AT	Telephone: 0131 334 0303 Fax: 0131 334 4473
9	Neath Port Talbot County Borough Council Civic Centre, Port Talbot, West Glamorgan, SA13 1PJ	Telephone: 01639 763333 Fax: 01693 763444 Website: www.neath-porttalbot.gov.uk
-	Public Health England - Radon Survey, Centre for Radiation, Chemical and Environmental Hazards Chilton, Didcot, Oxfordshire, OX11 0RQ	Telephone: 01235 822622 Fax: 01235 833891 Email: radon@phe.gov.uk Website: www.ukradon.org
-	Landmark Information Group Limited Imperium, Imperial Way, Reading, Berkshire, RG2 0TD	Telephone: 0844 844 9952 Fax: 0844 844 9951 Email: customerservices@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk

Please note that the Environment Agency / Natural Resources Wales / SEPA have a charging policy in place for enquiries.



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0 1 km



Groundwater Vulnerability

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

Bedrock Aquifers

- High Vulnerability, Principal Aquifer
- High Vulnerability, Secondary Aquifer
- Medium Vulnerability, Principal Aquifer
- Medium Vulnerability, Secondary Aquifer
- Low Vulnerability, Principal Aquifer
- Low Vulnerability, Secondary Aquifer

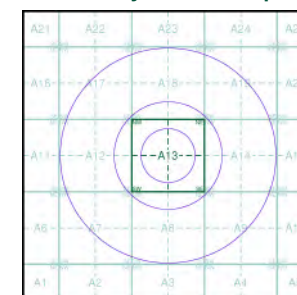
Superficial Aquifers

- High Vulnerability, Principal Aquifer
- High Vulnerability, Secondary Aquifer
- Medium Vulnerability, Principal Aquifer
- Medium Vulnerability, Secondary Aquifer
- Low Vulnerability, Principal Aquifer
- Low Vulnerability, Secondary Aquifer

Unproductive Aquifer

Soluble Rock

Site Sensitivity Context Map - Slice A



Order Details

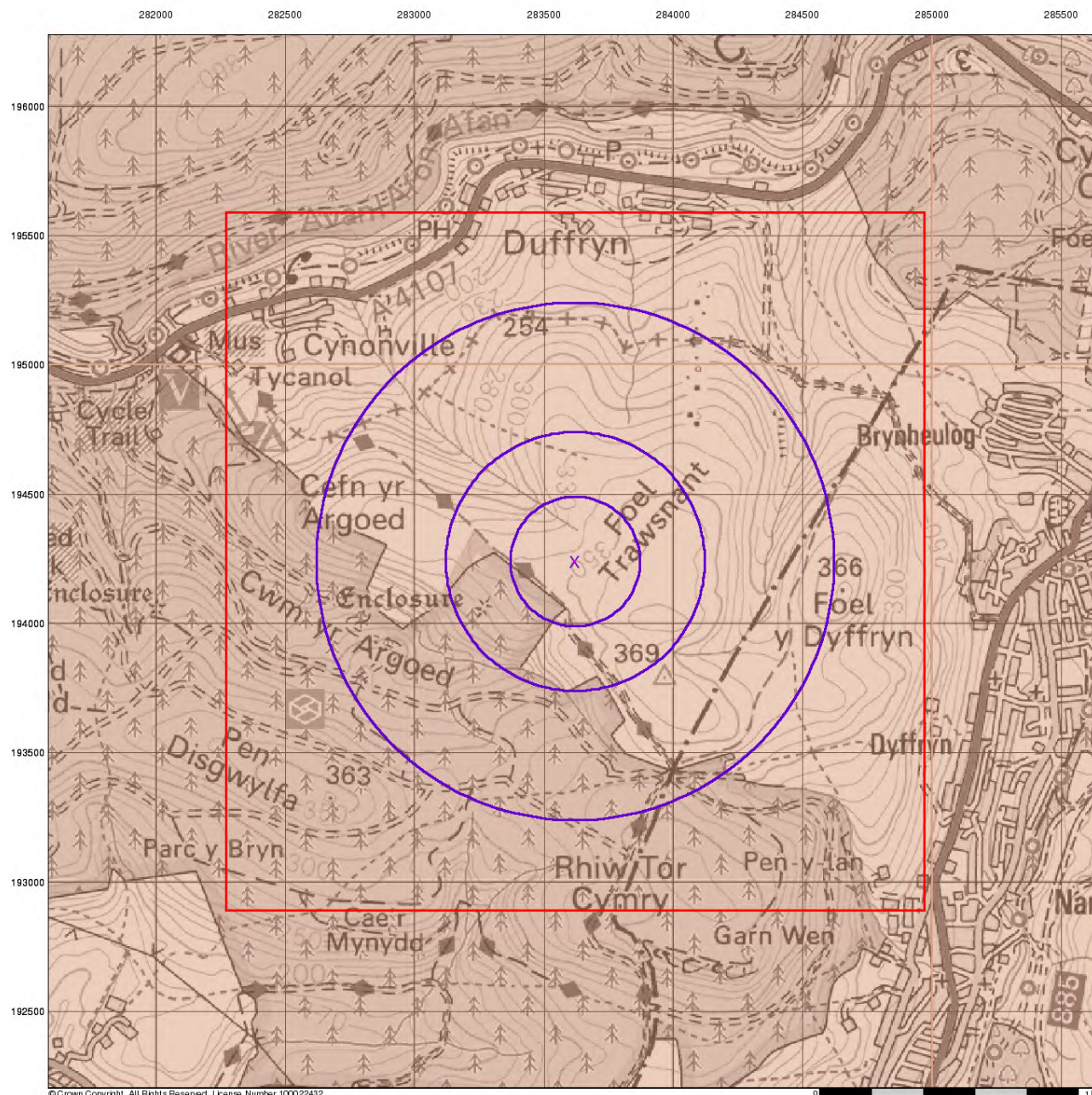
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 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm

Landmark
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0 1 km



Bedrock Aquifer Designation

General

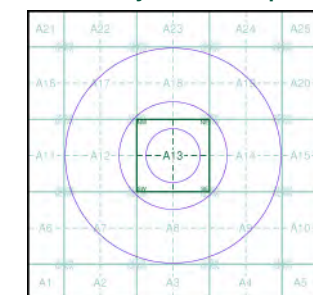
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- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



Order Details

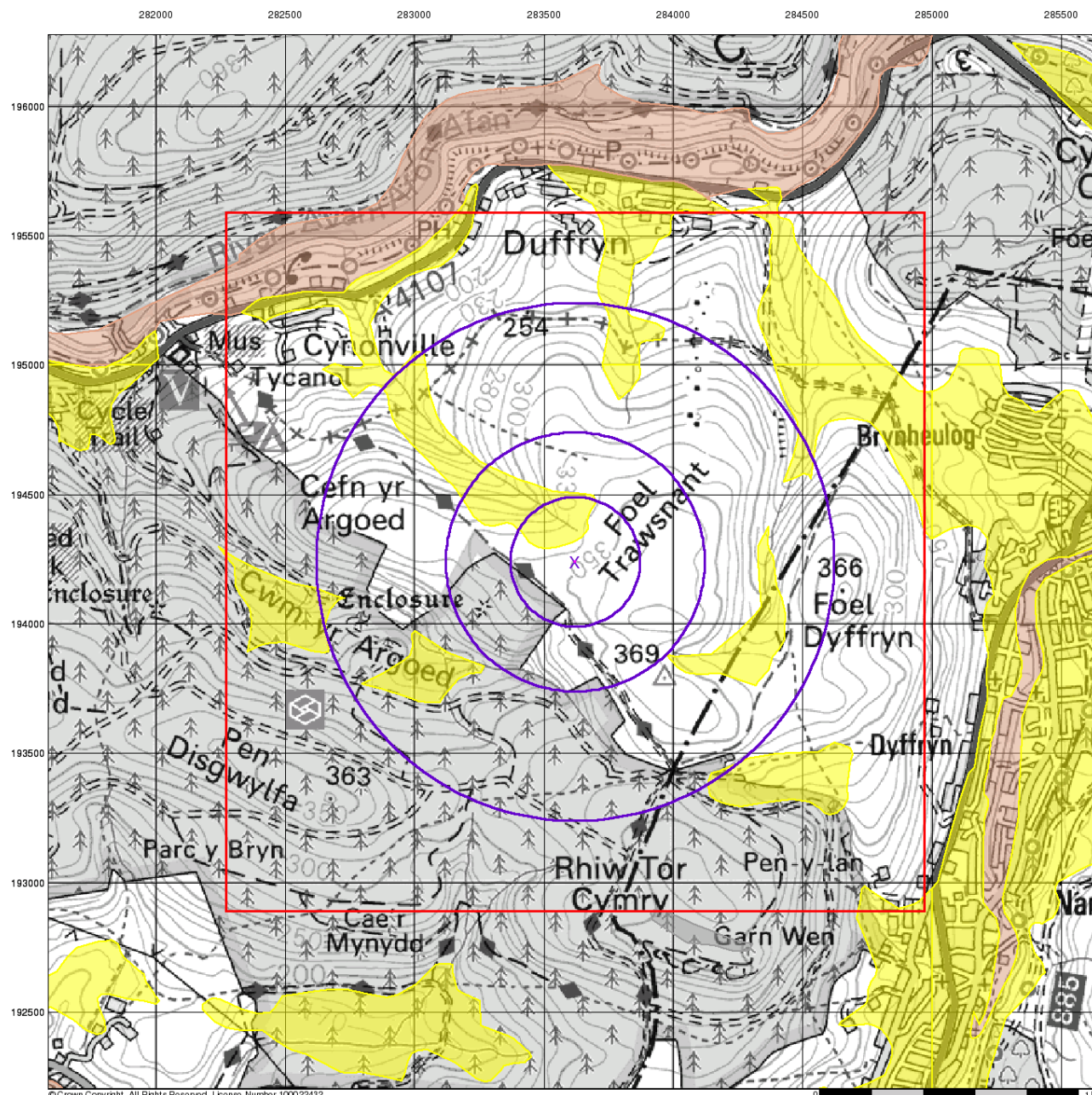
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Superficial Aquifer Designation

