Bradford Level 2 Strategic Flood Risk Assessment - Site H560

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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Contract

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JBA Project Code	2024s1078

This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Laura Thompson of JBA Consulting carried out this work.

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Acknowledgements

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H560. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2024) and is therefore familiar with the terminology used in this report.

1.1 Site H560

- Location: Long Lee Lane
- Existing site use: Agricultural, grassland used for grazing
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.24 hectares
- Proposed development impermeable area: 0.24 hectares (assumed 85% impermeable area)
- Environment Agency (EA) river model: N/A
- Watercourse: N/A
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk
    - Modelling of latest EA climate change allowances for peak rainfall intensities

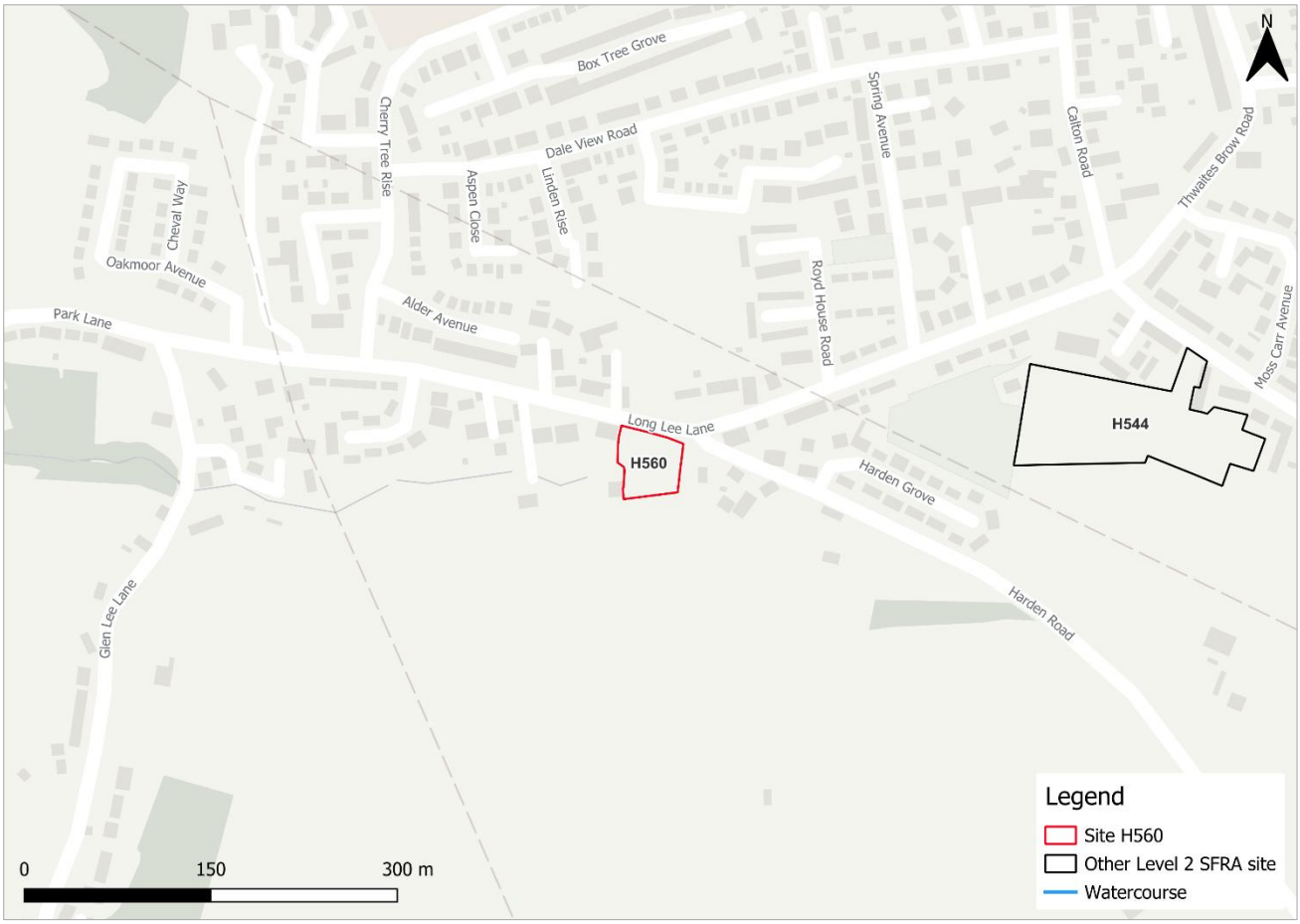


Figure 1-1: Existing site location boundary

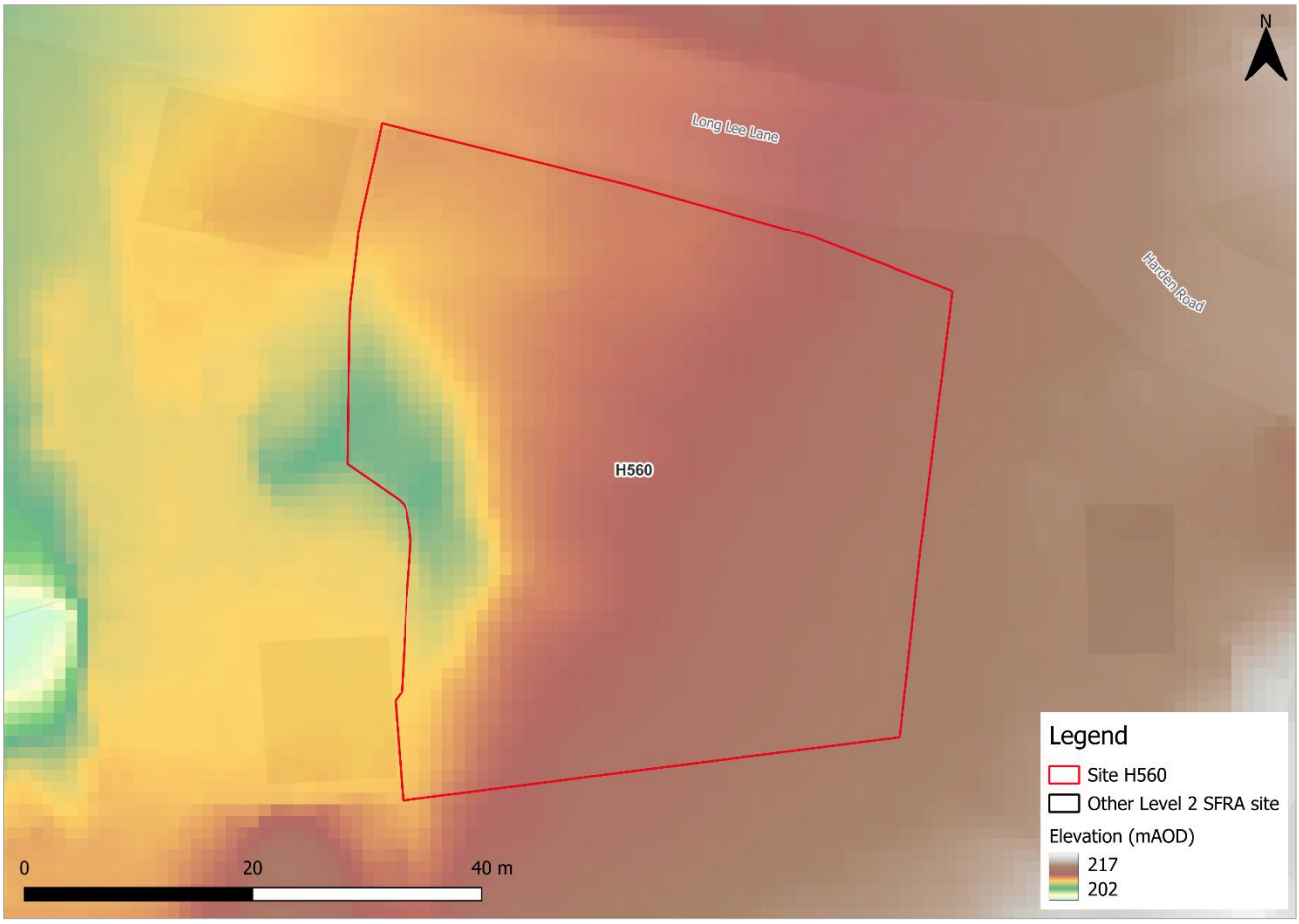


Figure 1-2: Topography



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.2) or the impacts of climate change.

