

Persimmon Homes East Wales

LAND AT ELM TREE GROVE, TWYNYRODYN

Outline Remediation Strategy Report

12690/LW/24/ORS

CLIENT: Persimmon Homes East Wales

PROJECT: Land at Elm Tree Grove, Twynyrodyn

TITLE: Outline Remediation Strategy Report

JOB NO: 12690

DOCUMENT REF: 12690/LW/24/ORS

Revision	Purpose Description	Originated	Reviewed	Authorised	Date
0	Issue	LW	RB	HP	May 2024

Geotechnical Engineers:

Intégral Géotechnique (Wales) Limited
Integral House
7 Beddau Way
Castlegate Business Park
Caerphilly
CF83 2AX

Tel: 029 2080 7991

CONTENTS

1.0 INTRODUCTION

- 1.1 General
- 1.2 Proposed Development

2.0 BACKGROUND

- 2.1 Site Location and Description
- 2.2 Available Site Investigation Data
- 2.3 Site History
- 2.4 Summary Ground Conditions
- 2.5 Identified Contamination
- 2.6 Detailed Site-Specific Risk Assessment – Soils
- 2.7 Detailed Site-Specific Risk Assessment – Controlled Waters

3.0 REMEDIATION STRATEGY

4.0 REMEDIATION IMPLEMENTATION

- 4.1 Objectives
- 4.2 Methodology
- 4.3 Operations

5.0 REMEDIATION VERIFICATION

- 5.1 Objectives
- 5.2 Remediation Verification Methodology and Data Gathering Requirements

6.0 FINAL REMEDIATION VALIDATION

FIGURES

- Figure 1 Site Location
- Figure 2 Proposed Development Layout
- Figure 3 Exploratory Hole Location Plot
- Figure 4 Groundwater Contour Plot
- Figure 5 Conceptual Site Model

1.0 INTRODUCTION

1.1 GENERAL

Intégral Géotechnique (Wales) Limited (IG) have been appointed as Geotechnical and Geoenvironmental Consultants by Persimmon Homes East Wales to prepare a remediation strategy for the redevelopment of Land at Elm Tree Grove, Twynyrodyn to a standard suitable for proposed residential end use. The location of the site is shown in Figure 1.

The development proposals include the construction of 121 No. conventional residential dwellings with private gardens, areas of public open space, and associated infrastructure such as access roads and areas of car parking.

A copy of the proposed development layout is presented in Figure 2.

The following reports have been produced by Intégral Géotechnique (Wales) Limited:

- Twynyrodyn, Mountain Hare, Merthyr Tydfil, Site Investigation Report, Report No. 9913/GNS/08, dated August 2008 (on behalf of Merthyr Tydfil Country Borough Council).
- Land at Elm Tree Grove, Twynyrodyn, Site Investigation Report, Report No. 12690/JJ/23/SI/RevA dated March 2024.

These reports have been relied upon as part of this remediation strategy and should be read in conjunction.

The purpose of this report is to provide a remediation strategy for the delivery of the site to a standard suitable for the proposed residential end use and details how the remediation works will be supervised and validated.

This report (including all appendices to it and any subsequent addendums or correspondence) has been prepared for the sole benefit, use and information of Persimmon Homes East Wales and no third party is entitled or permitted to rely on it. This report may not be used, reproduced or circulated (in whole or part) for any purpose without the written consent of Intégral Géotechnique (Wales) Limited. Intégral Géotechnique (Wales) Limited shall not be liable to any third party who does not have such express written permission to rely on the report for any losses they may suffer.

1.2 PROPOSED DEVELOPMENT

The development proposals include the construction of 121 No. conventional residential dwellings with private gardens, areas of public open space, and associated infrastructure such as access roads and areas of car parking.

A copy of the proposed development layout is presented in Figure 2.

2.0 BACKGROUND

2.1 SITE LOCATION AND DESCRIPTION

The site is situated off Elm Tree Grove, Twynyrodyn, Merthyr Tydfil. The centre of the site is situated at an approximate National Grid Reference of SO 059 057, see Figure 1. A site plan is presented in Figure 3.

The site is irregular in shape and occupies an area of approximately 5.6 hectares.

The site boundaries are defined by Elm Tree Grove and Oak Tree Rise to the east, the rear gardens of residential properties along Wallhead Road and Aneurin Crescent to the west, the rear gardens of residential properties along Wallhead Road to the north, and undeveloped land to the south.

The site topography slopes gently towards the south. The topographic elevation of site ranges from approximately 238m AOD at the northern boundary, to approximately 213m AOD at the southern boundary.

The site is generally covered by long grasses with fenced-off sections of semi mature trees and bushes. Invasive plant species including Japanese Knotweed have been identified in the eastern areas of the site.

It is understood that an existing culvert crosses the site in an approximate north-south direction. The accurate alignment, size and depth of this feature not been confirmed.

Live Welsh Water apparatus, including a foul rising main with an associated easement, cross the eastern edge of the site. An existing pumping station is also present adjacent to the eastern site boundary.

2.2 AVAILABLE SITE INVESTIGATION DATA

The following reports have been produced by Intégral Géotechnique (Wales) Limited:

- Twynyrodyn, Mountain Hare, Merthyr Tydfil, Site Investigation Report, Report No. 9913/GNS/08, dated August 2008 (on behalf of Merthyr Tydfil Country Borough Council).
- Land at Elm Tree Grove, Twynyrodyn, Site Investigation Report, Report No. 12690/JJ/23/SI/RevA dated March 2024.

2.2 AVAILABLE SITE INVESTIGATION DATA (CONTINUED)

These above reports should be reviewed in conjunction with this report to gain a detailed appraisal of the site and the works completed to date.