General

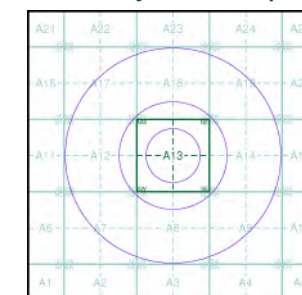
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- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown
- Unknown (Lakes and Landslip)

Site Sensitivity Context Map - Slice A



Order Details

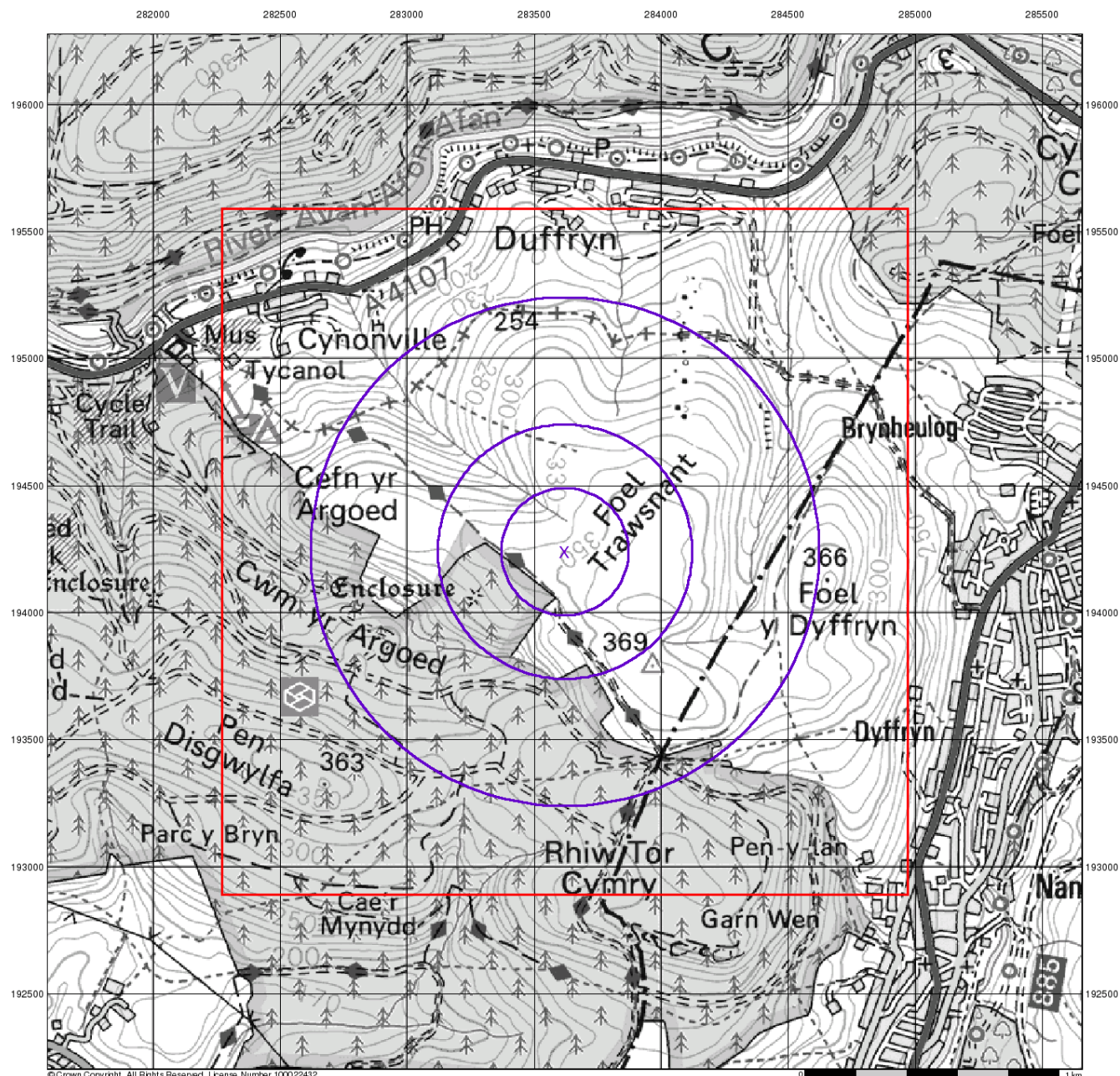
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0 1 km



Source Protection Zones

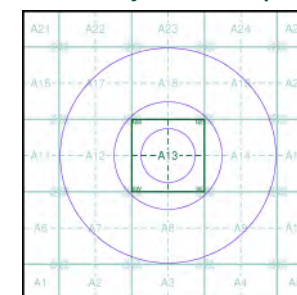
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

- Inner zone (Zone 1)
- Inner zone - subsurface activity only (Zone 1c)
- Outer zone (Zone 2)
- Outer zone - subsurface activity only (Zone 2c)
- Total catchment (Zone 3)
- Total catchment - subsurface activity only (Zone 3c)
- Special interest (Zone 4)

Site Sensitivity Context Map - Slice A



Order Details

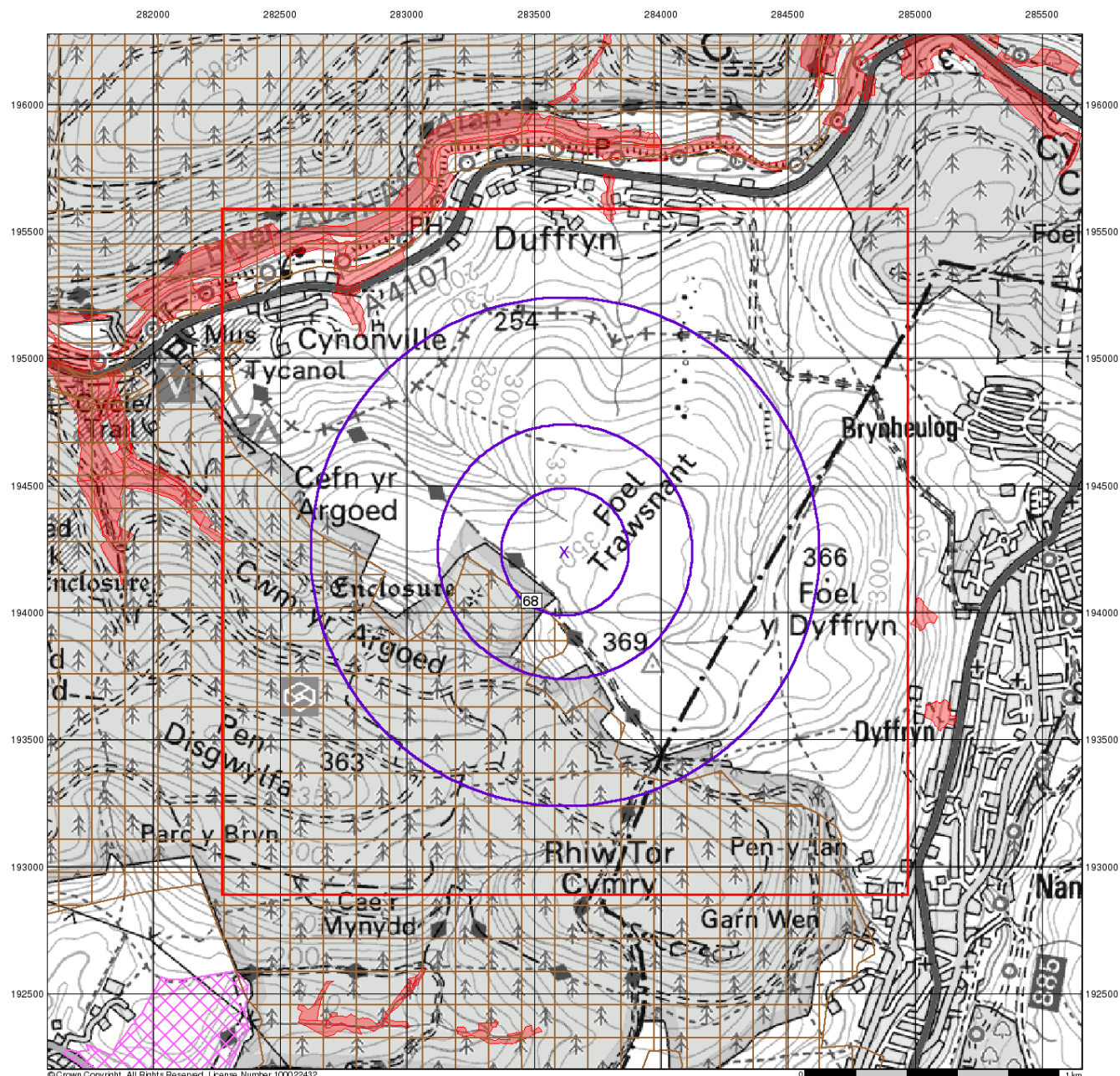
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Site Details

