GeoSmart Information

FloodSmart Plus

Flood Risk Assessment

Site Address

Twinbrooks Barn
Upbrooks
Clitheroe
BB7 1PL

Grid Reference

375382, 442286

Report Prepared for

Mr A Thornburn
Twinbrooks Barn
Upbrooks
Clitheroe
BB7 1PL

Date

2023-03-17

Report Status

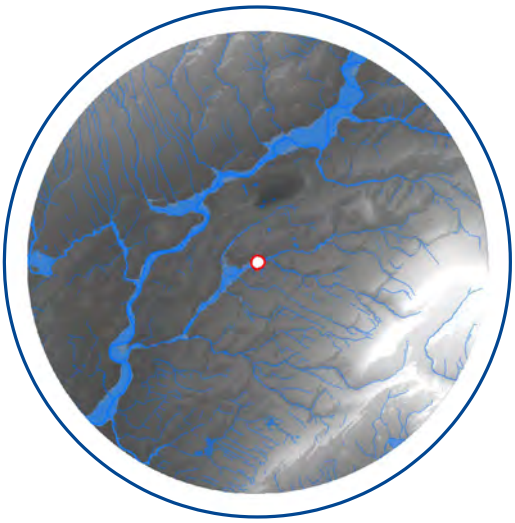
FINAL

Site Area

0.225 ha

Report Reference

74970.00.01R1



Flood Risk Assessment

The Site is mapped within the EA's fluvial Flood Zones 1, 2 and 3 (Low to High probability) from the Mearley Brook watercourse.

Detailed flood model data obtained from the EA confirms a modelled flood level of 83.08 mAOD during a 1 in 100 (plus 36% CC) event. The risk of flooding from rivers and sea is Very Low to Medium, taking flood defences into account.

The area proposed for development is at a Medium to Low risk of surface water flooding, a Low risk of groundwater flooding and a Negligible risk of flooding from artificial sources (sewers, canals and reservoirs).

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1. Executive summary

A review has been undertaken of national environmental data sets to assess the flood risk to the Site from all sources of flooding in accordance with The National Planning Policy Framework (NPPF) (2021) and National Planning Practice Guidance (NPPG) (2014). A site-specific flood risk assessment, to assess the flood risk to and from the development Site, is provided within this concise interpretative report written by an experienced GeoSmart consultant. Baseline flood risk and residual risks that remain after the flood risk management and mitigation measures are implemented are summarised in the table below.

Site analysis

Source of Flood Risk	Baseline	After Analysis	After Mitigation
River (fluvial) flooding	Medium to Very Low	Medium to Very Low	Low to Very Low
Sea (coastal/tidal) flooding	Negligible	Negligible	N/A
Surface water (pluvial) flooding	High to Low	Medium to Low	Low to Very Low
Groundwater flooding	Negligible	Low	Negligible
Other flood risk factors present	No	No	N/A
Is any other further work recommended?	Yes	Yes	Yes (see below)

N/A = mitigation not required

Summary of existing and proposed development

The Site is currently used within a residential capacity. At present there are two buildings on Site with areas of hardstanding and landscaped areas. Development proposals comprise the demolition of one of the buildings and the construction of a replacement outbuilding and a single two storey dwelling as well as an associated access road, car parking spaces and landscaped areas.. According to data from the Client the finished floor levels of the proposed replacement outbuilding are to be set at 82.70 mAOD and the new dwelling at 83.50 mAOD. The main existing building of Twinbrook Barn is not proposed to undergo any changes. Site plans are included within Appendix A.

Summary of flood risks

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

Sea (Coastal/Tidal) Flood Risk

The Site is located in an inland location and the risks of flooding from coastal and estuarine environments are considered to be Very Low.

River (Fluvial) Flood Risk

The Site is located 10 m north of the Mearley Brook watercourse. According to the EA's Flood Map for Planning Purposes, approximately 73% of the Site (1,775m^2) is located within fluvial Flood Zone 3 (High probability) from the River Mearley, a further 16% (390 m^2) is located within fluvial Flood Zone 2 at Medium probability. The remainder of the Site, 11% (265 m^2) and land to the north is located within Flood Zone 1 at Low probability.

The EA's Risk of Flooding from Rivers and Sea (RoFRS) map, which considers the type, condition and crest height of flood defences, indicates the Site has a Medium to Very Low risk of flooding from Rivers and the Sea.

- Modelled flood data obtained from the EA confirms part of the Site (in the south) proposed for development, is located in Flood Zone 3b.
- The EA's modelled data has been analysed in line with the most up to date guidance on climate change (EA, 2022), to confirm a maximum "design" flood level at the Site.
- During a 1 in 100 year plus 36% climate change allowance event the flood level at the Site would be 83.08 mAOD.
- During this event, flood depths in the area proposed for development could be up to 0.79 m. Flood mitigation measures are included in the next section.

Emergency evacuation routes are available to the north of the proposed development and Site.

Surface Water (Pluvial) Flood Risk

According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping, the Site is at a variable risk of pluvial flooding ranging from Low to High.

- It should be noted that the area proposed for development is classed as at Medium to Low risk with only the access road affected to depths less than 0.3 m.
- During a High risk event the area proposed for development is not likely to be affected with flooding restricted to areas outside of the development footprint.

Groundwater Flood Risk

Groundwater Flood Risk screening data indicates there is a Low risk of groundwater flooding at the surface in the vicinity of the Site during a 1 in 100 year event.

- Based on a review of (limited) site specific data groundwater levels may rise in the bedrock and superficial aquifer in response to high river events and prolonged rainfall recharge events.

Artificial Flood Risk

The risk of flooding from artificial (man-made) sources such as reservoirs, sewers and canals has been assessed:

- The EA's Risk of Flooding from Reservoir map confirms the Site is not at risk of reservoir flooding.
- Ordnance Survey (OS) data confirms there are no canals near to the Site.
- A sewer flooding history search was undertaken using the Strategic Flood Risk Assessment (Ribble Valley Borough Council, 2017). This confirms no recorded incidences of sewer flooding at or within the vicinity of the Site.

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

The risk to the development has been assessed over its expected 100 year lifetime, including appropriate allowances for the impacts of climate change. More extreme weather events could increase the risk to the Site from increased potential for surface water / river flooding. Site specific assessment indicates risk to the Site is not likely to increase significantly and appropriate mitigation measures are proposed.

In accordance with paragraphs 157, 164 and footnote 51 of the NPPF (2021), as the development proposals are comprised of new buildings within Flood Zones 2 and 3 a Sequential Test should be undertaken to assess the availability of other deliverable Sites at a lower flood risk.

Recommendations for flood mitigation are included overleaf.

Recommendations

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

- Fluvial flood depths could be up to 0.79m in depth in the area proposed for development, according to data provided by the Client Finished Floor Levels (FFL) of the new dwelling are proposed to be set to 83.50 mAOD[1] Standard flood resilient design measures should also be incorporated. It should be noted the replacement outbuilding FFL is to be set at 82.70 mAOD however given that the ground floor is to be used for a garage and garden store considered to be floodable structures further raising of FFL is not deemed necessary.
- A Medium to Low risk of flooding from pluvial sources has been identified in the area proposed for development. The mitigation measures for fluvial flooding are likely to provide suitable protection against pluvial flooding. 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.
- A surface water drainage (SuDS) strategy has been prepared separately (ref: 74970.01.01) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.
- Specific groundwater measures that may be considered for the Low risk identified could include:
    - Interceptor drains;
    - Automatic sump and pump to extract flood water; and
    - Non-return flap valves on the proposed foul and surface water sewer lines.

Additional Considerations

- Occupants of the Site should be signed up to receive EA Flood Warnings.
- A Flood Warning and Evacuation Plan (FWEP) is recommended to ensure persons using the Site can evacuate safely on receipt of a Flood Warning.
- As the development proposals involve the increasing of building footprint within the fluvial Flood Zones compensatory storage will be required, this should be achieved through level for level compensation or where this is not feasible through use of voids.

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.

[1] 0.42 m above the 1 in 100 year plus climate change flood level of 83.08 mAOD.

2. Introduction

Background and purpose

A site-specific flood risk 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 NPPF (2021) and the source(s) of any flood risk present, guided by the NPPG (Published in 2014 and updated in August 2022). 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 NPPF (2021) and NPPG (2022).

"*The National Planning Policy Framework set out the Government's planning policies for England and how these are expected to be applied*" (NPPF, 2021).

The NPPF (2021) and NPPG (2022) promote a sequential, risk based approach to the location of development. This also applies to locating a development within a Site which has a variable risk of flooding.

"*The approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. This means avoiding, so far as possible, development in current and future medium and high flood risk areas considering all sources of flooding including areas at risk of surface water flooding*" (Paragraph: 023. NPPG, 2022).

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

In accordance with the requirements set out within NPPG 2022 (Paragraph: 021 Reference ID: 7-021-20220825), a thorough review of publicly and commercially available flood risk data and EA supplied data indicating potential sources of flood risk to the Site from rivers and coastal 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 the EA and a review of the Ribble Valley Borough Council Strategic Flood Risk Assessment (SFRA) (2017) used to ascertain local flooding issues and, where appropriate, identify information to support a Sequential and/or Exception test required as part of the NPPF (2021).

The existing and future flood risks 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*	Environment Agency (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*	Environment Agency (Appendix B)	OS Data
Groundwater	X	X		
Sewer		X		
Culvert/bridges		X		X
Reservoir		X	X	

*Local guidance and policy, referenced in Section 6, has been consulted to determine local flood conditions and requirements for flood mitigation measures.

3. Site analysis

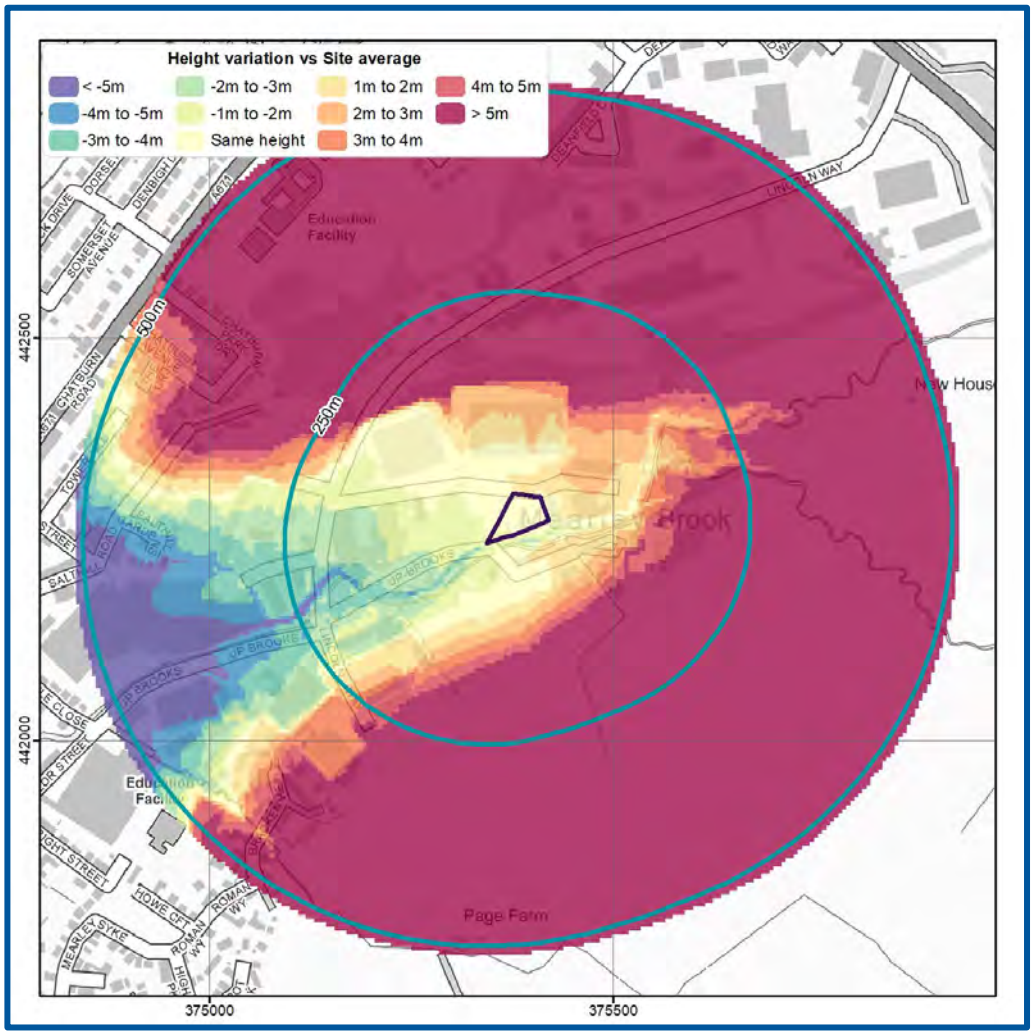
Site information

The Site is located in Clitheroe in a setting of commercial and residential land use at National Grid Reference SD 75384 42288. Site plans and drawings are provided in Appendix A.

According to OS data, using a 500 m buffer around the Site, the area is on a steep slope (Figure 1). It is noted that to the north land rises to c. 98.7 m above Ordnance Datum (AOD). To the west land falls to c. 77.7 mAOD, to the east land rises to c. 100.8 mAOD and to the south rises to c. 99.4 mAOD.

A topographic survey has been undertaken for the Site by Sunderland Peacock Architects (2018) identifying ground levels fall gradually to the southwest from 84.67 mAOD to 82.29 mAOD.

Figure 1. Site Location and Relative Elevations (GeoSmart, 2023).



Development

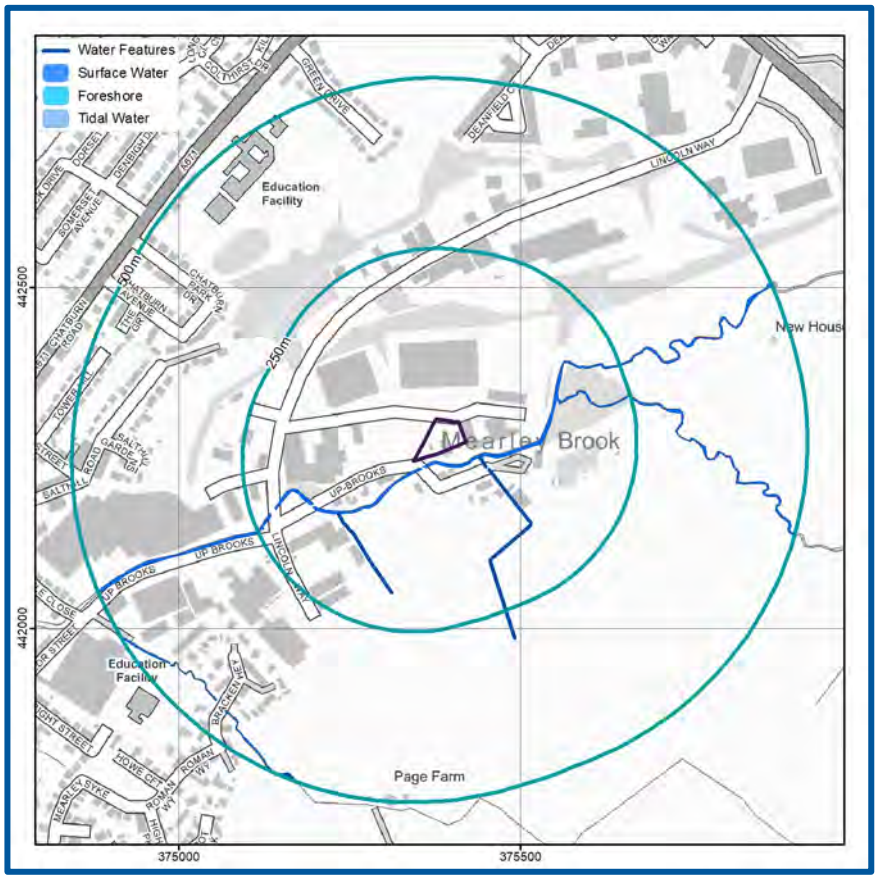
The Site is currently used within a residential capacity. At present there are two buildings on Site with areas of hardstanding and landscaped areas. Development proposals comprise the demolition of one of the buildings and the construction of a replacement outbuilding and a single two storey dwelling as well as an associated access road, car parking spaces and landscaped areas. According to data from the Client the finished floor levels of the proposed replacement outbuilding are to be set at 82.70 mAOD and the new dwelling at 83.50 mAOD. The main existing building of Twinbrook Barn is not proposed to undergo any changes. 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 Annex 3 of the NPPG (2022), the vulnerability classification of the existing development is More Vulnerable and proposed development is More Vulnerable. The estimated lifespan of the development is 100 years.

Hydrological features

According to Ordnance Survey (OS) mapping (Figure 2), there are a number of surface water features within 500 m of the Site.