The site is entirely within Flood Zone 1 indicating it is at low risk of flooding from rivers.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
100	0	0	0



Figure 2-1: Existing risk from rivers to the site

2.2 Historic land-use mapping

Historic land-use mapping held by the LLFA indicates Hog Holes Beck is culverted beneath the site. This should be confirmed, and the exact location ascertained, through site investigation. Potential flood risk from this watercourse may need to be ascertained at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset.

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) to reduce flood risk to the site and surrounding areas. These areas are shown in Figure 2-2. Within the site, there are opportunities for both riparian and wider catchment tree planting, indicating areas where tree planting would be effective to attenuate flooding. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.



Figure 2-2: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood events within the vicinity of the site.

2.5 Flood warning and access and escape routes

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The site is not located within a FWA.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. This site is also not located within a FAA.

Based on available information, safe access and escape routes could likely be achieved during a flood event via Long Lee Lane.

2.6 Observations, mitigation options and site suitability - fluvial

- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
- Given the change in use and therefore vulnerability of the site, the FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).
- The site is wholly within Flood Zone 1 and therefore is at low risk of flooding from rivers.
- Potential flood risk from the watercourse shown in historic land-use mapping to enter the site may need to be ascertained at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- If a watercourse is identified, it may need to be modelled to quantify the risk from any culverts.
- Assuming a culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map, surface water risk to the site is predominantly very low. Approximately 8% of the site is within the high risk surface water flood zone. A further 8% is at medium risk and a further 13% is at low risk of surface water flooding, as shown in Table 3-1.

In the high risk event, surface water risk is confined to an area of deep ponding within a topographic low spot within the west of the site. This is similar to the medium risk event, however there is a shallow flow path extending through the centre of the site flowing into the depression. In the low risk event, this flow path becomes more significant in extent, flowing from east to west through the centre of the site.

Greatest flood depths within the depressions in the medium risk event are > 1.2 m (Figure 3-1) with areas of hazard categorised as extreme (Figure 3-2). This depression is currently wooded and should be retained onsite as a landscape feature.

Safe access and escape routes should be achievable via Long Lee Lane in all events, given the low depth and hazard of flooding along this route in the extreme low risk event.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
71	13	8	8

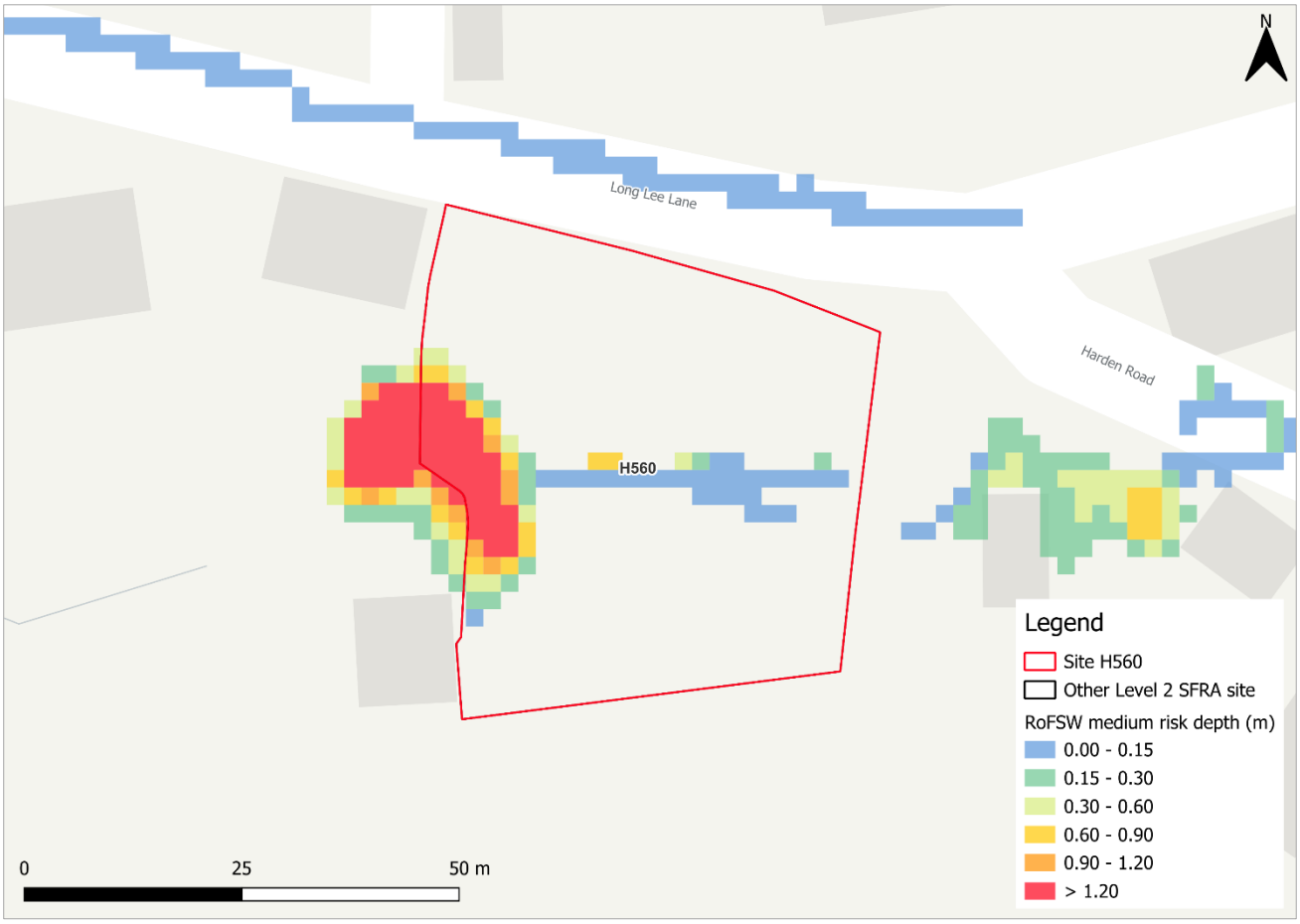


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)



Figure 3-2: Medium risk event surface water flood hazard[1] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event +45% climate change. Risk is modelled to be greater than for present day conditions, with the

1 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

medium risk climate change event showing a similar level of risk to the low risk present day event. Maximum depths are modelled to be > 1.2 m with areas of hazard categorised as extreme (Figure 3-4) within the depression. However, the flow path is predominantly shallow and low hazard. The flow path originates offsite to the east and flows down slope through the site into the depression. Safe access and escape routes should remain achievable via Long Lee Lane.