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Sensitive Land Uses

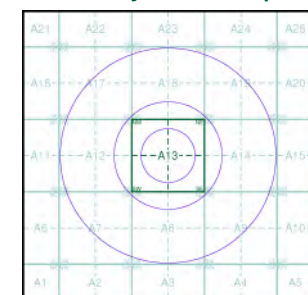
General

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- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Sensitive Land Uses

- Ancient Woodland
- Area of Adopted Green Belt
- Area of Unadopted Green Belt
- Area of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Park
- Local Nature Reserve
- Marine Nature Reserve
- National Nature Reserve
- National Park
- Nitrate Sensitive Area
- Nitrate Vulnerable Zone
- Ramsar Site
- Site of Special Scientific Interest
- Special Area of Conservation
- Special Protection Area
- World Heritage Sites

Site Sensitivity Context Map - Slice A



Order Details

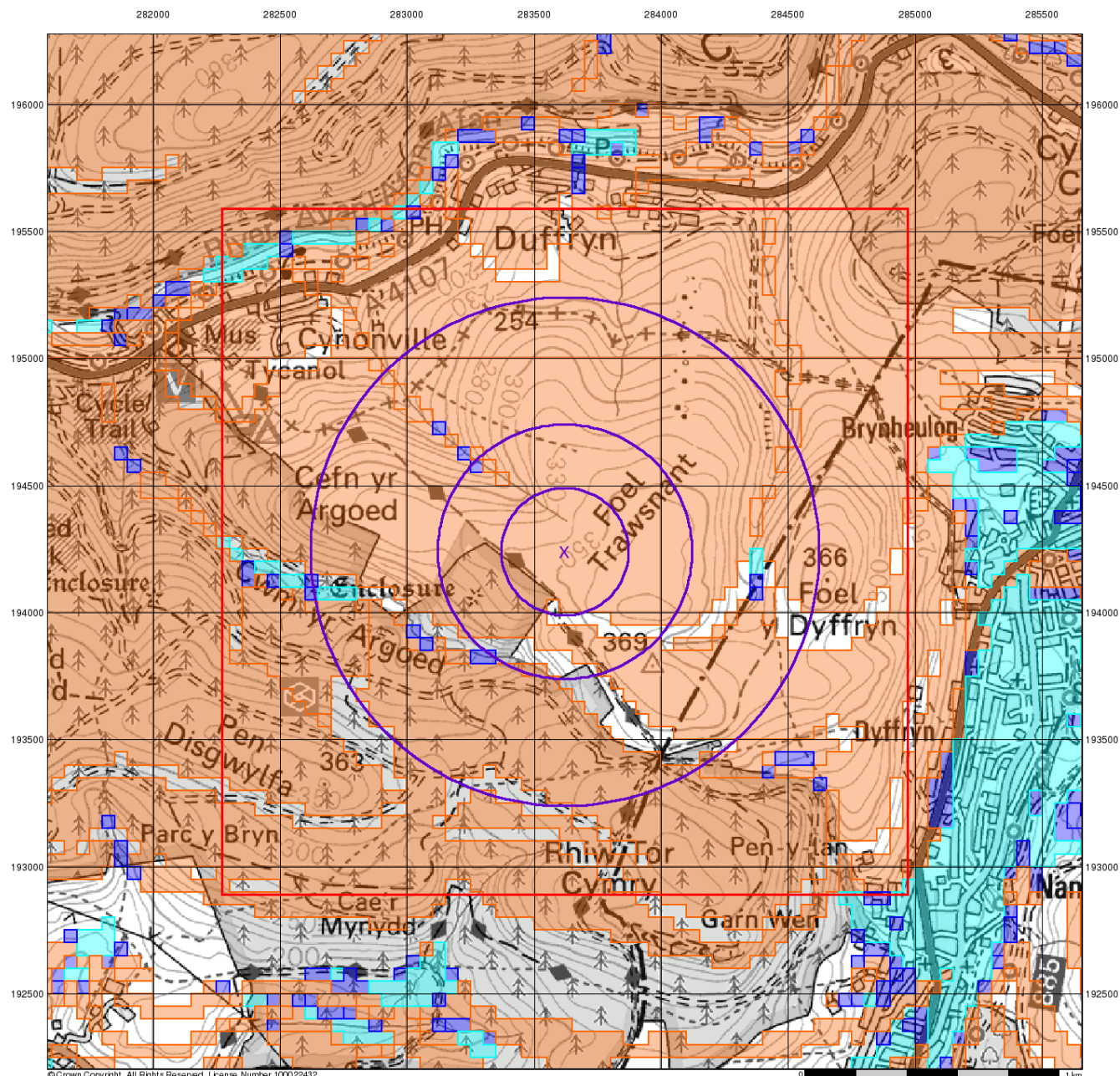
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Intégral Géotechnique

BGS Flood GFS Data

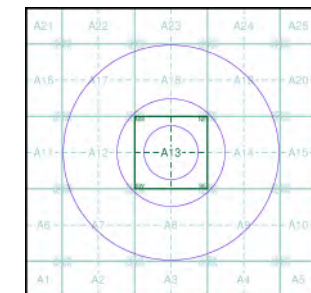
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice A



Order Details

Order Number: 279012478_1_1
 Customer Ref: 12826/RAH
 National Grid Reference: 283620, 194240
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm

Landmark
 INFORMATION GROUP

Tel: 0844 844 9952
 Fax: 0844 844 9951
 Web: www.envirocheck.co.uk

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location
- Pylon
- Overhead Transmission Line

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral
- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Non-water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Potentially Infilled Land (Water)
- Registered Landfill Site
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

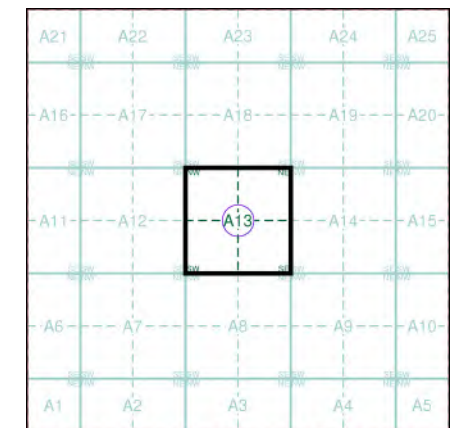
Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement
- BGS Recorded Mineral Site

Geological

- BGS Recorded Mineral Site

Site Sensitivity Map - Segment A13

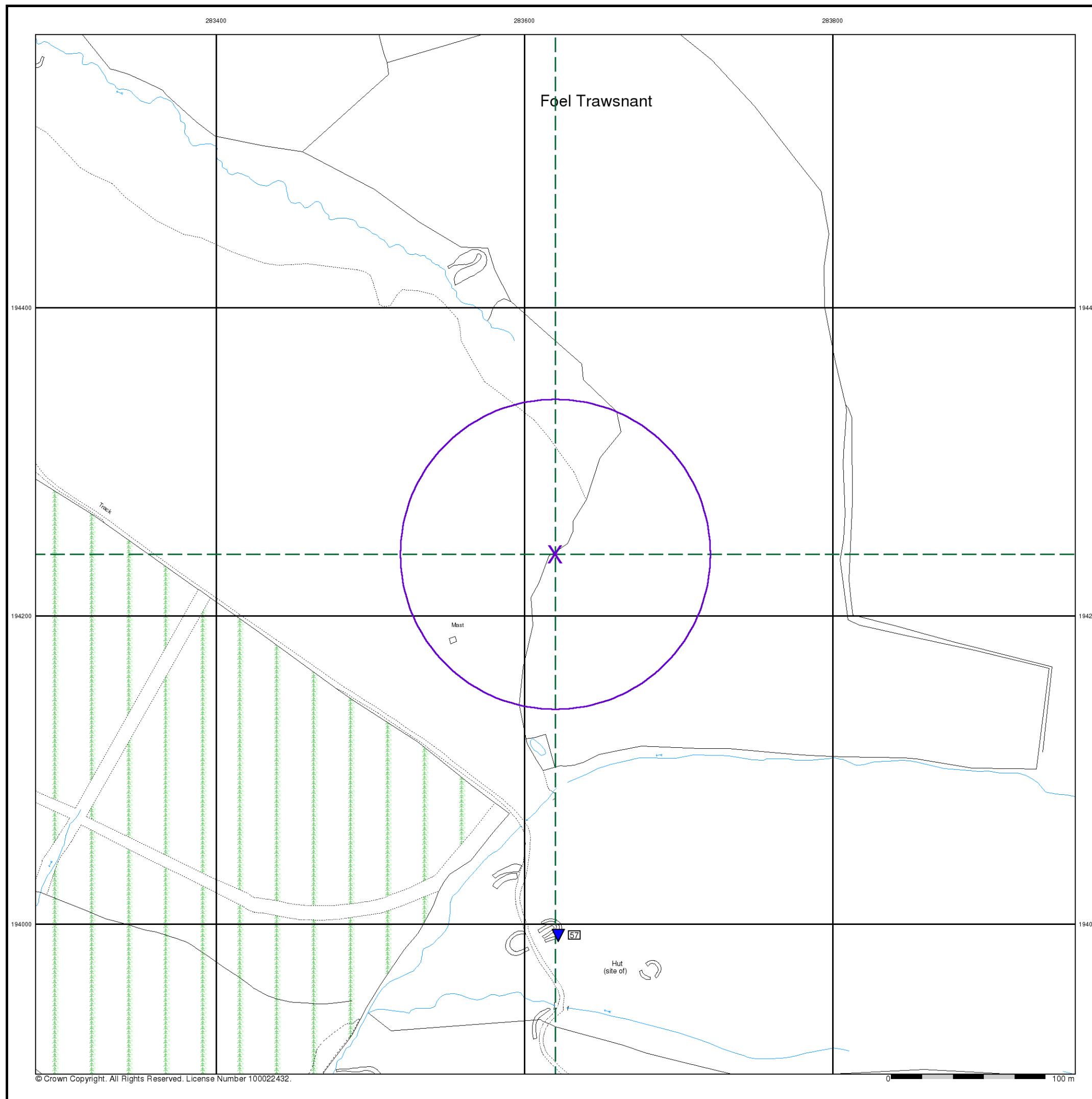


Order Details

Order Number: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Plot Buffer (m): 100