The Site Investigation reports produced by Intégral Géotechnique provide the information on which this Outline Remediation Strategy report is based.

2.3 SITE HISTORY

The history of the site was assessed with the aid of historical maps. The 1875 Edition shows the site area to be mostly surrounded by open fields. The site area is indicated to have comprised an undulating network of valleys and mounds of possible spoil. A brick works is indicated to have been present just inside the eastern site boundary. The Nant Cwm Blacks is indicated on or near the site's south-east boundary, flowing in a south-westerly direction. The Dowlais Railway is indicated approximately 70m north-west of the site boundary, running in a south-west to north-east direction. Various coal and ironstone shafts and levels are indicated to the north, east and south of the site.

The 1900 map indicates the presence of a coal level just inside the eastern site boundary. The Brick works is noted to have been demolished and removed by this time.

The 1919 map indicates the presence of an old coal level just inside, or close to the south-eastern site boundary. An old coal shaft is also indicated at Trebbedau, approximately 10-15m east of the site boundary.

The 1951 map indicates the development of residential housing up to the western site boundary. By this time, most of the site area is indicated to have been covered by tipped materials with a prominent valley and a small stream running from north to south close to the western boundary.

In the 1980s, the site formed part of the 'Cwm Blacks Reclamation Scheme' where the site was reclaimed and landscaped to form an area of public open space with a playground towards the northern tip of the site by the early 1990's.

The Google Earth images indicated that residential housing had been constructed within the land directly to the east of the site boundary by 2006. The former playground area in the northern part of the site had been used as a site compound for the residential development. The site compound area was cleared when the development was complete, and the area was indicated to be grass covered by 2008. A new playground area was constructed within the northern corner of the site by 2010.

2.4 SUMMARY GROUND CONDITIONS

2.4.1 Trial Pit/Trench and Shell and Auger Findings

The ground conditions encountered at the site generally consisted of a variable thickness of made ground over glacial till deposits, underlain by the South Wales Lower Coal Measures bedrock.

A summary of the shallow ground conditions encountered across the site is presented below in Table 1.

Table 1: Summary of Ground Conditions		
Depth (m)		Stratum
From	To	
0.00	0.90/14.00	MADE GROUND: Typically comprising loose to medium dense, brown, dark brown, dark grey and black slightly silty gravel with occasional to frequent cobbles of tabular mudstone and sandstone. Gravel is fine, medium, and coarse angular and tabular mudstone and rarely sandstone and coal [Historical Colliery Spoil].
0.00	2.60/2.80	MADE GROUND: Typically comprising loose dark grey and brown silty gravelly SAND with occasional to frequent cobbles. Gravel is fine to coarse angular of sandstone and mudstone. With occasional glass, metal, ash, and ceramic – <i>Encountered at TP110, TP110A, TP110B, and TP110C only.</i>
0.90/12.10	2.50/12.80	GLACIAL TILL: Typically comprising firm becoming firm to stiff grey mottled orange, brown, slightly silty, slightly gravelly to gravelly CLAY with frequent cobbles and boulders (0.4 x 0.5m) of sandstone and siltstone. Gravel is fine, medium, and coarse rounded and sub-rounded sandstone and siltstone. Gravel is fine, medium, and coarse rounded and sub-rounded sandstone and tabular mudstone and siltstone.

An exploratory hole location plan is presented in Figure 3.

Made ground was encountered at each exploratory hole location and extended to depths of between approximately 0.90m and 14.0m bgl, where accurately proven.

2.4 SUMMARY GROUND CONDITIONS (CONTINUED)

The variable thickness of made ground is dictated by the historical topographical nature of the site (prior to the Cwm Blacks Restoration Scheme), and the infilling works undertaken during the reclamation scheme of the 1980s which involved the infilling of former valleys.

Generally, the made ground was relatively consistent in physical nature and comprised relatively homogenous material comprising gravels of mudstone and sandstone.

However, increasingly heterogeneous and variable made ground was encountered in TP1, TP2 and TP7, with such deposits frequently characterised by their cohesive nature and the presence of anthropogenic materials including gravel, cobbles and rarely boulders, of brick, metal, plastic, ceramic, and pottery.

Similarly, more variable made ground was also encountered at TP110, TP110A, TP110B, and TP110C, with such deposits characterised by increased quantities of anthropogenic materials including ash and glass.

The made ground was found to be underlain by either glacial till or in direct contact with the bedrock strata. The presence of glacial till was predominantly concentrated around the peripheral margins of the site.

2.4.2 Rotary Borehole Findings

The purpose of the rotary boreholes was to establish the depth to, and amount of competent rock cover above any shallow coal seams / ironstone veins, and any associated old mine workings, in order to assess the potential shallow mining risk.

Rockhead was encountered at depths ranging from approximately 4.90m bgl (in BH01) to 11.70m bgl (in BH10).

Evidence of shallow coal seams were encountered in 16 out of 23 No. boreholes. The thicknesses of the encountered coal seams ranged between approximately 0.30m and 1.20m.

Eight out of the 23 No. boreholes encountered evidence of old mine workings, indicating an extraction ratio of approximately 35%.

The measured rock cover above the encountered coal seams and mine workings ranged from approximately 0.40m (at R14) to approximately 19.10m (at R3).

2.4 SUMMARY GROUND CONDITIONS (CONTINUED)

2.4.3 Groundwater

No significant groundwater inflows were identified in the trial pit excavations, although soils noted to be wet/damp or minor water seepages were identified in TP1, TP2, TP3, TP8, TP9, TP12, TP109, TP110E and TP111 at depths of between approximately 1.00m and 4.10m bgl. It is probable that such incidences are associated with the presence of pockets of perched water in the made ground deposits.

The shell and auger boreholes and rotary boreholes were noted to be dry during their drilling.