Figure 2. Surface water features (EA, 2023)



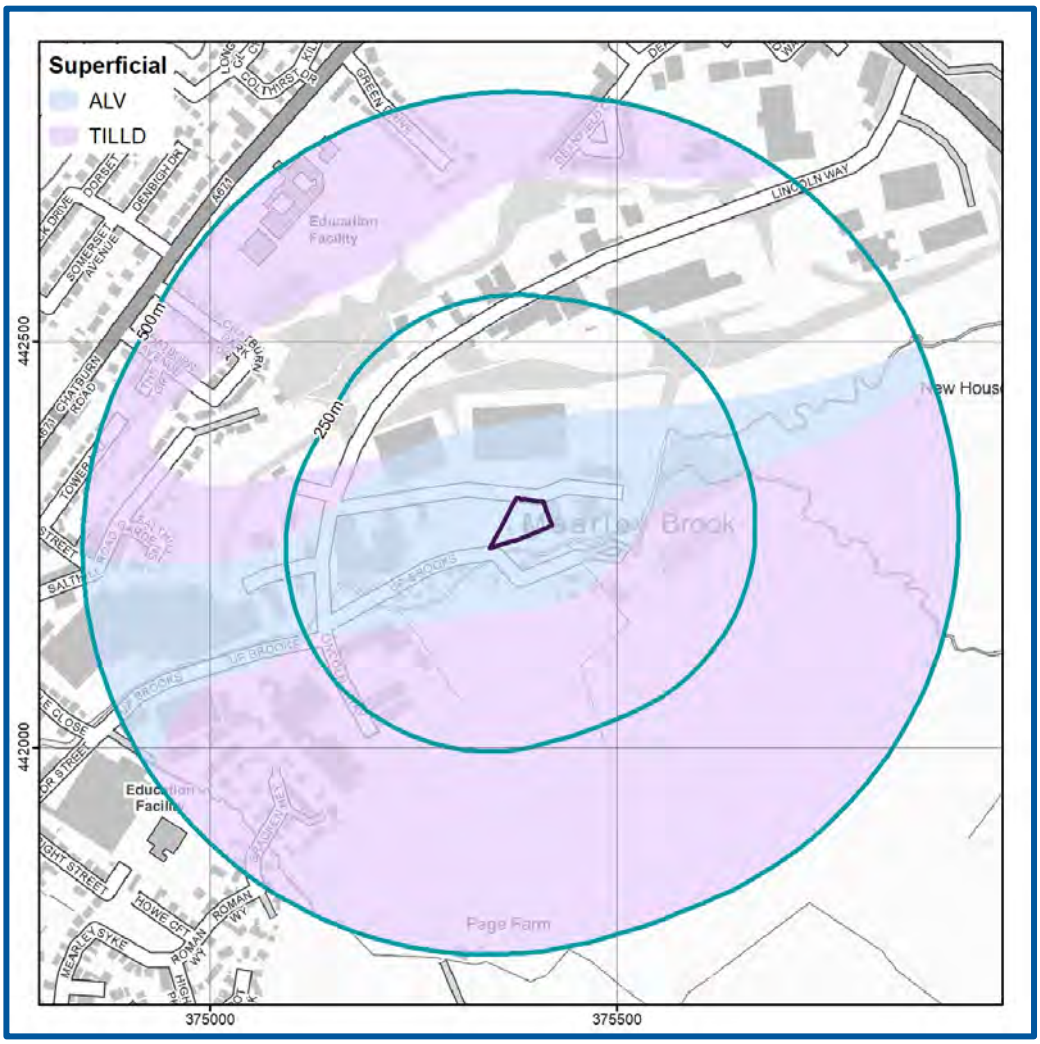
The Mearley Brook is located approximately 10 m south of the Site at a lower elevation.

A small unnamed waterbody is located approximately 350 m northwest of the Site at a higher elevation than the Site, however due to the significant distance from this feature and its limited scale this does not present a risk to the Site.

Hydrogeological features

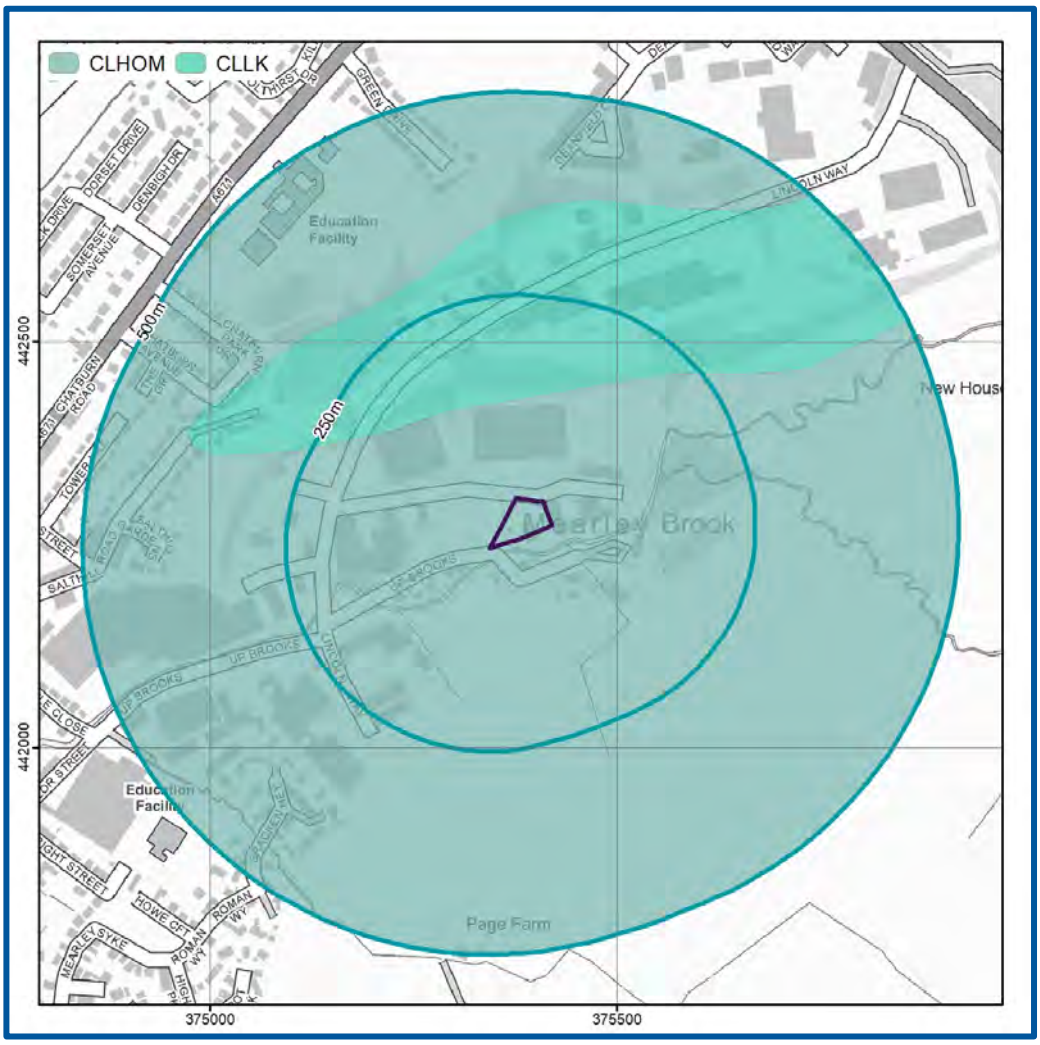
British Geological Survey (BGS) mapping indicates the underlying superficial geology (Figure 3) consists of Alluvium- clay, silt, sand and gravel (ALV) (BGS, 2023) and is classified as a Secondary (A) Aquifer (EA, 2023).

Figure 3. Superficial Geology (BGS, 2023)



BGS mapping indicates the underlying bedrock geology (Figure 4) consists of the Clitheroe Limestone Formation and Hodder Mudstone Formation (undifferentiated) (CLHOM) (BGS, 2021) and is classified as a Secondary (A) Aquifer (EA, 2023).

Figure 4. Bedrock Geology (BGS, 2023)



The Site does not lie within a groundwater Source Protection Zone (SPZ) (EA, 2023).

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 inferred.

The hydrogeological characteristics suggest there is potential for a groundwater table beneath the Site, but an exact depth could not be confirmed.

Groundwater levels may rise in the bedrock and superficial aquifer in response to high river events subject to hydraulic continuity between the driving water level, the groundwater system and the Site.

Additionally, groundwater levels may also rise in the bedrock and superficial aquifer in response to prolonged rainfall recharge which may cause an unusually high peak in groundwater levels during some years, subject to hydraulic continuity between the groundwater system and the Site.

4. Flood risk to the development

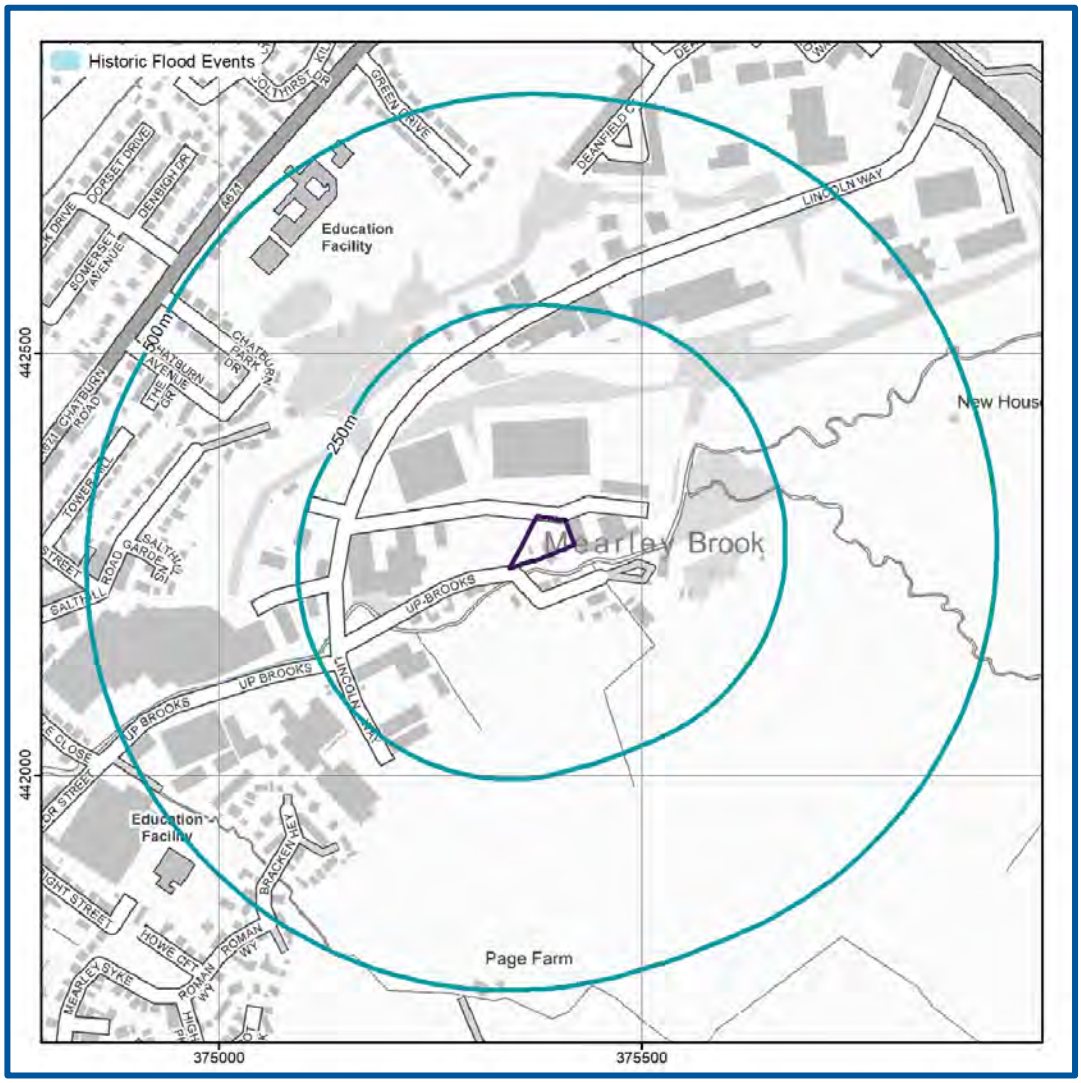
Historical flood events

According to the EA's historical flood map (Figure 5) no historical flood events have been recorded at the Site (EA, 2023).

According to the SFRA (2017), the community of Clitheroe has been impacted by flooding events occurring in 1866, 1923 and 1936. Specific information towards the extent, cause and damages is not provided. As a result of this information to whether this affected the Site could not be ascertained.

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 5. EA historic flood map (EA, 2023)



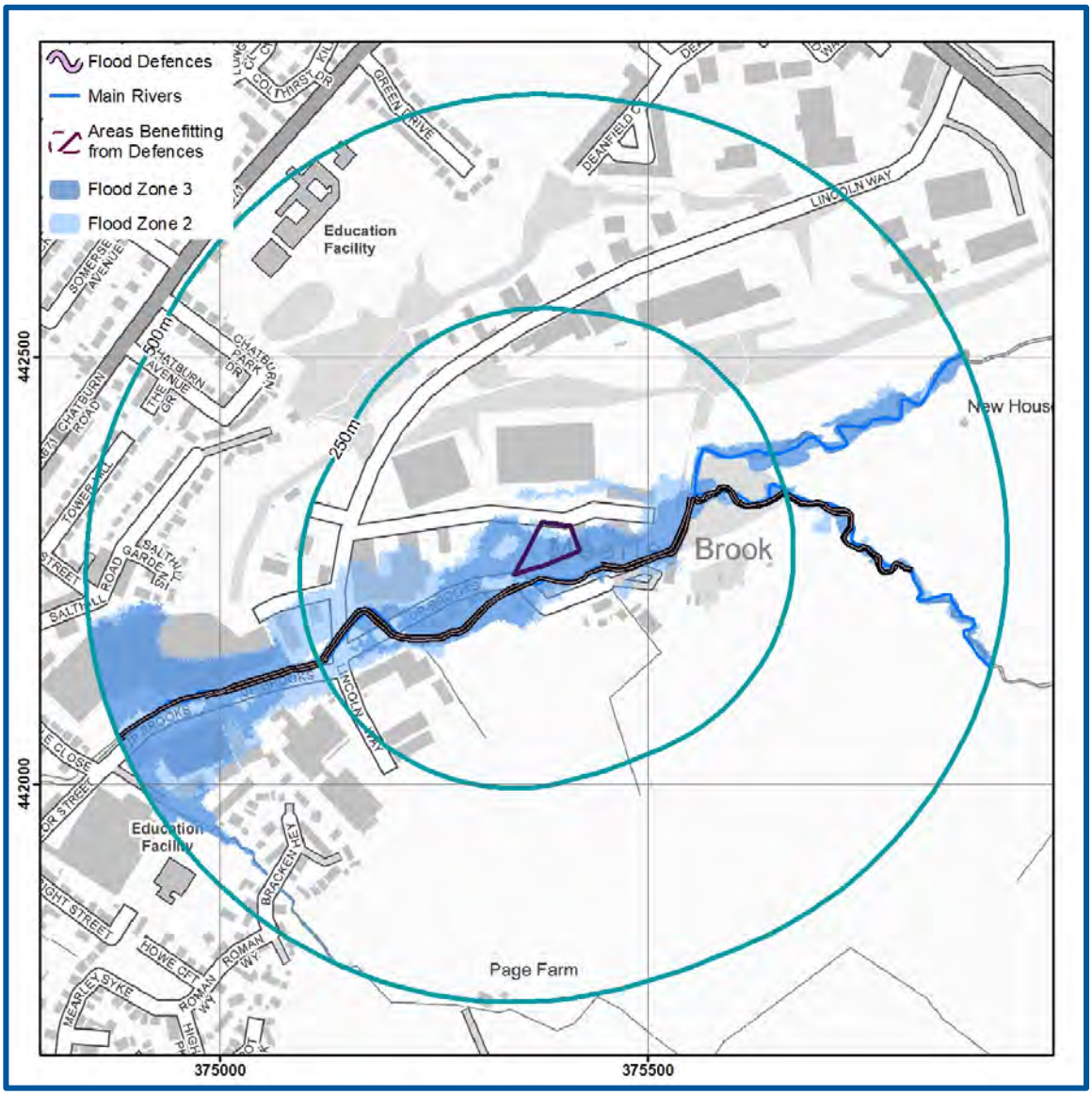
Rivers (fluvial) / Sea (coastal/tidal) flooding

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 Very Low.

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.

According to the EA's Flood Map for Planning Purposes (Figure 6), approximately 73% of the Site (1,775 m^2) is located within fluvial Flood Zone 3 classified as having a High probability of flooding from the River Mearley, a further 16% (390 m^2) is located within fluvial Flood Zone 2 at Medium probability. The remainder of the Site, 11% (265 m^2) and land to the north is located within Flood Zone 1 at Low probability.

Figure 6. EA Flood Map for Planning Purposes (EA, 2023)



Guidance

As defined in the NPPF (2021):

Ignoring the presence of any defences, land located in a Flood Zone 3 is considered to have High probability of flooding with a 1 in 100 year or greater annual probability of fluvial flooding or a 1 in 200 or greater annual probability of coastal flooding in any one year.

Development of "Water-Compatible" and "Less Vulnerable" land uses are suitable for this zone with "More Vulnerable" and "Essential Infrastructure" requiring an Exception test to be passed prior to development taking place. (see glossary for terminology).

Flood defences

- The Site is in an area which benefits from flood defences, but is not within the EA's ABD[2].
- According to the Mearley Brook Flood Modelling and Mapping (JBA Consulting, 2018) the Mearley brook and its tributaries are largely undefended with several linear fluvial defence walls.
- An area of raised ground is located adjacent to the Mearley Brook, based on LiDAR data the crest height is approximately 82.0 mAOD, 2 m above the watercourse in the areas in proximity to the Site. This feature has been allocated a Grade 4 condition, last inspected on 11/09/2020.

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 FRA subject to local topography.

