

FloodSmart Plus



Flood Consequence Assessment

Site Address

Land at Celtic Bunkhouse
10 School Road
Troedyrhiw
CF48 4JS

Date

2023-08-04

Report Status

FINAL

Grid Reference

307174, 202446

Site Area

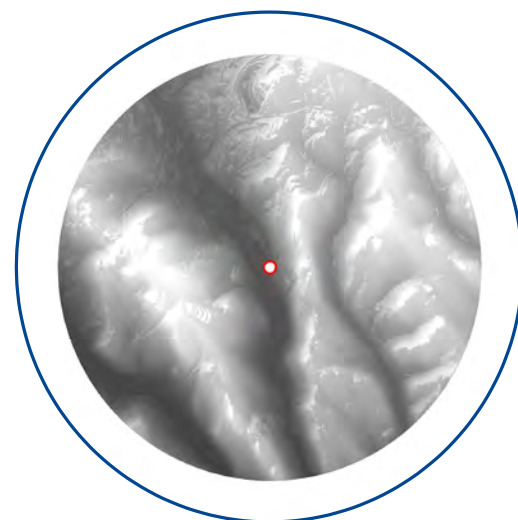
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Report Prepared for

Mr Gareth James and Mr Ashley Edwards

Report Reference

79872.02R1



RISK – Very Low to Moderate

The Site is located in Flood Zones 1 and 2, which equates to a Very Low to Medium probability of flooding from rivers and the sea. A review of flood model data indicates that the Site would not be at risk of fluvial flooding and therefore the actual risk is considered to be Very Low. Surface water (pluvial) flood risks are Very Low to Low. Groundwater flood risks are judged to be Moderate and flooding risks from artificial sources (i.e. canals, reservoirs and sewers) are Low. Mitigation measures are recommended in this report to reduce the risks to an acceptable level over the lifetime of the development.

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1. Executive summary



The Planning Policy Wales (PPW) 11th edition (2021) and Technical Advice Note 15 (TAN 15) (2004) requires Flood Consequence Assessments (FCA) to review flooding from all potential sources. A review has been undertaken of national environmental data sets to assess the potential flood risk to the Site. The review is provided within this concise interpretative report written by an experienced GeoSmart consultant.

It should be noted that the TAN15 (2004) is anticipated to be updated in June 2023 and a new Flood Map for Planning will be published at the same time to support this. The new Flood Map for Planning will supersede the NRW's Development Advice Map (DAM) and the conclusions of this report may change as a result. However, this is yet to be implemented and this report is based upon TAN15 (2004) and DAM.

Site analysis

Source of Flood Risk	Baseline ¹	After analysis ²	After Mitigation ³
River (fluvial) flooding	Very Low to Low	Very Low	N/A
Sea (coastal/tidal) flooding	Very Low		N/A
Surface water (pluvial) flooding	Very Low to Low		Very Low
Groundwater flooding	Low to Moderate	Moderate	Low
Other flood risk factors present	Yes (Reservoirs)		N/A
Is any other further work recommended?	Yes	Yes	Yes (see below)

1 BASELINE risks assigned for the whole Site, using national risk maps, including the benefit of NRW flood defences.

2 AFTER ANALYSIS risks include modification of risk assessments based on detailed site specific analysis including some or all of the following: flood model data, high resolution mapping, building location, access routes, topographic and CCTV surveys.

3 AFTER MITIGATION risks include risks to the proposed development / asset and occupants if mitigation measures recommended in this report are implemented, including the impacts of climate change.

*N/A indicates where mitigation is not required.

Summary of existing and proposed development

The Site is currently used within a residential capacity as a garden associated with Celtic Bunkhouse, situated adjacent to the east of the Site. Development proposals comprise the construction of two identical 3-storey dwellings with associated patios, parking and landscaping. According to Site plans, the Finished Floor Levels (FFL) of the proposed dwellings will be 140.90 mAOD, indicating ground levels will be lowered as part of the development proposals.

Summary of flood risks

The flood risks from all sources have been assessed as part of this report and are as follows:

- Historical flooding related to the inability of local drainage systems to cope with storm water flow is understood to have previously occurred at the Site.

River (fluvial) and Sea (Estuarine/Coastal) flooding

- According to NRW's Flood Map for Planning, the Site is located within fluvial Flood Zones 1 and 2.
- The NRW's Development Advice Map (DAM) confirms the Site is located within a DAM Zone B.
- The Site does not benefit from the presence of flood defences, and there are no formal flood defences within the vicinity of the Site.
- According to the NRW's Flood Risk Assessment Wales (FRAW) map, which considers the type, condition and crest height of flood defences, the Site has a risk of flooding ranging from Very Low to Low from the nearby watercourse, the River Taff. However, a review of the flood model data and local topography indicates the fluvial flood risk is likely to be lower.
- Modelled flood data obtained from the NRW has been analysed in line with the most up to date guidance on climate change to confirm a maximum "design" flood level at the Site.

During a 1 in 100 year plus 25% climate change allowance event the flood level at the Site would be 138.86 mAOD.

During this event, the Site would not be at risk of flooding as it is situated on higher ground relative to the floodplain area located to the west of the Site.

- Emergency evacuation routes are available to the northeast. In the event of a flood, safe refuge can be taken on the 1st floor levels and above.

Surface water (pluvial) flooding

- According to NRW's Flood Risk Assessment Wales (FRAW) mapping, the Site has a risk of flooding from surface water and small watercourses ranging from Very Low to Low.

Flooding depths of up to 0.3 m would impact isolated areas of the Site, however, due to the resolution of the NRW's mapping it is not possible to determine how the proposed

development would be impacted. It is therefore assumed that the Site is potentially impacted by flooding of up to 0.3 m in depth.

It is noted that according to Site plans (Appendix A), ground levels across the Site are proposed to be lowered. Therefore, the flood depths that could be anticipated at the proposed development in the Low risk scenario may be greater than shown on NRW mapping.

- Baseline mapping indicates a Very Low to Low risk; a review of available flood model data and the local topography indicates the risk is likely to remain the same.

Groundwater flooding

- Groundwater Flood Risk screening data indicates there is a variable potential risk of groundwater flooding at the surface in the vicinity of the Site, during a 1 in 100 year event ranging from Low to Moderate.

The groundwater level may be influenced by the adjacent river levels, although available flood model data suggest that river flooding is unlikely to give rise to groundwater emergence on-Site.

According to Site plans, the FFLs of the proposed dwellings will be set to 140.90 mAOD, compared to surveyed ground levels on Site of 141.49 to 143.96 mAOD, indicating ground levels across the Site will be lowered. As such, the ground floor of the proposed development will be more susceptible to groundwater flooding post-development.

- Baseline mapping indicates a Low to Moderate risk, however, a review of the local topography and the Site development plans indicates the risk may be Moderate.

Artificial sources of flooding

- The risk of flooding from artificial (man-made) sources such as reservoirs, sewers and canals has been assessed:
 - o The EA's Risk of Flooding from Reservoir map confirms the Site is at risk of reservoir flooding. The potential for a breach of a reservoir to occur and flooding affecting the Site is however considered to be low.
 - o Ordnance Survey (OS) data confirms there are no canals near to the Site.
 - o The Strategic Flood Consequence Assessment (SFCA) (WHS, 2018) confirms no recorded instances of sewer flooding at or within the vicinity of the Site.

The risk of flooding from artificial sources is considered to be Low.

- The risk to the development has been assessed over its expected 100 year lifetime, including appropriate allowances for the impacts of climate change which could increase the flood risk to the Site. Risks identified include increased potential for surface water and groundwater flooding and appropriate mitigation measures are proposed.

Recommendations for flood mitigation are provided below, based upon the flood risk identified at the Site and TAN15 (2004) requirements for residential 'Highly Vulnerable' development:

- *Developer is required to demonstrate that the site is designed to be flood free for the lifetime (A1.5) of development for either a 1 in 100 chance (fluvial) flood event, or a 1 in 200 chance (tidal) flood event including an allowance for climate change (depending on the type of flood risk present) in accordance with table A1.14. In addition, for tidal breach flood events, an escape route should be practical in all conditions. Finish floor levels (FFL) of highly vulnerable developments should be set 0.30m above the maximum flood level.*
- **GeoSmart Comment:** Analysis of the Site does demonstrate the development would be flood free during a 1 in 100 year (fluvial) present day and future climate change events.
- *In respect of the residual risk to the development, it should be designed so that over its lifetime (A1.5) in an extreme (1 in 1000 chance) event there would be less than 600mm of water on access roads and within properties, the velocity of any water flowing across the development would be less than 0.3 m/second on access roads and 0.15m/second in properties, and the maximum rate of rise of floodwater would not exceed 0.1m/hour. (see table A1.15).*

GeoSmart Comment: Analysis of the Site does demonstrate the access road and proposed development would not be affected by flooding during a 1 in 1000 year event, thus satisfying the requirements of A1.15 of TAN15 (2004).

Recommendations

Recommendations for flood mitigation are provided below, based upon the proposed development and the flood risk identified at the Site.

- The proposed development is not at risk of flooding from fluvial or tidal sources and therefore mitigation measures are not required.
- There is a risk of flooding from surface water (pluvial) sources, where flood depths could exceed 0.3 m in depth. According to Site plans the FFLs of the proposed development will be set to 140.90 mAOD. Furthermore, it is understood that ground levels across the Site will be lowered, and therefore it is unlikely that the FFLs of the proposed dwellings can be raised above the maximum flood level in the 1 in 1000 year surface water flood event. As such, the floor levels should be set as high as possible and flood resilience measures included (please see Section 7).
- As there is a risk of flooding from groundwater sources, the mitigation measures identified for surface water flooding should be employed in order to reduce the groundwater flood risk at the development. Risk to buried infrastructure should be considered along with water proofing of ground floor areas, standard flood resilient design and non-return valves on the sewer inlet. French drains and/or pumping systems may also be considered.
- A Flood Warning and Evacuation Plan (FWEP) is recommended to ensure persons using the Site can evacuate safely on receipt of a Flood Warning.
 - Occupants of the Site should also be signed up to receive NRW Flood Alerts and Flood Warnings.

- The ongoing management and maintenance of existing and any proposed drainage networks, under the riparian ownership of the developer, should be undertaken in perpetuity with the development.
- A Sustainable Drainage Strategy (SuDS) should be developed for the Site, for effective management of surface water runoff over the lifetime of the proposed development.

GeoSmart recommend the mitigation measures discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Planning Authority as part of the planning application.

2. Introduction



Background and purpose

A site-specific flood consequence assessment has been undertaken, to assess the flood risk to and from the development Site. This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information gathered was then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development, as defined in the PPW (2021), and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage flood risk to the development was undertaken.

This report has been prepared with reference to the Technical Advice Note (TAN) 15 (2004) which supplements the PPW (2021).

The general approach of PPW, supported by TAN15, is to advise caution in respect of new development in areas at high risk of flooding by setting out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is, in order of preference, to:

- Direct new development away from those areas which are at high risk of flooding; and,
- Where development is considered to be in high-risk areas (Zone C) only those developments which can be justified on the basis of the tests outlined in Section 6 and Section 7 are located within such areas.

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

A thorough review of a commercially available flood risk report and NRW supplied data has been undertaken, indicating potential sources of flood risk to the Site from rivers and tidal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information and modelled flood extent. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Information obtained from NRW and a review of the Merthyr Tydfil Strategic Flood Consequence Assessment (SFCA) (WHS, 2018) is used to ascertain local flooding issues and, where appropriate, identify information to support a Justification test and Assessment of Flood Consequences required as part of the PPW (2021).

The existing and future flood risk to and from the Site from all flood sources is assessed in line with current best practice using the best available data. The risk to the development has been assessed over its expected lifetime, including appropriate allowances for the impacts of climate change. Residual risks that remain after the flood risk management and mitigation measures are implemented, are considered with an explanation of how these risks can be managed to keep the users of the development safe over its lifetime.

An indication of whether the Site will potentially increase flood risk elsewhere is provided, including where the proposed development increases the building footprint at the Site. A drainage strategy to control runoff can be commissioned separately if identified as a requirement within this report.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions, we can offer no guarantee as to its validity and a proportionate programme of site investigations would be required to fully verify these findings.

The basemap used is the OS Street View 1:10,000 scale; however, the Site boundary has been drawn using BlueSky aerial imagery to ensure the correct extent and proportion of the Site is analysed.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Table 1. Datasets consulted to obtain confirmation of sources of flooding and risk

Source of flooding	Datasets consulted			
	Commercial Flood Maps	Local Policy & Guidance Documents*	Natural Resources Wales (Appendix B)	OS Data
Historical	X	X	X	
River (fluvial) / Sea (tidal/coastal)	X	X	X	
Surface water (pluvial)	X	X	X	

Source of flooding	Datasets consulted			
	Commercial Flood Maps	Local Policy & Guidance Documents*	Natural Resources Wales (Appendix B)	OS Data
Groundwater	X	X		
Sewer		X		
Culvert/bridges		X		X
Reservoir		X	X	

*Local guidance and policy, referenced below, has been consulted to determine local flood conditions and requirements for flood mitigation measures.

Local policy and guidance

For this report, several documents have been consulted for local policy and guidance and relevant information is outlined below:

Merthyr Tydfil Strategic Flood Consequence Assessment (WHS, 2018):

Fluvial Flooding

Fluvial flooding or flooding from rivers is the most dominant flooding mechanism throughout Merthyr Tydfil, with the River Taff and several smaller ordinary watercourses in the area. The smaller watercourses can result in flooding particularly at culverts where blockage risks are high. There are several hydraulic models in the area that provide a higher resolution of flood risk analysis through improved representation of the channel and floodplain compared with generalised JFLOW modelling. These have been used to update the NRW flood map in places; however, certain reaches in the study area are based on generalised, low resolution JFLOW modelling.

River Taff

The River Taff is the largest watercourse in Merthyr Tydfil. With the exception of the Merthyr Vale site, the NRW flood map for the River Taff is largely based on low resolution JFLOW modelling data, which often produces conservative flood extents in comparison to detailed 1D/2D hydraulic modelling as smaller watercourses and culverts are usually not represented in the model.

The NRW flood map shows large parts of central Merthyr Tydfil to be in Flood Zone 3 of the River Taff, particularly around areas such as Glebeland and Cae-draw, including flooding of the A4054 road network. There are also residential areas at Georgetown that lie in the 0.1% annual probability event (Flood Zone 2). The bus station site is also shown to be affected by the 1% annual probability event (Flood Zone 3), according to the existing NRW Flood Map.

The existing flood map shows that flood extents are relatively confined throughout Abercanaid, with both Flood Zone 2 and 3 remaining close to the river banks. There are localised areas in the north of the site where the floodplain becomes wider along the right bank of the River Taff at the Willows industrial estate.

Throughout the Merthyr Vale and Aberfan area, the extent of Flood Zone 3 is relatively constrained to the river banks, except for several low points to the north, as well as the B4285 at Aberfan. However, the Flood Zone 2 extent is shown to affect large parts of the Merthyr Vale/Project Riverside site.

Guidance

Strategic Flood Consequence Assessments are carried out by local authorities, in consultation with the Natural Resources Wales, to assess the flood risk to the area from all sources both now and in the future due to climate change. They are used to inform planning decisions to ensure inappropriate development is avoided (PPW, 2021).

3. Site analysis



Site information

The Site is located at 10 School Road, Troedyrhiw, CF48 4JS in a setting of commercial and residential land use at National Grid Reference SO 07174 02446.