Return visits to the site have been undertaken to monitor groundwater levels in the borehole installations.

It is evident from both the observations of groundwater levels during the site investigation works, and from the later groundwater monitoring, that two groundwater bodies may exist on site.

Shallow perched water was observed periodically in the made ground and superficial deposits, whilst a deep and potentially more mobile groundwater regime has been identified at depth within the solid strata.

The perched water level has been found to fluctuate, and in fact was not present in many of the boreholes across the site. It is considered that perched water reacts to rainfall infiltrations, temporarily perching the water prior to its gradual infiltration into the ground. The perched water body is therefore not considered to represent a continuous water body flowing beneath the site, but instead pockets of accumulated water from rainfall infiltrations.

Deeper groundwater has been identified within the mudstone bedrock in boreholes R14, BH105, and BH106. Although groundwater has not been identified in other deep rotary boreholes, boreholes R3 and R4 were damp towards the base of the holes. It has therefore been assumed that groundwater level must be close to these depths and, together with the groundwater data from borehole R14, a deep groundwater contour plot has been created as shown on Figure 4. Groundwater flow is indicated to be in a south-westerly direction.

From the groundwater contour plot a hydraulic gradient within the mudstone bedrock of 0.003 has been calculated.

2.5 IDENTIFIED CONTAMINATION

2.5.1 Soil Contamination

The following exceedances were recorded in the tested made ground samples:

- Petroleum hydrocarbon compound (Aromatic C5-C7) was recorded at a concentration of 0.2mg/kg in TP19 (0.50m bgl) which exceeds the adopted S4UL of 0.1mg/kg.
- Dibenzo(ah)anthracene was recorded at a concentration of 0.26mg/kg in TP110 (0.50m bgl) which exceeds the adopted S4UL of 0.24mg/kg.
- Beryllium was recorded at a concentration of 2.0mg/kg in TP110 (0.50m bgl) which exceeds the adopted S4UL of 1.7mg/kg.
- Lead was recorded at a concentration of 230mg/kg in TP110 (0.50m bgl) which exceeds the adopted C4SL of 200mg/kg.

In addition to the above identified soil contamination, visible fragments of asbestos containing material (ACM), confirmed to comprise chrysotile hard/cement type material, were observed in the made ground deposits at TP110 (0.50m) and TP110B (0.50m).

2.5.2 Soil Leachate

Most of the results were below the laboratory detection limits, or the relevant published screening values.

However, a single elevated concentration of fluoranthene was recorded in a made ground sample from TP12 (0.60m bgl). The recorded concentration of 0.02ug/l exceeds the adopted AA-EQS of 0.0063ug/l, but it is significantly below the MAC-EQS of 0.12ug/l.

No further exceedances were recorded in the tested soil leachate samples.

2.5.3 Groundwater Contamination

During the 2008 site investigation groundwater samples were obtained from both the perched and deeper groundwater body and three rounds of groundwater monitoring were undertaken.

Most of the results were below the laboratory detection limits or the relevant published guideline values. Within the perched groundwater exceedances of nickel, zinc, mercury and several PAH compounds and a localised exceedance of two petroleum hydrocarbon chains were detected. Within the deeper groundwater exceedances of nickel, zinc and several PAH compounds and two petroleum hydrocarbon chains were detected.

2.5 IDENTIFIED CONTAMINATION (CONTINUED)

Further groundwater monitoring of the deeper groundwater body was undertaken as part of the 2023 site investigation. It should be noted that the majority of the monitoring wells were noted to be dry, and no perched/shallow groundwater body was encountered within the boreholes.

Most of the results were below the laboratory detection limits, or the relevant published guideline values. However, some exceedances of copper, nickel and zinc have been recorded.

All organic contaminants (PAHs and petroleum hydrocarbons) and VOCs were recorded at concentrations below laboratory detectable limits.

With regards to copper and nickel in groundwater, 'Predicted No-Effect Concentrations' (PNECs) have been calculated utilising the Water Framework Directive M-BAT Tool and average measured values of pH, DOC, and calcium. A site specific PNEC of 5.89 ug/l has been calculated for copper. All the concentrations of copper are below the calculated PNEC. A site specific PNEC of 16.06 ug/l has been calculated for nickel. All the concentrations of nickel are below the calculated PNEC.

The recorded metal concentrations are not considered significant and are likely to be representative of normal background levels.

2.5.4 Ground Gas

The results of the 2008 and 2024 ground gas monitoring programmes, recorded a maximum methane concentration of 3.1% and a maximum carbon dioxide concentration of 5.1%. A maximum gas flow rate of <0.3l/hr was measured during the gas monitoring programme.

Due to elevated concentrations of methane and carbon dioxide, the site has been classified as 'Amber 1' in accordance with the NHBC Traffic Light System, and 'CS2' in accordance with BS8485:2015+A1:2019.

As per NHBC guidance, a Detailed Design Report for the required ground gas protection system should be prepared by a suitably qualified and competent person in accordance with BS8485. The Detailed Design Report should include a verification plan based on the site-specific design in accordance with CIRIA C735.

2.5 IDENTIFIED CONTAMINATION (CONTINUED)

All excavations should be regularly checked for safe atmospheres, including oxygen levels, and guidance sought should low oxygen levels be identified in excavations/confined spaces.

No radon protective measures are required for the site.

2.6 DETAILED SITE-SPECIFIC RISK ASSESSMENT - SOILS

The general approach for assessing the potential risk to a receptor is by a combination of qualitative and quantitative risk assessment.

A quantitative risk assessment would involve selecting and deriving generic assessment criterion to compare low risk substances, based on the fate, transport and toxicological properties and the exposure scenario being considered.

Localised elevated concentrations of lead, beryllium, petroleum hydrocarbon (Aromatic C5-C7), and the PAH compound dibenzo(ah)anthracene were detected within the made ground.