Site Details

Foel Trawsnant Windfarm

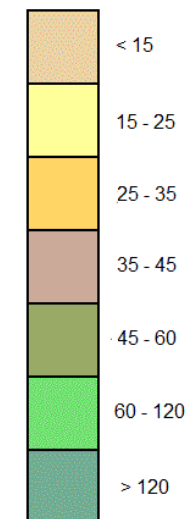


General

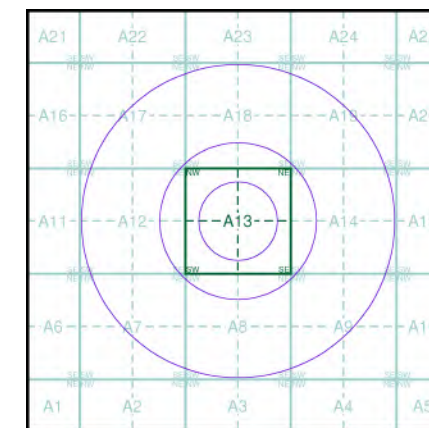
Specified Site Specified Buffer(s) Bearing Reference Point

Estimated Soil Chemistry Arsenic

Arsenic Concentrations mg/kg



Estimated Soil Chemistry Arsenic - Slice A

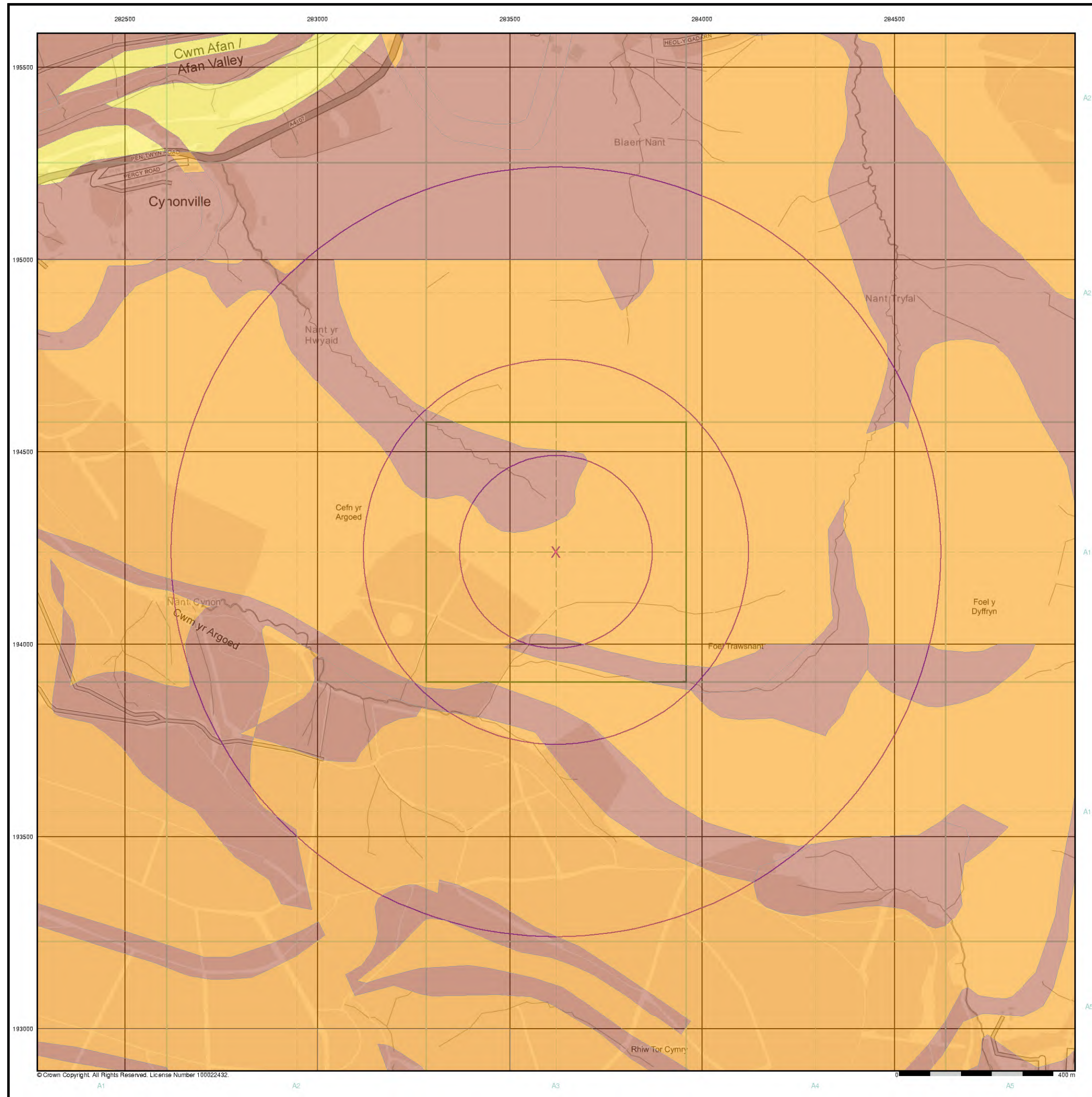


Order Details

Order Details: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm

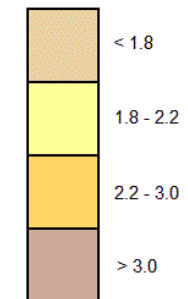


General

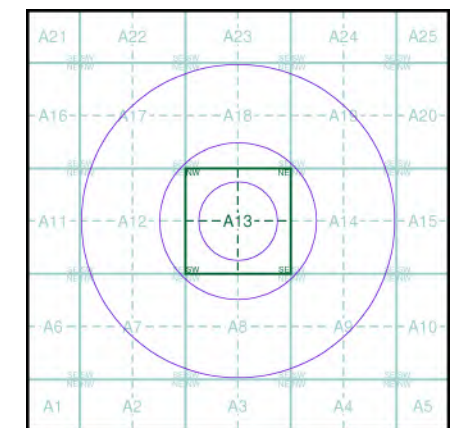
Specified Site Specified Buffer(s) Bearing Reference Point