Figure 1. Aerial imagery of the Site (Bluesky, 2023)

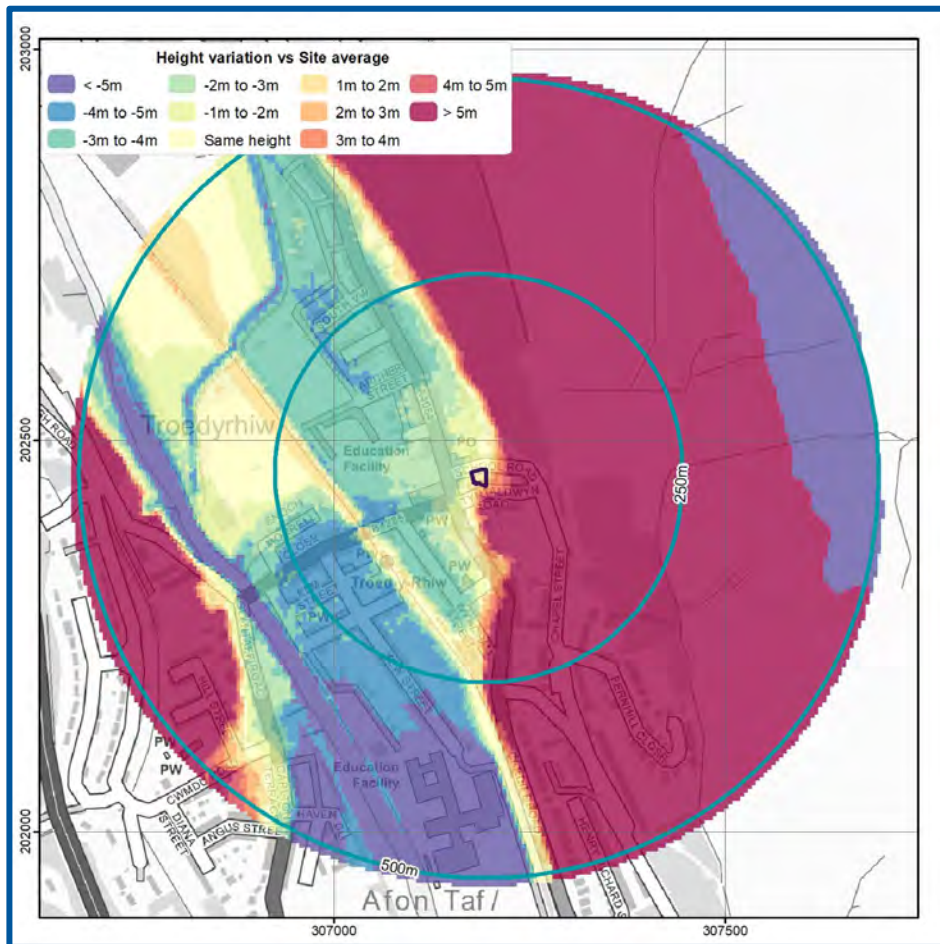


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Figure 2 indicates ground levels within 500m of the Site rise and fall, with significant undulations owing to the elevated nature of the nearby topography.

The general ground levels on the Site are between 141.49 mAOD and 143.96 mAOD with the Site falling gradually in a northwesterly direction. This is based upon a Site specific topographic survey undertaken by Alpine Land Surveyors Ltd (Appendix C).

Figure 2. Site Location and Relative Elevations (GeoSmart, 2023)



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Development

The Site is currently used within a residential capacity as a garden associated with Celtic Bunkhouse, which is adjacent to the east of the Site and is understood to be under the ownership of the Client.

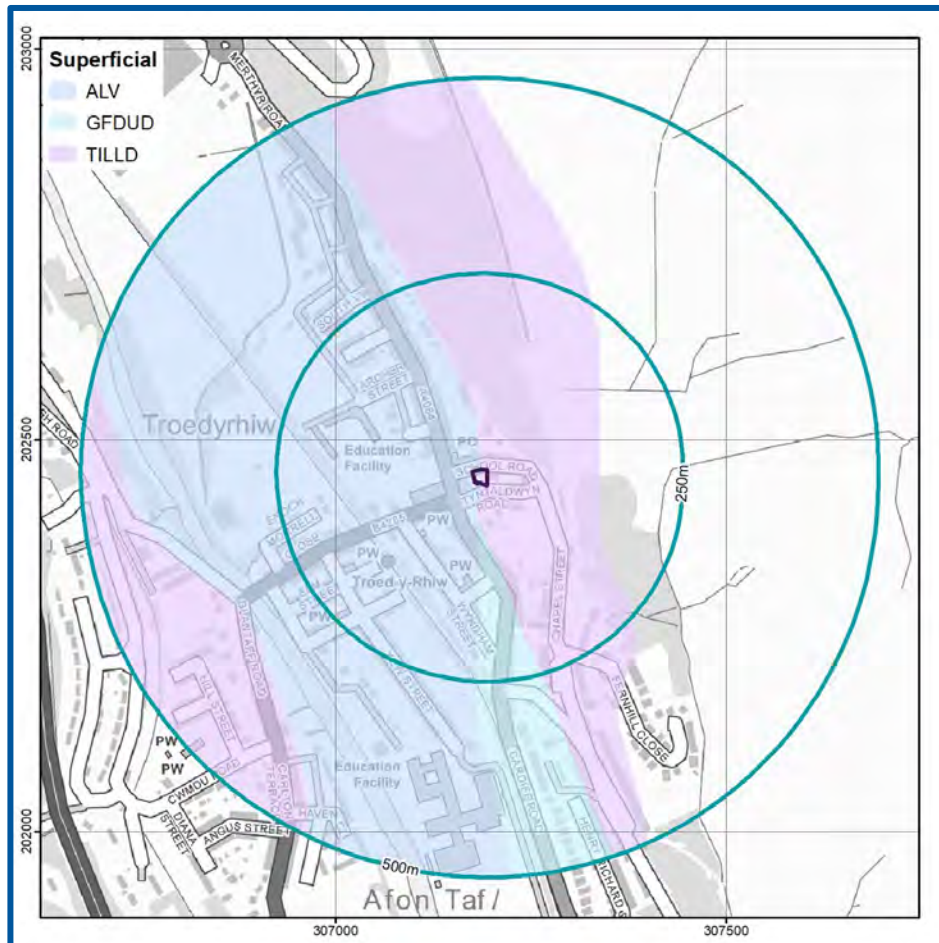
Development proposals comprise the construction of two identical 3-storey dwellings with associated patios, parking and landscaping. According to Site plans, the Finished Floor Levels (FFL) of the proposed dwellings will be 140.90 mAOD, indicating ground levels will be lowered as part of the development proposals. Site plans are included within Appendix A.

The effect of the overall development will result in an increase in number of occupants and/or users of the Site and will result in the change of use, nature or times of occupation. According to Figure 2 of the TAN15 (2004), the vulnerability classification of the existing development is Less Vulnerable and proposed development is Highly Vulnerable. The estimated lifespan of the development is 100 years.

Hydrogeological features

British Geological Survey (BGS) mapping indicates the underlying superficial geology (Figure 4) beneath the eastern half of the Site consists of Devensian Till – Diamicton (TILLD) (BGS, 2023), whereas the underlying superficial geology beneath the western half of the Site consists of Alluvium – clay, silt, sand and gravel (ALV), which is classified as a Secondary (A) Aquifer.

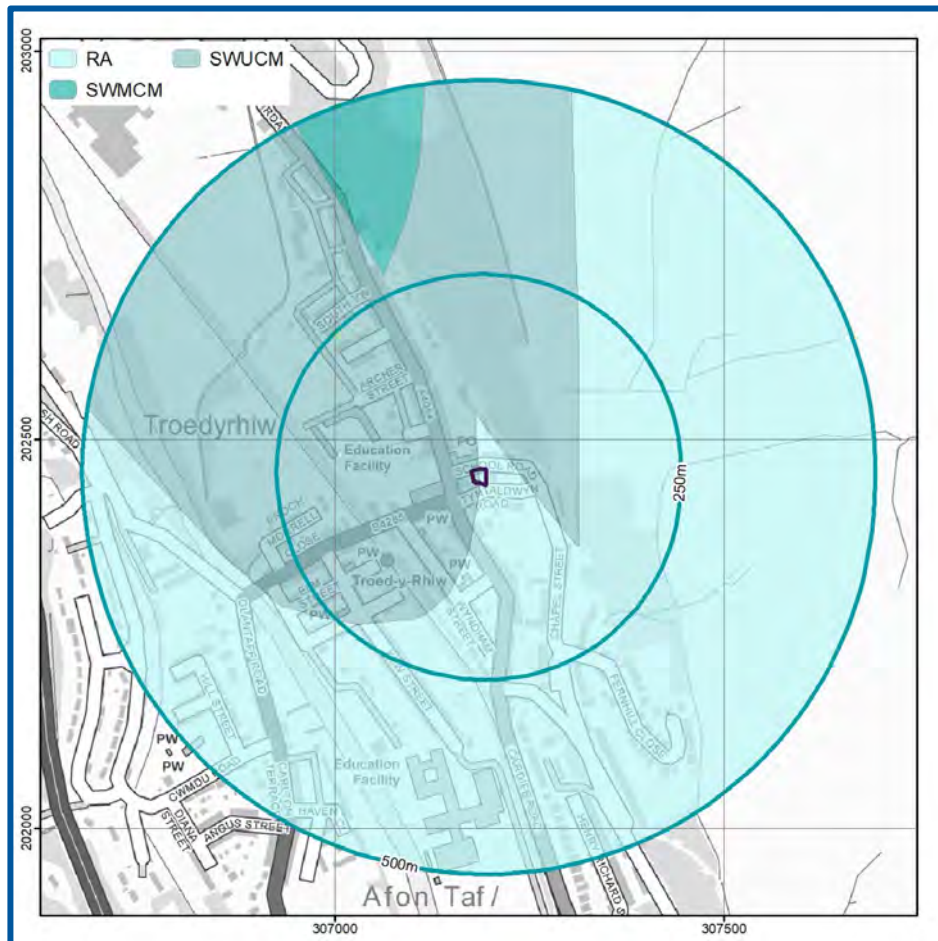
Figure 4. Superficial Geology (BGS, 2023)



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BGS mapping indicates the underlying bedrock geology (Figure 5) beneath the eastern half of the Site comprises of the Rhondda Member (RA) – Sandstone, whereas the bedrock geology beneath the western half of the Site is formed from the South Wales Upper Coal Measures Formation (SWUCM) – mudstone, siltstone and sandstone; both formations are classified as a Secondary (A) Aquifer (BGS, 2023).

Figure 5. Bedrock Geology (BGS, 2023)



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Geological conditions

A review of the BGS borehole database (BGS, 2023) indicates there are no relevant boreholes within the vicinity of the Site from which the mapped geology can be confirmed.

Groundwater

There are no relevant boreholes within the vicinity of the Site from which groundwater levels can be confirmed.

4. Flood risk to the development



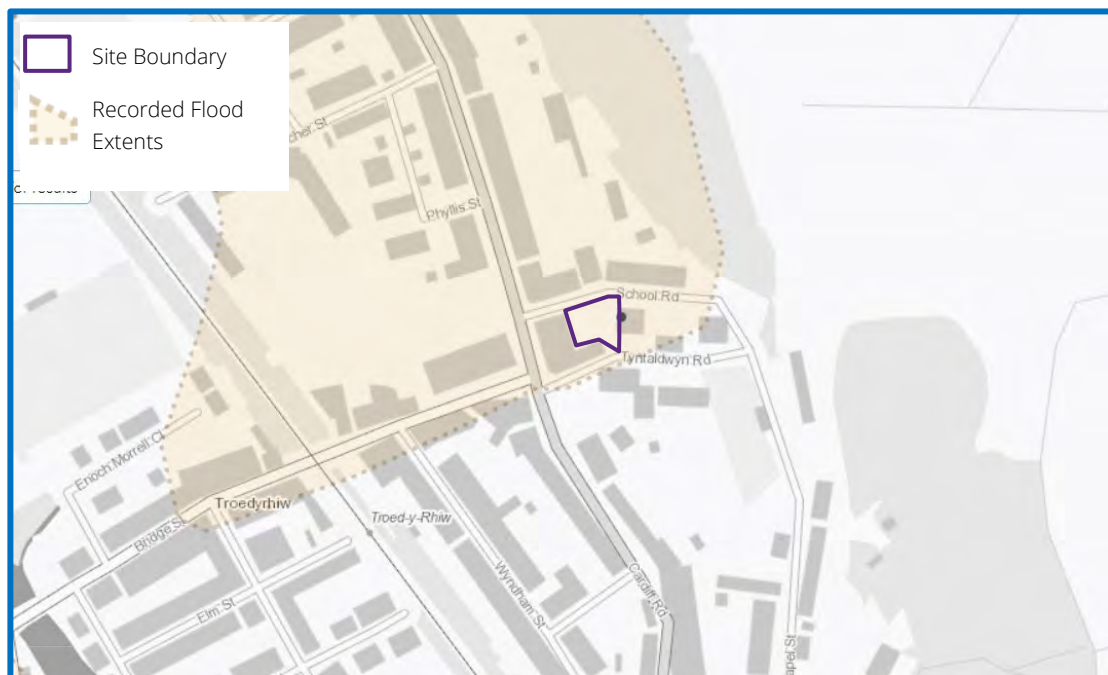
Historical flood events

According to the NRW's Recorded Flood Extents Map (Figure 6) and the SFCA (WHS, 2018), historical flood events have been recorded at the Site (NRW, 2023). According to the NRW flooding occurred in December 1979.

The Lead Local Flood Authority have compiled a Section 19 flood event report which confirms the area which was flooded as a result of the inability of local drainage systems to cope with storm water flow (rather than flood defences on the River Taff being breached). Following this event, and another flooding event in 1980, urgent repairs were carried out on the main Taff defences, after they were damaged during the storms. A report issued in 2009 noted that no other maintenance or improvements had been made to the defences since the original repair works.

The purpose of historical flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean flooding has never occurred on-Site or that flooding will never occur at the Site.

Figure 6. Historical Flood Event Outline (NRW, 2023)



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Rivers (fluvial) / Sea (coastal) / Estuarine (tidal) flooding

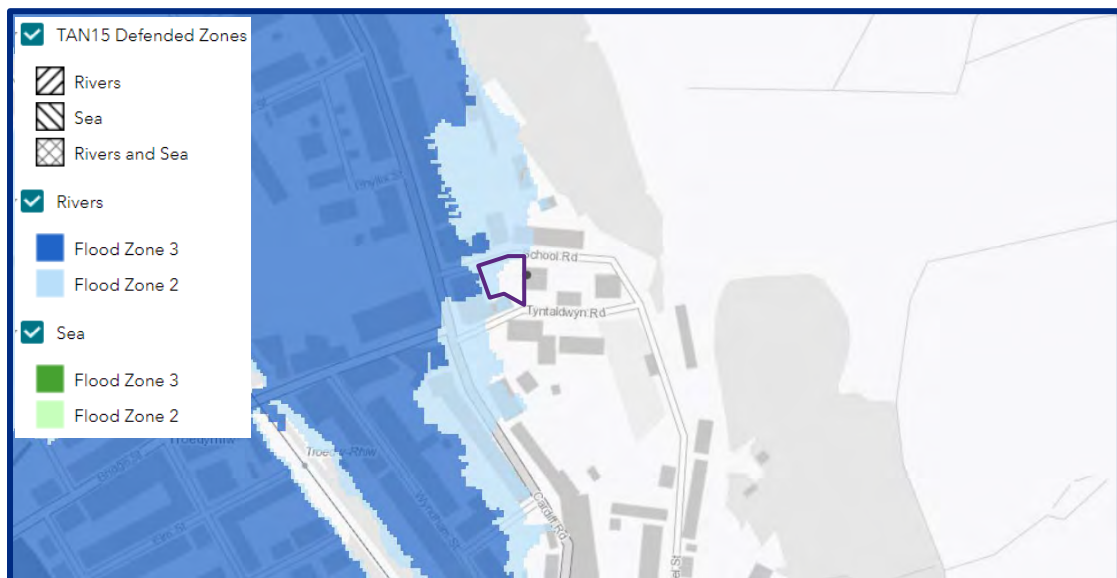
The predominant risk at the Site is from flooding from rivers, termed as fluvial flooding. The Site is located in an inland location and the risk of flooding from coastal and tidal processes are therefore considered to be Negligible.

River (fluvial) flooding occurs during times of heavy rainfall or snow melt when watercourses' capacity can be exceeded, over topping the banks and flood defences.

Flood Zones Map

According to the NRW's Flood Map for Planning (Figure 7), the Site is located within fluvial Flood Zones 1 and 2 and is therefore classified as having a Low to Medium probability of fluvial flooding from the River Taff and surrounding drainage ditches / small watercourses.

Figure 7. NRW Flood Zone mapping (NRW, 2023)



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Please note that Flood Zones 1 to 3 are not presently used for planning purposes, but instead provide an indicative extent for the 1 in 100 year / 1 in 200 year and 1 in 1000 year fluvial and tidal events, respectively.

The above Flood Zones will become live once the revised version of TAN15 is published in 2023. The Development Advice Map (DAM) is currently the most up to date mapping for planning purposes in line with TAN15 (2004).