Additionally, asbestos containing material (ACM) comprising fragments of chrysotile hard/cement type material, were locally observed within the made ground at TP110 and TP110B in an area where the made ground was observed to be more ash-rich with increased anthropogenic constituents. The approximate extent of the ashy made ground is shown in Figure 3.

There are no published screening criteria values for asbestos, and neither are there any in preparation. As discussed in CIRIA Report C733 Asbestos in Soil and Made Ground: a Guide to Understanding and Managing Risks, agreement has yet to be reached in the UK on an appropriate toxicological criterion on which a screening value for asbestos could be based. It also states that 'based on current knowledge, it is believed that a scientifically defensible UK GAC (generic acceptance criteria) for asbestos in soil cannot be developed or imported'.

It is therefore considered that a more qualitative assessment of the potential risk is appropriate, as asbestos is determined to be a non-threshold substance.

2.6 DETAILED SITE-SPECIFIC RISK ASSESSMENT – SOILS (CONTINUED)

CIRIA Report C733 states that asbestos (asbestos containing materials and asbestos containing soils) only present a risk to human health if airborne fibres are released into the atmosphere. The report goes on to state that the number of fibres released into the air from asbestos containing soils is likely to be influenced by a number of site-specific factors, as listed below:

- Characteristics of the asbestos (concentration, degree of heterogeneity, depth in relation to final ground level, volume/area, type, condition, extent of bonding, weathering, fraction of free fibres, shape of fibres)
- Characteristics of the soil (type, moisture content, surface vegetation, presence of hard standing)
- Weather (humidity, precipitation, temperature, ground freezing, wind speed and direction)
- Land use/soil disturbing activities (behaviour of receptors, distance between receptor and source, types of activity, duration/frequency of activity, dust mitigation measures).

The depth below ground level of the asbestos containing soils is imperative to the potential risk posed.

CIRIA Report C733 states that in the absence of significant physical disturbance, exposure to airborne asbestos fibres from soil will be from friable materials or asbestos fibres present at, or very close to, the soil surface (the soil – air interface).

Materials that have been buried, or are below the soil surface, will pose a lower, or less immediate risk, as these materials are unable to release airborne fibres unless brought to the soil surface by physical activity/disturbance.

Given the contamination recorded within the made ground, it is considered that a potential risk to human health may exist via the following relevant contaminant pathways:

- Dermal contact
- Ingestion of soil or soil derived dust
- Inhalation of soil born dust
- Indoor inhalation of ground gas
- Migration of contaminants in ground to drinking water supply pipes

It is considered that remedial measures will be necessary to protect future site users and construction site operatives from the contamination recorded within the made ground.

2.6 DETAILED SITE-SPECIFIC RISK ASSESSMENT – SOILS (CONTINUED)

The remedial measures to be carried out have been designed to address the identified potential active contaminant pathways listed above.

2.7 DETAILED SITE-SPECIFIC RISK ASSESSMENT – CONTROLLED WATERS

2.7.1 Hydrological Setting

The groundwater regime beneath the site generally comprises sporadic occurrences of shallow/perched groundwater within the made ground (caused by surface water infiltration), separated from a significantly deeper and likely continuous groundwater body present within the underlying mudstone bedrock strata.

The site investigation data suggests that the observed occurrences of shallow/perched groundwater are not representative of a continuous groundwater body flowing beneath the site. The majority of the boreholes positioned across the site drilled dry, and very minimal groundwater was subsequently recorded during the monitoring of the installed wells. Based on these observations, the minimal shallow/perched groundwater occurrences that have been observed are considered to be representative of laterally impersistent pockets of infiltrated surface water.

During the previous 2008 site investigation, deep groundwater was identified within the mudstone bedrock in rotary borehole R14. Although groundwater was not identified in any of the other deep rotary boreholes at this time, it was noted that that boreholes R3 and R4 were recorded as damp towards their base depths (it was therefore assumed that the deep groundwater level must be close to these depths at these locations). Additionally, during the supplemental 2023 site investigation, deep groundwater was also encountered at BH105 and BH106.

A deep groundwater contour plot is shown In Figure 4. The groundwater contour plot indicates that the deep groundwater body flows in the general south-westerly direction towards the River Taff. A relatively shallow hydraulic gradient of approximately 0.003 has been calculated.

An illustrative conceptual site model is shown in Figure 5.

Based on a review of the site investigation data, it is considered that the main groundwater body beneath the site lies at significant depth (in excess of 30m bgl) and within the mudstone bedrock. Any lateral groundwater migration is anticipated to occur in this stratum.

2.7 DETAILED SITE-SPECIFIC RISK ASSESSMENT – CONTROLLED WATERS (CONTINUED)

The groundwater contamination testing results did not demonstrate any clear evidence of a potential vertical linkage between the shallow/perched groundwater and the deep groundwater beneath the site.

2.7.2 Shallow/Perched Groundwater

It is noted that some slightly elevated contaminants (namely PAH compounds) were identified within tested samples of the shallow/perched groundwater obtained during the previous 2008 site investigation works. However, due to the discontinuous/impersistent nature of the shallow/perched groundwater occurrences beneath the site, and the lack of evidence to support potential vertical contaminant migration to the deep groundwater body, the occurrences of shallow/perched groundwater are not considered to present a risk to off-site environmental receptors such as the River Taff.

Note that no evidence of a shallow/perched groundwater body was recorded during the more recent 2023 site investigation works.

The underlying deep groundwater body within the mudstone bedrock is considered to be the primary receptor of any migrating contaminants. Consequently, the risk assessment addressed the maximum concentrations of contaminants recorded within the deep groundwater body beneath the site.