Estimated Soil Chemistry Cadmium

Cadmium Concentrations mg/kg



Estimated Soil Chemistry Cadmium - Slice A

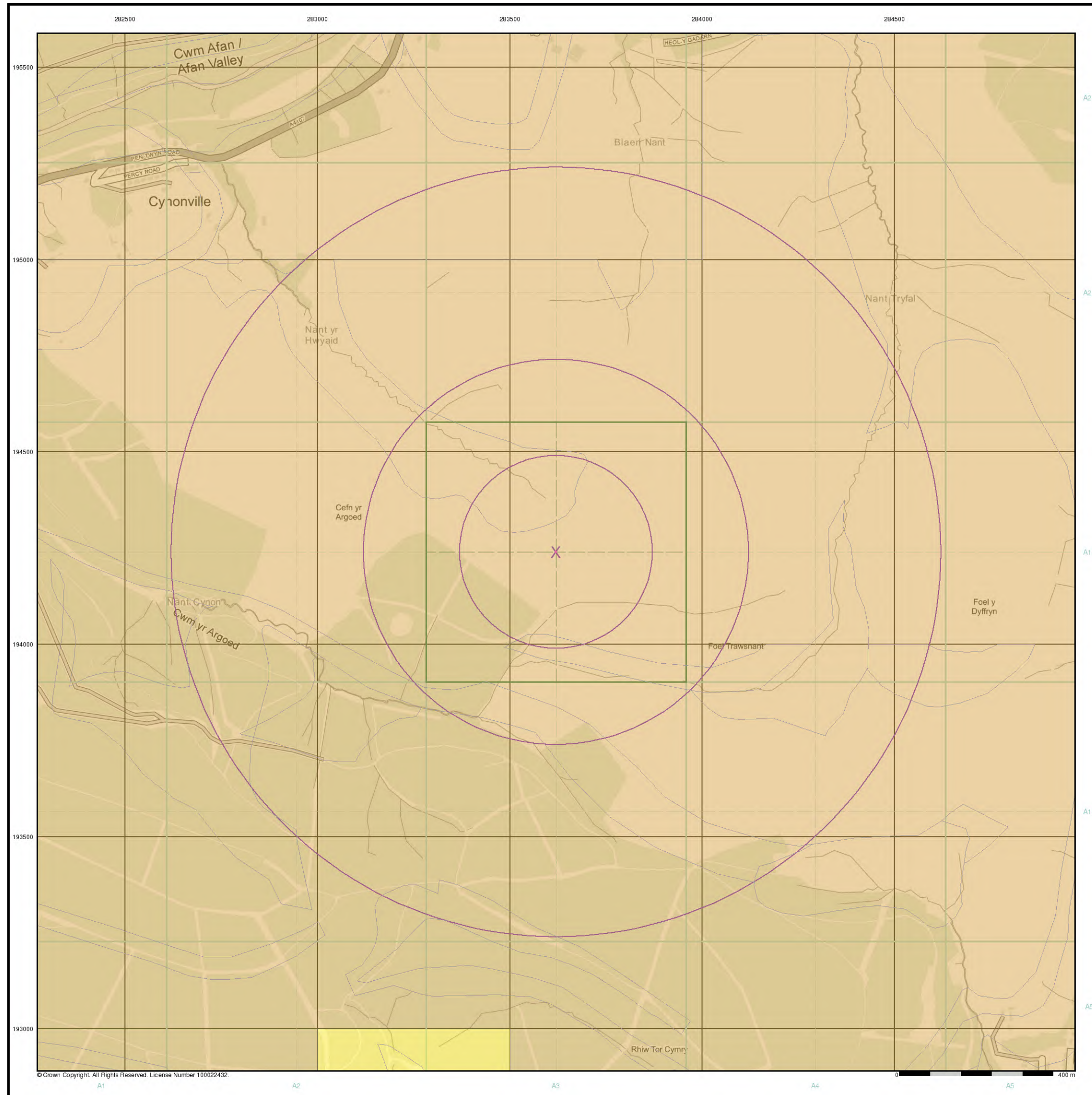


Order Details

Order Details: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm

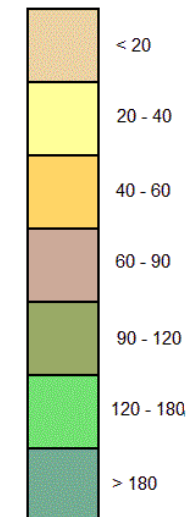


General

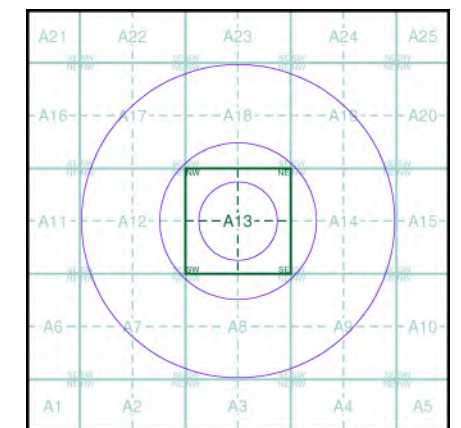
Specified Site Specified Buffer(s) Bearing Reference Point

Estimated Soil Chemistry Chromium

Chromium Concentrations mg/kg



Estimated Soil Chemistry Chromium - Slice A

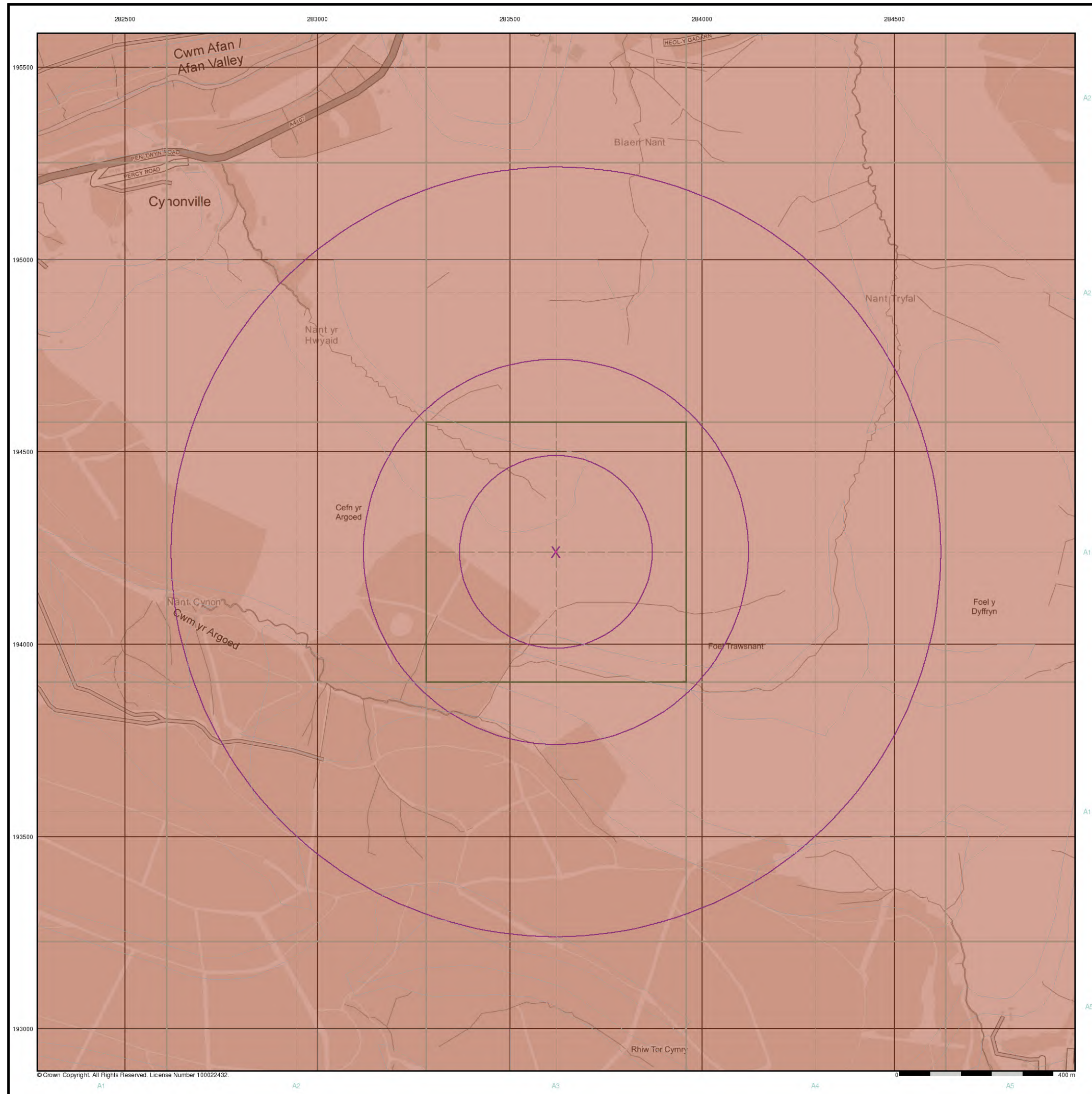


Order Details

Order Details: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm

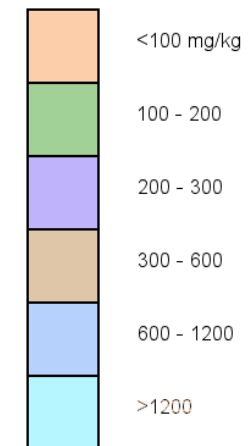


General

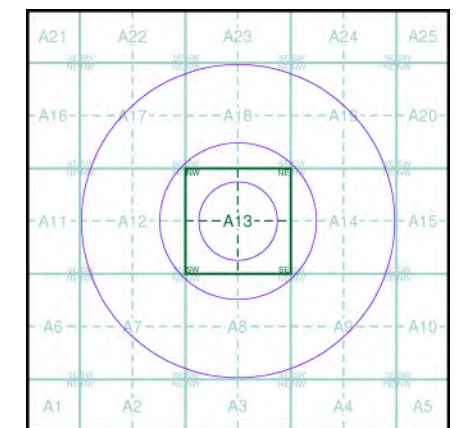
Specified Site Specified Buffer(s) Bearing Reference Point

Estimated Soil Chemistry Lead

Lead Concentrations mg/kg



Estimated Soil Chemistry Lead - Slice A



Order Details

Order Details: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

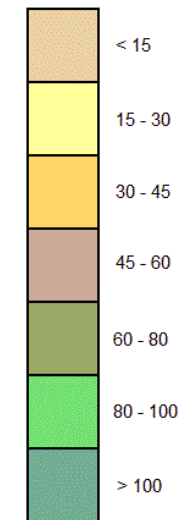
Foel Trawsnant Windfarm

General

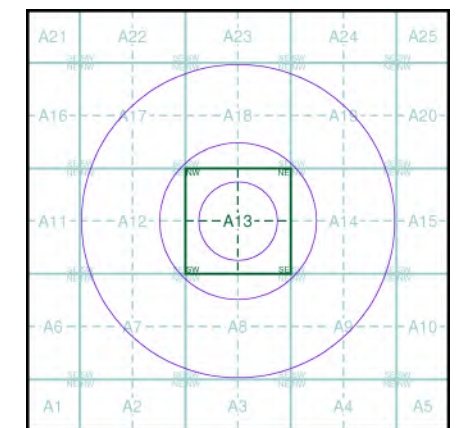
Specified Site Specified Buffer(s) Bearing Reference Point