[2] The EA maps Areas which Benefit from the presence of Defences (ABD) in a 1 in 100 (1%) chance of flooding each year from rivers; or 1 in 200 (0.5 %) chance of flooding each year from the sea. If the defences were not there, these areas would flood in a 1 in 100 (1%)/ 1 in 200 (0.5 %) or larger flooding incident. The EA do not show all areas that benefit from all flood defences, some defences are designed to protect against a smaller flood with a higher chance of occurring in any year, for example a flood defence which protects against a 1 in 30 chance of flooding in any year. Such a defence may be overtopped in a flood with a 1 in 100 (1%)/ 1 in 200 (0.5%) chance of occurring in any year, but the defence may still reduce the affected area or delay (rather than prevent) a flood, giving people more time to act and therefore reduce the consequences of flooding.

Model data

As the Site is located within the EA's fluvial floodplain, modelled flood elevation data was obtained from the EA. This data is more up to date than that which is included in the Ribble Valley Borough SFRA (2017) and has been used to assess flood risk and to provide recommendations for mitigation for the proposed development.

Defended modelled flood data from the Mearley Brook Modelling Study (JBA Consulting, 2018) has been taken from the eight 2D node points located within the watercourse and 2D floodplain nodes provided, have been used to assess flood risk[3]. The data is provided in the table below and is included within Appendix B.

Table 2. EA modelled flood level data

Ground levels at the Site (mAOD)	Modelled Flood Levels (mAOD)			
	1 in 20 year	1 in 100 year	1 in 100 year plus 30% CC	1 in 1000 year
82.29 to 84.67	82.86	82.92	83.07	83.24
Flood depths	Up to 0.57	Up to 0.63	Up to 0.78	Up to 0.95

Flood Zone 3b

According to the Ribble Valley Borough SFRA (2017) Flood Zone 3b is defined as:

"land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)."

With the only appropriate uses being water-compatible and essential infrastructure and designed to operate and remain safe for users in time of flood, resulting in no net loss of floodplain storage, no impedance of water flows and not increase flood risk elsewhere. Whilst an area of development is located within Flood Zone 3b, as this is replacing an existing outbuilding with a floodable structure at ground floor level this represents no increase in flood risk to the residents, with the mitigation measures proposed in this report likely providing a greater standard of protection.

[3] 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 the Environment Agency.

Climate change factors

The EA's fluvial flood modelling produced modelled results for a range of events up to and including the 1 in 100 year plus a 20% allowance for climate change event. However, the EA's Flood risk assessments: climate change allowances guidance published in 2021 now requires consideration of a range of increases in river flows for the proposed development. Furthermore, due to the 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 management catchment).

In accordance with the guidance, as the Site is located within the North West river Basin in the Ribble catchment and the proposed development is classed as More Vulnerable, where the proposed lifespan is 100 years, the Central allowance for the 2050s (23%) and 2070s (36%) have been used to determine a suitable climate change factor. The updated guidance confirms 'More Vulnerable' developments are required to undertake a Basic assessment approach.

Table 3. Flood levels plus climate change allowances

Ground levels at the Site (mAOD)	1 in 100 year plus 23% allowance for climate change flood level (mAOD)	1 in 100 year plus 36% allowance for climate change flood level (mAOD)
82.29 to 84.67	83.03	83.08
Flood depths	Up to 0.74	Up to 0.79

Flood risk including the benefit of defences

The type and condition of existing flood defences influence the 'actual' risk of fluvial flooding to the Site, albeit the long-term residual risk of flooding (ignoring the defences) should be considered when proposing new development.

According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) mapping (Figure 7, overleaf), which considers the crest height, standard of protection and condition of defences, there is a Medium to Very Low risk flood risk from Rivers and the Sea.

Figure 7. Risk of Flooding from Rivers and Sea map (EA, 2023)

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 coastal floodplains.

- According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping, the Site has a variable risk of pluvial flooding ranging from Low to High.

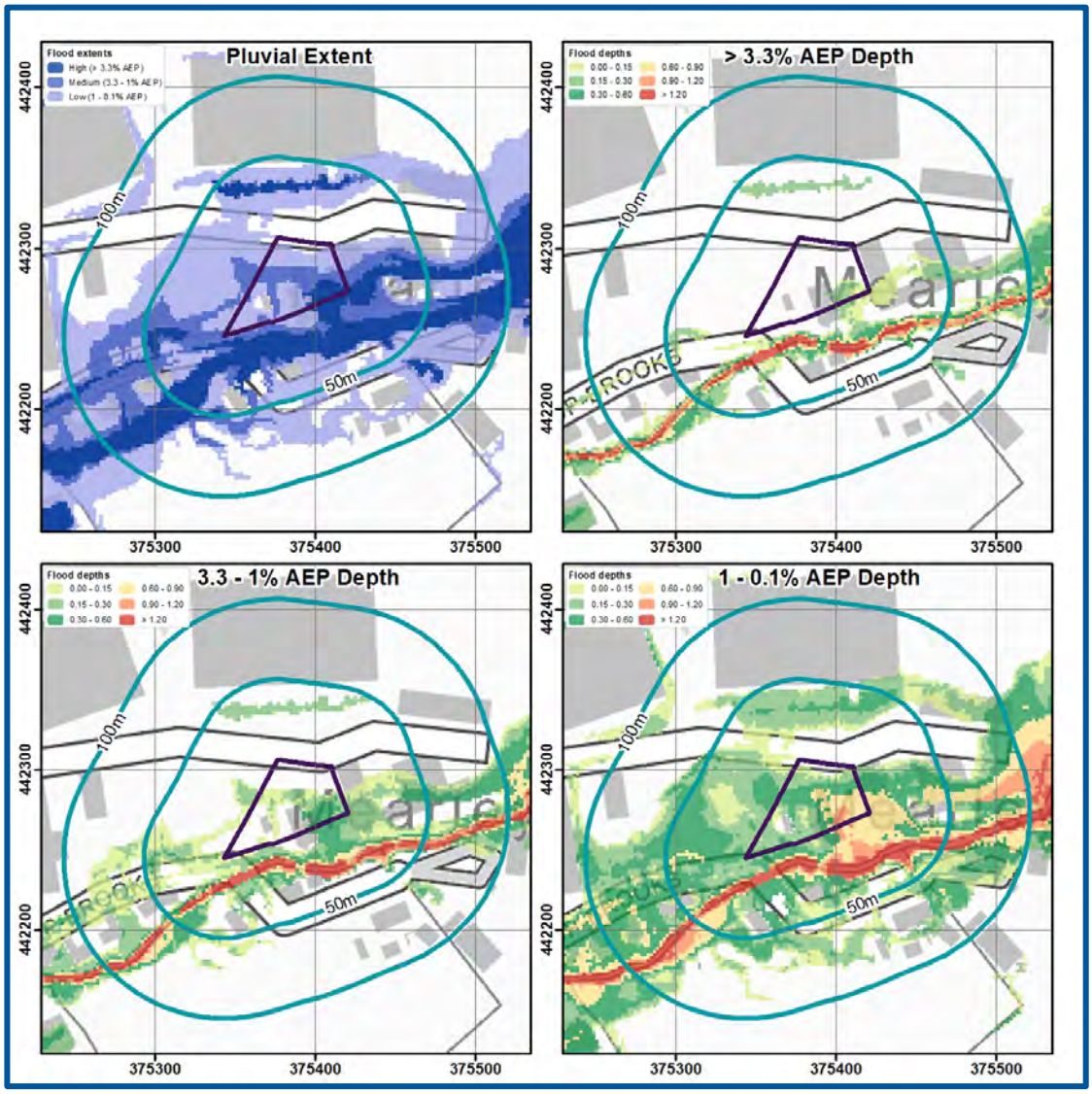
Guidance

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

- Low risk - chance of flooding of between a 1 in 1000 & 1 in 100 (0.1% and 1%).
- Medium risk - chance of flooding of between a 1 in 100 and 1 in 30 (1% and 3.3%).
- High risk - chance of flooding of greater than 1 in 30 (3.3%).

Figure 8 confirms the extent and depth in multiple modelled scenarios. This confirms the proposed new dwelling at the north of the Site is at risk of surface water flooding during the Medium risk scenario with depths of up to 0.60 expected.

Figure 8. EA surface water flood risk map (EA, 2023)



Guidance

According to EA's surface water flood risk map the following advisory guidance applies to the Site:

Flood Depth

- 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

- 0.3 to 0.9 m - Flooding is likely to exceed average property threshold levels and cause internal flooding. Resilience measures are typically effective up to a water depth of 0.6 m above floor level.

Surface water flooding flow routes

Analysis of OS mapping, ground elevation data and the EA's pluvial flow route mapping in the 1 in 100 year event confirms the Site is located on a potential overland flow route during a Medium risk scenario.

During this event all of flow velocities are greater than 0.25 m/s. The flows could potentially affect the buildings and/or access routes to the Site.

The Site may potentially transmit overland flows off-Site in a south west direction however the separate SuDS strategy (ref: 74970.01.01) is proposed to suitably manage runoff up to an including the 1 in 100 (plus 50% CC) event.

The SFRA does not indicate reported incidents of historical surface water flooding within 100 m of the Site (Ribble Valley Borough Council, 2017).

Climate change factors

Paragraph 002 of the National Planning Practice Guidance (August, 2022) requires consideration of the 1% AP (1 in 100 year) event, including an appropriate allowance for climate change.

As the Site is located within the Ribble Management Catchment and the proposed development is classed as More Vulnerable, where the proposed lifespan is approximately Choose an item. years. years, the Central (50%) allowance is required to determine a suitable climate change factor to apply to rainfall data.

The 0.1% AP (1 in 1000 year) surface water flooding event has been used as a proxy in this instance for the 1% AP (1 in 100 year) plus climate change event.

Groundwater flooding

Groundwater flooding occurs when sub-surface water emerges from the ground at the surface or into Made Ground and structures. This may be as a result of persistent rainfall that recharges aquifers until they are full; or may be as a result of high river levels, or tides, driving water through near-surface deposits. Flooding may last a long time compared to surface water flooding, from weeks to months. Hence the amount of damage that is caused to property may be substantially higher.

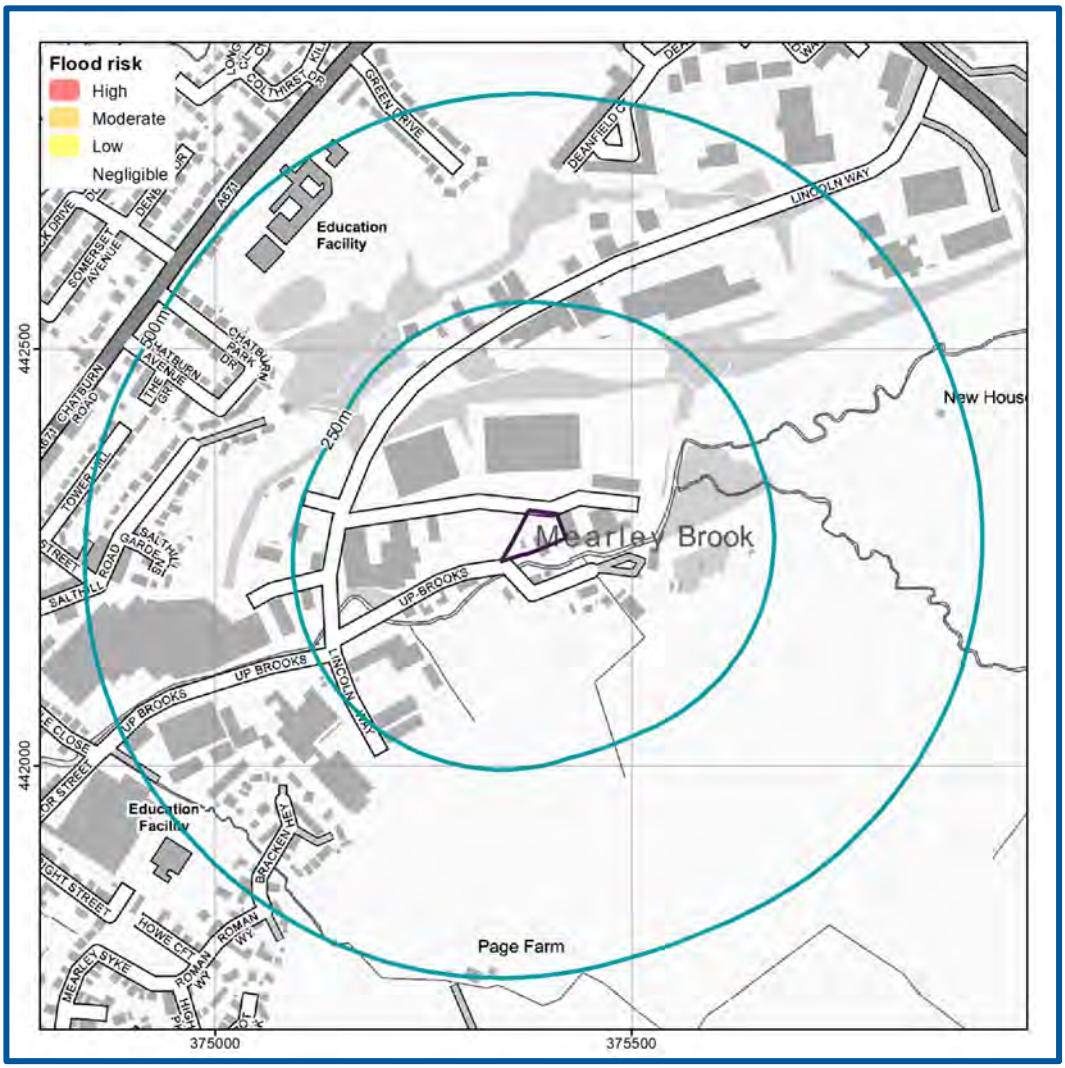
Groundwater Flood Risk screening data (Figure 10) indicates there is a Negligible risk of groundwater flooding at surface in the vicinity during a 1 in 100 year event.

Mapped classes combine likelihood, possible severity and the uncertainty associated with predicting the subsurface system. The map is a national scale screening tool to prompt site-specific assessment where the impact of groundwater flooding would have significant adverse consequences. Mapping limitations and a number of local factors may reduce

groundwater flood risk to land and property even where it lies within mapped groundwater flood risk zones, which do not mean that groundwater floods will occur across the whole of the risk area.

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, the EA'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.

Figure 9. GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2023)



Based on a review of (limited) site specific data:

- Groundwater levels may rise in the bedrock and superficial aquifer in response to high river events and prolonged rainfall recharge events.

- The SFRA (Ribble Valley Borough Council, 2017) indicates that groundwater flooding within the Ribble Valley Borough Council is not considered a significant flood risk factor, with no evidence of groundwater flooding having occurred in the area.
- It is noted that groundwater flooding may occur in response to prolonged high river levels even if overtopping of flood defences does not occur.
- Areas of surface water flooding identified on the Site may be exacerbated by groundwater flooding.
- On the basis of the site-specific assessment the groundwater flood risk is considered to be Low.

The risks can be higher for basements, buried infrastructure and soakaway systems which may be affected by high groundwater levels.

Guidance
Low Risk - There will be a remote 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.

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 SFRA provides limited information to the incidence of sewer flooding within the Ribble Valley Borough and therefore the risk of sewer flooding could not be ascertained. According to a previous Flood Risk Assessment prepared for the Site though, (Flood Risk Consultants, 2020) anecdotal evidence from the Client has indicated that there have been no incidences of sewer flooding at 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.

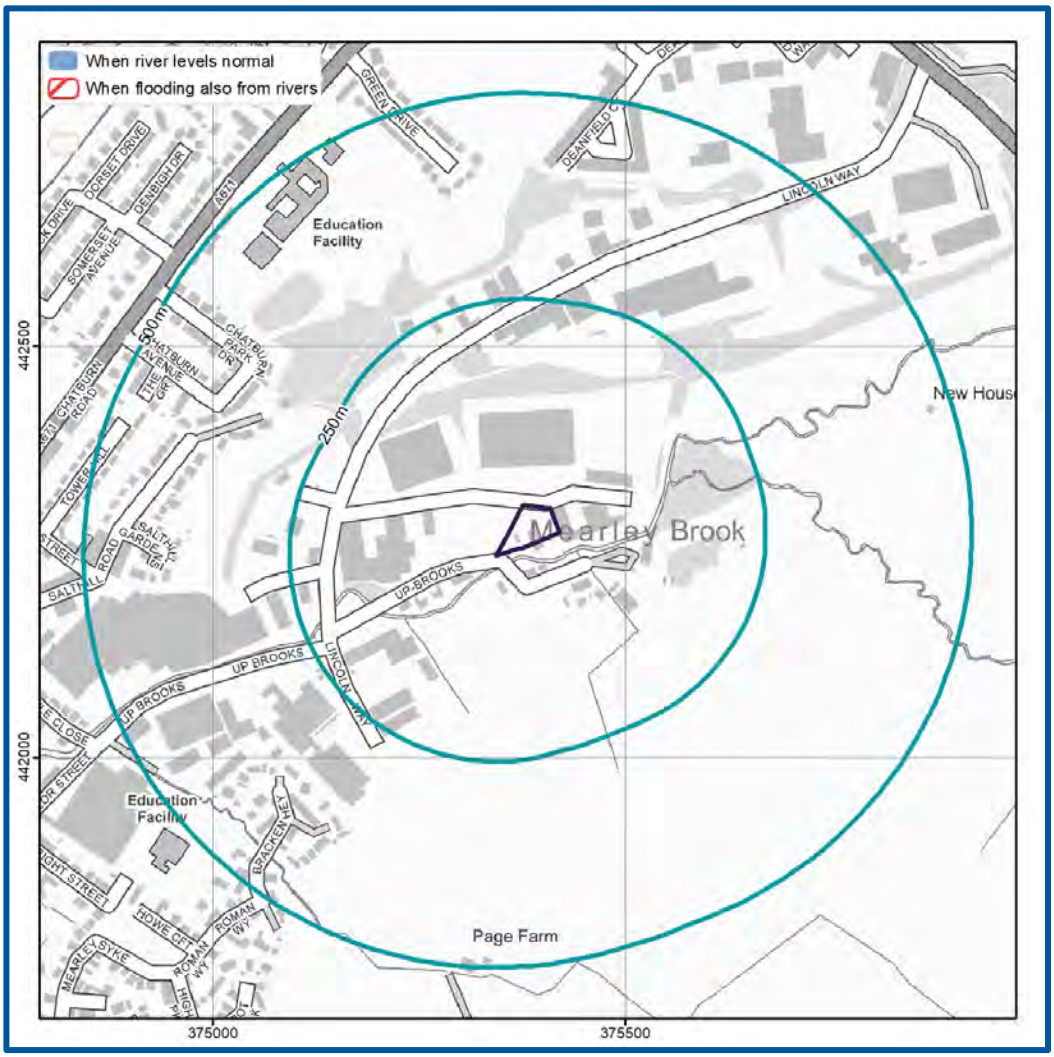
Canal failure

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

Reservoir flooding

According to the EA's Risk of Flooding from Reservoir mapping the Site is not at risk of flooding from reservoirs (Figure 11) (EA, 2023).