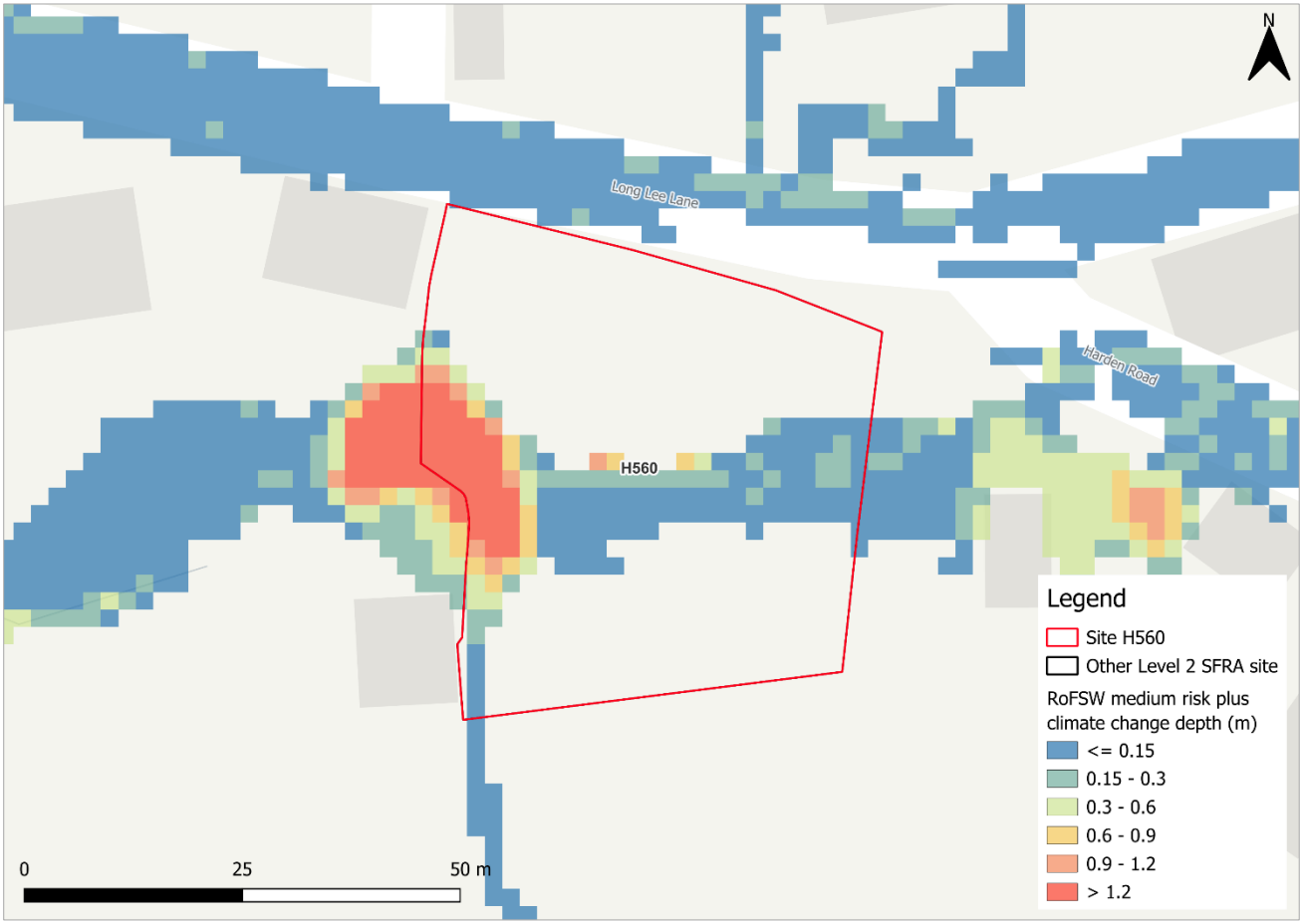


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

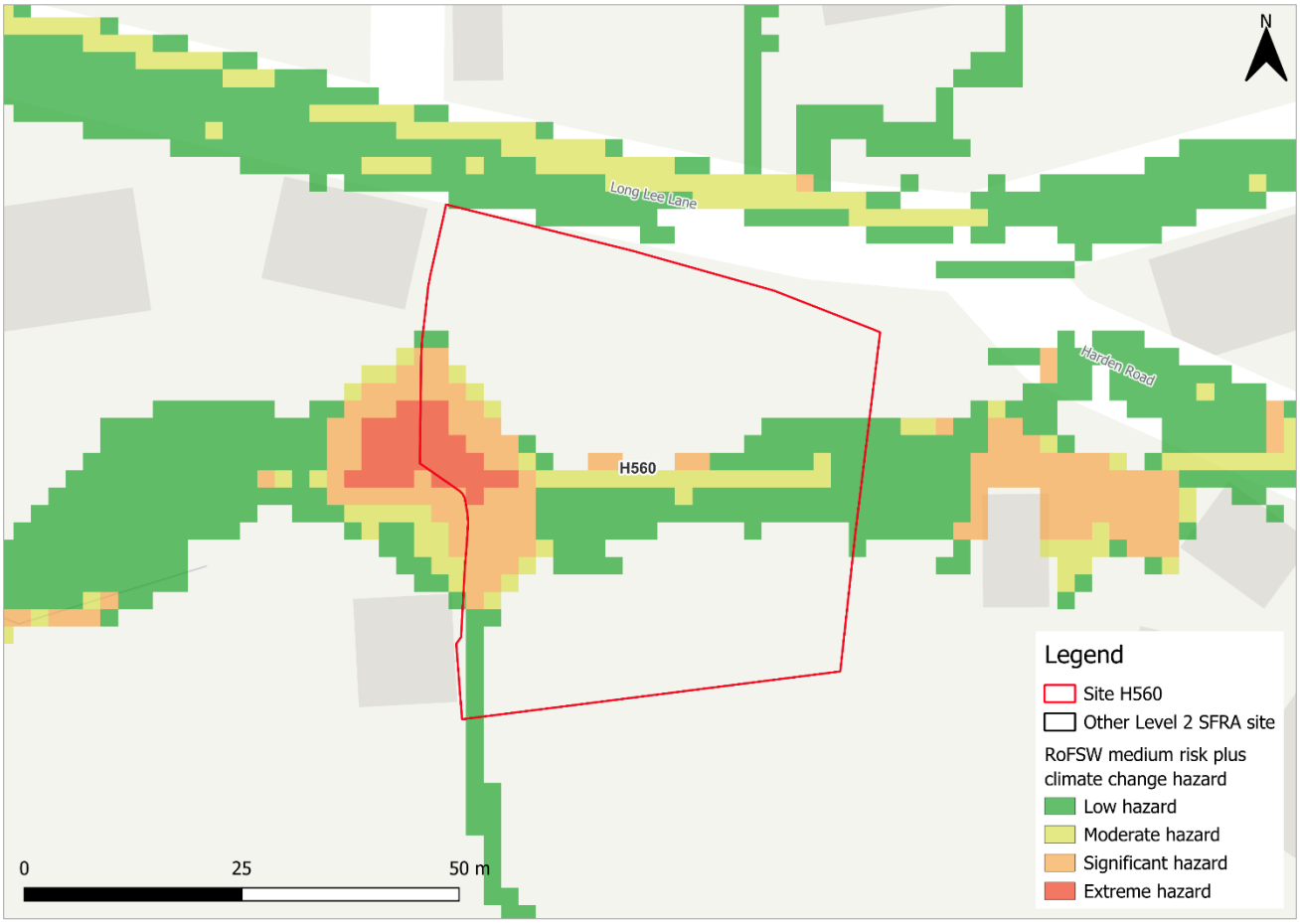


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is considerable within the area of ponding within the west of the site. Surface water depths and hazards are modelled to be significant in this area. An additional flow path that runs through the centre of the site develops in the medium and low risk events.
- The medium risk modelled climate change outputs indicate a similar extent of risk to the present day low risk event, with a significant area of risk to the west combined with a surface water flow path through the centre of the site.
- Topographic flow routes and depressions should be considered and included in site design and ideally left in place to flood naturally when required. Any regrading of land must include like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. Runoff rates should be restricted to greenfield rates and betterment should be achieved if possible. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA.

- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[2]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The risk of groundwater emergence across the site is generally low. Within the centre and southwest of the site, the risk of groundwater emergence is unlikely. Across the remaining area of the site, there is no risk of groundwater emergence. Groundwater conditions may therefore be suited to infiltration SuDS.

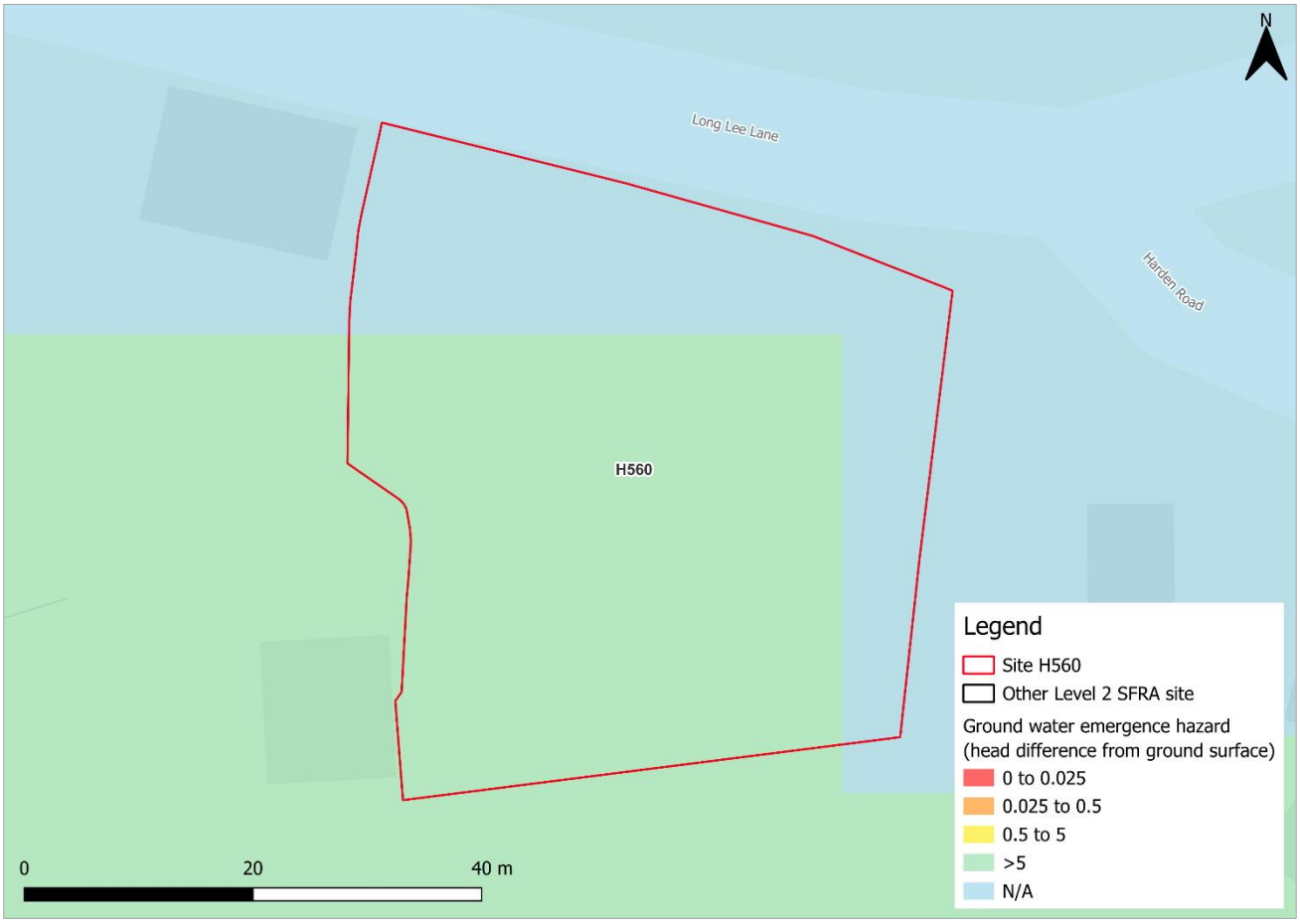


Figure 4-1: JBA 5m Groundwater Emergence Map

2 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

5.1 Potential culvert

Historic land-use mapping held by the LLFA, indicates that there may be a watercourse culverted beneath the site. If a watercourse is present, there will be a residual risk of flooding to the site were there to be a culvert failure or blockage. A model for this watercourse is not available. Therefore, residual risk could not be modelled for this Level 2 SFRA.

5.2 Flood risk from canals

The site is not likely to be at risk from a canal breach.

5.3 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is not modelled to be at risk from reservoir flooding.

5.4 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.5 Observations, mitigation options and site suitability - residual risk

- There is no modelled residual risk to the site.
- Historic mapping indicates there may be a watercourse culverted beneath the site. If present, the culvert represents potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage.

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is not required to pass part b) of the exception test[3] as it is located within Flood Zone 1, however it must still be proven that the development can be safe for its lifetime, which is 100 years for residential development.

6.2 Recommendations, FRA requirements, and further work

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

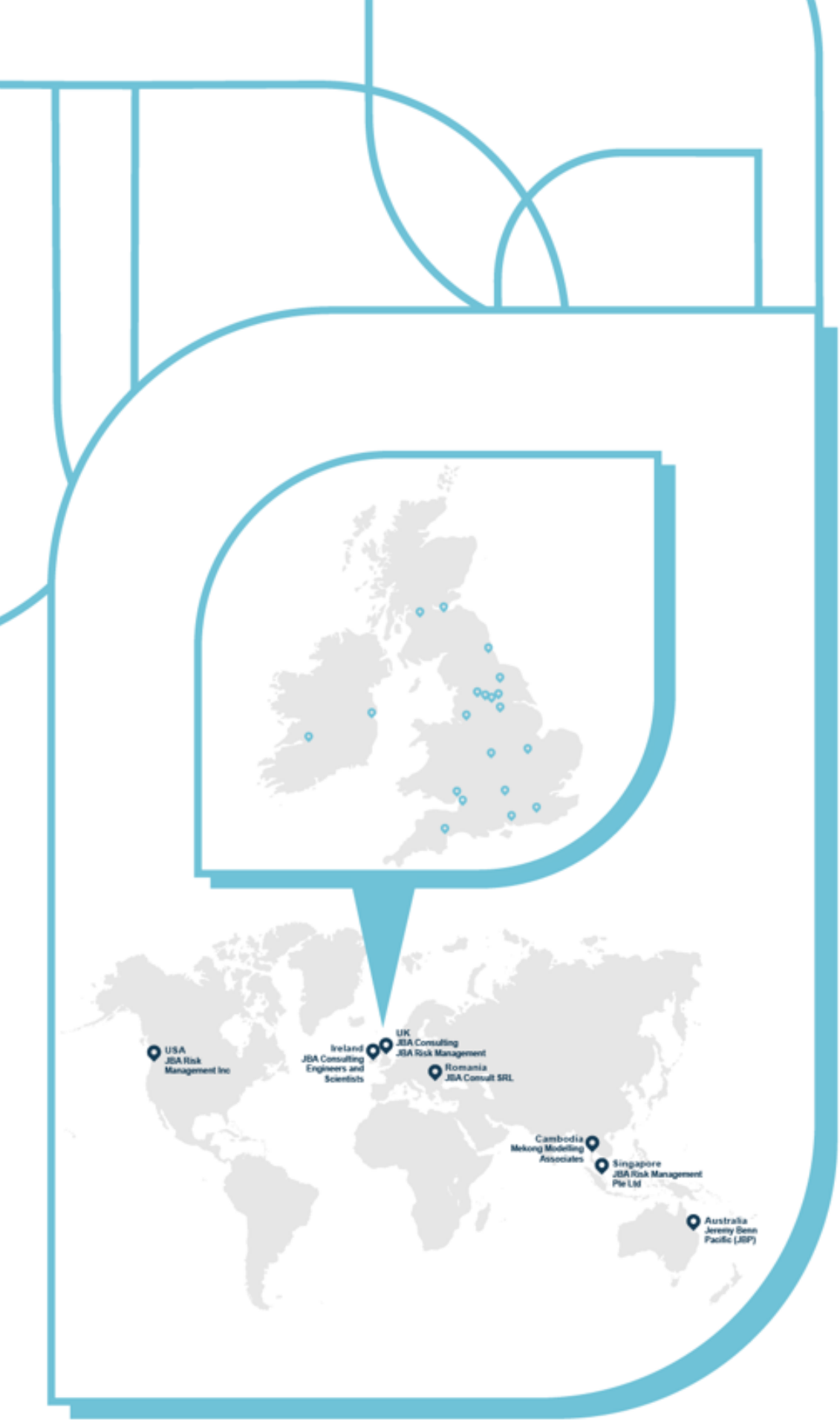
- Based on the evidence in this SFRA, it should be appropriate to develop this site for more vulnerable purposes given its location in Flood Zone 1.
- Historic mapping indicates there may be a watercourse culverted beneath the site. If present, the culvert represents potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage. Modelling should include for residual risk and options for culvert removal.
- No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- Assuming the culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- Surface water should be retained onsite which may reduce units. This would include retention of the topographic depression and the flow path. This will require detailed surface water modelling based on layout plans and detailed design and full consultation with the LLFA on required runoff rates, likely to be greenfield or betterment. The use of infiltration SuDS should be investigated.
- The topographic low spot within the west of the site should ideally be left free of development. This depression is currently wooded and should be retained onsite as a landscape feature enabling storage of surface water.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA online guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