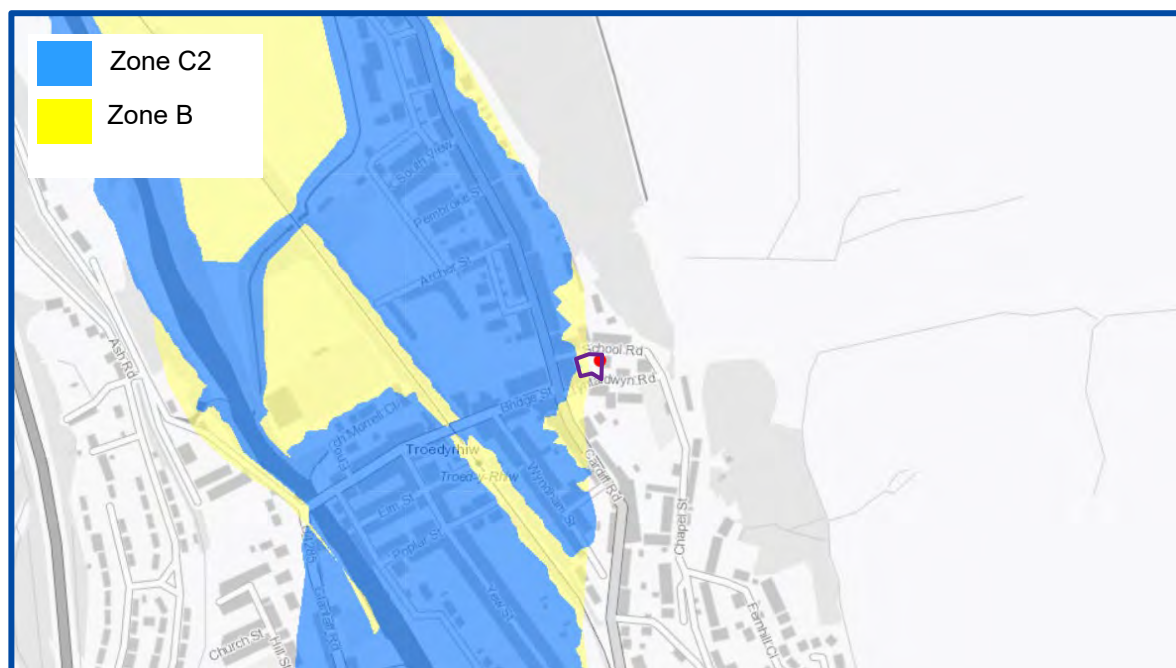
Development Advice Map

The NRW's Development Advice Map (DAM) confirms the Site is located partially within DAM Zone B (approximately 40% of the Site) (TAN15, 2004).

Table 1. Development Advice Map Classification

Description of Zone	Zone
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1
Areas of the floodplain without significant flood defence infrastructure.	C2

Figure 8. Development Advice Map (NRW, 2023)



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Flood defences

Guidance

Sites that are located close to flood defences are likely to be zones where rapid inundation will occur in the event of the flood defences being overtopped or breached. A Site located close to flood defences (within 250 m) may require a more detailed FCA subject to local topography.

Existing flood defences

- According to NRW's Flood Map for Planning (Figure 9), the Site is not located within a TAN15 Defended Zone for fluvial flooding.
- There are no formal flood defences within 200 m of the Site.

Figure 9. Location of flood defences mapping (NRW, 2023)



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Flood Risk including the benefit of defences

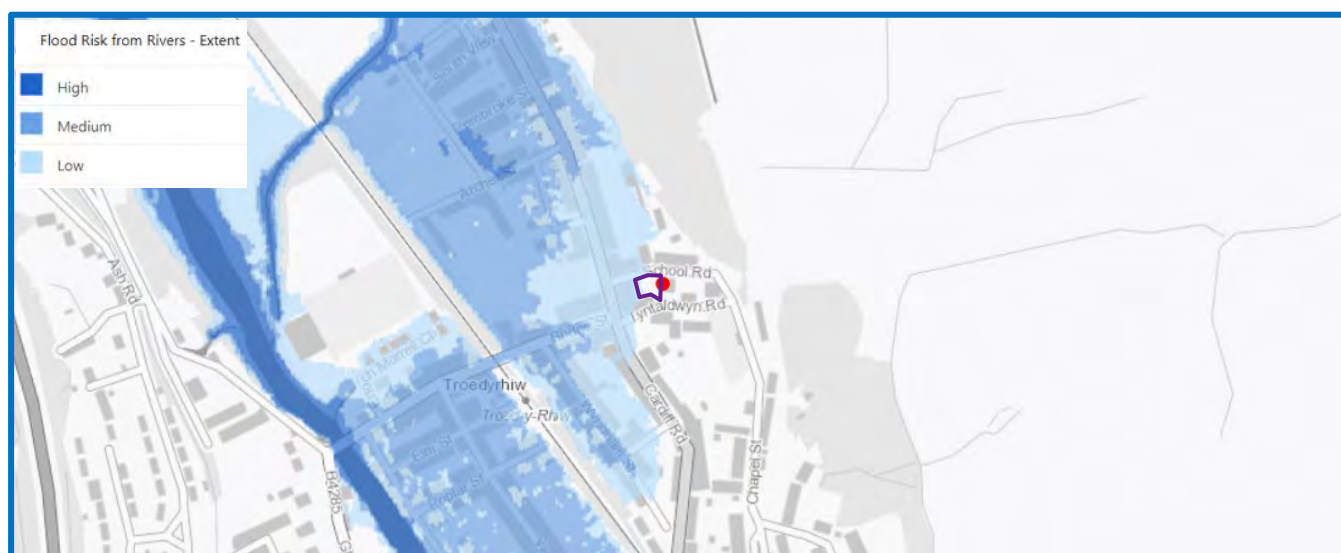
The Flood Risk Assessment Wales (FRAW) maps were published in the Summer of 2020.

The FRAW mapping includes consideration of flood defences that have been built to protect against flooding from rivers and the sea. The defences shown provide different levels of flood protection and this is recognised in the risk classification shown in the Flood Risk Assessment Wales (FRAW) map.

The FRAW maps indicate:

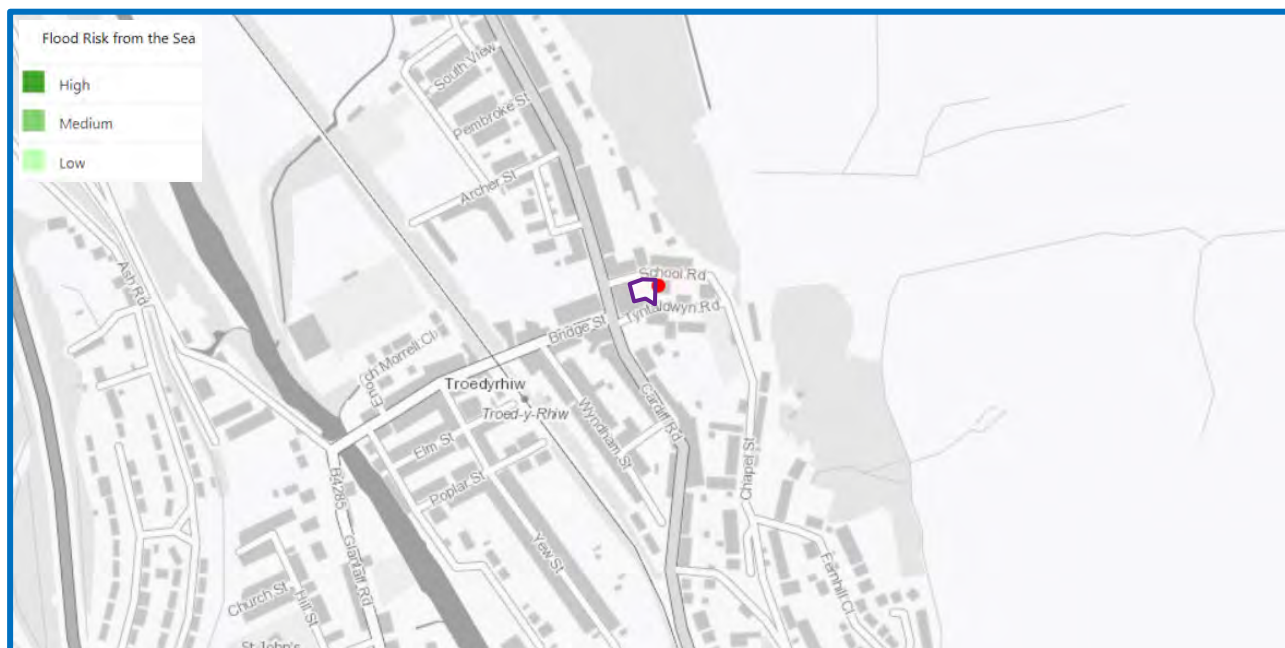
- The risk from Rivers is Very Low to Low, with the majority of the Site being at Very Low risk (see Figure 10).
- The risk from the Sea is Very Low (see Figure 11).
- The risk from Surface Water and Small Watercourses is Very Low to Low (see Figure 12).

Figure 10. Rivers – FRAW Risk Map (NRW 2023)



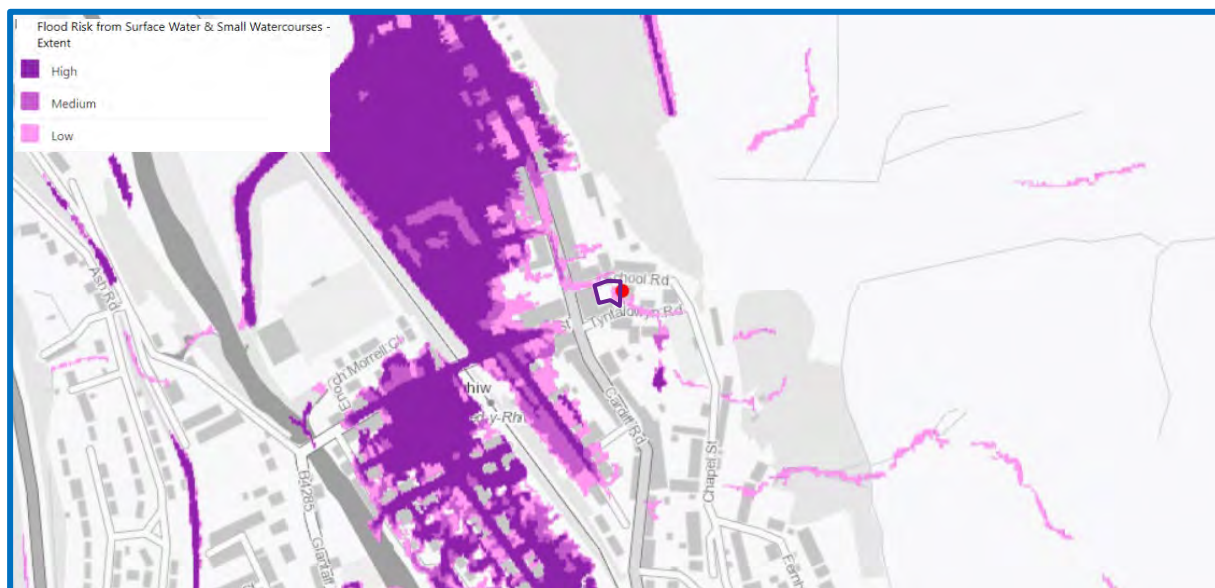
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Figure 11. Sea – FRAW Risk Map (NRW 2023)



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Figure 12. Surface Water and Small Watercourses – FRAW Risk Map (NRW 2023)



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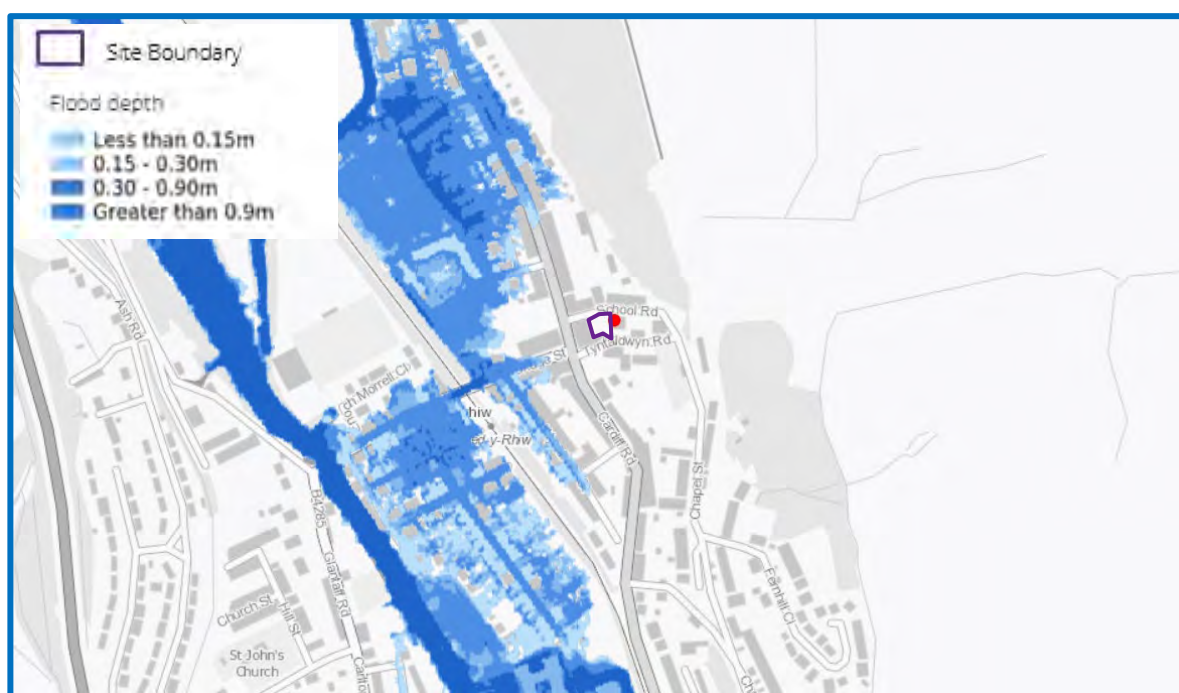
National Flood Hazard Maps

The National Flood Hazard (NFH) maps were published in the Summer of 2020, these show results for an undefended scenario which means the modelling and mapping process explicitly excluded any flood defences.

NFH maps have been included in order to understand the risk of flooding in a worst-case undefended scenario. As the Site does not benefit from defences, the risk shown by the NFH maps would be representative of the risks for the Site.

National Flood Hazard – Fluvial Flood Risk

Figure 13. 1 in 100 year (Medium risk) map for river flooding (NRW, 2023)



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Figure 14. 1 in 1000 year (Low risk) map for river flooding (NRW, 2023)

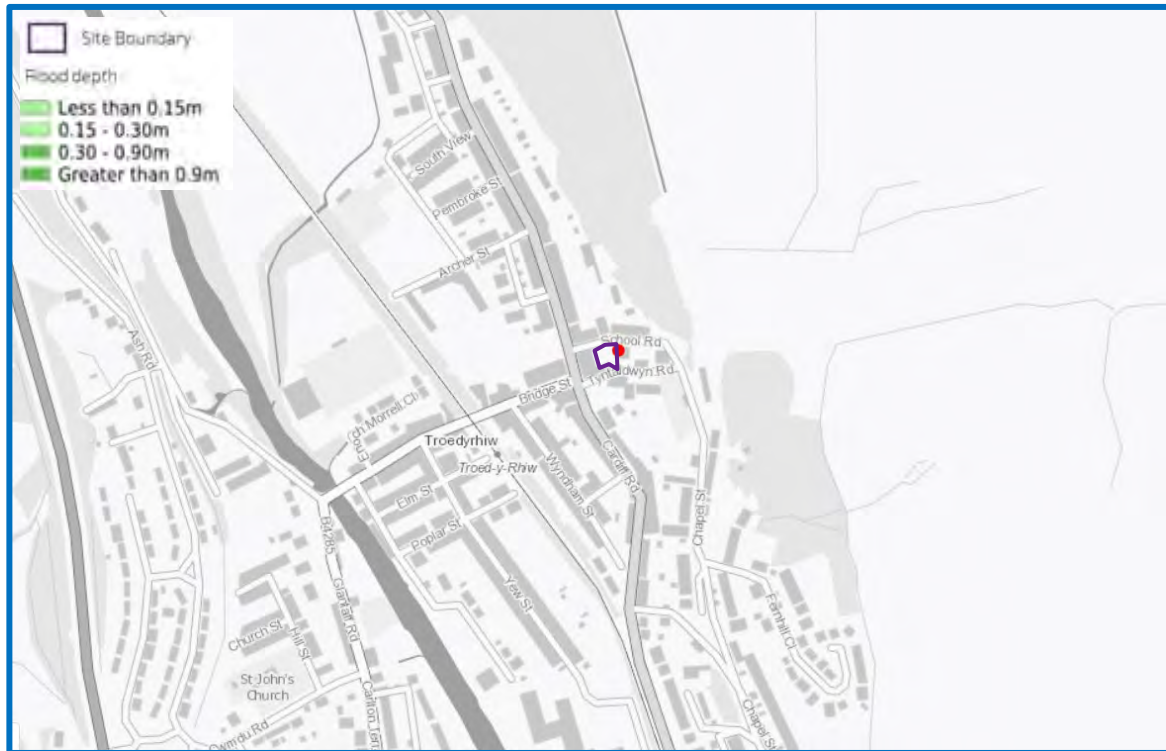


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The fluvial flood risk maps demonstrate that the Site would likely not be affected by flooding from the 1 in 1000 event, however, land immediately adjacent to the west of the Site would flood. It is noted that model data for the undefended scenarios confirm that the Site would not flood. Therefore, it can be assumed that the Site is at Very Low risk of fluvial flooding.

National Flood Hazard – Tidal Flood Risk

Figure 15. 1 in 1000 year (Low risk) map for tidal flooding (NRW, 2023)



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The tidal flood risk maps demonstrate that the Site would not be affected by flooding from the 1 in 1000 tidal event as it is not in an area that is affected by tidal/coastal flooding.