2.7.3 Deep Groundwater

The test results for samples of the deep groundwater recovered from borehole R14 during the 2008 site investigation recorded elevated concentrations of zinc and petroleum hydrocarbon bands C16-C44 Aliphatic and C16-C44 Aromatic above the adopted guideline values (including the calculated site-specific PNEC values discussed in Section 8.5). However, it should be noted that no elevated contaminant concentrations were recorded during the 2023 supplemental groundwater sampling and testing works.

No potential contaminative source has been identified on site and considering the significant depth of the groundwater body within the mudstone bedrock, it is reasonable to conclude that the previously recorded 2008 groundwater contamination was flowing beneath the site from an off-site source.

In order to assess the potential risk of these contaminants to groundwater quality and the River Taff a detailed quantitative risk assessment (DQRA) using the Environment Agency Remedial Targets Methodology (RTM) Worksheet has been completed.

2.7 DETAILED SITE-SPECIFIC RISK ASSESSMENT – CONTROLLED WATERS (CONTINUED)

The results of the DQRA indicate that the maximum detected concentrations of petroleum hydrocarbons from 2008 do not pose a risk to groundwater quality beyond the down hydraulic gradient site boundary. Furthermore, it is important to note that no elevated petroleum hydrocarbons concentrations were recorded within the deep groundwater during the supplemental 2023 site investigation works.

The results also indicate that the maximum measured concentrations of zinc from 2008 exceed the freshwater EQS remedial target at the site boundary. However, it should be noted that no elevated concentrations of zinc were recorded within the deep groundwater during the supplemental 2023 site investigation works. As such zinc is not considered to be a contaminant of concern.

Based on the results of the groundwater and soil testing, and the subsequent DQRA, the overall level of risk to controlled waters from site sourced contamination is considered to be low and no groundwater remedial measures are considered necessary at the site.

3.0 REMEDIATION STRATEGY

The findings of the site investigation carried out across the site has identified that a potential risk to end users is present from the contamination recorded within the made ground.

A remediation strategy is proposed such that the site is prepared to a standard suitable for the proposed residential end use.

The following remediation strategy is proposed for the site:

- Following site strip, exposed formations and any excavated made ground should be visually inspected for potential asbestos containing materials (ACM) by asbestos awareness trained site personnel. Any suspected ACM should be handpicked by a suitably licenced contractor in accordance with an appropriate risk assessment and managed in accordance with the requirements of the Control of Asbestos Regulations (2012).
- Any handpicked ACM should be disposed off-site at a suitable licensed facility as hazardous waste. Daily records and waste transfer notes should be kept in order to document the identification and subsequent removal of any ACM. These records and waste transfer notes should be made available for review as they will be required for potential remediation verification.
- A capping layer, of a minimum 600mm thickness, of clean inert imported subsoil and topsoil will be required in all gardens and areas of soft landscaping that are underlain by made ground. A geotextile separation membrane should be placed at the base of the capping soils to maintain the integrity of the capping layer and to prevent the upwards migration of contamination.
- A system should be established by which any 'unusual' materials (such as any unforeseen contamination, such as petroleum hydrocarbons or asbestos containing material) that may be encountered are reported rapidly to the site management, so that the appropriate action may be taken, following specialist advice if necessary. An unusual material may be identified on site by colour, odour or physical nature.
- As per NHBC guidance, a Detailed Design Report for the required ground gas protection system should be prepared by a suitably qualified and competent person in accordance with BS8485. The Detailed Design Report should include a verification plan based on the site-specific design in accordance with CIRIA C735.

3.0 REMEDIATION STRATEGY (CONTINUED)

- Installation and verification of CS2 compliant ground gas protective measures by a specialist contractor, in accordance with CIRIA C735.
- Drinking water supply pipe specification to be agreed between Persimmon Homes East Wales and DCWW.

4.0 REMEDIATION IMPLEMENTATION

4.1 OBJECTIVES

The main objective of the proposed remediation works is to render the site suitable for residential end use. In order to achieve this objective, it is necessary to break any potential pathways between proposed site end users and the locally encountered contaminated soils.

4.2 METHODOLOGY

The remediation works required in order to meet the objectives defined above will be undertaken as follows:

- During site clearance works and during construction, all exposed formations within the site should be visually inspected by an asbestos awareness trained ground worker. Any identified asbestos containing materials (ACM) should be reported to the site management and picked/disposed of by a licensed asbestos contractor.
- Any excavated material (e.g arising from foundation and drainage runs excavations, site strip etc.) from within the site should be visually inspected by an asbestos awareness trained ground worker. Any identified ACM should be reported to the site management and picked/disposed of by a licensed asbestos contractor.
- All of the above works should be carried out under an appropriate risk assessment and managed in accordance with the Control of Asbestos Regulations 2012. Any handpicked ACM should be disposed off-site at a suitable licensed facility as hazardous waste.
- Daily records and waste transfer notes should be kept in order to document the identification and subsequent removal of any ACM. These records and waste transfer notes should be made available for review as they will be required for potential remediation verification.
- A system should be established by which any 'unusual' materials and potential hotspots of contamination (including any unforeseen contamination such as petroleum hydrocarbons or asbestos containing material) that may be encountered are reported rapidly to the site management, so that the appropriate action may be taken, following specialist advice if necessary. An unusual material may be identified on site by colour, odour or physical nature.

4.2 METHODOLOGY (CONTINUED)

- Installation of capping layer, of a minimum 600mm thickness, of clean inert imported subsoil and topsoil in all gardens and areas of soft landscaping that are underlain by made ground. A geotextile separation membrane should be placed at the base of the capping soils to maintain the integrity of the capping layer and to prevent the upwards migration of contamination.
- The undertaking of a Detailed Design Report for the required ground gas protection system by a suitably qualified and competent person in accordance with BS8485. The Detailed Design Report should include a verification plan based on the site-specific design in accordance with CIRIA C735.
- Installation and verification of CS2 compliant ground gas protective measures by a specialist contractor, in accordance with CIRIA C735.
- Installation of appropriate drinking water supply pipes.