3 Para 178 National Planning Policy Framework 2024

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Bradford Level 2 Strategic Flood Risk Assessment - Site H569

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May 2025

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Reviewed by	Mike Williamson BSc MSc CGeog FRGS EADA Principal Analyst
Authorised by	Krista Keating BSc MSc CEnv CSci MCIWEM C.WEM Associate Director

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1.1 Site H569

- Location: Higher Wheathead Farm, Keighley
- Existing site use: Agricultural, predominantly industrial
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Residential
- Proposed site use vulnerability: More vulnerable
- Site area: 0.94 hectares
- Proposed development impermeable area: 0.85 hectares
- Environment Agency (EA) river model: N/A
- Watercourse: N/A
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk



Figure 1-1: Existing site location boundary

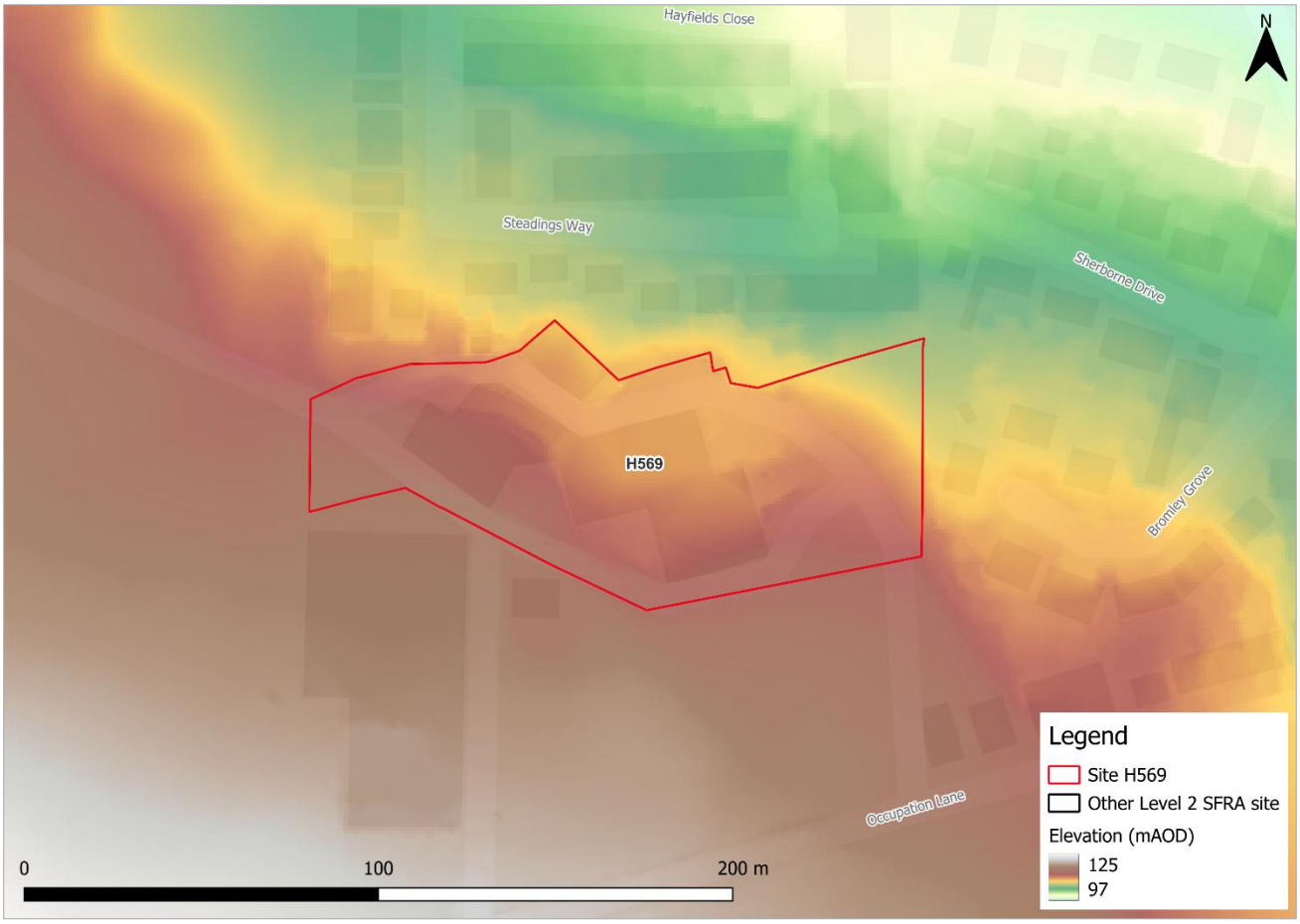


Figure 1-2: Topography



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3) or the impacts of climate change.

The site is modelled to be wholly within Flood Zone 1, indicating it is at low risk of flooding from rivers.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
100	0	0	0