Model data

As the Site is located within the NRW's fluvial floodplain, modelled flood elevation data was obtained from NRW and has been used to assess flood risk and to provide recommendations for mitigation for the proposed development.

Defended and undefended modelled data from the Hydraulic Modelling at Merthyr Vale Colliery Site report (JBA Consulting, 2017) has been extracted from the 2D floodplain data provided at the Site.¹ The data is provided in the table below and also within Appendix B.

Table 2. EA present day modelled flood data (defended)

Finished Floor Levels of the Proposed Development (mAOD)	Modelled Flood Levels (mAOD)			
	1 in 20 year	1 in 75 year	1 in 100 year	1 in 1000 year
140.90	139.29	138.67	138.80	140.08
Flood depths (m)	No Flooding	No Flooding	No Flooding	No Flooding

The Site is not impacted by fluvial flooding up to and including the 1 in 1000 year flood event. It is noted that very shallow flood depths of up to 0.02 m are mapped immediately adjacent to the western boundary of the Site, however, this is unlikely to impact the proposed development.

¹ The accuracy of the modelled flood levels are not known. These are dependent on the accuracy of input datasets such as LiDAR data, used to model the impacts of flooding within the 2D domain. Confirmation of the accuracy of the modelled flood data can be obtained separately from Natural Resources Wales.

The following figure confirms the flood extent associated with the present day 1 in 1000 year defended flooding scenario.

Figure 16. Modelled flood depths in the defended 1 in 1000 year scenario (NRW, 2023)



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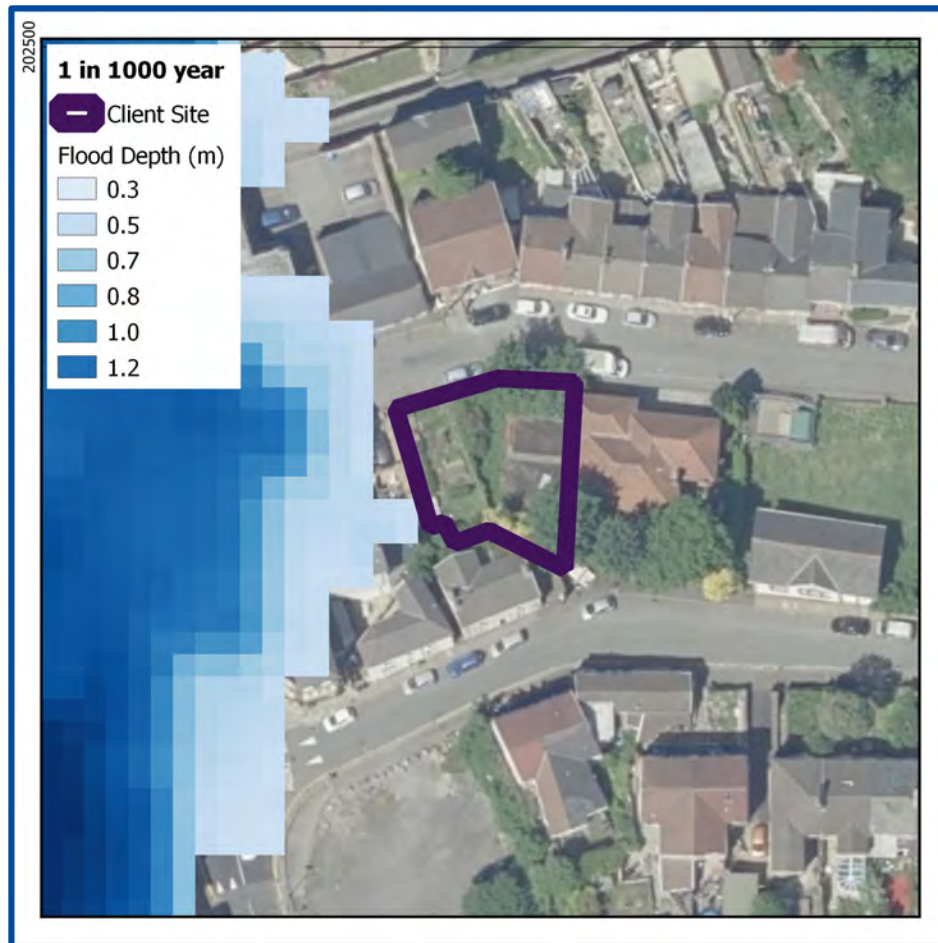
Table 3. EA present day modelled flood data (undefended)

Finished Floor Levels of the Proposed Development (mAOD)	Modelled Flood Levels (mAOD)	
	1 in 100 year	1 in 1000 year
140.90	138.75	140.09
Flood depths (m)	No Flooding	No Flooding

It is noted that the extent of flooding during the undefended scenario is largely the same as in the defended scenario, however, flood depths are mapped as being slightly higher in the 1 in 1000 year undefended scenario.

The following figure illustrates the flood extent associated with the present day 1 in 1000 year undefended flooding scenario.

Figure 17. Modelled flood depths in the undefended 1 in 1000 year scenario (NRW, 2023)



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Climate change factors

In accordance with the Welsh Government's Climate Flood Consequences Assessments: Climate change allowances guidance (2021), allowances should be made for the impact of increased river and sea levels and flows to the proposed development.

Due to recent changes in guidance on the allowances for climate change, the 20% increase in river flows should no longer to be used for development design purposes, unless the guidance stipulates this is the correct allowance to use (depending on the river basin and development proposals).

As the Site is located within the Severn River Basin and the proposed development is classed as More Vulnerable, where the proposed lifespan is 100 years, the Central (25%) allowances have been used to determine a suitable climate change factor to apply to river data.

The climate change allowances provided by the model report (JBA Consulting, 2017) for the defended scenario is 25% and has therefore been included in the table below.

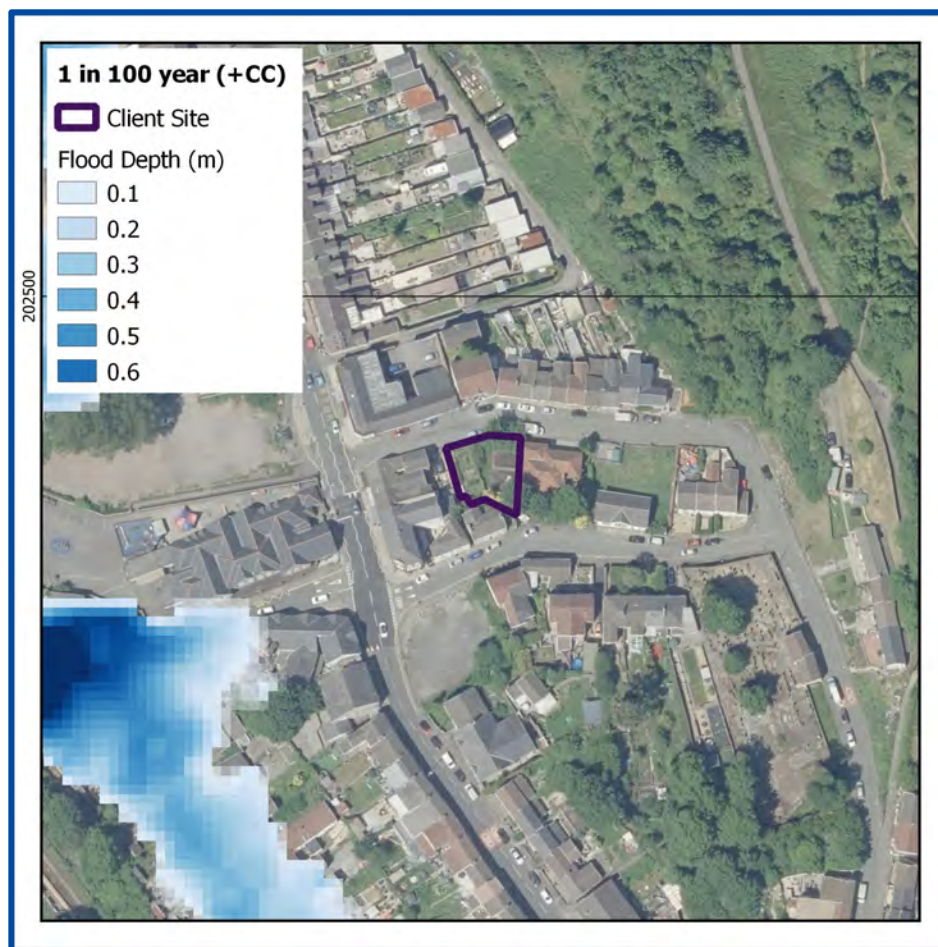
Table 4. Flood levels plus climate change allowances (defended)

Finished Floor Levels of the Proposed Development (mAOD)	Modelled Flood Levels (mAOD)	
	1 in 100 year	1 in 100 year plus 25% central allowance for climate change
140.90	138.75	138.86
Flood depths (m)	No Flooding	No Flooding

The Site is not impacted by flooding in the 1 in 100 year (plus 25% allowance for climate change) scenario as it is situated on higher ground than land to the west of the Site.

The following figure shows the flood extent associated with the defended 1 in 100 year (plus 25% allowance for climate change) flooding scenario.

Figure 18. Modelled flood depths in the defended 1 in 100 year plus climate change scenario (NRW, 2023)



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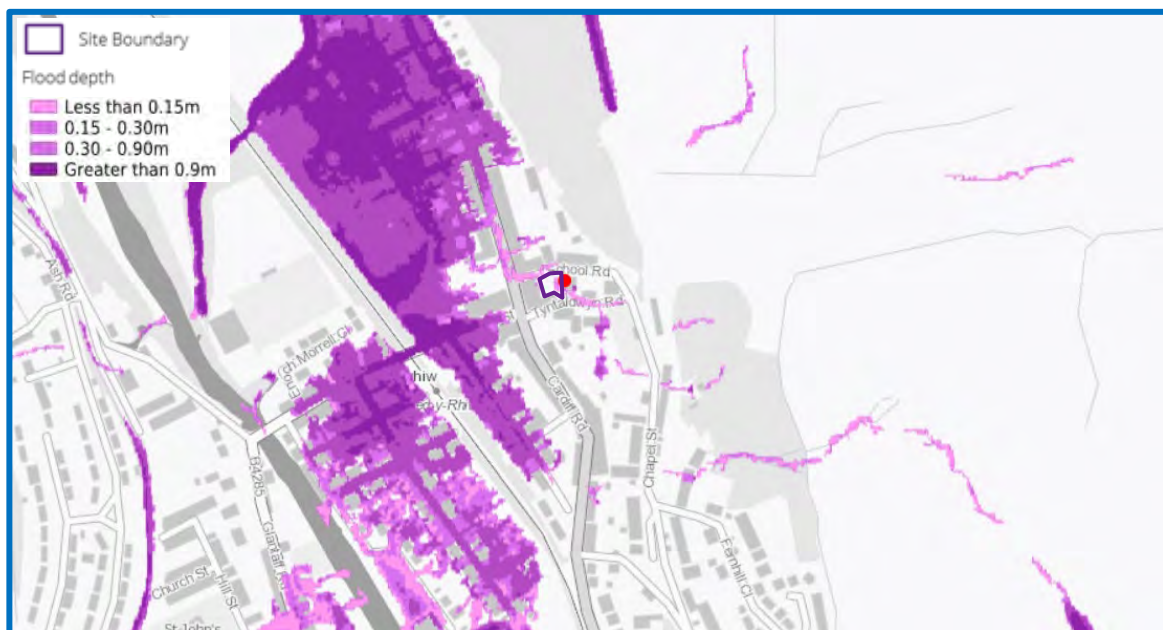
Surface water (pluvial) flooding

Surface water flooding occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems. It can occur in most locations even at higher elevations and at significant distances from river and tidal floodplains.

The SFCA does not indicate any reported incidents of historical surface water flooding within 100 m of the Site (WHS, 2018).

According to the National Flood Hazard Map's Flood Risk from Surface Water and Small Watercourses flood mapping (Figure 19), the Site is at a variable risk of pluvial flooding ranging from Very Low to Low.

Figure 19. NRW Low surface water risk Hazard map (NRW, 2023)



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Guidance

According to NRW's surface water flood risk map the Site is at:

- Very Low risk - chance of flooding of less than 1 in 1000 (0.1%).
- Low risk - chance of flooding of between a 1 in 1000 & 1 in 100 (0.1% and 1%).

Figure 19 shows the extent and depth of flooding during the 1 in 1000 year (Low risk) scenario. Flooding depths of up to 0.3 m would impact isolated areas of the Site, however due to the resolution of the NRW's mapping it is not possible to determine how the proposed development would be impacted. It is therefore assumed that the Site is potentially impacted by flooding of up to 0.3 m in depth.

It is noted that according to Site plans (Appendix A), ground levels across the Site are proposed to be lowered. Therefore, the flood depths that could be anticipated at the

proposed development in the Low risk scenario may be greater than shown on the NRW mapping.

Guidance

According to NRW's surface water flood risk mapping the following advisory guidance applies to the Site:

Flood Depths:

- 0.15 to 0.3 m - Flooding would: typically exceed kerb height, likely exceed the level of a damp-proof course, cause property flooding in some areas.

Climate change may lead to an increase in rainfall intensity which affects river levels, land and urban drainage systems. Rainfall intensity for small and urban catchments may increase from 5 to 20% (central estimate) or 10 to 40% (upper estimate) over the period to 2115 (NRW, 2023).

Any existing and proposed on-Site surface water drainage systems should be designed and maintained appropriately to manage the run-off over the lifetime of the proposed development.

A site-specific assessment has been undertaken to refine the groundwater risk screening information on the basis of site-specific datasets (see Section 3) including BGS borehole data, and the NRW's fluvial and tidal floodplain data (where available) to develop a conceptual groundwater model. The risk rating is refined further using the vulnerability of receptors including occupants and the existing and proposed Site layout, including the presence of basements and buried infrastructure. The presence of any nearby or on-Site surface water features such as drainage ditches, which could intercept groundwater have also been considered.

It is understood there are no existing basements and basements are not proposed as part of the development. However, according to Site plans, the FFLs of the proposed dwellings will be set to 140.90 mAOD, compared to surveyed ground levels on Site of between 141.49 mAOD and 143.96 mAOD, indicating ground levels across the Site will be lowered. Therefore, the ground floor of the proposed development may be more susceptible to groundwater flooding.

According to a review of the hydrogeology (Section 3), the Site is underlain by superficial deposits of variable permeability above permeable bedrock. Groundwater levels may rise in the bedrock and superficial aquifers in a seasonal response to prolonged rainfall recharge which may cause an unusually high peak in groundwater levels during some years.

Despite the presence of underlying aquifers, the Site would only be at risk of groundwater flooding if the water table reaches the base of the Site development or the ground surface when groundwater seepage could lead to overland flow and ponding.

There are no nearby BGS borehole records from which the underlying groundwater depth can be inferred.

The groundwater level may be influenced by the adjacent river levels; the 1 in 1000 year flood level associated with the River Taff is estimated to be c. 140.08 mAOD at a distance of approximately 5 m from the Site at the nearest point, compared with Site levels of 141.49 to 143.96 mAOD. As such, river levels are unlikely to drive groundwater flooding at the Site.

The SFCA does not indicate any reported incidents of historical groundwater flooding within 50 m of the Site (WHS, 2018).

Spring lines have not been identified in close proximity to the Site.

The local topography and drainage is such that the development threshold is likely to be higher than the area where groundwater emerges in adjacent low points.

The hydrogeological characteristics suggest there is potential for a groundwater table beneath the Site although it is considered unlikely that groundwater will emerge from the ground surface.

The baseline groundwater flood risk rating is Low to Moderate. On the basis of the site-specific assessment, including the absence of any reliable groundwater level data and also the potential lowering of ground levels, the overall groundwater flood risk is considered to be Moderate.

Moderate Risk - There will be a significant possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Climate change predictions suggest an increase in the frequency and intensity of extremes in groundwater levels. Rainfall recharge patterns will vary regionally resulting in changes to average groundwater levels. A rise in peak river levels will lead to a response of increased groundwater levels in adjacent aquifers subject to the predicted climate change increases in peak river level for the local catchment. Sea level rises of between 0.4 m and 1 m are predicted by 2100, leading to a rise in average groundwater levels in the adjacent coastal aquifer systems, and potential increases in water levels in the associated drainage systems. The 'backing up' of groundwater levels from both coast and tidal estuary locations may extend a significant distance inland and affect infrastructure previously constructed above average groundwater levels.

The impact of climate change on groundwater levels beneath the Site is linked to the predicted risk in both peak river levels and also the variation in rainfall recharge which is uncertain.

Flooding from artificial sources

Artificial sources of flood risk include waterbodies or watercourses that have been amended by means of human intervention rather than natural processes. Examples include reservoirs (and associated water supply infrastructure), docks, sewers and canals. The flooding mechanism associated with flood risk from artificial sources is primarily related to breach or failure of structures (reservoir, lake, sewer, canal, flood storage areas, etc.).