Figure 10. EA Risk of Reservoir Flooding (EA, 2023)



Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m^3 of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (EA, 2023).

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.

A bridge has been identified within 10 m southwest of the Site as well as additional smaller bridges upstream. These structures have been included in the model data discussed in Tables 2 and 3 and therefore in the event of a blockage the consequent flood risk has already been assessed.

It is recommended that confirmation is sought to ensure an appropriate maintenance schedule is in place with the relevant authorities/landowners.

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 (United Utilities).

5. Flood risk from the development

Floodplain storage

The development is located within a fluvial Flood Zone, it would be impacted by the 1 in 100 year plus 36% climate change event and involves an increase in building footprint, as such the proposed development would result in a loss in floodplain storage.

Any losses in floodplain storage are likely to displace flooding and could potentially alter flood flow routes, increasing flood risk elsewhere.

Compensation for any reduction in floodplain storage and displacement of flood water (up to the 1 in 100 year event with allowance made for climate change) should be provided. Compensatory flood storage must be provided through a level for level, volume for volume approach and may require an area at the edge of the floodplain to provide storage.

Where this is not possible, the EA and Lead Local Flood Authority (LLFA) may accept voids, stilts or undercroft parking as options for flood plain storage compensation. These solutions should be discussed at an early stage and may require a management and maintenance plan, as they can become blocked over time leading to a gradual reduction in storage. More information is provided in the EA's "*Framework and Guidance for Assessing and Managing Flood Risk for New Development*" FD2320/TR2 publication (EA, 2005).

Scoping estimates of the storage requirements can be made by multiplying the increase in building footprint by the average flood depth at the development, during the 1 in 100 year flood event with a 35% allowance for climate change.

Drainage and run-off

The proposed development involves an increase in the lifespan of the development an estimation of run-off is required to permit effective Site water management and prevent any increase in flood risk to off-Site receptors from the Site as a result of climate change.

A Sustainable Drainage Strategy has been prepared separately by GeoSmart (ref: 74970.01.01) to manage the increased in runoff from the Site.

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 are achieved through application of the Sequential Test and in some cases the Exception Test.

Guidance

Sequential test: The aim of this test is to steer new development towards areas with the lowest risk of flooding (NPPF, 2021). Reasonably available sites located in Flood Zone 1 should be considered before those in Flood Zone 2 and only when there are no reasonably available sites in Flood Zones 1 and 2 should development in Flood Zone 3 be considered.

Exception test: In some cases, this may need to be applied once the Sequential Test has been considered. For the exception test to be passed it must be demonstrated that the development would provide wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Suitability of the proposed development, and whether the Sequential and Exception Tests are required, is based on the Flood Zone the Site is located within and the flood risk vulnerability classification of the existing and proposed development. Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

This report has been produced to assess all development types, prior to any development. The vulnerability classification and Flood Zones are compared within the table overleaf (Table 2 of the NPPG (2022)).

The Site is located within Flood Zones 3b, 3a, 2 and 1. Whilst the development is proposed within Flood Zone 3b as it is replacing an existing dwelling this will represent no additional increase in flood risk to the residents. Furthermore, the mitigation measures recommended as part of the report are likely to offer a greater standard of protection to residents than the existing dwelling and therefore represents a decrease in flood risk to occupiers of the Site.. As the other two dwellings are proposed within Flood Zones 3a and 2 the development may be acceptable, but may be subject to the Exceptions Test and Sequential Test.

Where it is confirmed by the Local Planning Authority (LPA) that the Sequential Test is required, it must be demonstrated that there are no alternative reasonably available Sites at lower risk of flooding within Flood Zones 1 and 2, in order to pass the Sequential Test. For a site to be considered to be reasonably available it must be 'deliverable' and 'developable' as defined by the NPPF (2021).

Table 4. Flood risk vulnerability and flood zone 'compatibility (taken from NPPG, 2022)

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone	Zone 1 – low probability	✓	✓	✓	✓	✓
	Zone 2 – medium probability	✓	✓	Exception test required	✓	✓
	Zone 3a - high probability	Exception test required	✓	X	Exception test required	✓
	Zone 3b – functional flood plain	Exception test required	✓	X	X*	X

*replacing an existing building representing no additional increase in flood risk to the residents.

EA Flood Risk Standing Advice for vulnerable developments 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 risk 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 5m^2.

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;
- 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:

- 0.3 m above the general ground level of the Site; OR
- At least 0.6 m above the estimated river or sea flood level[4].

If you cannot raise floor levels above the estimated flood level, you need to consider extra flood resistance and resilience measures.

Extra flood resistance and resilience measures

Follow the extra flood resistance and resilience requirements for developments in flood risk areas where ground floor levels are lower than the estimated flood level for the Site.

Water depth up to 0.3 m

The design of the building or development should keep water out as much as possible. You should use materials that have low permeability (materials that water cannot pass through, for example, impermeable concrete).

[4] This is 0.6 m above the 1 in 100 year fluvial or 1 in 200 year tidal flood events. The 0.6 m is split into a 0.3 m freeboard allowance for climate change and 0.3 m allowance for the inaccuracies in the EA's flood modelling. Where the climate change flood level is known, a 0.3 m allowance should be added to the climate change flood level to allow for the inaccuracies in the EA's flood modelling.

Water depth from 0.3 m to 0.6 m

The design of the building or development should keep water out (unless there are structural concerns) by:

- using materials with low permeability to at least 0.3 m
- using flood resilient materials (for example lime plaster) and design (for example raised electrical sockets)
- making sure there's access to all spaces to enable drying and cleaning

Water depth above 0.6 m

The design of the building or development should allow water to pass through the property to avoid structural damage by:

- using materials with low permeability to at least 0.3 m
- making it easy for water to drain away after flooding
- making sure there's access to all spaces to enable drying and cleaning

Local policy and guidance

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

Ribble Valley Borough District Council Strategic Flood Risk Assessment (2017):

Zone 1 Low Probability

Definition

This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)

Appropriate uses

All uses of land are appropriate in this zone.

FRA requirements

For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

Zone 2 Medium Probability

Definition

This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.

Appropriate uses

The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this zone. Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test (see para. D.9.) is passed.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

Zone 3a High Probability

Definition

This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

Appropriate uses

The water-compatible and less vulnerable uses of land in Table D.2 are appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test (see para. D.9) is passed. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood.

FRA requirements

All development proposals in this zone should be accompanied by a FRA. See Annex E for minimum requirements.

Policy aims

In this zone, developers and local authorities should seek opportunities to:

i. Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques;

ii. Relocate existing development to land in zones with a lower probability of flooding; and

iii. *Create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.*

Guidance

Strategic Flood Risk Assessments are carried out by local authorities, in consultation with the Environment Agency, 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 (NPPF, 2021).

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

The Site is located within an area which is affected by flooding from rivers, the following table confirms the flood depths associated with the area proposed for development.

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Table 5. Flood levels compared to ground levels at the Site

Ground levels in area proposed for development (mAOD)	Modelled Flood Levels (mAOD)		
	1 in 100 year plus 23% CC (mAOD)	1 in 100 year plus 36% CC (mAOD)	1 in 1000 year (mAOD)
82.29 to 84.67	83.03	83.08	83.24
Flood depths (m)	Up to 0.74	Up to 0.79	Up to 0.95

Raising minimum floor levels

The vulnerability classification of the Site and the Flood Zone means proposals for the Site fall under the EA's Flood Risk Standing Advice (FRSA) for more vulnerable developments.

In this instance, in line with the EA's FRSA the recommended minimum Finished Floor Level (FFL) should be set at least 0.3m above the 1 in 100 year plus 36% allowance for climate change flood level of 83.08 mAOD. According to data from the Client Finished Floor levels of the proposed dwelling have been designed at 83.50 mAOD 0.42 m above the 1 in 100 plus 36% climate change providing additional freeboard against the EA's FRSA.

Table 6. Recommended Minimum Finished Floor Level Required

Ground Level (mAOD)	Flood Level (mAOD)	Freeboard above Flood Level (m)	Recommended minimum FFL (mAOD)

82.29 to 84.67	83.08	0.3 m	83.38

Whilst the replacement outbuilding is to be set at 82.70 mAOD, given that the ground floor of this is to be used as a garage, considered a floodable structure, the raising of FFL is not deemed necessary.

Additional 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 EA'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 (subject to further investigation, to confirm they do not increase flood risk elsewhere) include:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing);
- Non-return flap valves on sewer outfalls;
- 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:
    - Use of low permeability building materials up to 0.3 m such as engineering bricks (Classes A and B) or facing bricks;
    - Hard flooring and flood resilient metal staircases;
    - 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;
    - Water, electricity and gas meters and electrical sockets should be located above the predicted flood level;
    - Communications wiring: wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage.

Surface water (pluvial) flood mitigation measures

The mitigation measures detailed above for river and sea flood risk are likely to be suitable for the relatively shallow flood depths which could be experienced in a 1 in 100 year pluvial flood event.

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.

A surface water drainage strategy has been prepared separately (ref: 74970.01.01) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.

Groundwater flood mitigation measures

It is likely the flood mitigation measures recommended for river/sea or surface water (pluvial) risk will be sufficient to reduce the groundwater flood risk at the development. However specific groundwater measures that may also be considered for the Choose an item. risk identified include:

- Interceptor drains;
- Automatic sump and pump to extract flood water; and
- Non-return flap valves on the proposed foul and surface water sewer lines.

Reservoir flood mitigation measures

The Site is not a risk of flooding from reservoirs; therefore, mitigation measures are not required.

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

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 EA 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 EA Flood Warning and Alerts coverage area (ref: 012FWFL31A and 012WAFUR, respectively) so is able to receive warnings (Figure 12). All warnings are also available through the EA's 24 hour Floodline Service 0345 988 1188.

The EA 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.

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 EA's Flood Zone Map the closest dry evacuation area within Flood Zone 1 is located at the north of the Site or alternatively west along Lincoln Way. 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 EA Flood Warning is issued in order to completely avoid flood waters.

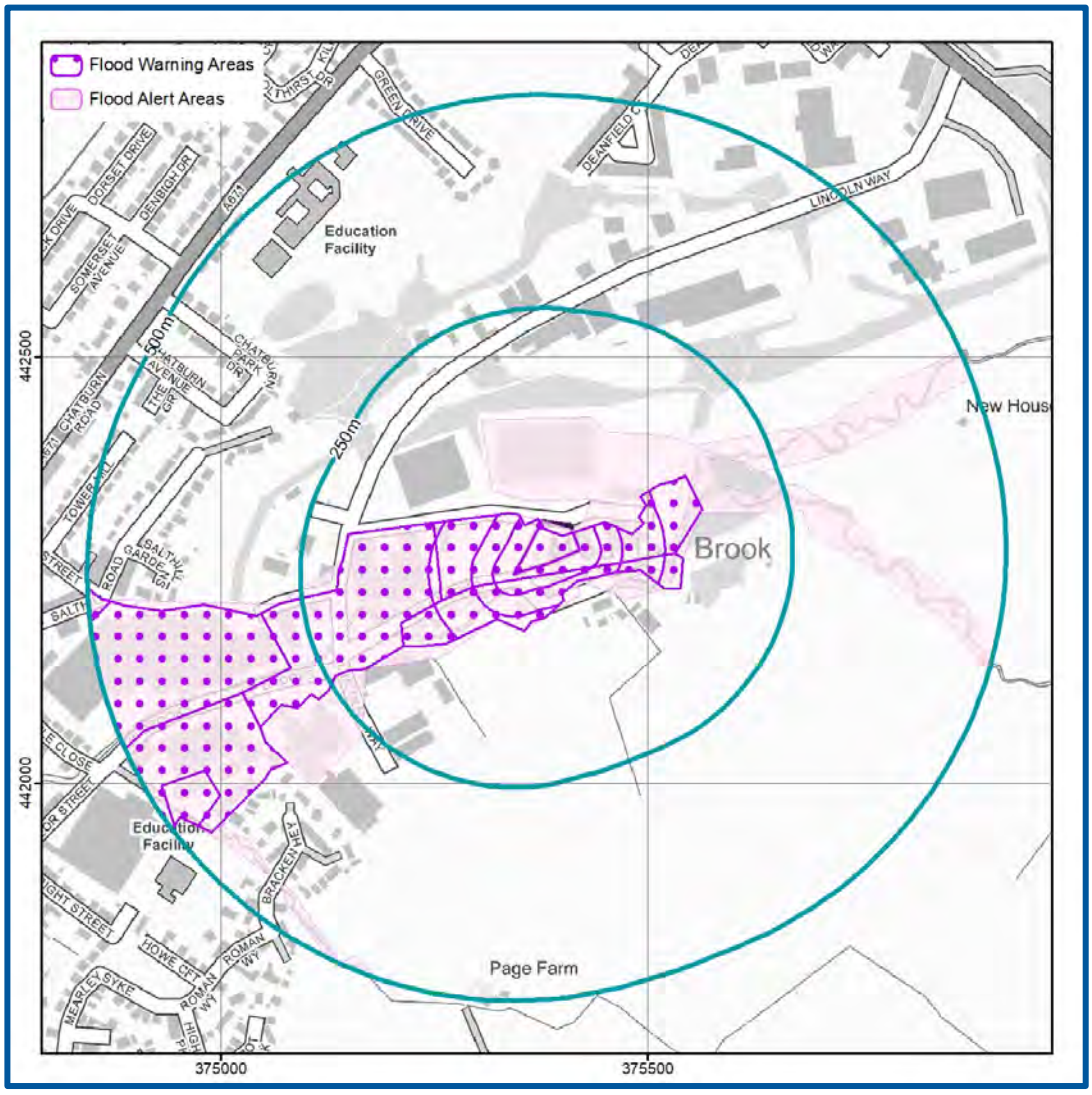
Other relevant information

A Flood Warning and Evacuation Plan (FWEP) is recommended, and occupants should be signed up to receive EAs Flood Warnings.

Registration to the Environment Agency's 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.

Figure 11. EA Flood Warning Coverage for the local area (EA, 2023).



8. Conclusions and recommendations

Table 7. Risk ratings following implementation and subsequent maintenance of mitigation measures

Source of Flood Risk	Baseline	After Analysis	After Mitigation
River (fluvial) flooding	Medium to Very Low	Medium to Very Low	Low to Very Low
Sea (coastal/tidal) flooding	Negligible	Negligible	N/A
Surface water (pluvial) flooding	High to Low	Medium to Low	Low to Very Low
Groundwater flooding	Negligible	Low	Negligible
Other flood risk factors present	No	No	N/A

N/A = mitigation not required

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.

Table 8. Summary of responses to key questions in the report

Key sources of flood risks identified	Fluvial (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
Recommendations for flood mitigation are provided below, based upon the proposed development and the flood risk identified at the Site. • Fluvial flood depths could be up to 0.79m in depth in the area proposed for development, according to data provided by the Client Finished Floor Levels (FFL) of the	

dwelling are proposed to be set to 83.50 mAOD[5] Standard flood resilient design measures should also be incorporated. Whilst the replacement outbuilding is to be set at 82.70 mAOD, given that the ground floor of this is to be used as a garage, considered a floodable structure, the raising of FFL is not deemed necessary.

- A Medium to Low risk of flooding from pluvial sources has been identified in the area proposed for development. The mitigation measures for fluvial flooding are likely to provide suitable protection against pluvial flooding. 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.
- A surface water drainage (SuDS) strategy has been prepared separately (ref: 74970.01R1) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.
- Specific groundwater measures that may be considered for the Low risk identified could include:
    - Interceptor drains;
    - Automatic sump to extract flood water; and
    - Non-return flap valves on the proposed foul and surface water sewer lines.

Additional Considerations

- Occupants of the Site should be signed up to receive EA Flood Warnings.
- A Flood Warning and Evacuation Plan (FWEP) is recommended to ensure persons using the Site can evacuate safely on receipt of a Flood Warning.
- As the development proposals involve the increasing of building footprint within the fluvial Flood Zones compensatory storage will be required this should be achieved through level for level compensation or where this is not feasible through use of voids.

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.