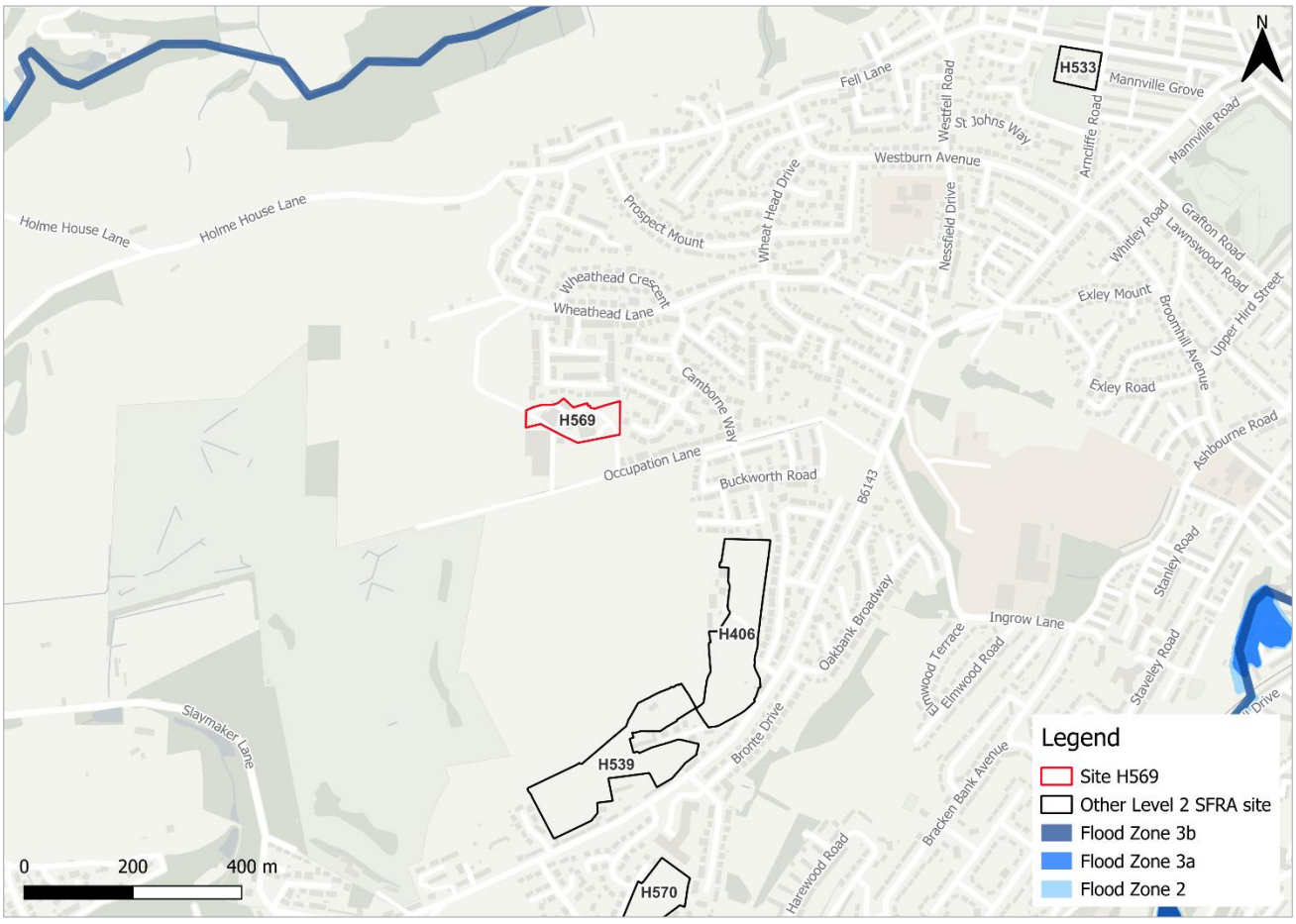


Figure 2-1: Existing risk from rivers to the site

2.2 Historic land-use mapping

Historic land-use mapping held by the LLFA indicates a watercourse within the eastern side of the site. This should be confirmed, and the exact location ascertained, through site investigation. Potential flood risk from this watercourse may need to be ascertained at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset.

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) to reduce flood risk to the site and surrounding areas. At the western site boundary there is a small area with potential for wider catchment tree planting, which can reduce flood peaks and frequency, reduce bankside erosion and increase flood depths on the floodplain These areas are shown in Figure 2-2. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

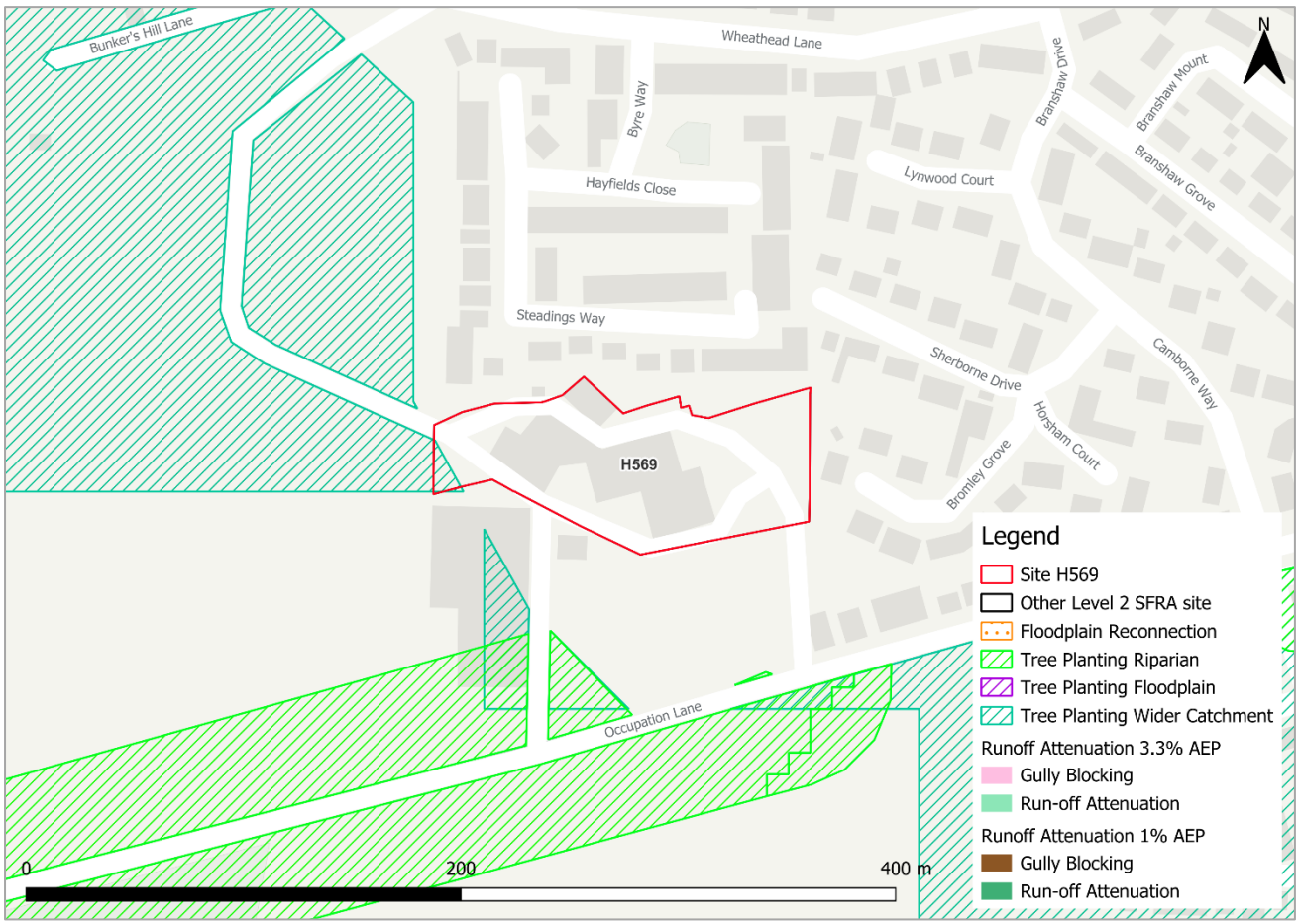


Figure 2-2: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood events within the vicinity of the site.

2.5 LLFA flood incidents

The LLFA have records of incidents on site and adjoining the site relating to a culverted watercourse, which appears in historic land-use mapping to flow through the eastern side of the site. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site and surrounding areas, associated with these incidents.

2.6 Flood warning and access and escape routes

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The site is not located within a FWA.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be

issued when there is less confidence that flooding will occur in a FWA. This site is not located within a FAA.

2.7 Observations, mitigation options and site suitability - fluvial

- The site is wholly located within Flood Zone 1, indicating it is modelled to be at low risk of flooding from rivers.
- However, potential flood risk from the watercourse shown in historic land-use mapping to enter the site may need to be ascertained at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- If a watercourse is identified, it may need to be modelled to quantify the risk from any culverts.
- Assuming a culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map, surface water risk to the site is largely very low. Approximately 3% of the site is within the high risk surface water flood zone, 2% is within the medium risk zone and a further 6% is within the low risk zone.