Sewer flooding

The SFCA does not include any information regarding flooding events from sewers (WHS, 2018) in the vicinity of the Site.

Guidance

Properties classified as “at risk” are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period. Records held by the sewage utility company provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

Canal failure

According to Ordnance Survey (OS) mapping, there are no canals within 500 m of the Site.

Water supply infrastructure

Water supply infrastructure is comprised of a piped network to distribute water to private houses or industrial, commercial or institution establishments and other usage points. In urban areas, this represents a particular risk of flooding due to the large amount of water supply infrastructure, its condition and the density of buildings. The risks of flooding to properties from burst water mains cannot be readily assessed.

If more information regarding the condition and history of the water supply infrastructure within the vicinity of the Site is required, then it is advisable to contact the local water supplier Dwr Cymru Welsh Water.

Culverts and bridges

The blockage of watercourses or structures by debris (that is, any material moved by a flowing stream including vegetation, sediment and man-made materials or refuse) reduces flow capacity and raises water levels, potentially increasing the risk of flooding. High water levels can cause saturation, seepage and percolation leading to failure of earth embankments or other structures. Debris accumulations can change flow patterns, leading to scour, sedimentation or structural failure.

Culverts and bridges have not been identified within 50 m of the Site.

The SFCA has not identified any historical drainage issues within the Site area (WHS, 2018).

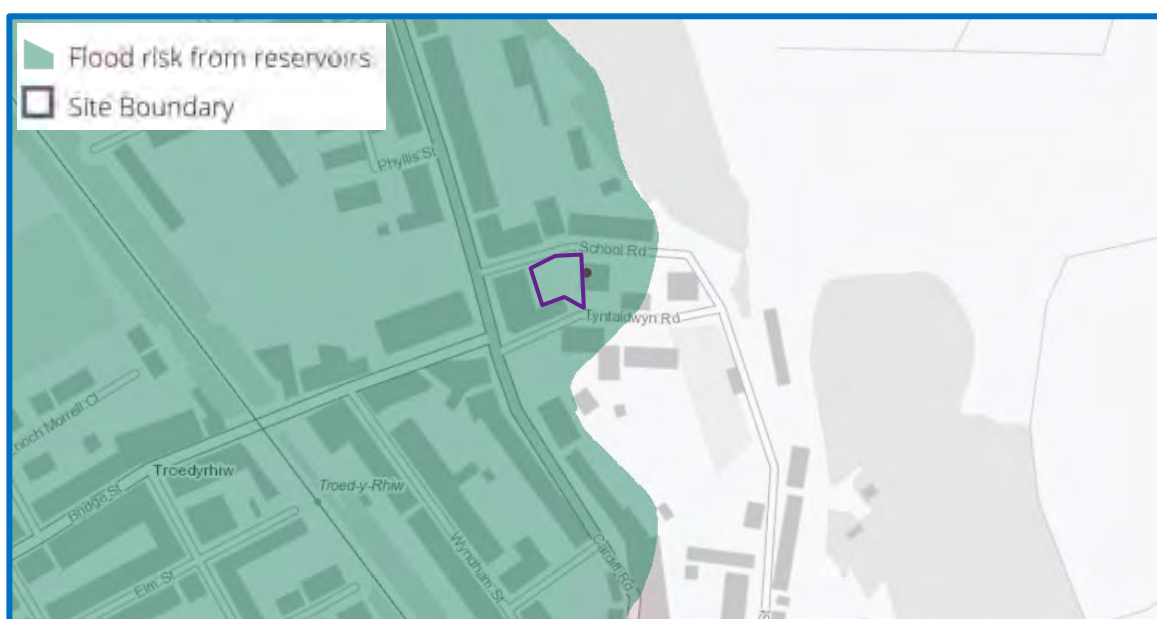
Reservoir flooding

According to the NRW's Flood Risk from Reservoirs mapping the Site is at risk of flooding from reservoirs (Figure 21) (NRW, 2023).

The Site is considered to be at risk of flooding from the following reservoirs:

- Beacons
- Pontsticill (Taf Fechan)
- Cantref
- Llwyn-On

Figure 21. NRW Flood Risk from Reservoirs Flooding (NRW, 2023)



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Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m³ of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (NRW, 2023).

5. Flood risk from the development



Floodplain storage

Where flood storage from any source of flooding is to be lost as a result of development, on-site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided. Where it is not possible to provide compensatory storage on site, it may be acceptable to provide it off-site if it is hydraulically and hydrologically linked.

The loss of floodplain storage is less likely to be a concern in areas benefitting from appropriate flood risk management infrastructure or where the source of flood risk is solely tidal.

The development is located partially within fluvial Flood Zone 2 and involves an increase in building footprint but would not be impacted by the 1 in 100 year plus 25% climate change event. Therefore, there would be no displacement of flood water and compensatory flood storage is not required.

Drainage and run-off

Based on the topography and low surface water flood risk in the vicinity, interference or interaction with overland flow paths and inflows from offsite is considered unlikely.

The potential surface water run-off generated from the Site during a 1 in 100 year return period should be calculated, using FEH 2013 rainfall data from the online Flood Estimation Handbook (FEH), developed by NERC (2009) and CEH (2016).

The PPW (2021) recommends the effects of climate change are incorporated into FRA's and the recently updated climate change guidance (published in 2016 and updated in 2021) confirms the requirements for inclusion within FRA's.

As the proposed development is residential, the lifespan of the development and requirements for climate change should allow up to the 2123 scenario.

Table 5. Climate change rainfall allowances

Applies across the Severn Basin	Total potential change anticipated by the 2020s	Total potential change anticipated by the 2050s	Total potential change anticipated by the 2080s
Upper end	20%	30%	45%
Central	10%	15%	20%

A separate assessment of surface water runoff may be required, as the Statutory requirements in Wales are to include a SuDS strategy, where development proposals are

greater than 100m² in size. This is to ensure surface water runoff is managed in accordance with the Welsh Statutory requirements over the lifetime of the proposed development.

Sustainable Drainage System (SuDS)

It is recommended that attenuation of run-off is undertaken on-Site to compensate for proposed increases in impermeable surface areas. Attenuation may comprise the provision of storage within a Sustainable Drainage System (SuDS). SuDS can deliver benefits from improving the management of water quantity, water quality, biodiversity and amenity. Potential SuDS options are presented in the table below, subject to further investigation:

Table 6. SuDS features which may be feasible for the Site

Option	Description
Rainwater harvesting	Rainwater harvesting can collect run-off from the roofs for use in non-potable situations, using water butts for example.
Permeable paving	Permeable pavements can be used for driveways, footpaths and parking areas to increase the amount of permeable land cover. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2007) will improve water quality due to their filtration capacity. Plastic geocellular systems beneath these surfaces can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles.

6. Suitability of the proposed development



The information below outlines the suitability of proposed development in relation to national and local planning policy.

National policy and guidance

The aims of the national planning policies TAN15 (2004) and PPW (2021) are achieved through application of the Justification Test and by assessing Flood Consequences. The key requirements of these are outlined below:

Guidance

Justification Test: New developments should be directed away from Zone C and towards suitable land in Zone A, or Zone B where river or coastal flooding will be less of an issue. In Zone C the tests outlined in sections 6 and 7 of TAN15 will be applied, recognizing, however, that highly vulnerable development and Emergency Services in Zone C2 should not be permitted. All other new development should only be permitted within Zones C1 and C2 if determined by the planning authority to be justified in that location.

Assessing Flood Consequences: If a development proposal in Zone C1 or in C2, and if it is defined as being of low vulnerability, it would meet the test outlines in section 6. However, it should be noted that those developments would be more likely to flood and appropriate mitigation would need to be planned accordingly. This section applies to Zone C, and those parts of Zone B where flooding has been identified as a material consideration to allow for localised problems.

Assessing whether a development should proceed or not will depend upon whether the consequences of flooding of that development can be managed and reduced to a level which is acceptable for the nature/type of proposed development, including its effects on existing development.

The proposed Site use is residential and is classified as “Highly Vulnerable” development. The Site is located with the Development Advice Map (DAM) Zone B.

Table 7. Flood risk vulnerability and flood zone compatibility (taken from TAN15, 2004)

DAM Zone	Development Type	Planning Requirements	Acceptability Criteria	Development Advice
A	Emergency Services, highly vulnerable development, less vulnerable	- Justification test not applicable - Refer to surface water requirements	No increase in flooding elsewhere	No constraints relating to river or coastal flooding, other than to avoid

	development, other			increasing risk elsewhere
B	Emergency services & Highly vulnerable development	- If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further - Refer to surface water requirements	- Acceptable consequences for nature of use - Occupiers aware of flood risk - Escape/Evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Generally suitable for most forms of development. Assessments where required, are unlikely to identify consequences that cannot be overcome or managed to an acceptable level. It is unlikely, therefore, that these would result in a refusal of planning consent on the grounds of flooding
	Less vulnerable development		- Occupiers aware of flood risk - No increase in flooding elsewhere	
	Other	Refer to surface water requirements	No increase in flooding elsewhere	
C1	Emergency services, highly vulnerable development, less vulnerable development	- Application of justification test including acceptability of consequences - Refer to surface water requirements	- Acceptable consequences for nature of use - Flood defences adequate - Agreement for construction and maintenance costs secured - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Plan allocations and applications for all development can only proceed subject to justification in accordance to section 6 of TAN 15 and acceptability of consequences in accordance to section 7 and Appendix 1 of TAN 15
	Other	Application of acceptability of consequences (TAN 15)	Acceptable consequences for nature of use	Plan allocations and applications for development should only be

		section 7 and Appendix 1) Refer to surface water requirements	- Occupiers aware of flood risk - Desirable if effective flood warning and evacuation routes/procedure provided depending on nature of proposal - No increase in flooding elsewhere	made if considered acceptable in accordance with section 7 and Appendix 1 of TAN 15
C2	Emergency services, highly vulnerable development	The flooding consequences associated with Emergency Services and highly vulnerable developments are not considered to be acceptable. Plan allocations should not be made for such developments and planning applications not proposed		
	Less vulnerable development	- Application of justification test (section 6 of TAN 15), including acceptability of consequences (section 7 and Appendix 1 of TAN 15) - Refer to surface water requirements	- Acceptable consequences for nature of use - Flood defences adequate - Agreement for construction and maintenance costs secured - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures	Plan allocations or applications for less vulnerable development can only proceed subject to justification in accordance with section 6 of TAN 15 and acceptability of consequences in accordance with section 7 and Appendix 1 of TAN 15
	Other	- Application of acceptability of consequences (section 7 and Appendix 1 of TAN 15) - Refer to surface water requirements	- Flood resistant design - No increase in flooding elsewhere - Acceptable consequences for nature of use - Occupiers aware of flood risk - Effective flood warning provided - No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix 1 of TAN 15.

Natural Resources Wales Flood Risk Standing Advice for Sites located in Flood Zones 2 or 3

For all relevant vulnerable developments (i.e. more vulnerable, less vulnerable and water compatible), advice on the points should be followed:

- Surface water management;
- Access and evacuation; and
- Floor levels.

Surface water management

Plans for the management of surface water need to meet the requirements set out in either the local authority's:

- Surface water management plan where available; OR
- Strategic flood consequence assessment.

They also need to meet the requirements of the approved building regulations Part H: drainage and water disposal. Read section H3 rainwater drainage.

Planning permission is required to use a material that can't absorb water (e.g. impermeable concrete) in a front garden larger than 5 square metres.

Access and evacuation

Details of emergency escape plans should be provided for any parts of a building that are below the estimated flood level:

Plans should show:

- Single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- Basement rooms have clear internal access to an upper level, e.g. a staircase; and
- Occupants can leave the building if there's a flood and there's enough time for them to leave after flood warnings.

Floor levels

The following should be provided:

- Average ground level of the building; and
- Finished floor level of the lowest habitable room in the building.

Ground floor levels should be a minimum of whichever is higher of:

- 300 millimetres (mm) above the general ground level of the site; OR
- At least 600 mm above the estimated river or sea flood level.

7. Resilience and mitigation



Based on the flood risk identified at the Site, the national and local policies and guidance and proposed development, the mitigation measures outlined within this section of the report are likely to help protect the development from flooding.

Sea (coastal/tidal) flood mitigation measures

As the Site is not identified as being at risk of flooding from the sea, mitigation measures are not required.

Rivers (fluvial) flood mitigation measures

As the Site is not identified as being at risk of flooding from fluvial sources, mitigation measures are not required.

Surface water (pluvial) flood mitigation measures

A Very Low to Low surface water (pluvial) flooding risk has been identified at the Site. In order to ensure the development includes sufficient flood mitigation measures to reduce the risk of pluvial flooding over its lifetime, the flood depths, levels and appropriate mitigation measures have been assessed.

According to Site plans the FFLs of the proposed development will be set to 140.90 mAOD, indicating ground levels across the Site will be lowered; as such, it is unlikely that the FFLs of the proposed dwellings can be raised above the maximum flood level in the 1 in 1000 year surface water flood event. As such, the floor levels should be set as high as possible and flood resilience measures included (see below).

Alternative Mitigation

Where it is not possible to raise the minimum finished floor levels to the recommended elevation, it may be appropriate to adopt a water exclusion strategy for flood depths up to 0.3 m in line with the NRW's Standing Advice. A water exclusion strategy, using avoidance and resistance measures, is appropriate where floods are expected to last for short durations. Potential water exclusion strategies include:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing);
- Non-return flap valves on sewer outfalls.
- Construction of local bunds;
- Landscaping to divert water away from the property;
- Sustainable Drainage Systems (SuDS) to store/intercept flood water;

- Boundary walls/fencing;

Avoidance and resistance measures are unlikely to completely prevent floodwater entering a property, particularly during longer duration flood events. Therefore, it is recommended that the following flood resilience measures are also considered.

- Flood resilient materials and designs:
 - o Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
 - o Hard flooring and flood resilient metal staircases;
 - o The use of internal lime plaster/render or where plasterboards are used these should be fitted horizontally instead of vertically and/or using moisture resistant plasterboard at lower levels;
 - o Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;
 - o Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

In addition, the regular maintenance of any drains and culverts surrounding/on the Site under the riparian ownership of the developer should be undertaken to reduce the flood risk.

If these mitigation measures are implemented this would reduce the flood risk to the development from Very Low/Low to Very Low.

Groundwater flood mitigation measures

It is likely the flood mitigation measures recommended for surface water (pluvial) risk will reduce the groundwater flood risk at the development. However, specific groundwater measures that may also be considered for the Low to Moderate risk identified include:

- Waterproof tanking of the ground floor;
- Interceptor drains;
- Automatic sump to extract flood water; and
- Non-return flap valves on the proposed foul and surface water sewer lines.

If these mitigation measures are implemented this could reduce the flood risk to the development from Moderate to Low.

Reservoir flood mitigation measures

According to NRW data, the Site is considered to be at risk of flooding from the following reservoirs:

- Beacons
- Pontsticill (Taf Fechan)

- Cantref
- Llwyn-On

Although the risk from reservoirs cannot be quantified, the likelihood of flood from a reservoir occurring in the UK is very low due to the high level of maintenance carried out on these reservoirs.

However, if this did occur there would be a relatively high rate and onset of flooding associated with a reservoir breach, it is therefore unlikely that safe access could be achieved unless a long warning period was provided. Therefore, occupants should get to the highest level of the building as possible and contact the emergency services.

Other flood risk mitigation measures

As the Site is not identified as at risk from other sources, mitigation measures are not required.

Residual flood risk mitigation measures

The risk to the Site has been assessed from all sources of flooding and appropriate mitigation and management measures proposed to keep the users of the development safe over its lifetime. There is however a residual risk of flooding associated with the potential for failure of mitigation measures if regular maintenance and upkeep isn't undertaken. If mitigation measures are not implemented or maintained, the risk to the development will remain as the baseline risk.

Further flood mitigation information

More information on flood resistance, resilience and water entry can be found here:
http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf
www.knowyourfloodrisk.co.uk

Emergency evacuation – safe access / egress and safe refuge

Emergency evacuation to land outside of the floodplain should be provided if feasible. Where this is not possible, 'more vulnerable' developments and, where possible, development in general (including basements), should have internal stair access to an area of safe refuge within the building to a level higher than the maximum likely water level. An area of safe refuge should be sufficient in size for all potential users and be reasonably accessible to the emergency services.

Emergency evacuation from the development and the Site should only be undertaken in strict accordance with any evacuation plans produced for the Site, with an understanding of the flood risks at the Site including available mitigation, the vulnerability of occupants and preferred evacuation routes.

Flood warnings

The NRW operates a flood warning service in all areas at risk of flooding; this is available on their website: <https://www.gov.uk/check-flood-risk>. The Site is located within an NRW Flood Alerts area (ref: 103WAFtaf) so is able to receive alerts (Figure 22). All warnings are also available through the NRW's 24 hour Floodline Service 0345 988 1188.