Estimated Soil Chemistry Nickel

Nickel Concentrations mg/kg



Estimated Soil Chemistry Nickel - Slice A

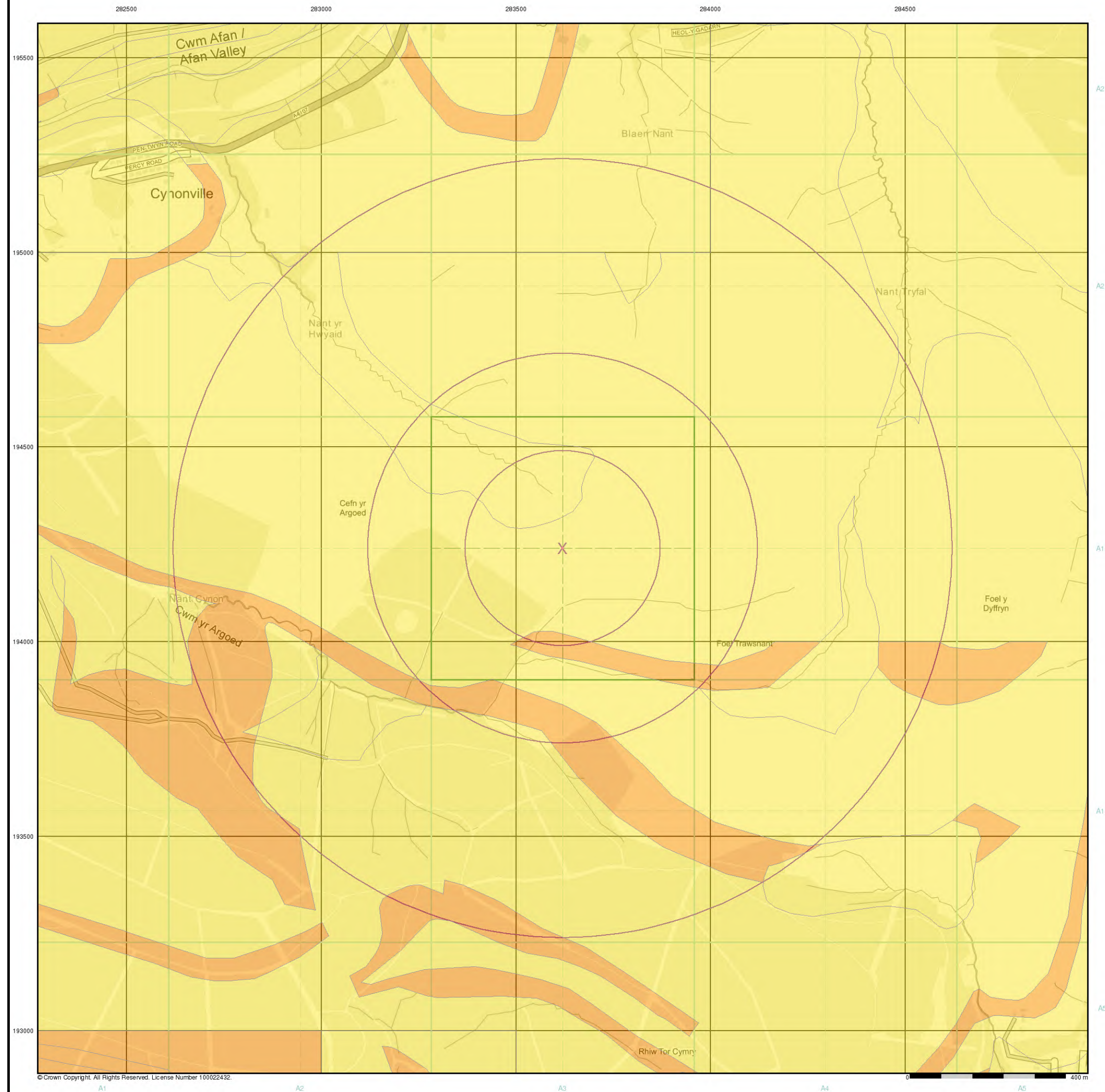


Order Details

Order Details: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

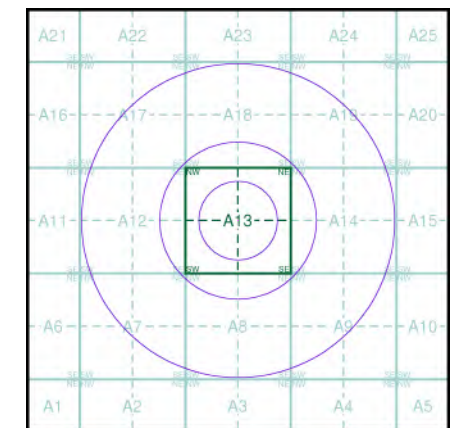
Site Details

Foel Trawsnant Windfarm



General	
Specified Site	Specified Buffer(s)
Several of Type at Location	Bearing Reference Point
Map ID	
Agency and Hydrological	
Contaminated Land Register Entry or Notice (Location)	BGS Recorded Landfill Site (Location)
Contaminated Land Register Entry or Notice	BGS Recorded Landfill Site
Discharge Consent	EA Historic Landfill (Buffered Point)
Enforcement or Prohibition Notice	EA Historic Landfill (Polygon)
Integrated Pollution Control	Integrated Pollution Control Registered Waste Site
Integrated Pollution Prevention Control	Licensed Waste Management Facility (Landfill Boundary)
Local Authority Integrated Pollution Prevention and Control	Licensed Waste Management Facility (Location)
Local Authority Pollution Prevention and Control	Local Authority Recorded Landfill Site (Location)
Local Authority Pollution Prevention and Control Enforcement	Local Authority Recorded Landfill Site
Pollution Incident to Controlled Waters	Potentially Infilled Land (Non-water)
Prosecution Relating to Authorised Processes	Potentially Infilled Land (Non-water)
Prosecution Relating to Controlled Waters	Potentially Infilled Land (Non-water)
Registered Radioactive Substance	Potentially Infilled Land (Water)
River Network or Water Feature	Potentially Infilled Land (Water)
River Quality Sampling Point	Potentially Infilled Land (Water)
Substantiated Pollution Incident Register	Potentially Infilled Land (Water)
Water Abstraction	Potentially Infilled Land (Water)
Water Industry Act Referral	Potentially Infilled Land (Water)
Hazardous Substances	
COMAH Site	Explosive Site
NIHS Site	Explosive Site
Planning Hazardous Substance Consent	Explosive Site
Planning Hazardous Substance Enforcement	Explosive Site
BGS Recorded Mineral Site	Explosive Site
Geological	
	Explosive Site

Site Sensitivity Map - Slice A



Order Details

Order Number: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm

Industrial Land Use Map

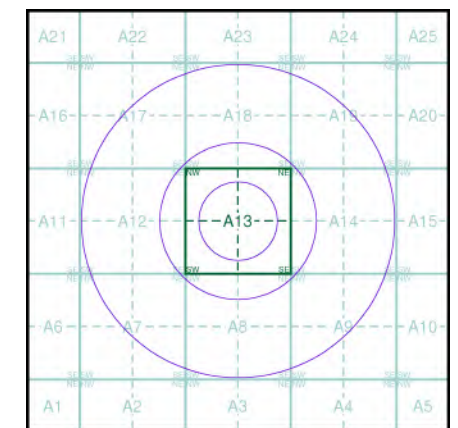
General

-  Specified Site  Specified Buffer(s)  Bearing Reference Point
 Slice  Map ID

Industrial Land Use

- ★ Contemporary Trade Directory Entry
- ★ Fuel Station Entry
- Gas Pipeline
- ★ Points of Interest - Commercial Services
- ★ Points of Interest - Education and Health
- ★ Points of Interest - Manufacturing and Production
- ★ Points of Interest - Public Infrastructure
- ★ Points of Interest - Recreational and Environmental
- Underground Electrical Cables