[5] 0.42 m above the 1 in 100 year plus climate change flood level of 83.08 mAOD.

9. Further information

The following table includes a list of additional products by GeoSmart:

Additional GeoSmart Products			
	Additional assessment: EnviroSmart Report		Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

10. References and glossary

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GeoSmart Information

Glossary

General terms

BGS	British Geological Survey
EA	Environment Agency
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 ±0.25m for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFRA	Strategic Flood Risk 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.

NPPF (2021) terms

Exception test	Applied once the sequential test has been passed. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.
Sequential test	Aims to steer new development to areas with the lowest probability of flooding.
Essential infrastructure	Essential infrastructure includes essential transport infrastructure, essential utility infrastructure and wind turbines.

Water compatible	Water compatible land uses include flood control infrastructure, water-based recreation and lifeguard/coastal stations.
Less vulnerable	Less vulnerable land uses include police/ambulance/fire stations which are not required to be operational during flooding and buildings used for shops/financial/professional/other services.
More vulnerable	More vulnerable land uses include hospitals, residential institutions, buildings used for dwelling houses/student halls/drinking establishments/hotels and sites used for holiday or short-let caravans and camping.
Highly vulnerable	Highly vulnerable land uses include police/ambulance/fire stations which are required to be operational during flooding, basement dwellings and caravans/mobile homes/park homes intended for permanent residential use.

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 Features/Reservoir/ Flood Alert & Warning)	Environment Agency copyright and database rights 2023 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 Environment Agency copyright and database rights 2023

11. Appendices

GeoSmart Information

Appendix A

Site plans

North

0 2 4 6 8 10 12 14 16 18 20
Metres

ABBREVIATIONS

BT	BT Cover
CH	Cable Height
CL	Cover Level
EH	Eaves Height
FH	Fire Hydrant
GP	Gate Post
GV	Gas Valve
GU	Gully
IC	Inspection Cover
LP	Lamp Post
MH	Man Hole
RE	Rodding Eye
RH	Ridge/Roof Height
TC	TriCAD Control
TF	Top of Fence
TL	Threshold Level
TP	Telegraph Pole
TH	Top of Hedge
TW	Top of Wall
WL	Water Level
WV	Water Valve

Twin Brook Road

Upbrooks

Client
Mr and Mrs Thornburn

Job Title
Proposed Residential Development
on land at:
Twinbrooks Farm
Upbrooks
Clitheroe
BB7 1PL

Drawing Title
Existing Site Survey Plan

Scale	Date	Drawn
1:200 @ A1	Dec 2018	TriCAD

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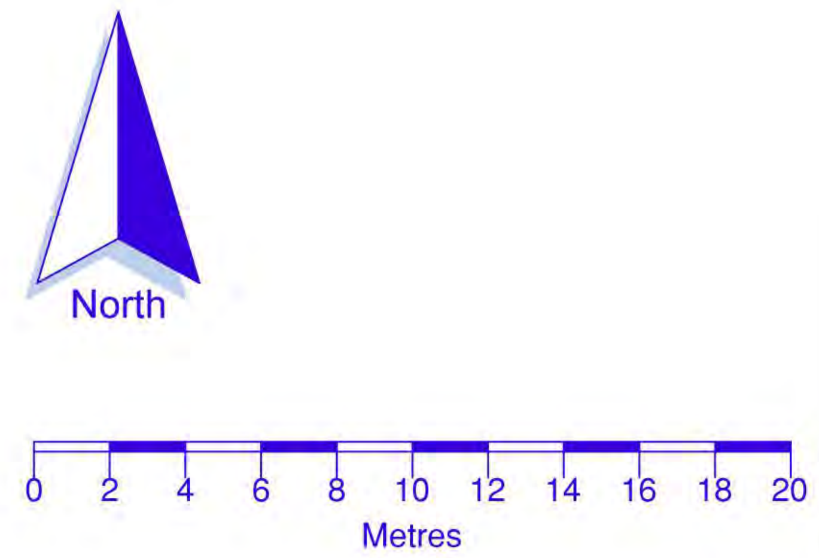
This drawing is to be read in conjunction with all relevant Architect, consultants' and specialists' drawings and specifications. The Architect is to be notified of any discrepancies before proceeding. Do not scale from this drawing. All dimensions and levels are to be checked on site. This drawing is subject to copyright. All work carried out before Planning and Building Permission has been granted is at the contractor/clients risk.



REVISIONS:

Rev C - Scheme amended. - 08.02.2023 - NE

Client
Mr and Mrs Thornburn

Job Title
Proposed Residential Development
on land at:
Twinbrooks Farm
Upbrooks
Clitheroe
BB7 1PL

Drawing Title
Proposed Site Plan

Scale	Date	Drawn
1:200 @ A1	July 2022	TriCAD

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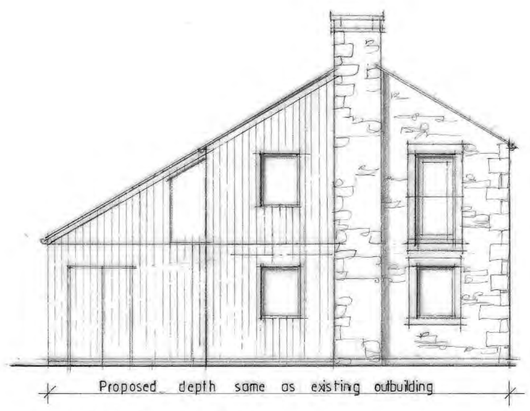
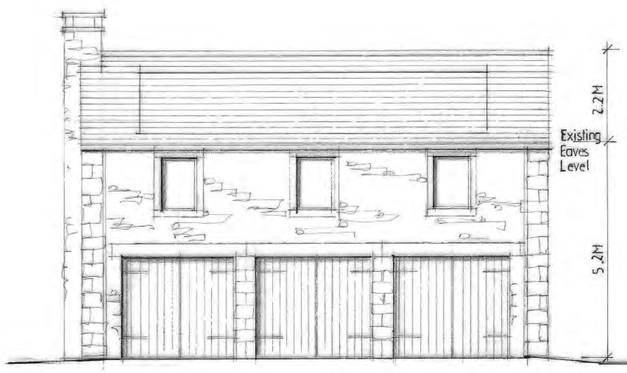
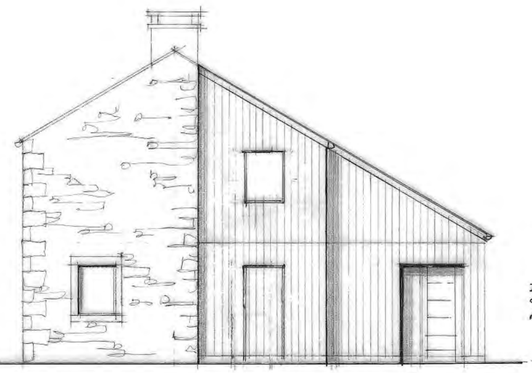
5765 - 16 Rev C



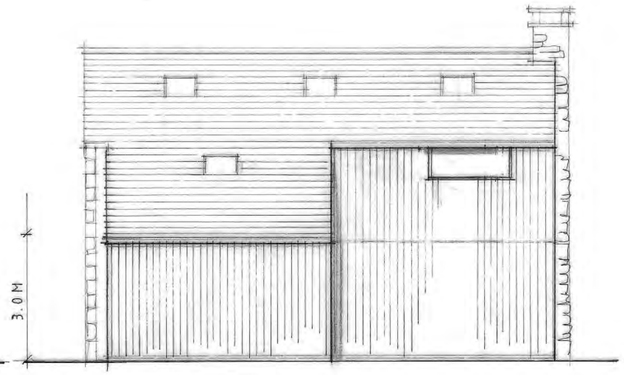
Southwest Elevation



Southeast (front) Elevation



Northeast Elevation



Northwest Elevation

External Materials

Roof is to be finished with natural blue slate with flush fitting Velux roof lights to the rear slope, and photovoltaic solar panels to the front slope.

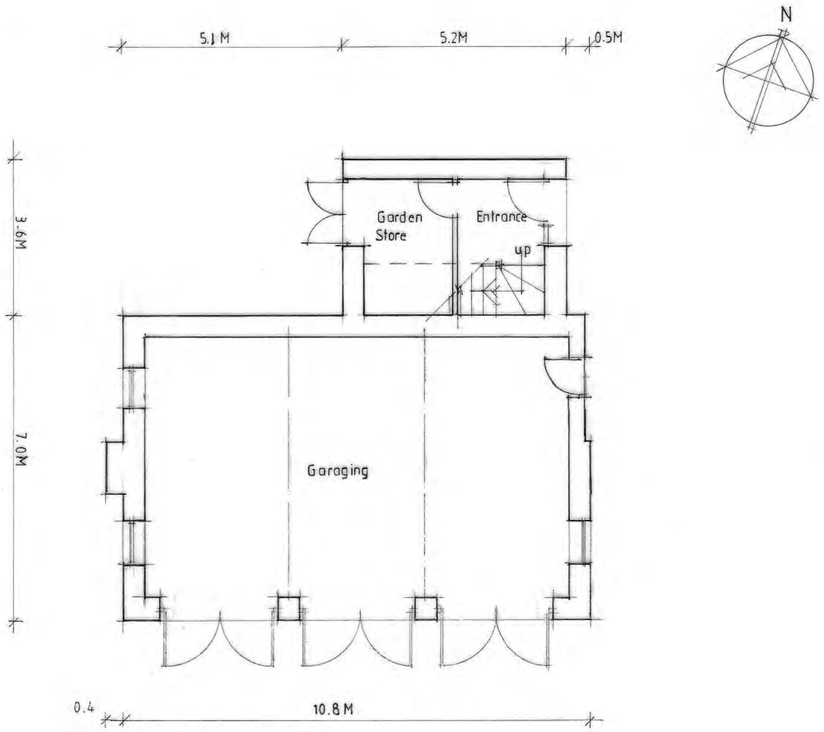
Rainwater goods are to be black coloured powder coated aluminium and fascia boards are to be black timber.

Walls to the front and side returns including the chimney are to be constructed from reclaimed stone including stone from demolition of the existing outbuilding, with dressed stone surrounds.

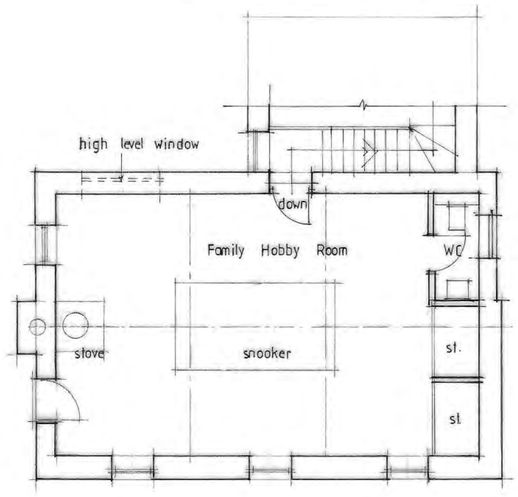
Other walls are to be clad with vertical timber boarding with a black charred finish, over dark grey brick plinth.

Doors and windows set in timber clad walls are to have black powder coated aluminium frames. Other windows and door in stone walls are to be either powder coated aluminium, or painted timber.

Front garage doors are to be vertically boarded painted timber.



Ground Floor Plan



First Floor Plan

Client
Mr and Mrs Thornburn

Job Title
Proposed Development at
Twinbrooks Farm
Upbrooks
Clitheroe

Drawing Title
Proposed Outbuilding

Scale	Date	Drawn
1/100 @ A2	Oct. 2022	SGH

spa
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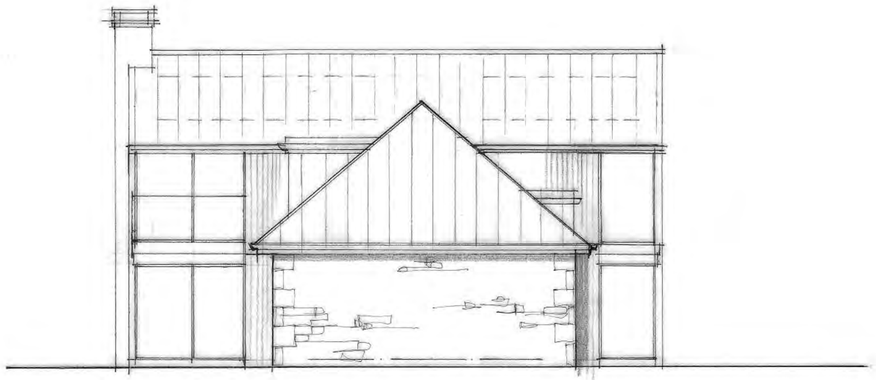
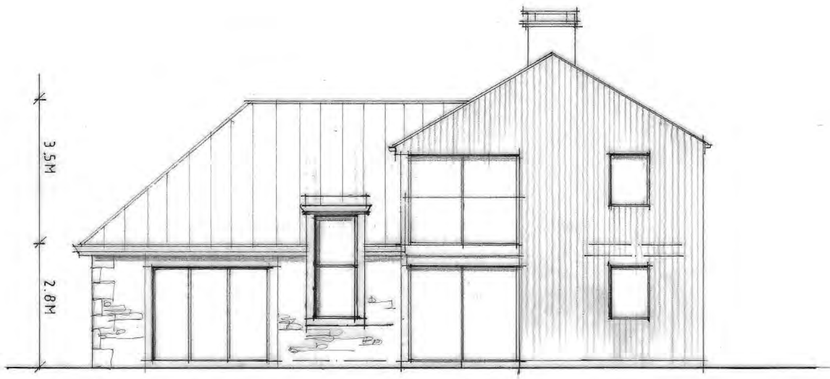
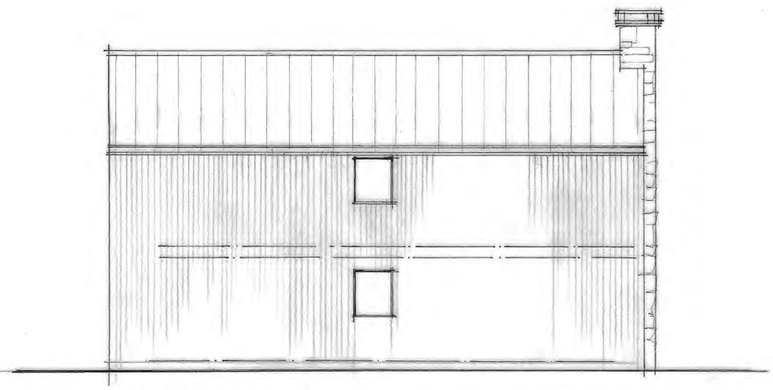
Southwest Elevation



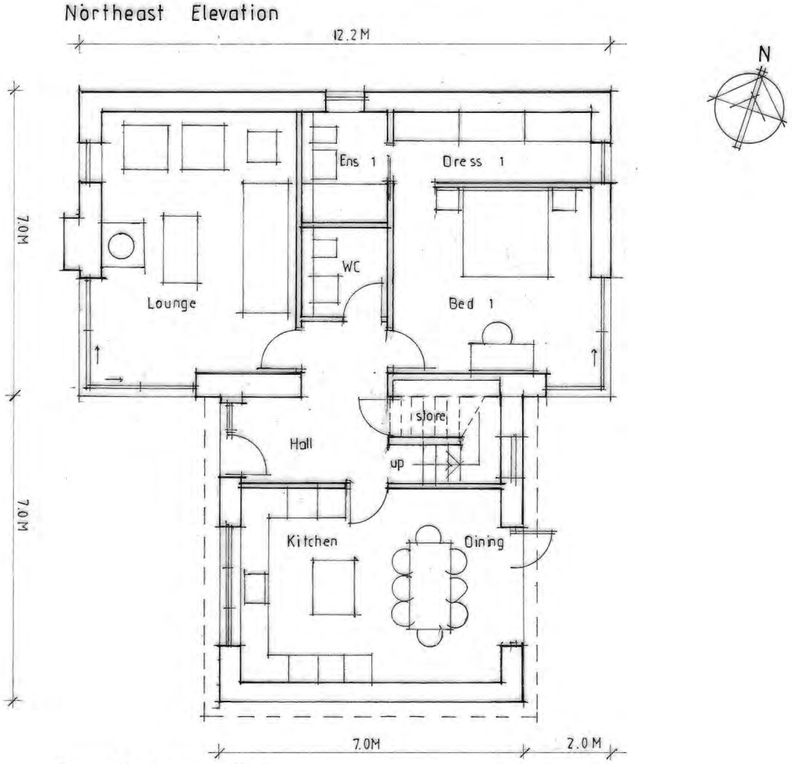
Southeast Elevation



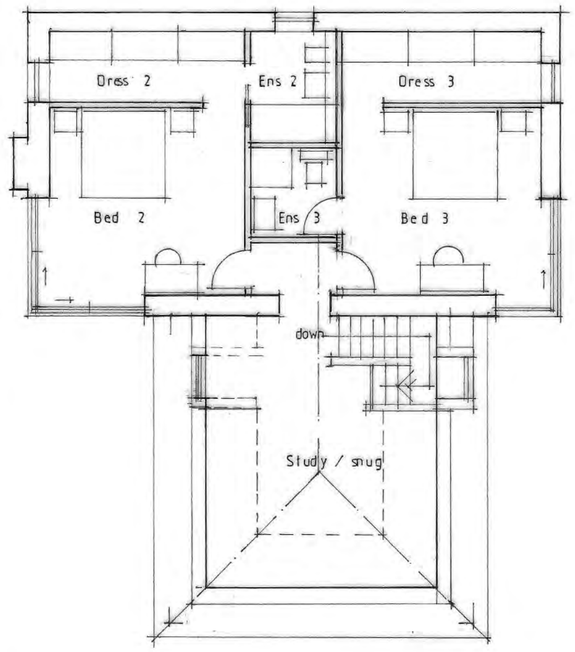
Northeast Elevation



Northwest Elevation



Ground Floor Plan



First Floor Plan

External Materials

All roofs including dormer windows are to be finished with graphite grey metal roof cladding with standing seam, which provision for photovoltaic solar panels to the southeast roof slope.