The NRW aims to issue Flood Warnings 2 hours in advance of a flood event. Flood Warnings can provide adequate time to enable protection of property and evacuation from a Site, reducing risk to life and property.

Figure 22. NRW Flood Warning Coverage for the local area (NRW, 2023).



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Emergency evacuation

Where possible, a safe access and egress route with a 'very low' hazard rating from areas within the floodplain to an area wholly outside the 1 in 100 year flood event including an allowance for climate change should be demonstrated.

Based on the NRW's Flood Zone Map the eastern half of the Site is in Flood Zone 1, and the closest dry evacuation area within Flood Zone 1 outside of the Site boundary is along School Road (c.30 m northeast – direct measurement). It is advised that evacuation from the

premises would be the preferred option in a flood event if safe to do so. It is recommended that residents prepare to evacuate as soon as an NRW Flood Warning is issued in order to completely avoid flood waters.

On-Site refuge

Evacuation should be the primary action in preference, however, safe refuge could be sought at first or second floor level in a worst-case scenario.

Other relevant information

A Flood Warning and Evacuation Plan (FWEP) is recommended, and occupants should be signed up to receive NRW's Flood Alerts.

Occupants should be signed up to receive NRW's Flood Alerts.

Registration to the Natural Resource Wales flood warning scheme can be done by following this link: <https://www.gov.uk/sign-up-for-flood-warnings>.

It is recommended that main communication lines required for contacting the emergency services, electricity sockets/meters, water supply and first aid stations and supplies are not compromised by flood waters. Where possible these should all be raised above the extreme flood level.

8. Conclusions and recommendations



Table 8. Risk ratings following Site analysis

Source of Flood Risk	Baseline ¹	After analysis ²	After Mitigation ³
River (fluvial) flooding	Very Low to Low	Very Low	N/A
Sea (coastal/tidal) flooding	Very Low		N/A
Surface water (pluvial) flooding	Very Low to Low		Very Low
Groundwater flooding	Low to Moderate	Moderate	Low
Other flood risk factors present	Yes (Reservoirs)		N/A
Is any other further work recommended?	Yes	Yes	Yes (see below)

1 BASELINE risks assigned for the whole Site, using national risk maps, including the benefit of NRW flood defences.

2 AFTER ANALYSIS risks include modification of risk assessments based on detailed site specific analysis including some or all of the following: flood model data, high resolution mapping, building location, access routes, topographic and CCTV surveys.

3 AFTER MITIGATION risks include risks to the proposed development / asset and occupants if mitigation measures recommended in this report are implemented, including the impacts of climate change.

*N/A indicates where mitigation is not required.

The table below provides a summary of where the responses to key questions are discussed in this report. Providing the recommended mitigation measures are put in place it is likely that flood risk to this Site will be reduced to an acceptable level.

Highly vulnerable developments in a DAM Zone B are acceptable according to TAN15 (2004) and providing the recommended mitigation measures are put in place (see previous sections) it is likely that flood risk to this Site will be reduced to an acceptable level.

Table 9. Summary of responses to key questions in the report

Key sources of flood risks identified	Surface Water and Groundwater (see Section 4).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes (see Section 7).
Is any further work recommended?	Yes (see executive summary and Section 7).

9. References and glossary



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Glossary

General terms

BGS	British Geological Survey
NRW	National Resource Wales
GeoSmart groundwater flood risk model	GeoSmart's national groundwater flood risk model takes advantage of all the available data and provides a preliminary indication of groundwater flood risk on a 50m grid covering England and Wales. The model indicates the risk of the water table coming within 1 m of the ground surface for an indicative 1 in 100 year return period scenario.
Dry-Island	An area considered at low risk of flooding (e.g. In a Flood Zone 1) that is entirely surrounded by areas at higher risk of flooding (e.g. Flood Zone 2 and 3)
Flood resilience	Flood resilience or wet-proofing accepts that water will enter the building, but through careful design will minimise damage and allow the re-occupancy of the building quickly. Mitigation measures that reduce the damage to a property caused by flooding can include water entry strategies, raising electrical sockets off the floor, hard flooring.
Flood resistance	Flood resistance, or dry-proofing, stops water entering a building. Mitigation measures that prevent or reduce the likelihood of water entering a property can include raising flood levels or installation of sandbags.
Flood Zone 1	This zone has less than a 0.1% annual probability of river flooding
Flood Zone 2	This zone has between 0.1 and 1% annual probability of river flooding and between 0.1% and 0.5 % annual probability sea flooding
Flood Zone 3	This zone has more than a 1% annual probability of river flooding and 0.5% annual probability of sea flooding
Functional Flood Plain	An area of land where water has to flow or be stored in times of flood.
Hydrologic model	A computer model that simulates surface run-off or fluvial flow. The typical accuracy of hydrologic models such as this is $\pm 0.25\text{m}$ for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFCA	Strategic Flood Consequence Assessment. This is a brief flood risk assessment provided by the local council

SuDS

A Sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS also significantly improve the quality of water leaving the Site and can also improve the amenity and biodiversity that a Site has to offer. There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. Sites over 1 Ha will usually require a sustainable drainage assessment if planning permission is required. The current proposal is that from April 2014 for more than a single dwelling the drainage system will require approval from the SuDS Approval Board (SABs).

Aquifer Types

Principal aquifer

These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

Secondary A aquifer

Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Secondary B aquifer

Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

Secondary undifferentiated

Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type due to the variable characteristics of the rock type.

Unproductive Strata

These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2023 BlueSky copyright and database rights 2023
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (Flood Zone/RoFRS/Historic Flooding/Pluvial/Surface Water)	Natural Resource Wales copyright and database rights 2023

Features/Reservoir/ Flood Alert & Warning)	Ordnance Survey data © Crown copyright and database right 2023
Flood Risk (Groundwater)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2023) Contains British Geological Survey materials © NERC 2023 Ordnance Survey data © Crown copyright and database right 2023
Location Plan	Contains Ordnance Survey data © Crown copyright and database right 2023
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2023 Natural Resource Wales copyright and database rights 2023

10. Appendices



Appendix A

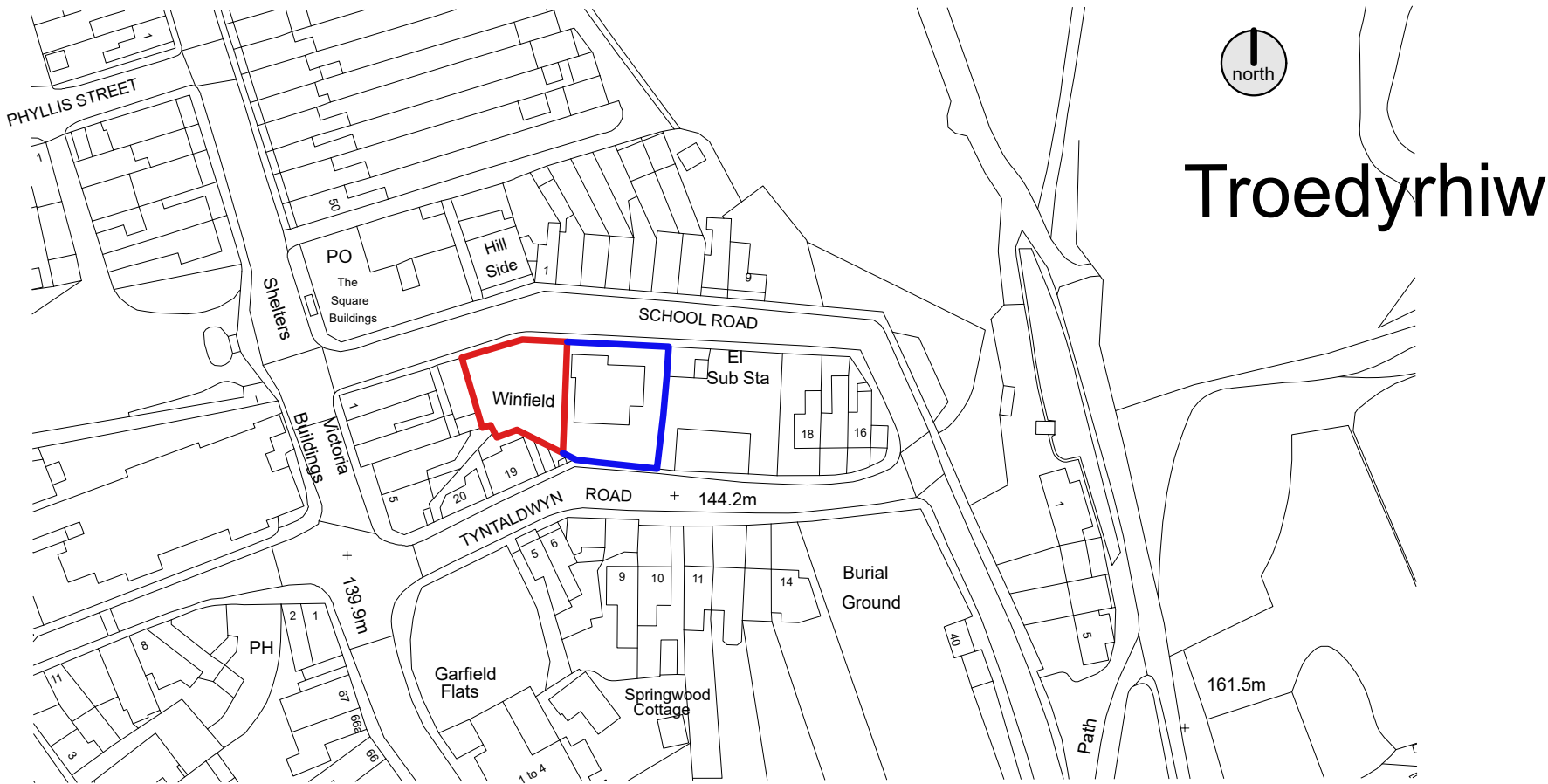


Site plans

 George and Co.

Land at Celtic Bunkhouse,
10 School Rd, Troedyrhiw,
Merthyr Tydfil, CF48 4JS.

932. 01	site location plan		
planning	1:1250 @ A3	May 23	AJ
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Land at Celtic Bunkhouse,
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932. 02

ground floor plan

planning

1:50 @ A3

May 23

AJ

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Mid Glamorgan, Wales, CF47 8EU
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43.3 sqm per floor, per dwelling

ground floor plan

The ground floor plan shows two identical residential units side-by-side. Each unit includes a kitchen (16.9 sqm), a living area (15.8 sqm), a bathroom (2.1 sqm), and a staircase. The plan is oriented with a north arrow pointing towards the top-left corner. Dimensions are marked in red lines, and room areas are labeled in black text.

Room	Area (sqm)
Kitchen	16.9
Living	15.8
Bathroom	2.1

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932. 03

first floor plan

planning

1:50 @ A3

May 23

AJ

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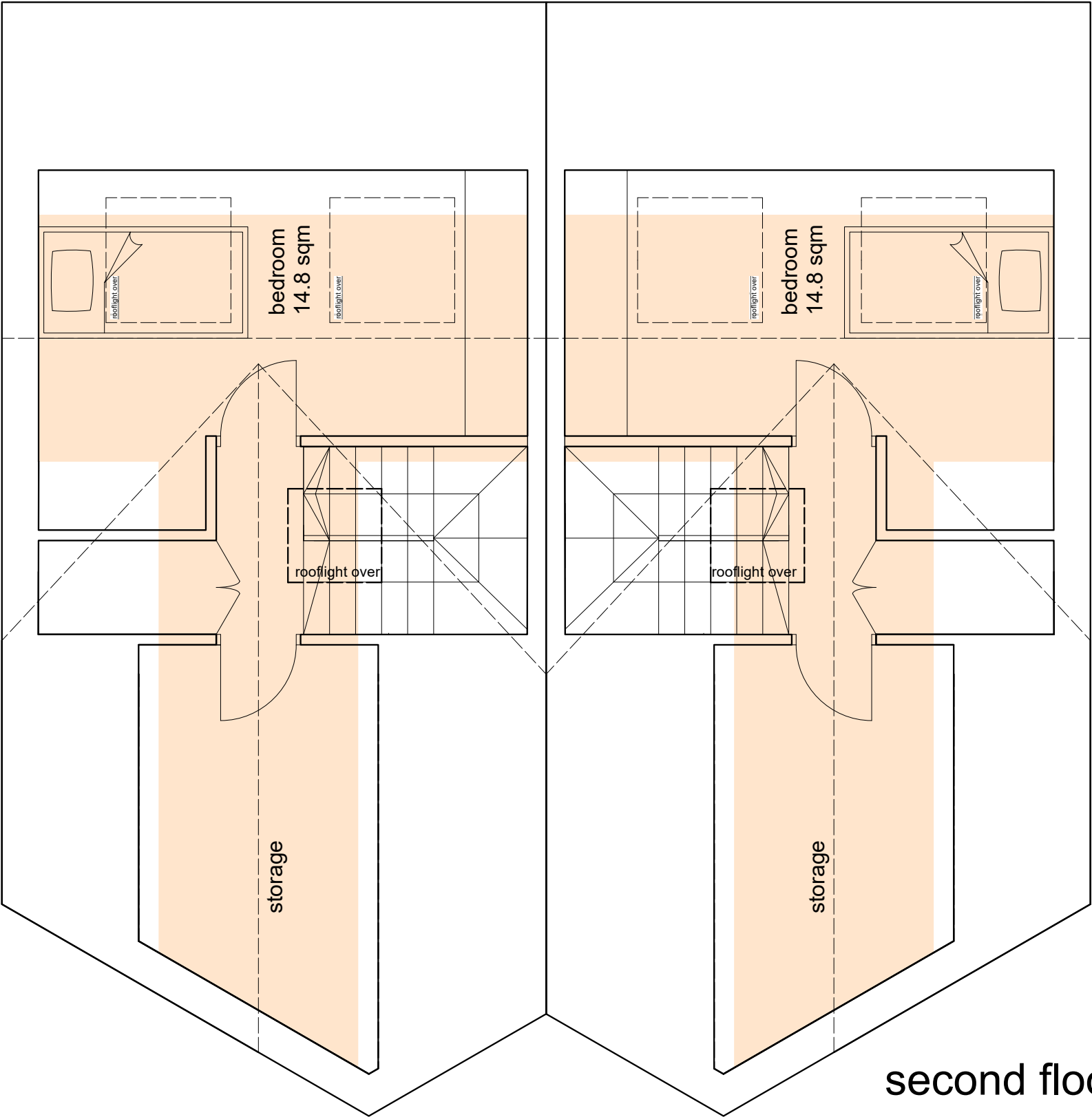
43.3 sqm per floor, per dwelling

The floor plan is symmetrical around a central vertical axis. At the top, a horizontal section is labeled 'A'. At the bottom, a horizontal section is labeled 'A'. On the left and right sides, vertical sections are labeled 'B'. The plan features two bedrooms, each 10.1 sqm, located at the top. Below each bedroom is a smaller bedroom, 5.7 sqm. In the center, there are two master bedrooms, each 12.1 sqm, with a staircase between them. To the left of the master bedroom is a bathroom (3.8 sqm) and an ensuite (1.9 sqm). To the right of the master bedroom is a bathroom (3.8 sqm) and an ensuite (1.9 sqm). A store is located between the 5.7 sqm bedroom and the bathroom. The plan also shows a central staircase and various doors and windows.