Industrial Land Use Map - Slice A

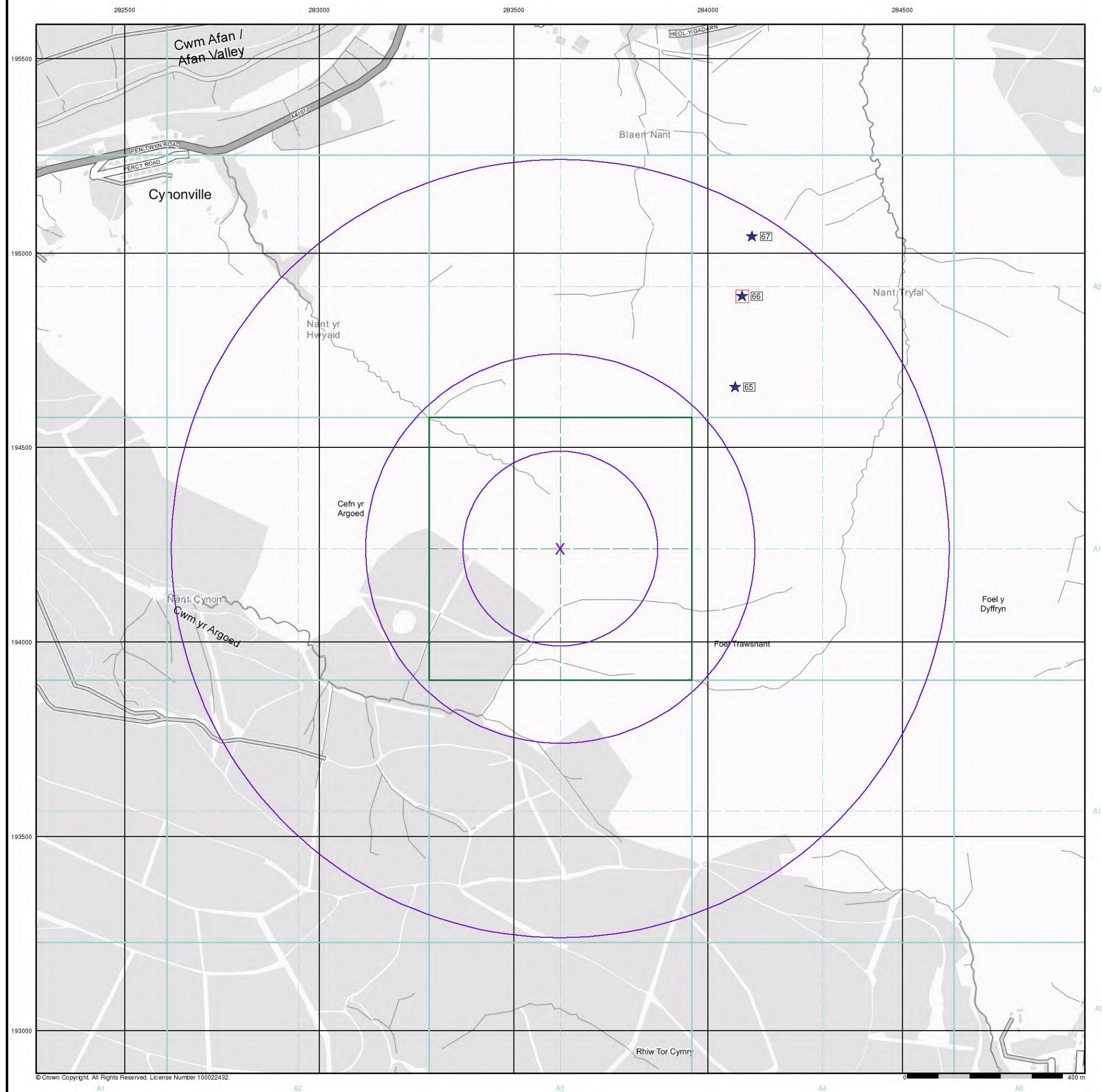


Order Details

Order Number: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm



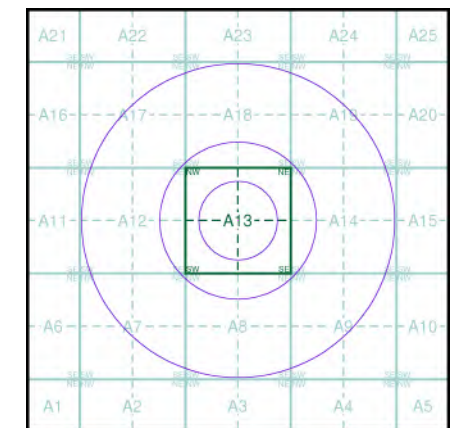
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A

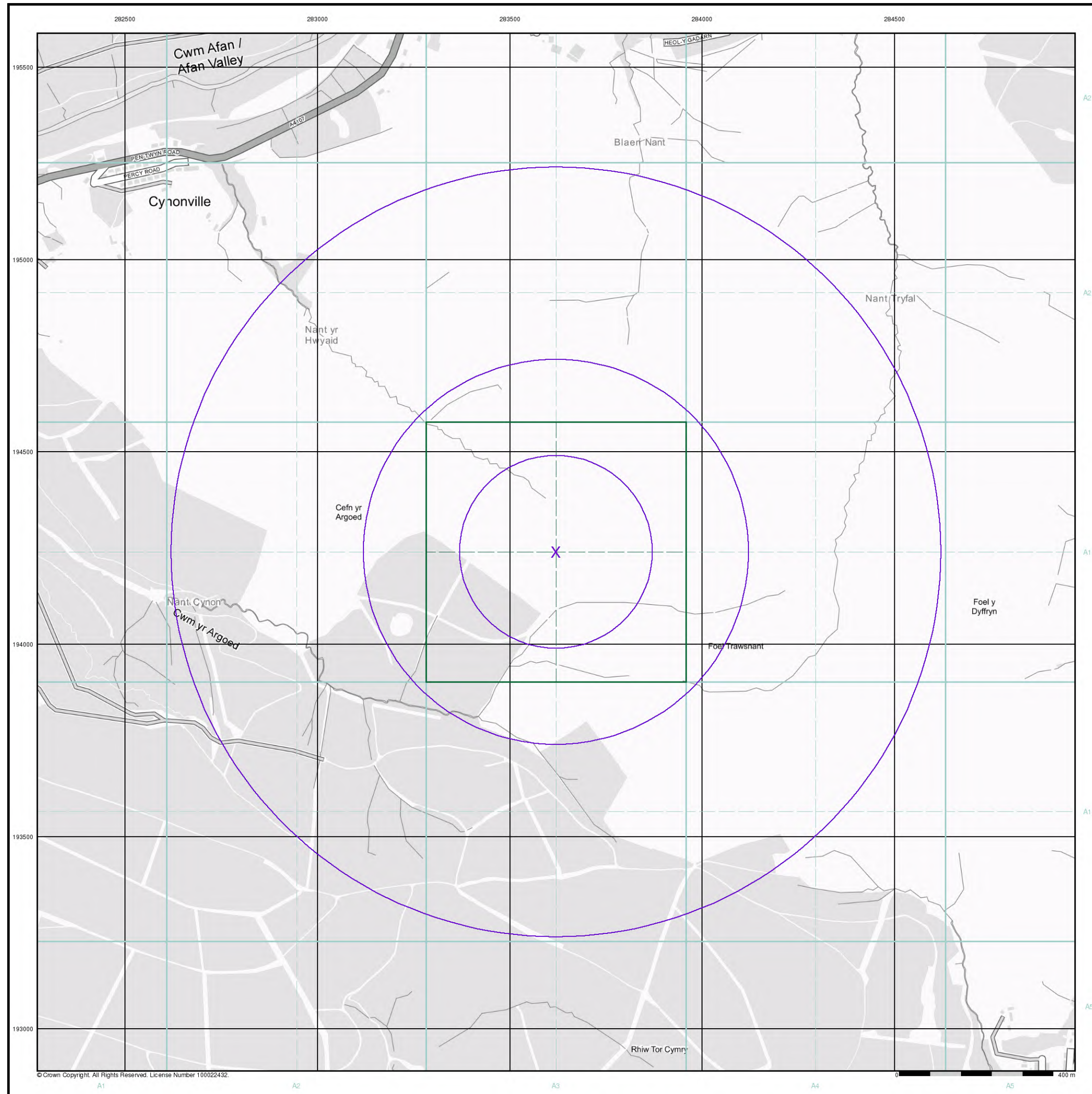


Order Details

Order Number: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm



General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location

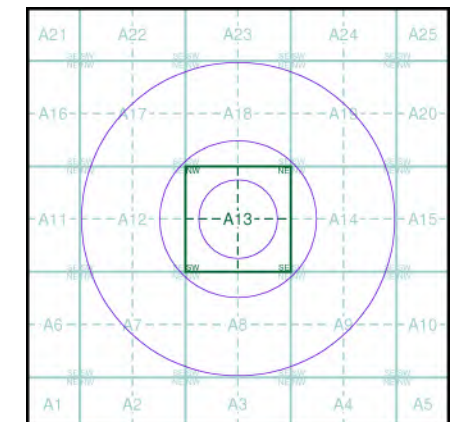
Agency and Hydrological (Boreholes)

- BGS Borehole Depth 0 - 10m
- BGS Borehole Depth 10 - 30m
- BGS Borehole Depth 30m +
- Confidential
- Other

For Borehole information please refer to the Borehole .csv file which accompanied this slice.

A copy of the BGS Borehole Ordering Form is available to download from the Support section of www.envirocheck.co.uk.