Rainwater guttering and downpipes are to be black coloured powder coated aluminium.

Walls are to be natural reclaimed stone to the 1 ½ storey hipped roof element and the chimney, with dressed stone surrounds.

Other walls are to be clad with vertical charred/ black stained finish, over dark grey brick plinth.

Doors and windows are to have black / grey powder coated aluminium frames.

Client
Mr and Mrs Thornburn

Job Title
Proposed Development At
Twinbrooks Farm
Upbrooks
Clitheroe

Drawing Title
Proposed New Dwelling

Scale	Date	Drawn
1/100 @ A2	Dec. 2022	SGH

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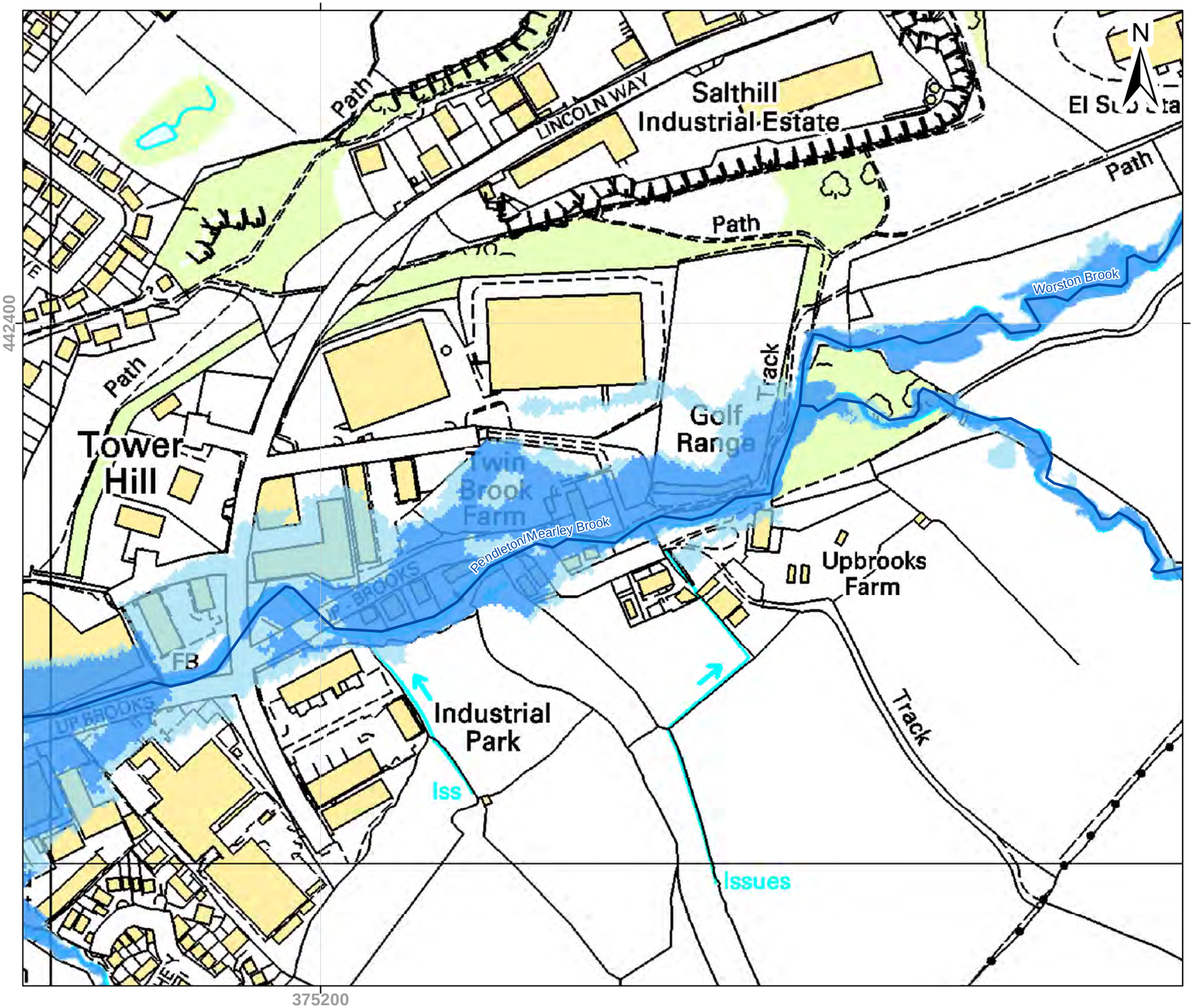
GeoSmart Information

Appendix B

Environment Agency data



Environment Agency

Flood Zones Map:
Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

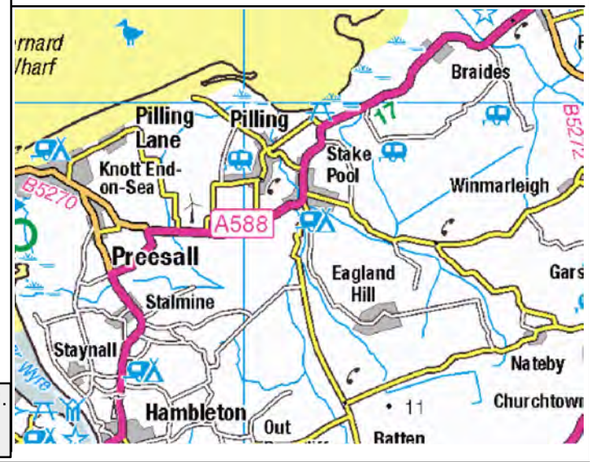
Key

- Main River
- Areas Benefitting from Defences
- Flood Zone 3
- Flood Zone 2

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.

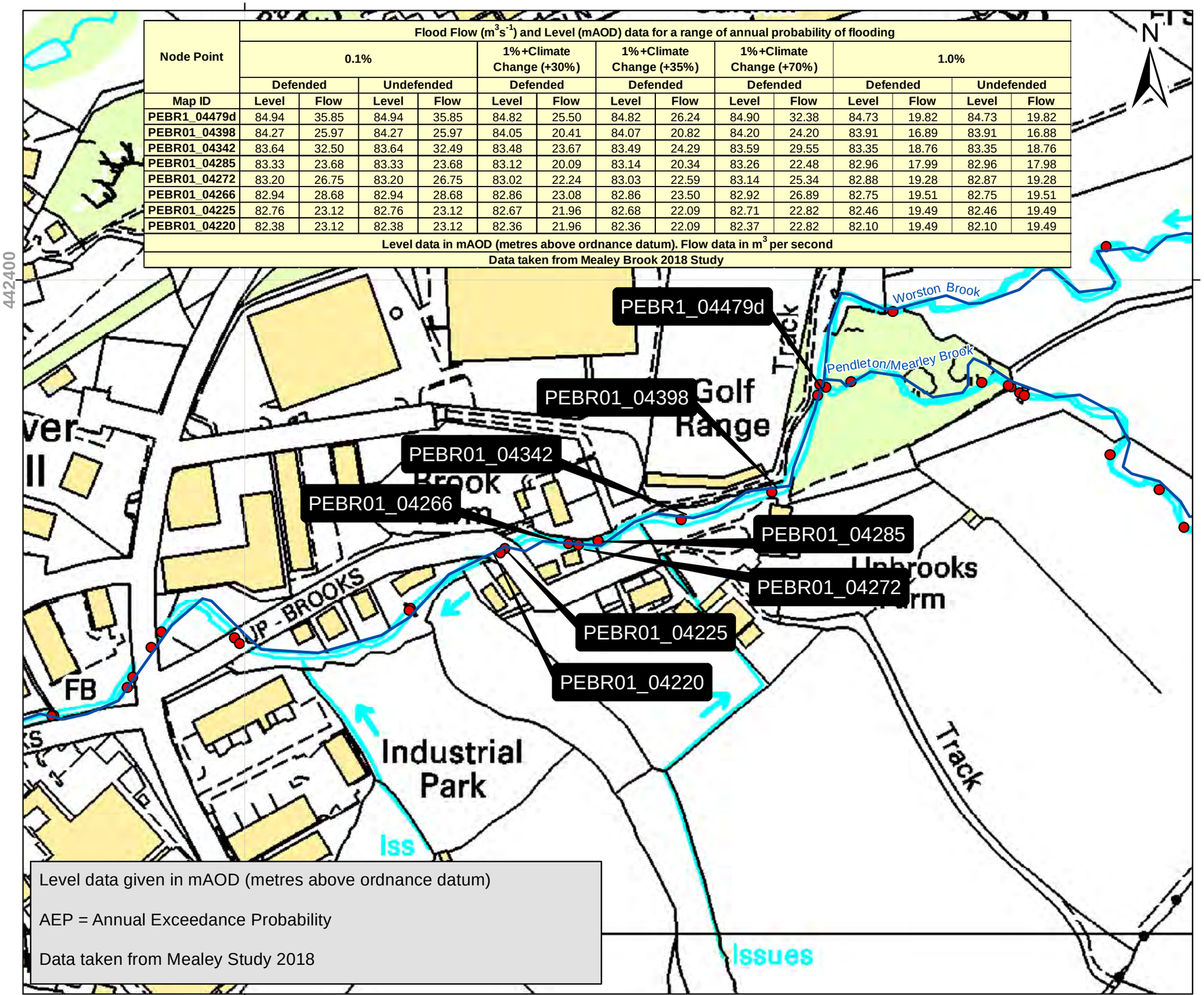


Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Node Point	Flood Flow (m^3s^{-1}) and Level (mAOD) data for a range of annual probability of flooding													
	0.1%				1%+Climate Change (+30%)		1%+Climate Change (+35%)		1%+Climate Change (+70%)		1.0%			
	Defended		Undefended		Defended		Defended		Defended		Defended		Undefended	
Map ID	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow	Level	Flow
PEBR1_04479d	84.94	35.85	84.94	35.85	84.82	25.50	84.82	26.24	84.90	32.38	84.73	19.82	84.73	19.82
PEBR01_04398	84.27	25.97	84.27	25.97	84.05	20.41	84.07	20.82	84.20	24.20	83.91	16.89	83.91	16.88
PEBR01_04342	83.64	32.50	83.64	32.49	83.48	23.67	83.49	24.29	83.59	29.55	83.35	18.76	83.35	18.76
PEBR01_04285	83.33	23.68	83.33	23.68	83.12	20.09	83.14	20.34	83.26	22.48	82.96	17.99	82.96	17.98
PEBR01_04272	83.20	26.75	83.20	26.75	83.02	22.24	83.03	22.59	83.14	25.34	82.88	19.28	82.87	19.28
PEBR01_04266	82.94	28.68	82.94	28.68	82.86	23.08	82.86	23.50	82.92	26.89	82.75	19.51	82.75	19.51
PEBR01_04225	82.76	23.12	82.76	23.12	82.67	21.96	82.68	22.09	82.71	22.82	82.46	19.49	82.46	19.49
PEBR01_04220	82.38	23.12	82.38	23.12	82.36	21.96	82.36	22.09	82.37	22.82	82.10	19.49	82.10	19.49

Level data in mAOD (metres above ordnance datum). Flow data in m^3 per second

Data taken from Mealey Brook 2018 Study



Environment Agency

Fluvial Levels and Flows Map: Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

Key

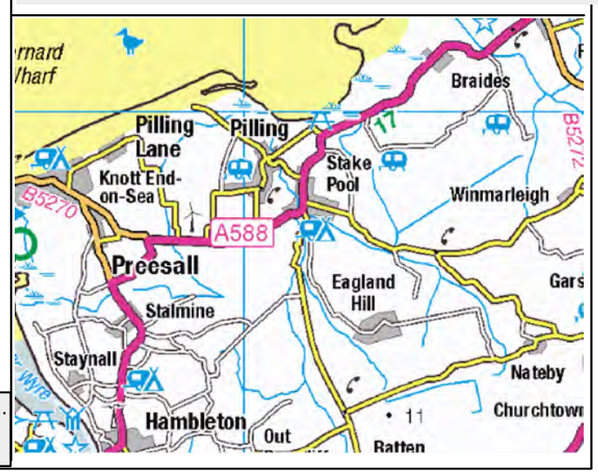
Main River

MODELLED_INFO_LOCS

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



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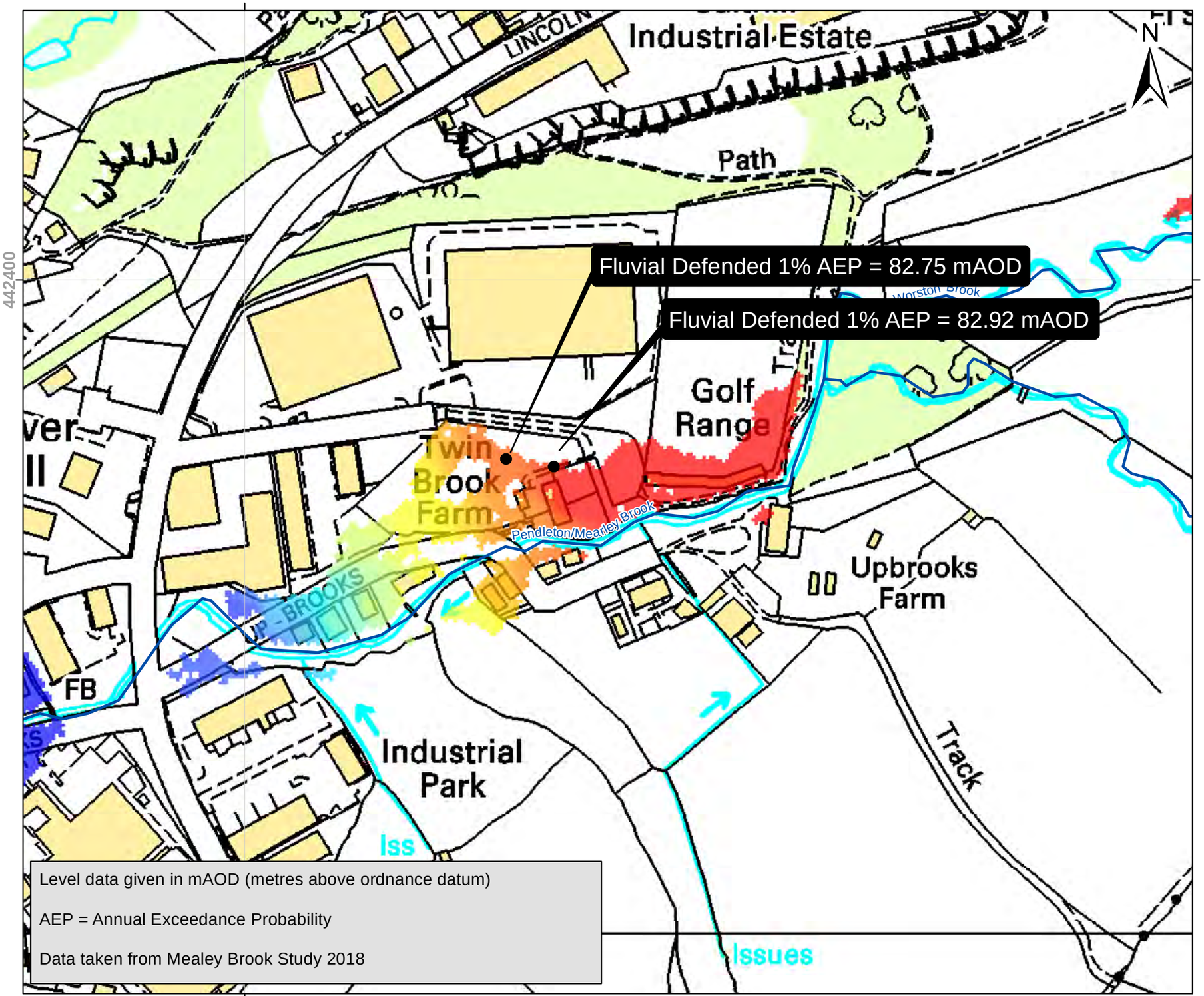