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932. 04	second floor plan		
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second floor plan

21.3 sqm (1800mm head height) per floor, per dwelling

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932. 05	elevations		
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rear elevation



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932. 06	elevations		
planning	1:50 @ A3	May 23	AJ
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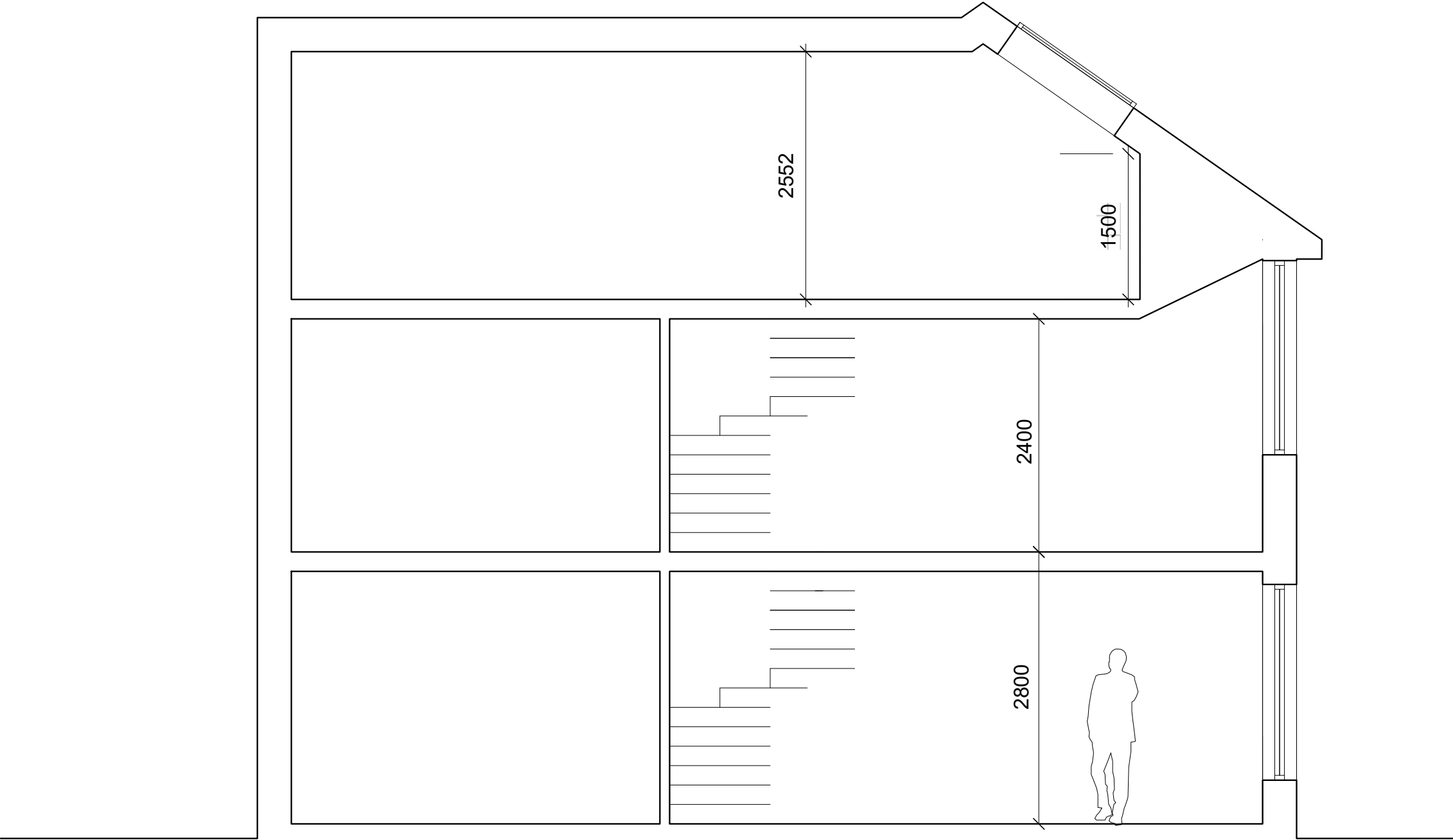
front elevation



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932. 07		section	
planning	1:50 @ A3	May 23	AJ
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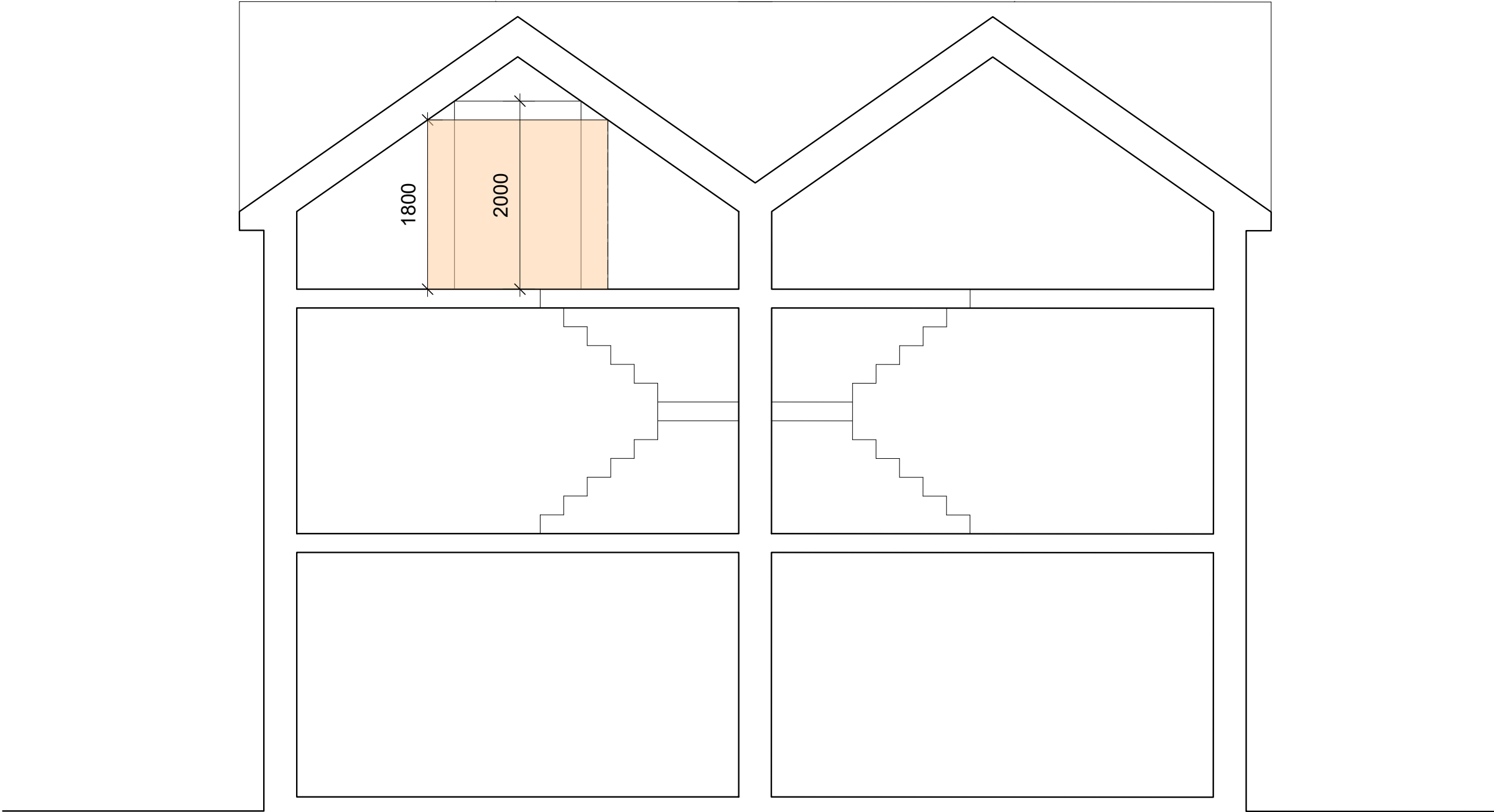


section A-A

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932. 08		section	
planning	1:50 @ A3	May 23	AJ
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section B-B

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932. 09	elevation		
planning	1:50 @ A3	May 23	AJ
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side elevation

 George and Co.

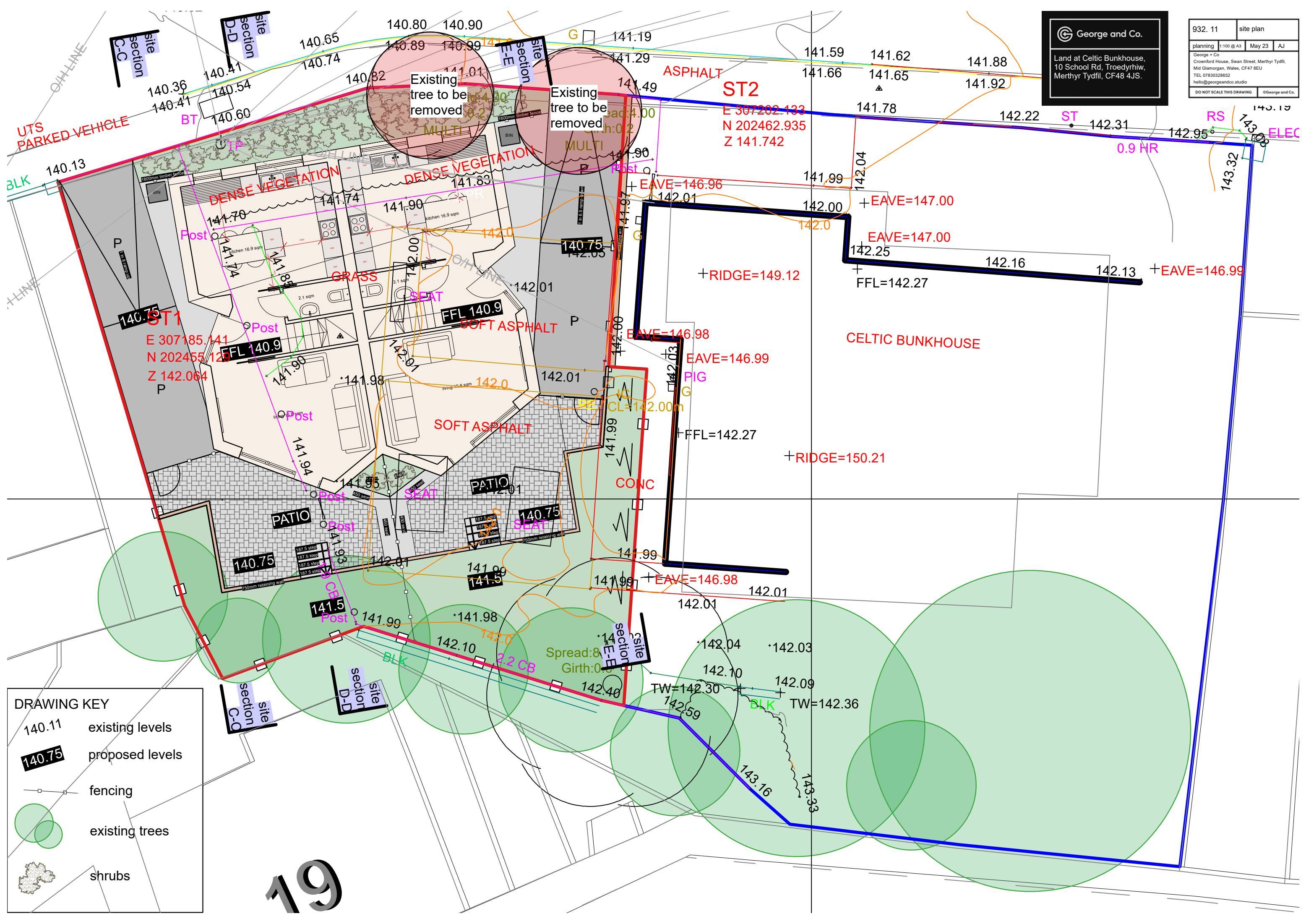
Land at Celtic Bunkhouse,
10 School Rd, Troedyrhiw,
Merthyr Tydfil, CF48 4JS.

932. 10	elevation		
planning	1:50 @ A3	May 23	AJ
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side elevation





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932. 11		site plan	
planning	1:100 @ A3	May 23	AJ
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DRAWING KEY

140.11

existing levels

140.75

proposed levels

fencing

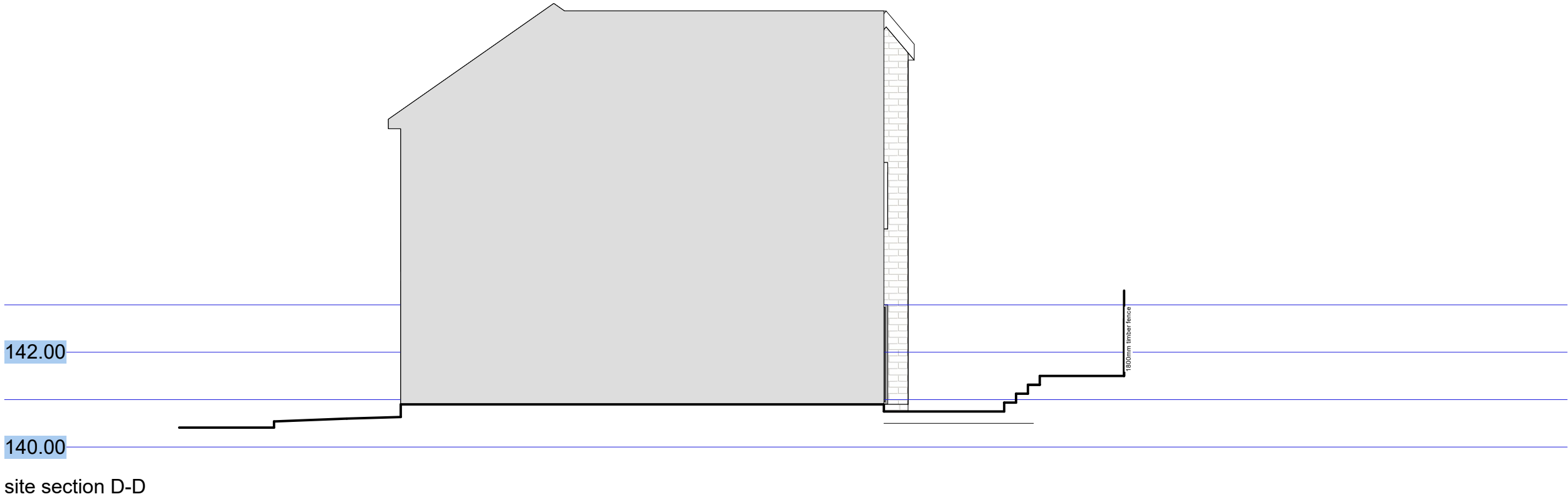
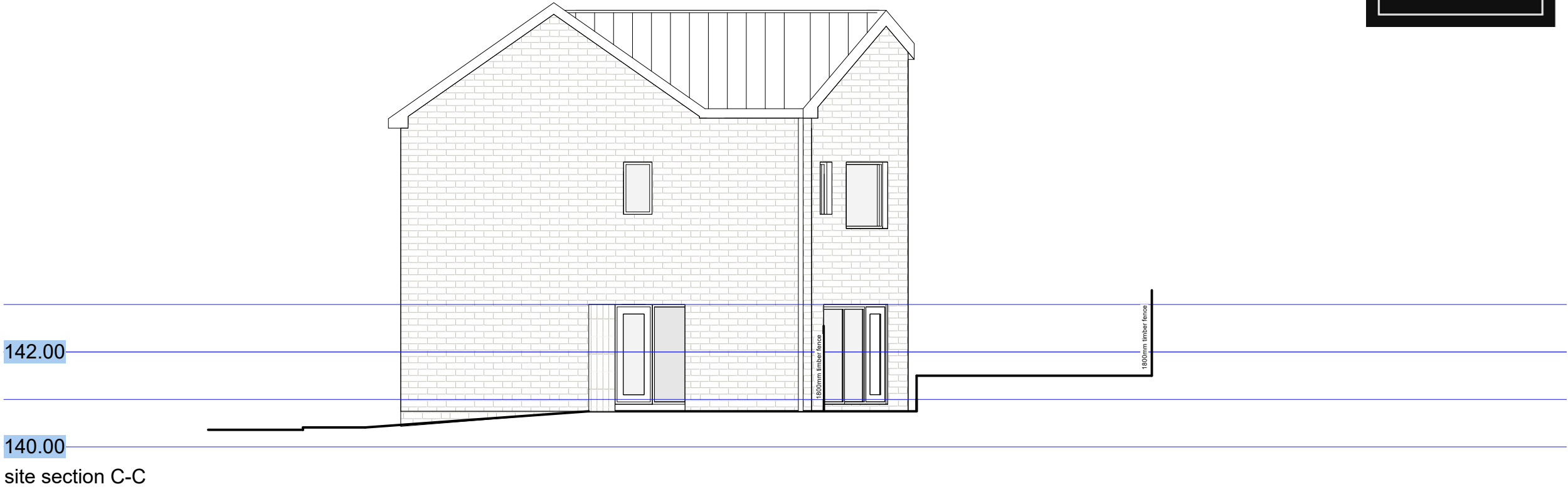
existing trees

shrubs

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932. 12		site sections	
planning	1:100 @ A3	May 23	AJ
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932. 13		site sections	
planning	1:100 @ A3	May 23	AJ
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site section E-E