The site will be deemed remediated by the following active remedial measures:

- Handpicking and removal of any encountered ACM by a licensed asbestos contractor.
- Incorporation of a robust clean 600mm thick capping layer within proposed garden and soft landscaped areas that are underlain by made ground, with a geotextile separation membrane at the base of the capping soils.
- Installation and verification of CS2 ground gas protective measures by a specialist contractor, in accordance with CIRIA C735.
- Provision of DCWW agreed drinking water supply pipe.

Review of the methodologies will be a continuing process and subject to findings of the proposed validation works, and if necessary further quantitative and qualitative risk assessments.

4.3 OPERATIONS

The works are to be undertaken by a specialist contractor experienced in brownfield reclamation/remediation. The remediation works will be monitored by Intégral Géotechnique (Wales) Limited.

Site preparation and operational constraints will be covered in the contractor's method statements. These should include the contractor's proposals for controls and monitoring of dust, noise, vibrations and odour.

Site procedures for managing the remedial works in a manner that will not cause pollution to controlled waters will be covered in the contractor's method statements which will be submitted in discharge of the Conditions of Planning.

The proposed remediation works will be controlled by the appropriate mobile treatment license to be held by the remediation contractor, if such works become necessary. The conditions imposed under the planning process will be considered adequate to control the works.

Additionally, a system should be established by which any 'unusual' materials that may be encountered are reported rapidly to the site management, so that the appropriate action may be taken, following specialist advice if necessary. An unusual material may be identified on site by colour, odour or physical nature.

5.0 REMEDIATION VERIFICATION

5.1 OBJECTIVES

A remediation verification report is required in order to record the data gathering necessary to demonstrate that the works have been carried out in accordance with the agreed strategy, confirm that the works satisfy the site remediation criteria and that the site is suitable for the proposed development.

5.2 REMEDIATION VERIFICATION METHODOLOGY AND DATA GATHERING REQUIREMENTS

The site reclamation/remediation will be verified by the following measures:

- Evidence to be provided of the site records and waste transfer notes relating to identification and subsequent removal of any asbestos containing materials (ACM).
- Validation of the geotextile separation membrane at the base of the capping soils.
- Validation of the chemistry and thickness of the proposed 600mm capping layer to be placed within any gardens and areas of soft landscaping that are underlain by made ground.
- Certification of installation and verification of CS2 compliant ground gas protective measures by a specialist contractor, in accordance with CIRIA C735.
- Notification in the CDM file of residual risks associated with the remediated site.
- Certification of installation of DCWW agreed drinking water supply pipe.

6.0 FINAL REMEDIATION VALIDATION

The development will not be complete, in accordance with the remediation strategy for the site, until all visible ACM has been handpicked, installation and verification of appropriate CS2 ground gas protective measures, installation of an appropriate of DCWW agreed drinking water supply pipe and placement of the final 600mm (minimum thickness) of clean imported capping soils over a geotextile separation membrane in all gardens and soft finished areas that are underlain by made ground.

In order to validate these works a series of hand dug pits will be excavated to confirm an adequate thickness of inert soils are in place. A photographic record will be kept. The capping system is to comprise imported clean inert materials conforming to the Requirements for the Chemical Testing of Imported Materials for Various End Uses and Validation of Cover Systems prepared by Welsh Land Contamination Working Group and satisfy appropriate soil guideline values for residential development with gardens. Samples of topsoil and subsoil will be taken for laboratory analysis, at a rate of 4 per 250m³.

Placement of the required final 600mm capping layer will be the responsibility of the developer and is usually undertaken on a plot by plot basis, late in the development programme, as plots are completed.

Reporting of the clean capping to garden areas will be submitted independently of the remediation works.

In order to aid drainage of the garden areas, it is recommended that the surface of the engineered formation is raked and loosened prior to the placement of the required geotextile separation membrane at the base of the 600mm thick capping layer.