Borehole Map - Slice A

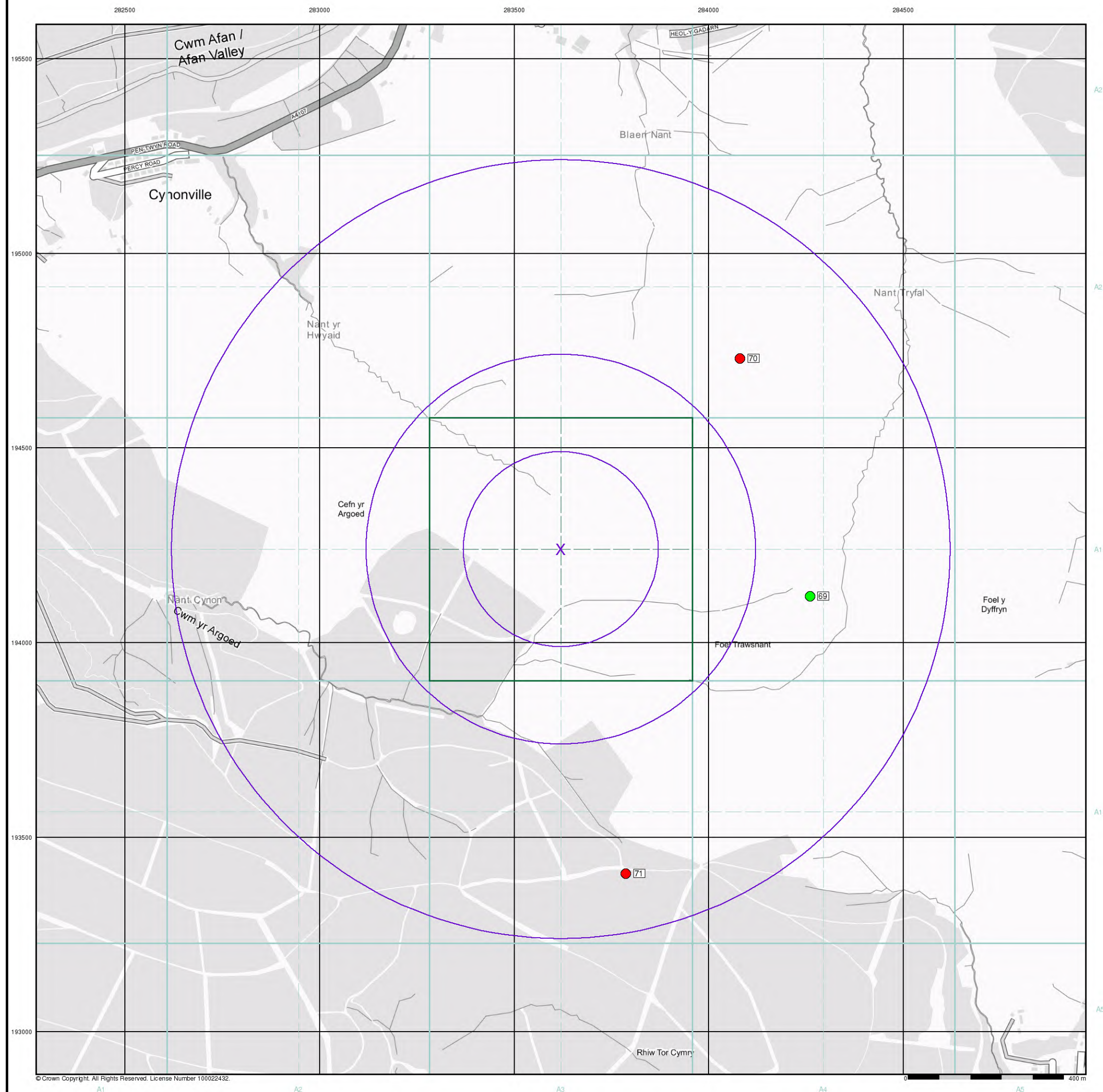


Order Details

Order Number: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm



Intégral Géotechnique

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

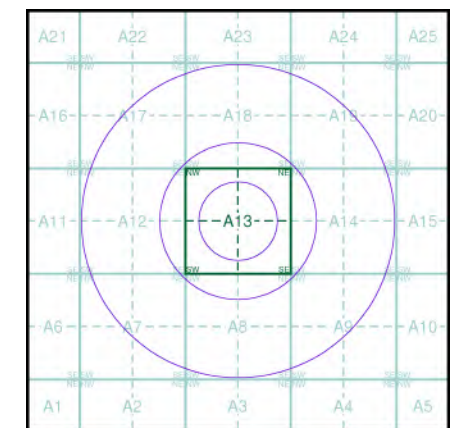
OS Water Network Data

- | | |
|--------------|-------------------------|
| Canal | Drain |
| Reservoir | Other |
| Foreshore | Lake |
| Marsh | Transfer |
| Tidal River | Lock Or Flight Of Locks |
| Inland River | Sea |

Contours (height in meters)

- Standard Contour 105 100 95
- Master Contour
- Spot Height 167.3
- MLW Mean Low Water
- MHW Mean High Water

OS Water Network Map - Slice A



Order Details

Order Number: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsant Windfarm

Landmark
INFORMATION GROUP

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Risk of Flooding from Surface Water

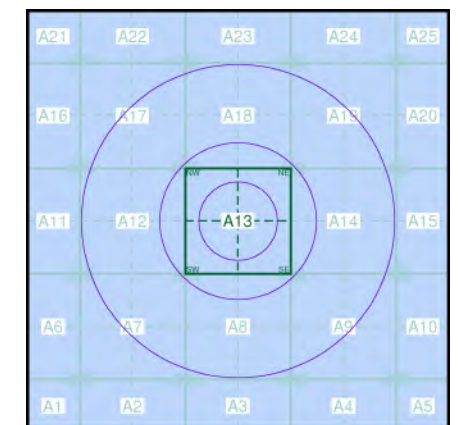
- High - 30 Year Return
- Medium - 100 Year Return
- Low - 1000 Year Return

Suitability

See the suitability map below

- National to county
- County to town
- Town to street
- Street to parcels of land
- Property

EAN/RW Suitability Map - Slice A

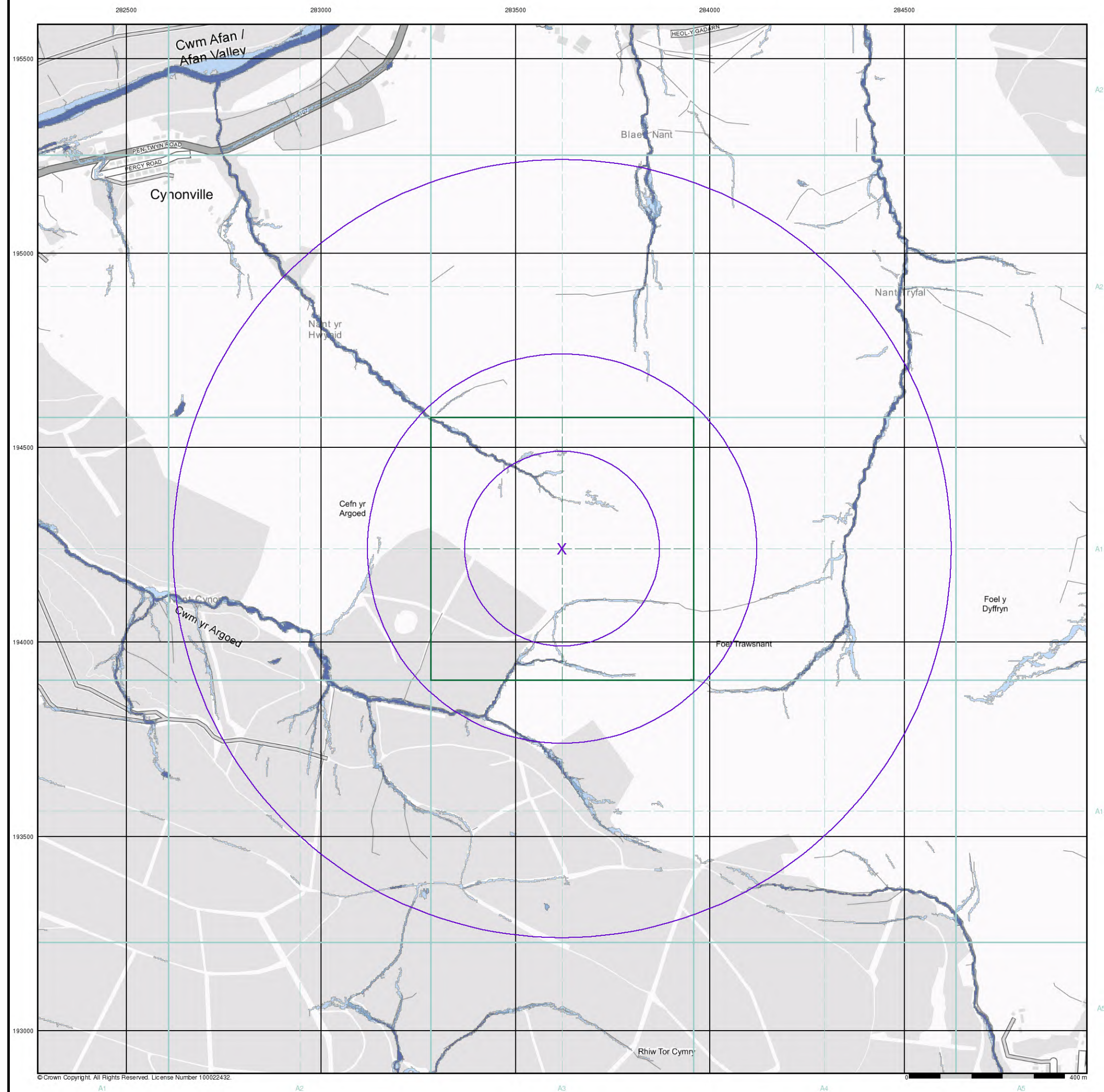


Order Details

Order Number: 279012478_1_1
Customer Ref: 12826/RAH
National Grid Reference: 283620, 194240
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

Foel Trawsnant Windfarm



Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	SLIP	Landslide Deposit	Unknown/Unclassified Entry	Not Supplied - Quaternary

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	TILLD	Till, Devensian	Diamicton	Not Supplied - Devensian
	GFDUD	Glaciofluvial Deposits, Devensian	Sand and Gravel	Not Supplied - Devensian
	PEAT	Peat	Peat	Not Supplied - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	BD	Brithdir Member	Sandstone	Not Supplied - Westphalian
	BD	Brithdir Member	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	RA	Rhondda Member	Sandstone	Not Supplied - Westphalian
	LLFB	Llynfi Member	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	RA	Rhondda Member	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	LLFB	Llynfi Member	Sandstone	Not Supplied - Westphalian
	SWUCM	South Wales Upper Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	SWMCM	South Wales Middle Coal Measures Formation	Mudstone, Siltstone and Sandstone	Not Supplied - Westphalian
	SWMCM	South Wales Middle Coal Measures Formation	Sandstone	Not Supplied - Westphalian
		Rock Segments		
		Faults		

Intégral Géotechnique

Geology 1:50,000 Maps

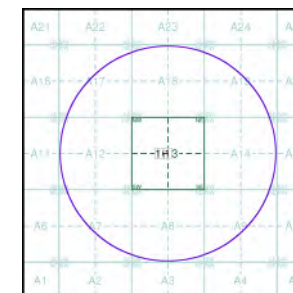
This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.

The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	1
Map Sheet No:	248
Map Name:	Pontypridd
Map Date:	1960
Bedrock Geology:	Available
Superficial Geology:	Available
Artificial Geology:	Not Available
Faults:	Not Supplied
Landslip:	Available
Rock Segments:	Not Supplied

Geology 1:50,000 Maps - Slice A



Order Details:

Order Number:	279012478_1_1
Customer Reference:	12826/RAH
National Grid Reference:	283620, 194240
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details:

Foel Trawsnant Windfarm