Appendix B

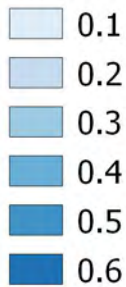


Natural Resource Wales data

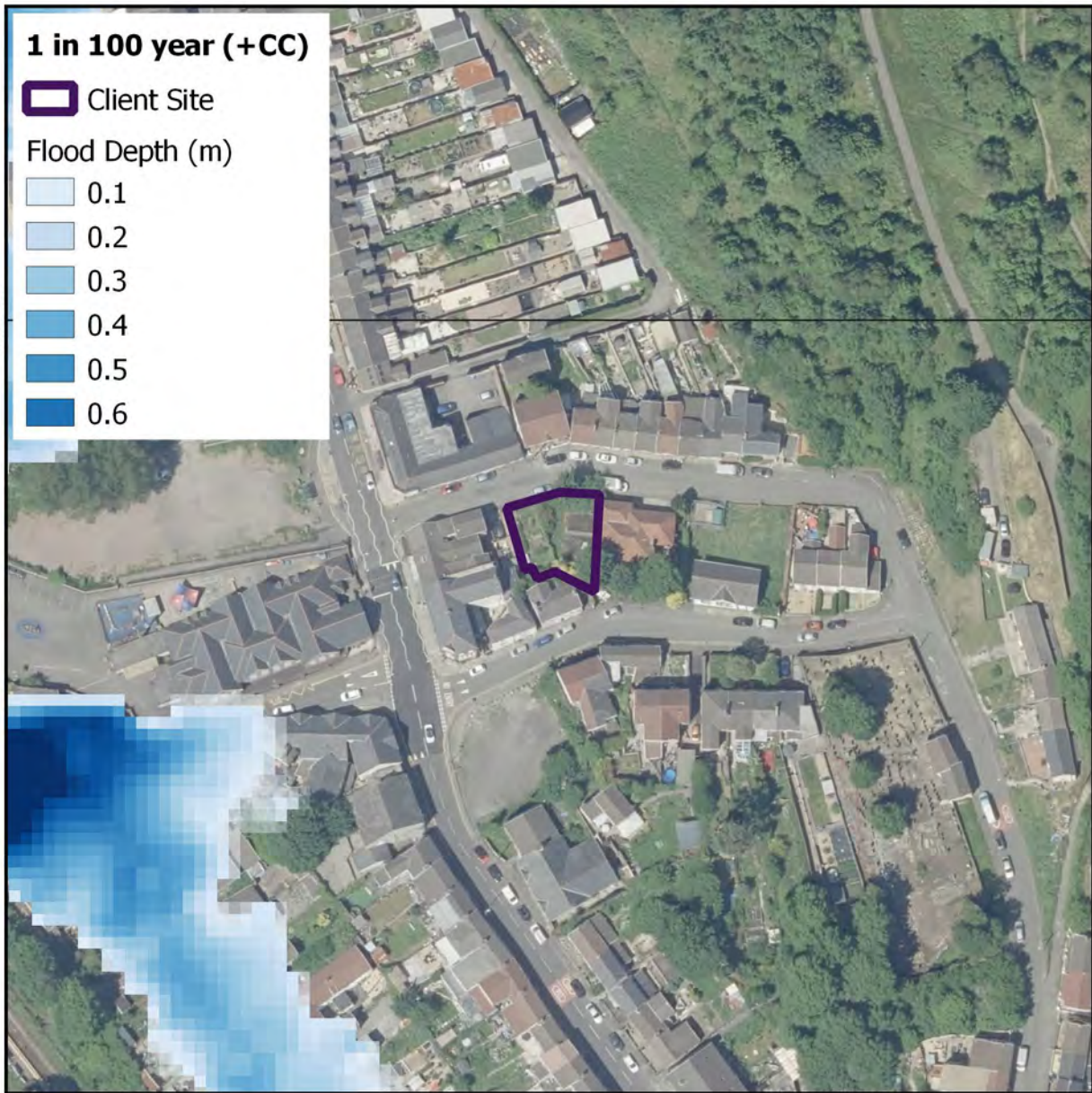
1 in 100 year (+CC)

 Client Site

Flood Depth (m)

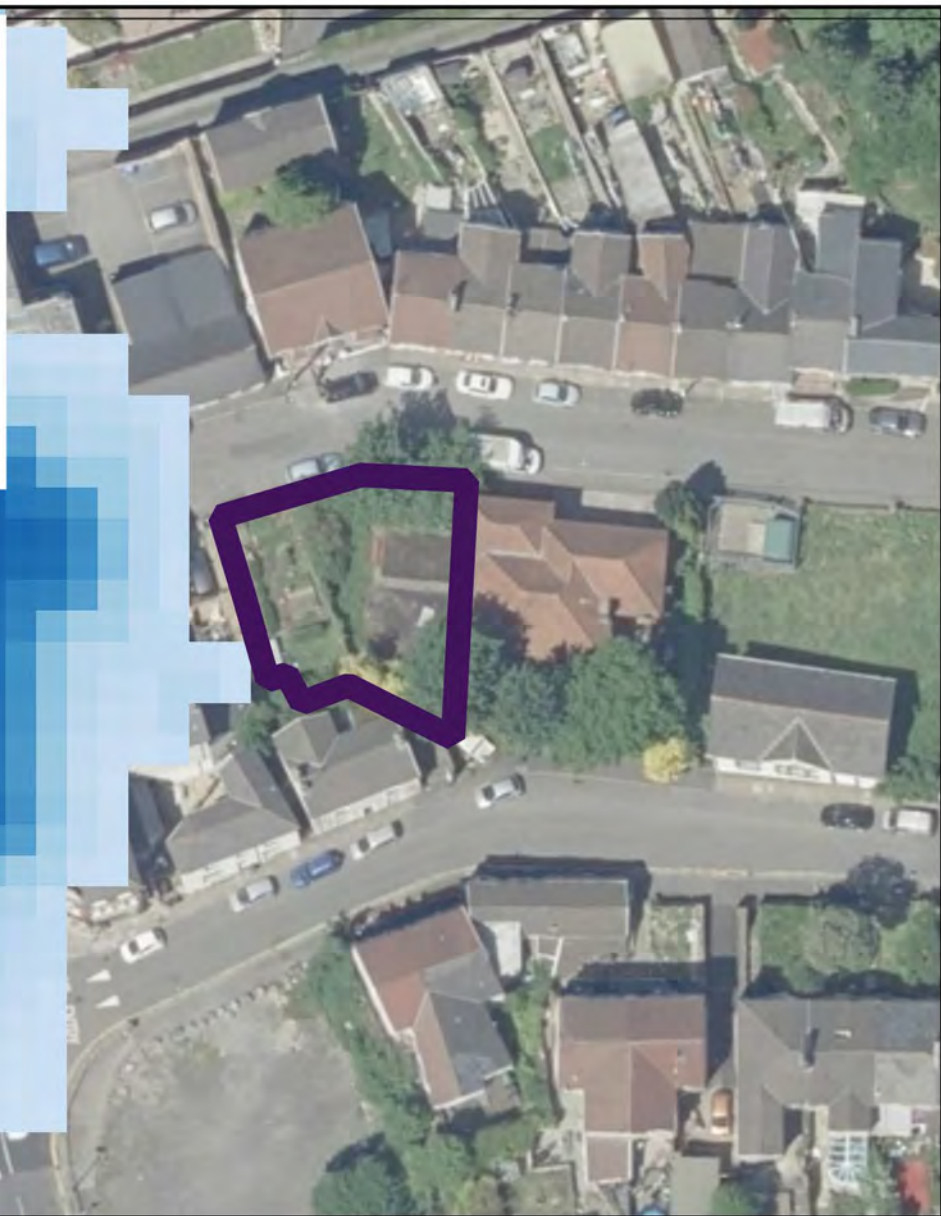


202500



1 in 1000 year

Flood Depth (m)

 0.3 0.5 0.7 0.8 1.0 1.2

1 in 1000 year Client Site

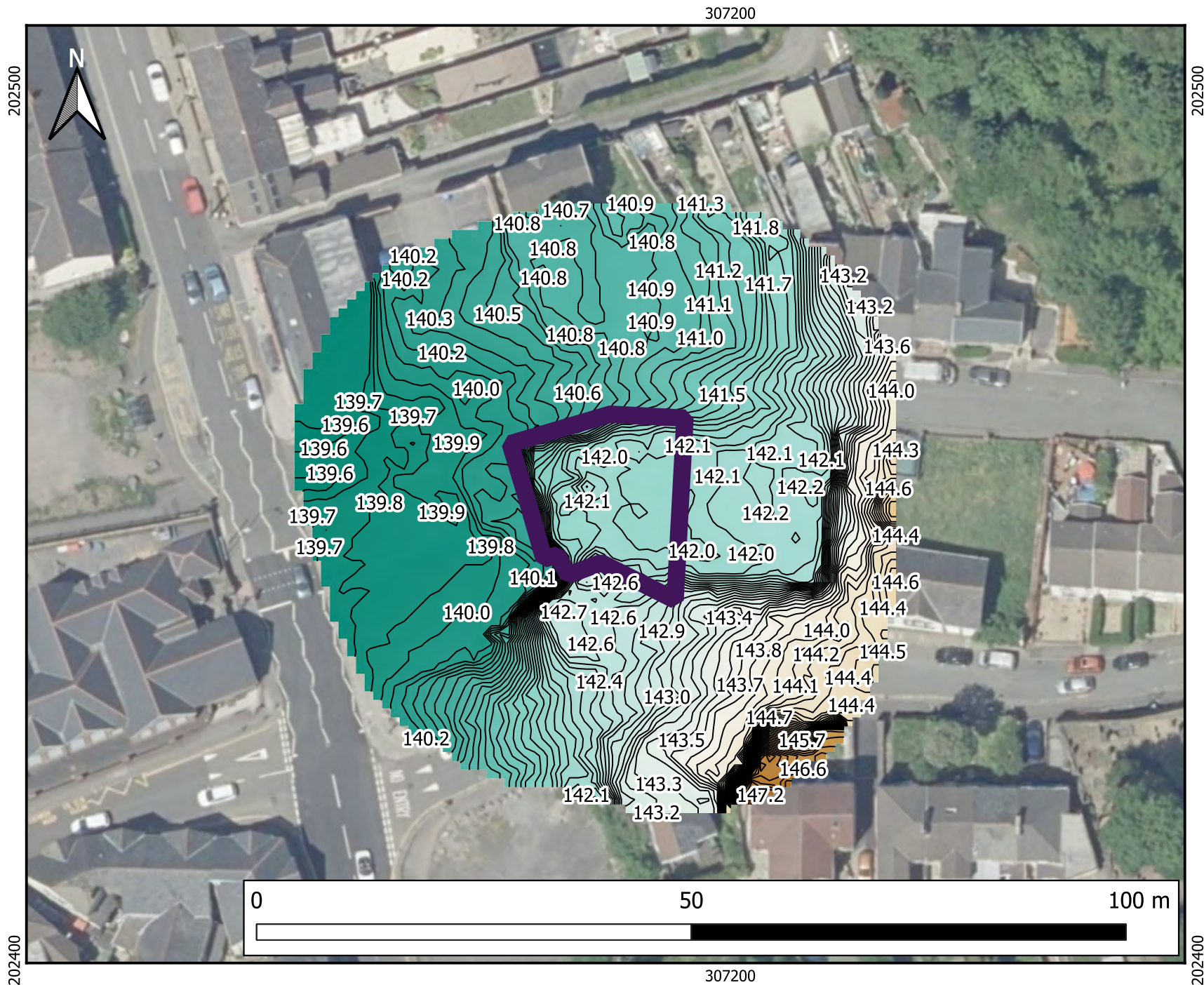
Flood Depth (m)

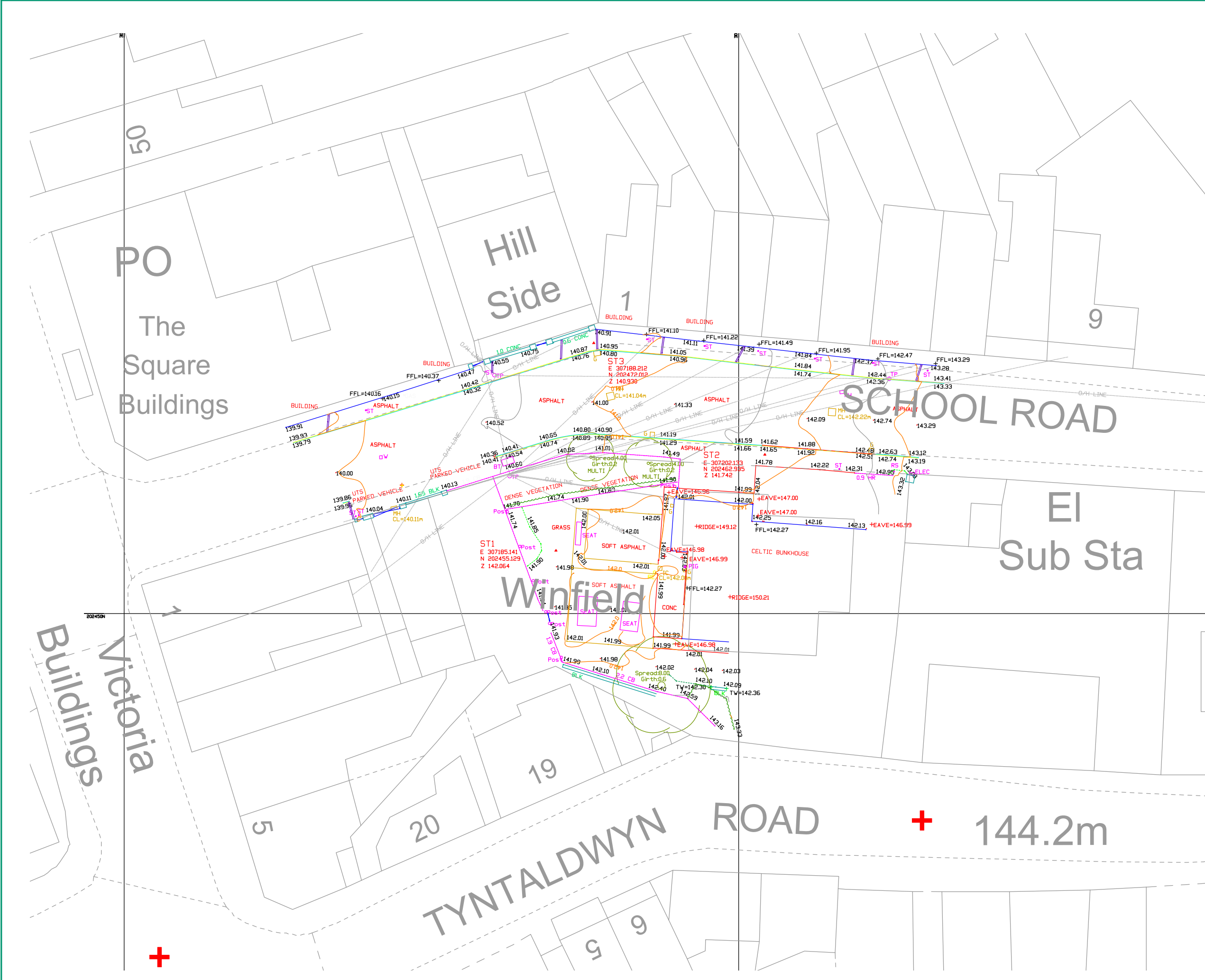
 0.1 0.2 0.3 0.4 0.5

Appendix C



Natural Resource Wales LiDAR ground elevation & topographic survey data





Rev	Amendments	Date	By

NOTES:
1. SITE GRID AND LEVELS ARE BASED UPON ORDNANCE SURVEY VIA THE ACTIVE GPS NETWORK.

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KEY		
	BOTTOM OF BANK	
	TOP OF BANK	
	CONTOURS	
	CABINET	
	TREE	
	FIRE HYDRANT	
	BRITISH TELECOM	
	CABLE TV	
	OVERHEAD LINE	
	GAS VALVE	
	BRICK WALL	
	BLOCK WALL	
	STONE WALL	
	VEGETATION	
	CLOSE BOARD	
	POST RAIL FENCE	
	HERAS FENCE	
	POST WIRE FENCE	
	DROPPED KERB	
	KERB CHANNEL	
	TOP OF KERB	
	RIDGE LEVEL	
	EAVE LEVEL	
	FINISHED FLOOR LEVEL	
	FLAT ROOF LEVEL	
	SURVEY STATION	
	TREE HEIGHT	
	POST BOX SQUARE	
	POST BOX ROUND	
	GRILL SQUARE	
	GRILL ROUND	
	BOLLARD ROUND	
	BOLLARD SQUARE	
	BIN SQUARE	
	BIN ROUND	
	SPOT LEVEL	
	ASPHALT	
	GRASS	
	GRAVEL	
	HARDSTANDING	
	BELUSHA BEACON	
	ROAD SIGN	
	TRAFFIC SIGNAL	
	INSPECTION COVER	
	MANHOLE SQUARE	
	MANHOLE ROUND	
	MARKER POST	
	TELEGRAPH POLE	
	LIGHTING COLUMN	
	GULLY	
	WATER METER	
	SLUICE VALVE	
	STOP TAP	

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Hirwaun Industrial Estate,
Hirwaun,
Aberdare,
CF44 9UP
Tel. 01685 814544
Mob. 07980 404208
j.price@alpinelandsurveyors.co.uk

CLIENT
GEORGE AND CO

PROJECT
TOPOGRAPHICAL SURVEY AT
CELTIC BUNKHOUSE
SCHOOL ROAD
MERTHYR

Surveyed by CS	Date 31/03/2023
Drawn CS	Date 31/03/2023
Scales 1:200@A2	Checked: TC
Project Reference No. ALS/5479	
Drawing Number CB/01	

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Fax: 01722 332296
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- Liaise, at your request, with anyone acting formally on your behalf.

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Martin Lucass

Commercial Director

GeoSmart Information Limited

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Tel: 01743 298 100

martinlucass@geosmartinfo.co.uk

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