FIGURES

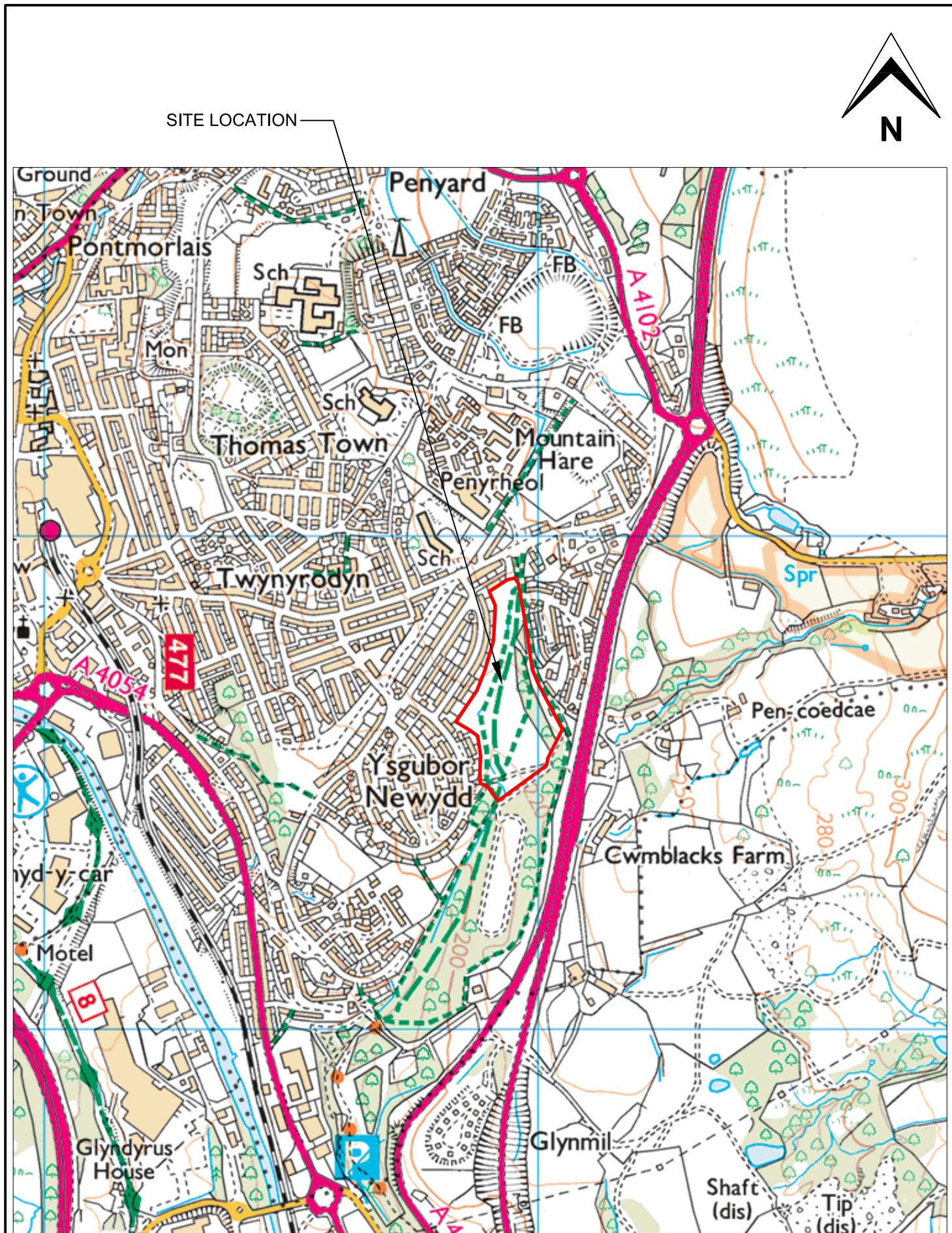


Figure 1: Site Location

Project: Land at Elm Tree Grove, Twynyrodyn

Job no.: 12690

Client: Persimmon Homes East Wales

Scale: 1:10,000 at A4

Intégral
Géotechnique

Integral House,
7 Beddau Way,
Castlegate Business Park,
Caerphilly,
CF83 2AX.
Tel: 029 2080 7991

LEGEND

APPROXIMATE SITE BOUNDARY



APPROXIMATE TRIAL PIT/TRENCH LOCATION (2008)



APPROXIMATE BOREHOLE LOCATION (2008)



APPROXIMATE PROBEHOLE LOCATION (2008)