Environment Agency

Fluvial Flood Levels Map:
Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

Key

Main River

Fluvial Defended 1% annual probability of flooding scenario

mAOD

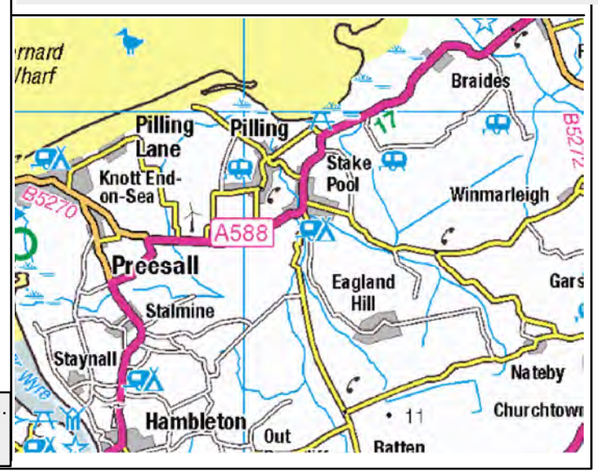
High : 83

Low : 80

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



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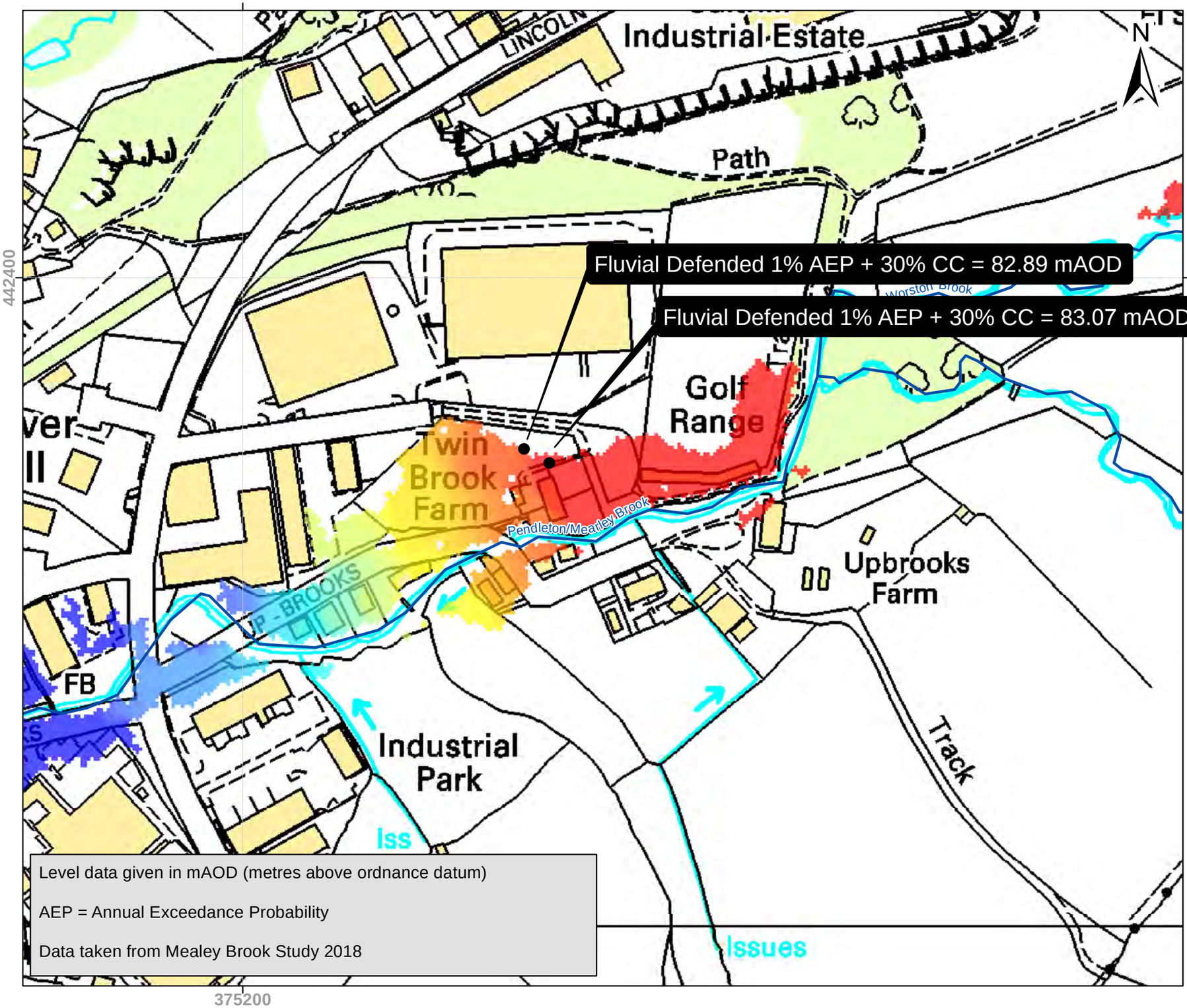


Level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Mealey Brook Study 2018

Environment Agency

Fluvial Flood Levels Map:
Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

Key

Main River

Fluvial Defended 1% annual probability of flooding scenario + 30% Climate Change

mAOD

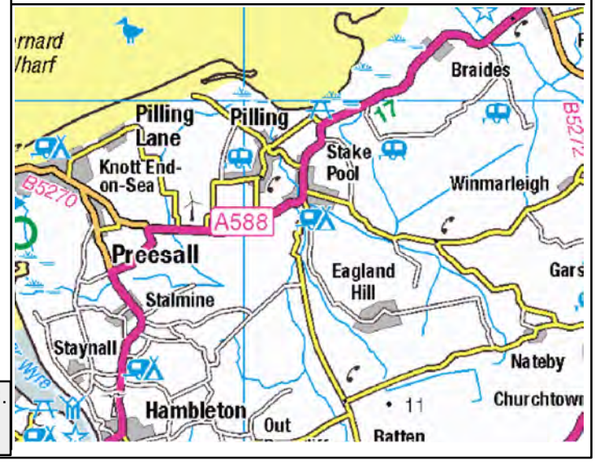
High : 83

Low : 80

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



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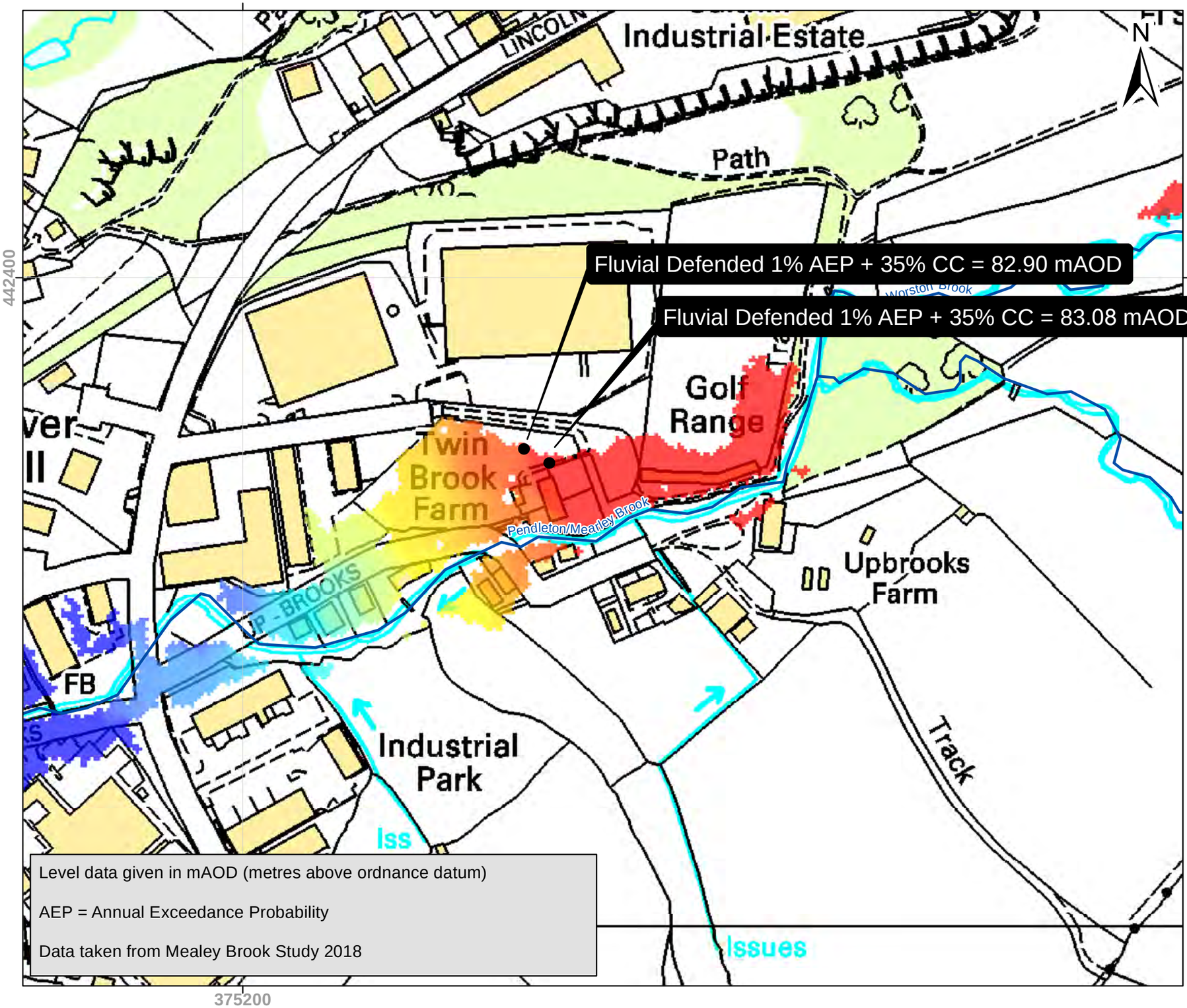


Level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Mealey Brook Study 2018

Environment Agency

Fluvial Flood Levels Map:
Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

Key

Main River

Fluvial Defended 1% annual probability of flooding scenario + 35% Climate Change

mAOD

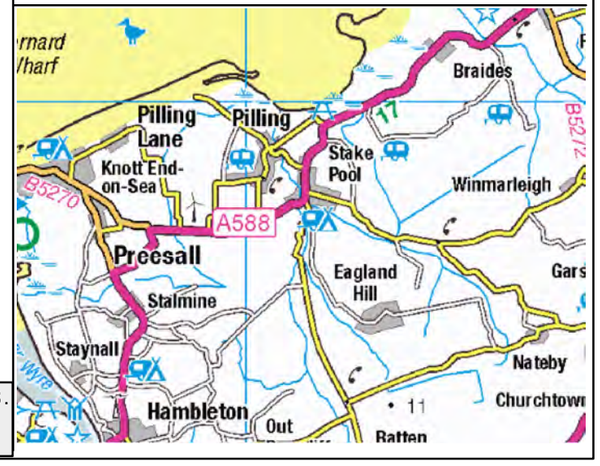
High : 83

Low : 80

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



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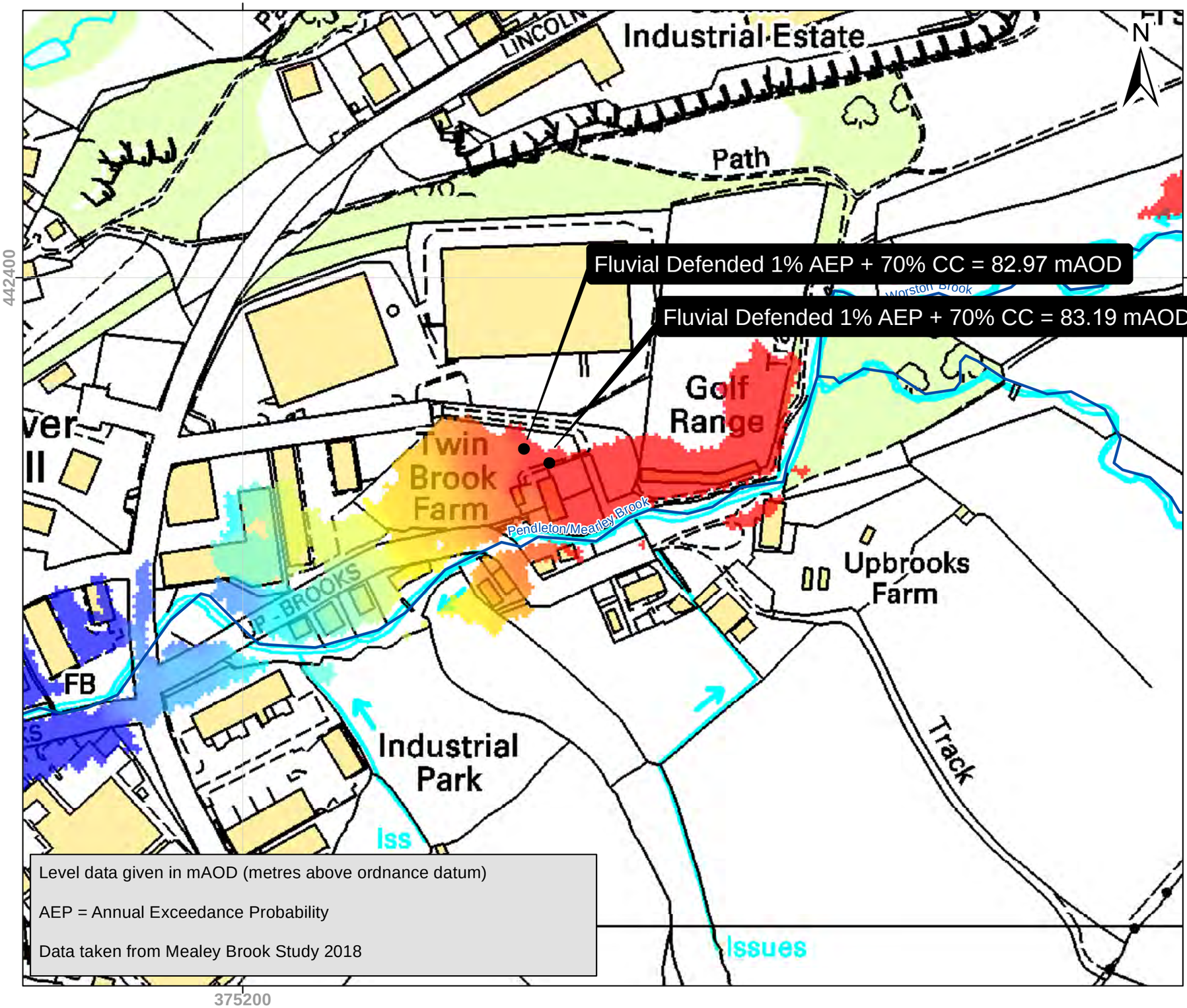

Level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Mealey Brook Study 2018

Environment Agency

Fluvial Flood Levels Map:
Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

Key

Main River

Fluvial Defended 1% annual probability of flooding scenario + 70% Climate Change

mAOD

High : 83

Low : 80

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

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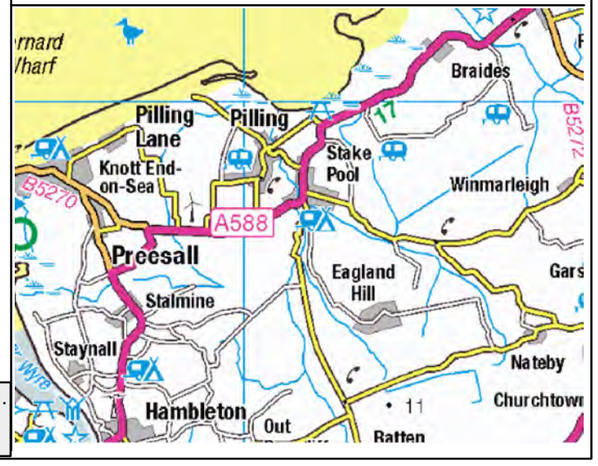
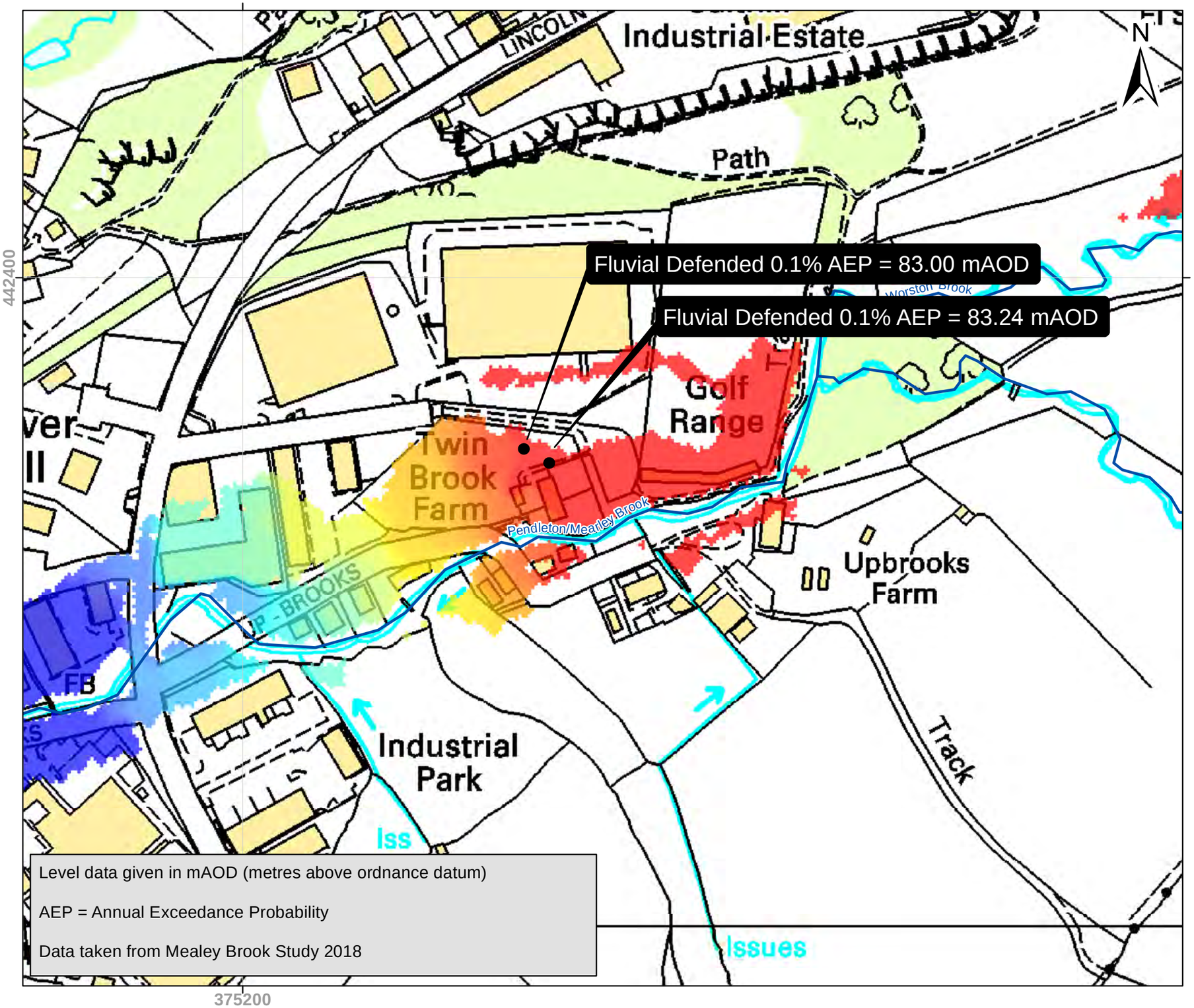


Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk



Level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Mealey Brook Study 2018

Environment Agency

Fluvial Flood Levels Map:
Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

Key

Main River

Fluvial Defended 0.1% annual probability of flooding scenario

mAOD

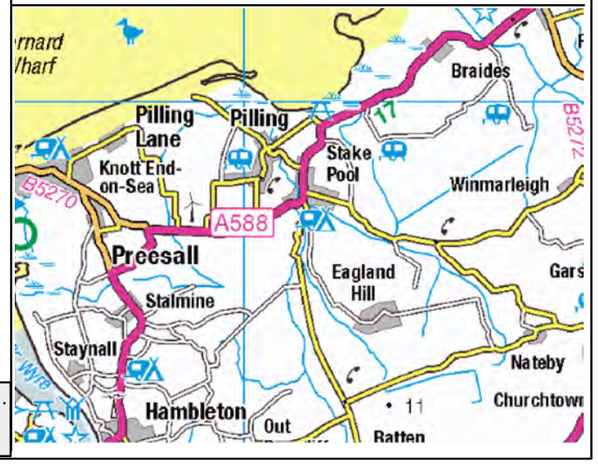
High : 83

Low : 80

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
- or from a river with a 1.0% or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to 0.1% chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 0.5% tidal, or 1.0% fluvial flood event.