APPROXIMATE SCALE = 1:2,500



APPROXIMATE GROUNDWATER CONTOUR

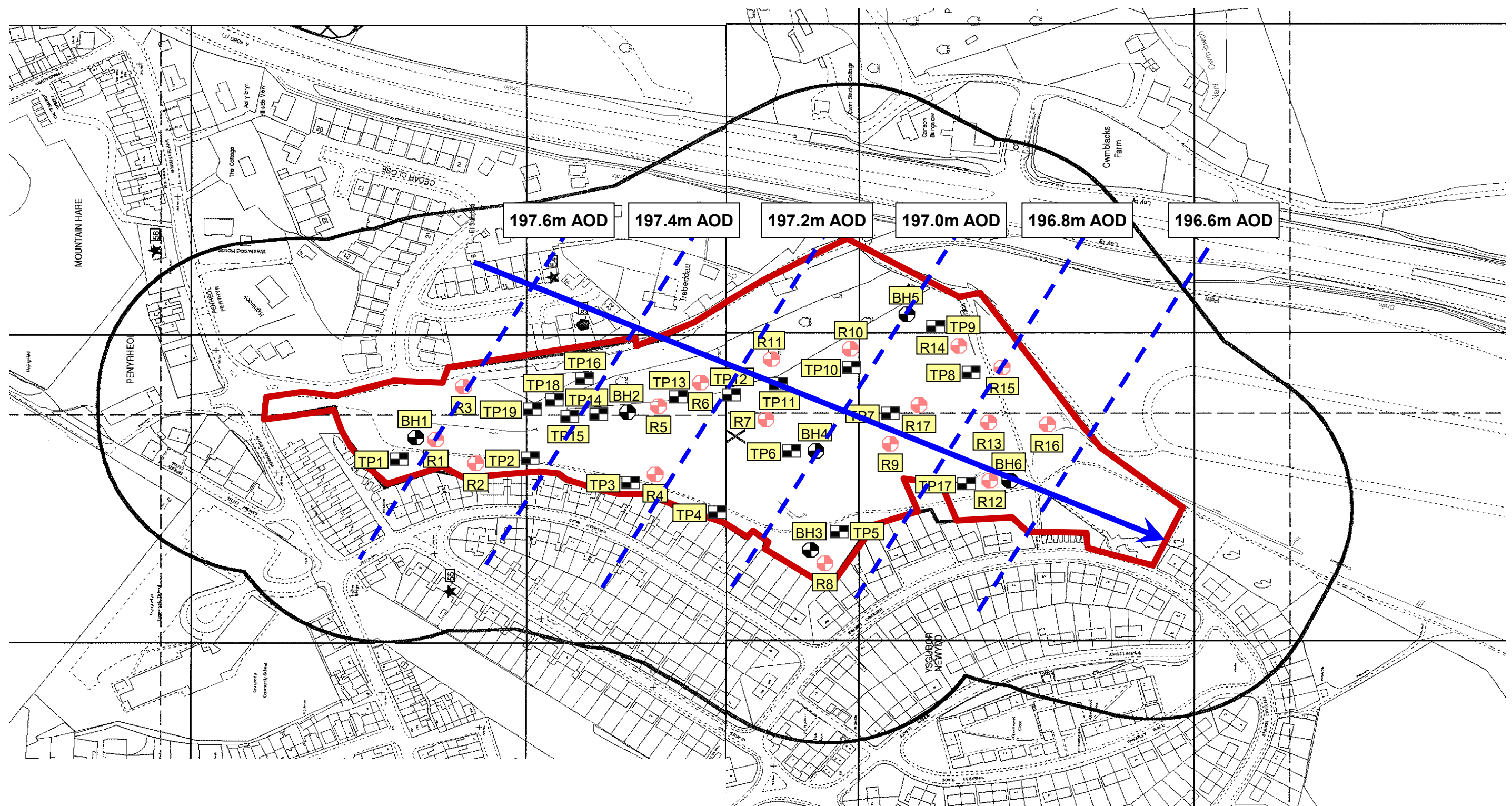


APPROXIMATE GROUNDWATER FLOW DIRECTION

CALCULATED HYDRAULIC GRADIENT = 0.003



NORTH

**FIGURE 4 - GROUNDWATER CONTOUR PLOT**

Land at Elm Tree Grove, Twynrodyn

Intégral
Géotechnique50 Cathedral Road
Cardiff
CF11 9LL
Tel: 029 20220462
Fax: 029 20340789

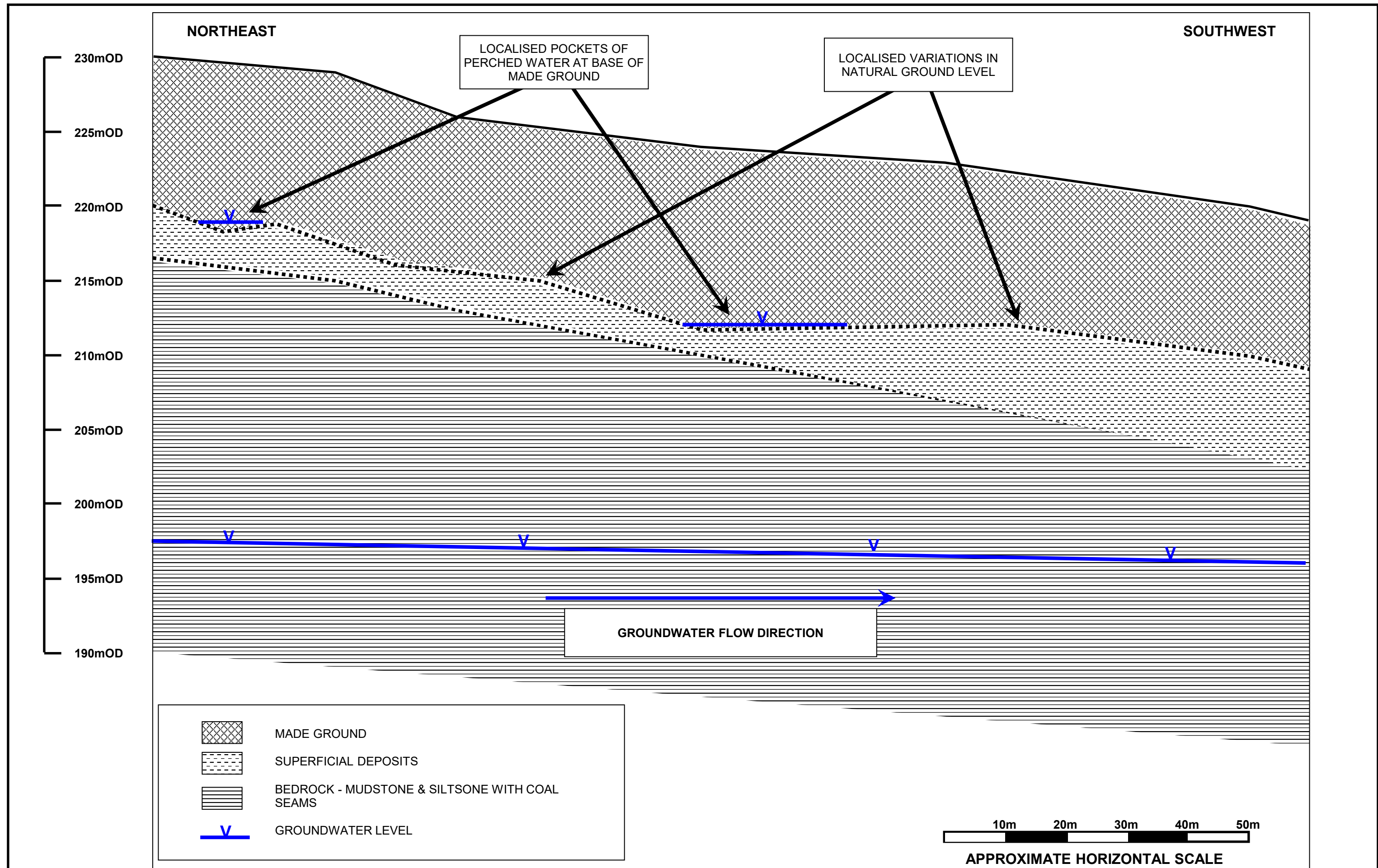


FIGURE 5 - CONCEPTUAL SITE MODEL

Land at Elm Tree Grove, Twynyrodyn

Intégral
Géotechnique

50 Cathedral Road
Cardiff
CF11 9LL
Tel: 029 20220462
Fax: 029 20340789