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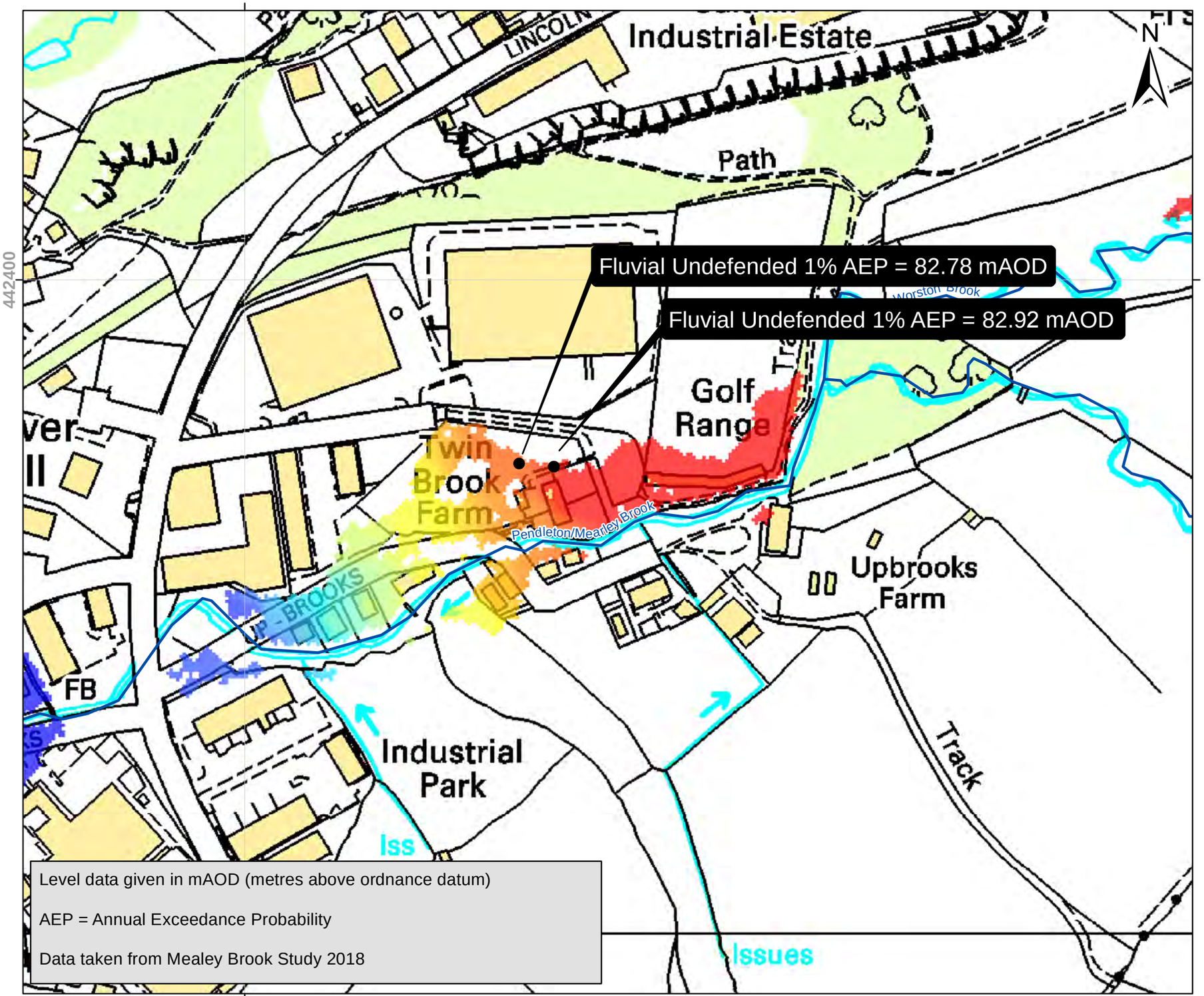

Level data given in mAOD (metres above ordnance datum)

AEP = Annual Exceedance Probability

Data taken from Mealey Brook Study 2018

Environment Agency

Fluvial Flood Levels Map:
Twinbrooks Barn, Upbrooks, Clitheroe BB7 1PL
Produced: 23 October 2021
Our Ref: CL220677
NGR: SD 75369 42273

Key

Main River

Fluvial Undefended 1% annual probability of flooding scenario

mAOD

High : 83

Low : 80

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 0.5% or greater chance of happening each year
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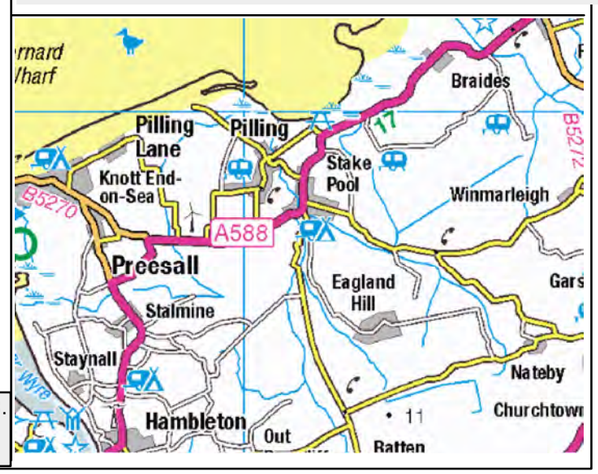

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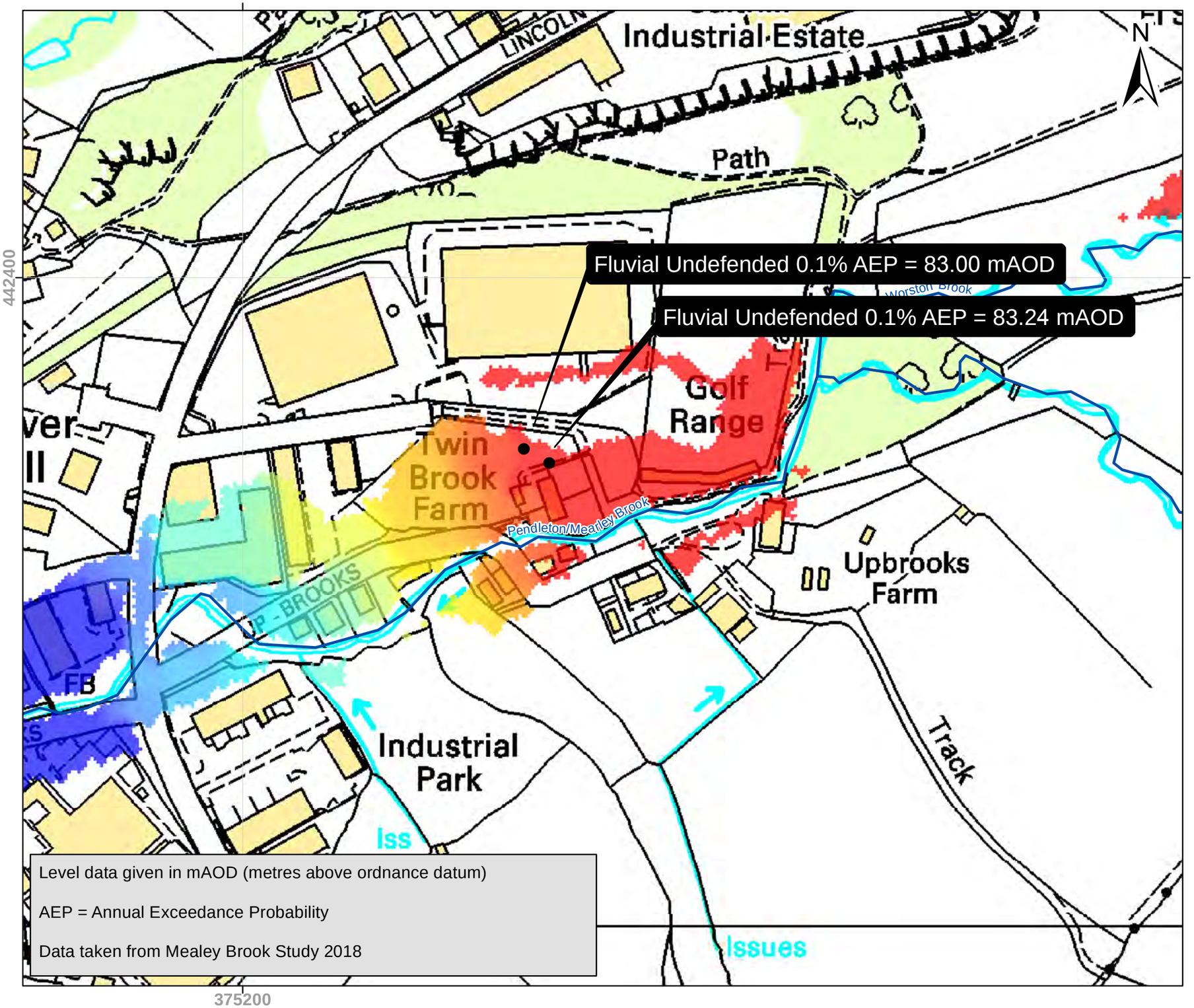

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Main River

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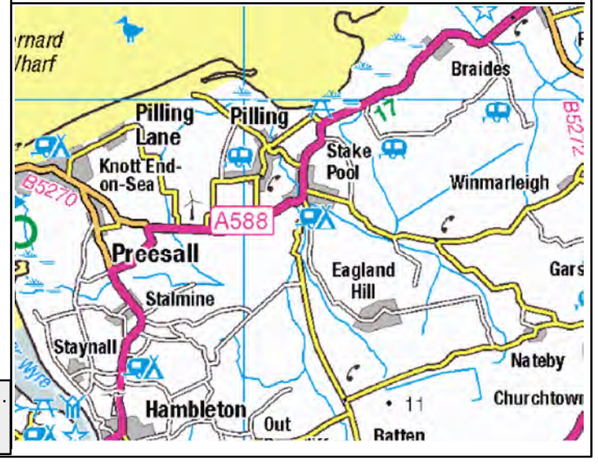

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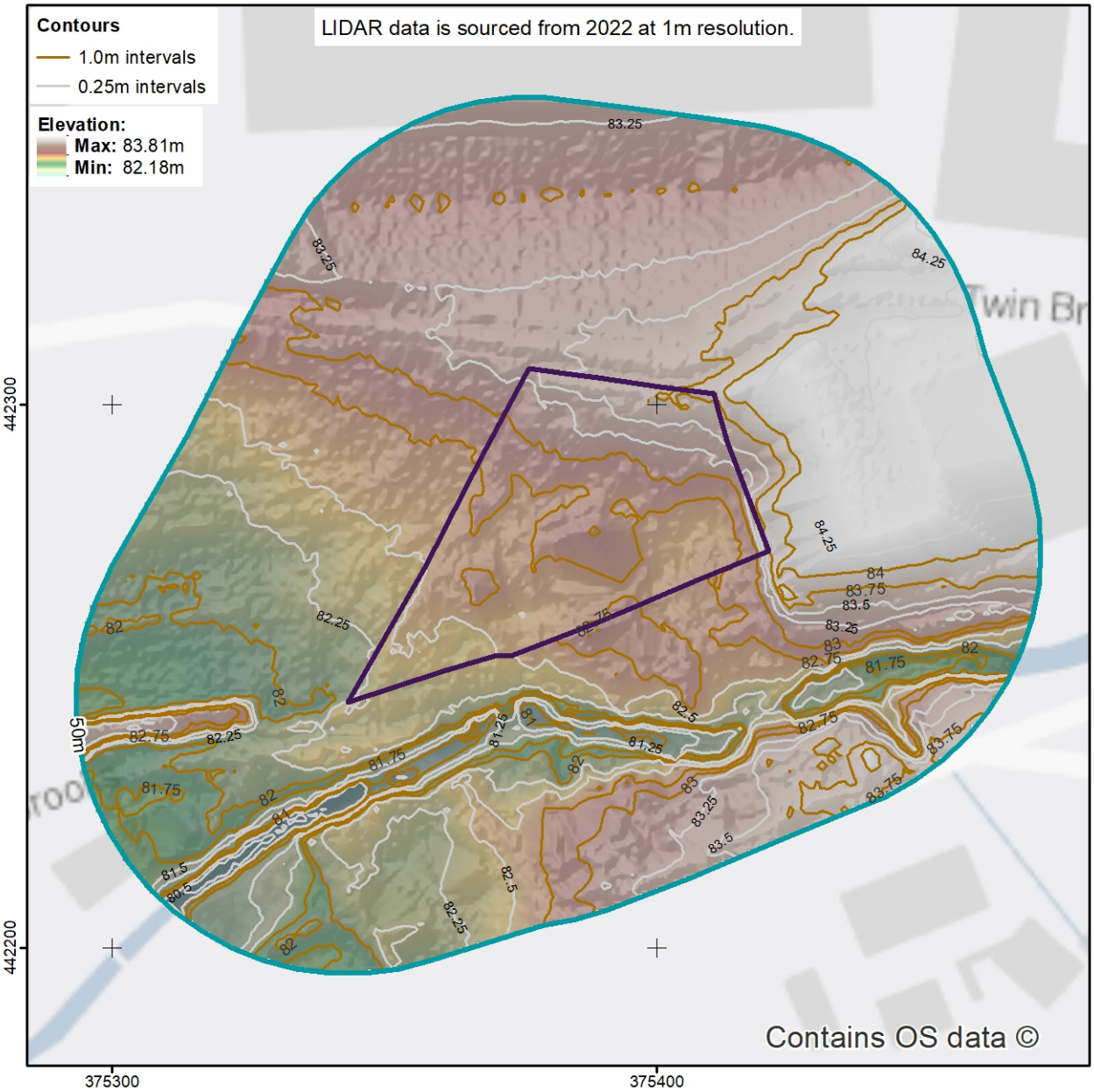
GeoSmart Information

Appendix C

Environment Agency LiDAR ground elevation data



Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil, groundwater, flood risk and drainage specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by GeoSmart solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

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Important consumer protection information

This search has been produced by GeoSmart Information Limited, Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU.

Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

GeoSmart Information Limited is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom.
- sets out minimum standards which firms compiling and selling search reports have to meet.
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals.
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports.
- act with integrity and carry out work with due skill, care and diligence.
- at all times maintain adequate and appropriate insurance to protect consumers.
- conduct business in an honest, fair and professional manner.
- handle complaints speedily and fairly.
- ensure that products and services comply with industry registration rules and standards and relevant laws.
- monitor their compliance with the Code.

GeoSmart Information

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award compensation of up to £5,000 to you if he finds that you have suffered actual loss as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs contact details:

The Property Ombudsman scheme

Milford House

43-55 Milford Street

Salisbury

Wiltshire SP1 2BP

Tel: 01722 333306

Fax: 01722 332296

Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly. If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision. Complaints should be sent to:

Martin Lucass

Commercial Director

GeoSmart Information Limited

Suite 9-11, 1st Floor,

Old Bank Buildings,

Bellstone, Shrewsbury, SY1 1HU

Tel: 01743 298 100

MartinLucass@geosmartinfo.co.uk

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http://geosmartinfo.co.uk/terms-conditions/

CDM regulations can be found on our website:

http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website:

http://geosmartinfo.co.uk/data-limitations/