Risk is constrained by the current buildings onsite. In the high risk event flooding is concentrated to an area of ponding at the southern centre of the site. In the medium risk event a second area of ponding, further west within the site forms. In the low risk event, a third area of ponding forms at the centre of the northern site boundary. The first area of ponding also joins a flow path which flows through the eastern half of the site.

Greatest flood depths in the medium risk event are > 1.2 m (Figure 3-1) with an extreme hazard rating (Figure 3-2). There is some flooding on Occupation Road during the low risk event, however safe access and escape should be achievable due to the low depths of flooding to the road.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
89	6	2	3

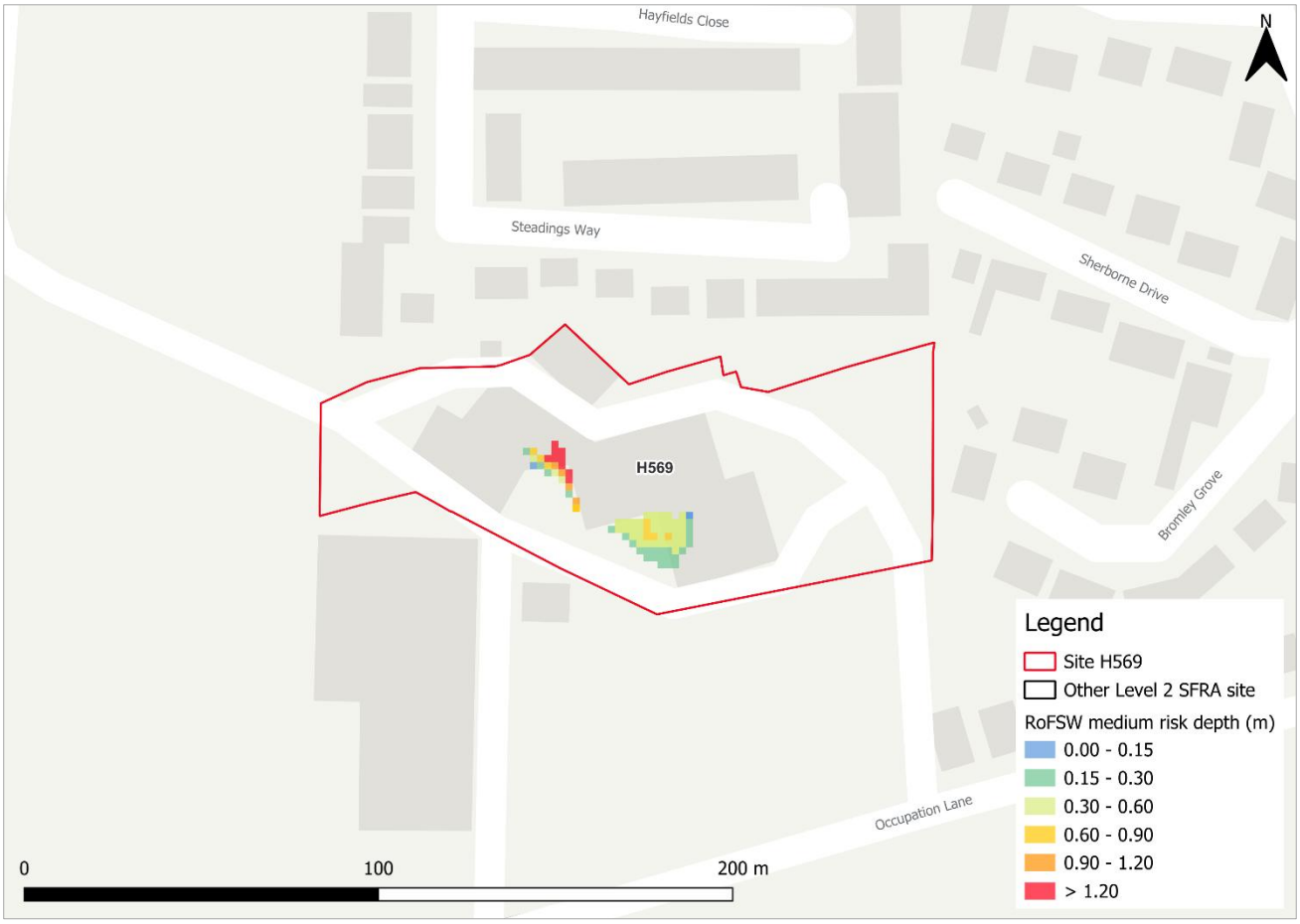


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

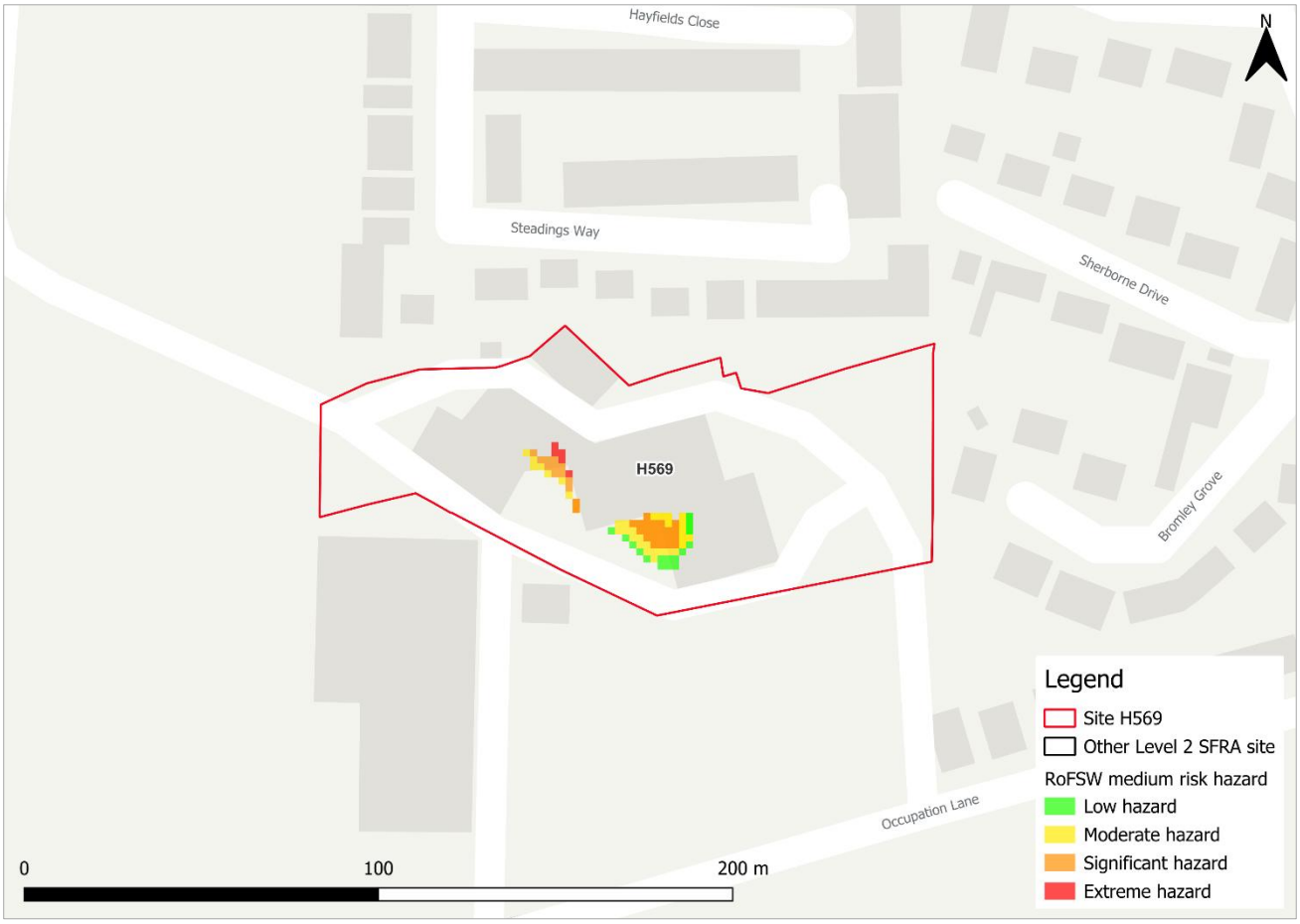


Figure 3-2: Medium risk event surface water flood hazard[1] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event +45% climate change. Risk is modelled to be greater than for present day conditions, with the

1 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

medium risk climate change event showing a greater level of risk than the low risk present day event. The areas of ponding within the site merge to join the flow path which flows through the site. A second flow path forms within the western half of the site. Maximum flood depths remain > 1.2 m (Figure 3-3) with an area of extreme hazard within the centre of the site (Figure 3-4).



Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

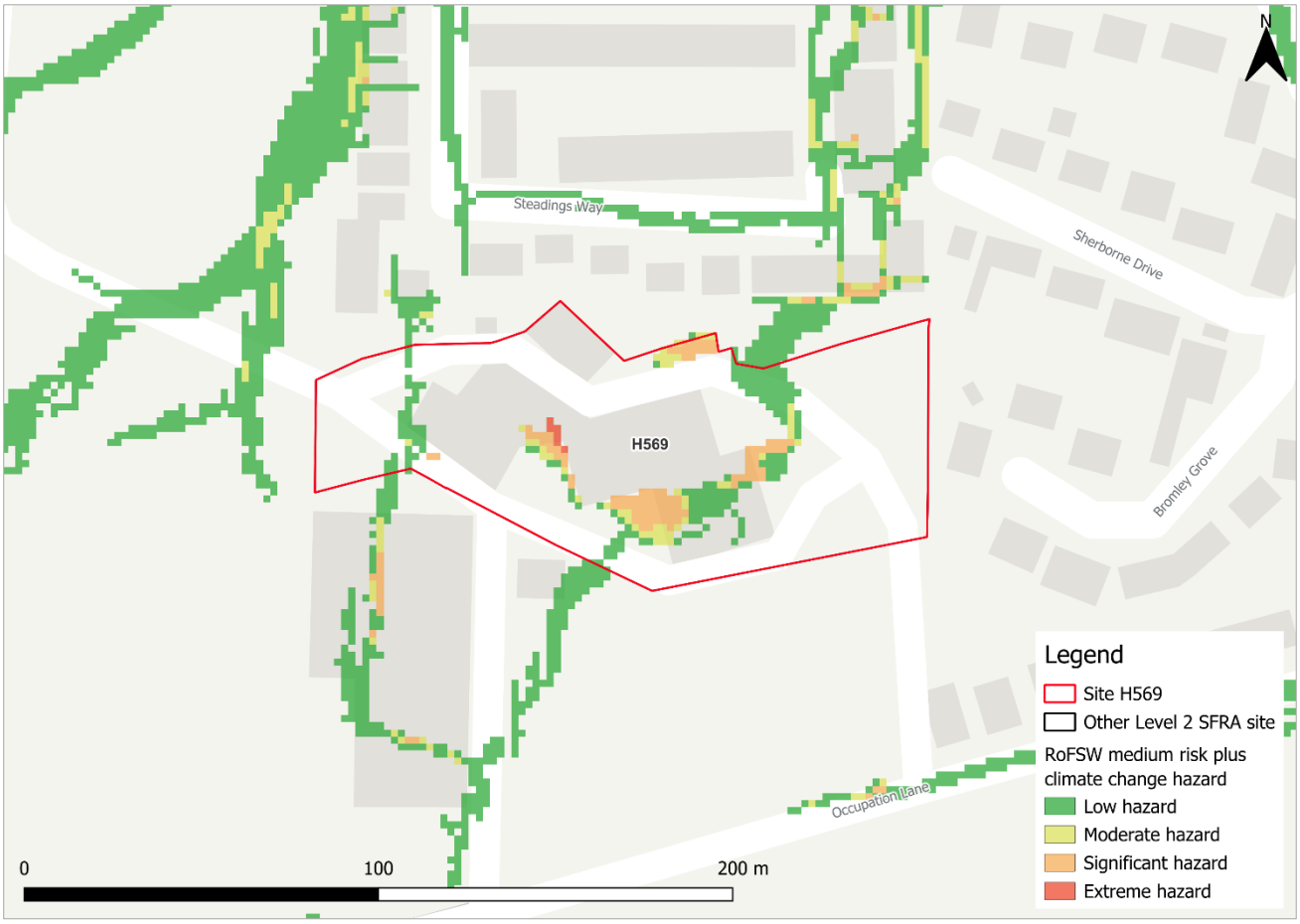


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is largely very low, with a small amount of surface water ponding at the centre of the site during the high risk event, a second area of ponding during the medium risk event and a third area in the low risk event. The first area of ponding also joins a flow path which flows through the eastern half of the site. Risk is constrained by the current onsite buildings.
- Any change in site layout where there are changes to current building footprints or road layouts, will require detailed surface water modelling to ascertain flow routes and low-lying areas.
- Topographic flow routes and depressions should be considered and included in site design and ideally left in place to flood naturally when required. Any regrading of land must include like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. Runoff rates should be restricted to current brownfield rates or betterment on existing where possible. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA.

- The Groundwater Emergence Map (Figure 4-1) indicates that ground conditions may be suitable for infiltration SuDS across the site. This should be further explored through appropriate ground surveys as part of the FRA and drainage strategy.
- Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate the proposed residential development or whether further capacity will be required.
- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[2]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

In the northeastern side of the site there is no risk of groundwater emergence. In the southwestern half of the site, flooding from groundwater is unlikely.



Figure 4-1: JBA 5m Groundwater Emergence Map

2 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

5.1 Potential culvert

Historic land-use mapping held by the LLFA, indicates that there may be a watercourse culverted beneath the eastern side of the site. If a watercourse is present, there will be a residual risk of flooding to the site were there to be a culvert failure or blockage. A model for tis watercourse is not available. Therefore, residual risk could not be modelled for this Level 2 SFRA.

5.2 Flood risk from canals

The site is not likely to be at risk from a canal breach.

5.3 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is not modelled to be at risk of reservoir flooding.

5.4 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded, blocked or it cannot discharge due to a high water level in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.5 Observations, mitigation options and site suitability - residual risk

- There is no modelled residual risk to the site.
- Historic mapping indicates there may be a watercourse culverted beneath the site. If present, the culvert represents potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage.

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is not required to pass part b) of the exception test[3] as it is located within Flood Zone 1, however it must still be proven that the development can be safe for its lifetime, which is 100 years for residential development.

6.2 Recommendations, FRA requirements, and further work

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

- It should be appropriate to develop this site for more vulnerable purposes given its location in Flood Zone 1.
- Historic mapping indicates there may be a watercourse culverted beneath the site. If present, the culvert represents potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage. Modelling should include for residual risk and options for culvert removal.
- No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- Assuming the culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- There is risk from surface water in the medium and low risk events and with climate change, currently affecting the centre and eastern side of the site. A detailed drainage strategy will be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development.
- Surface water should be retained onsite which may reduce units. This will require detailed surface water modelling based on layout plans and detailed design and full consultation with the LLFA on required runoff rates, likely to be brownfield or betterment. The use of infiltration SuDS should be investigated for suitability across the majority of the site.
- Groundwater conditions must be investigated further through the site-specific FRA to ascertain groundwater levels and conditions.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA online guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood

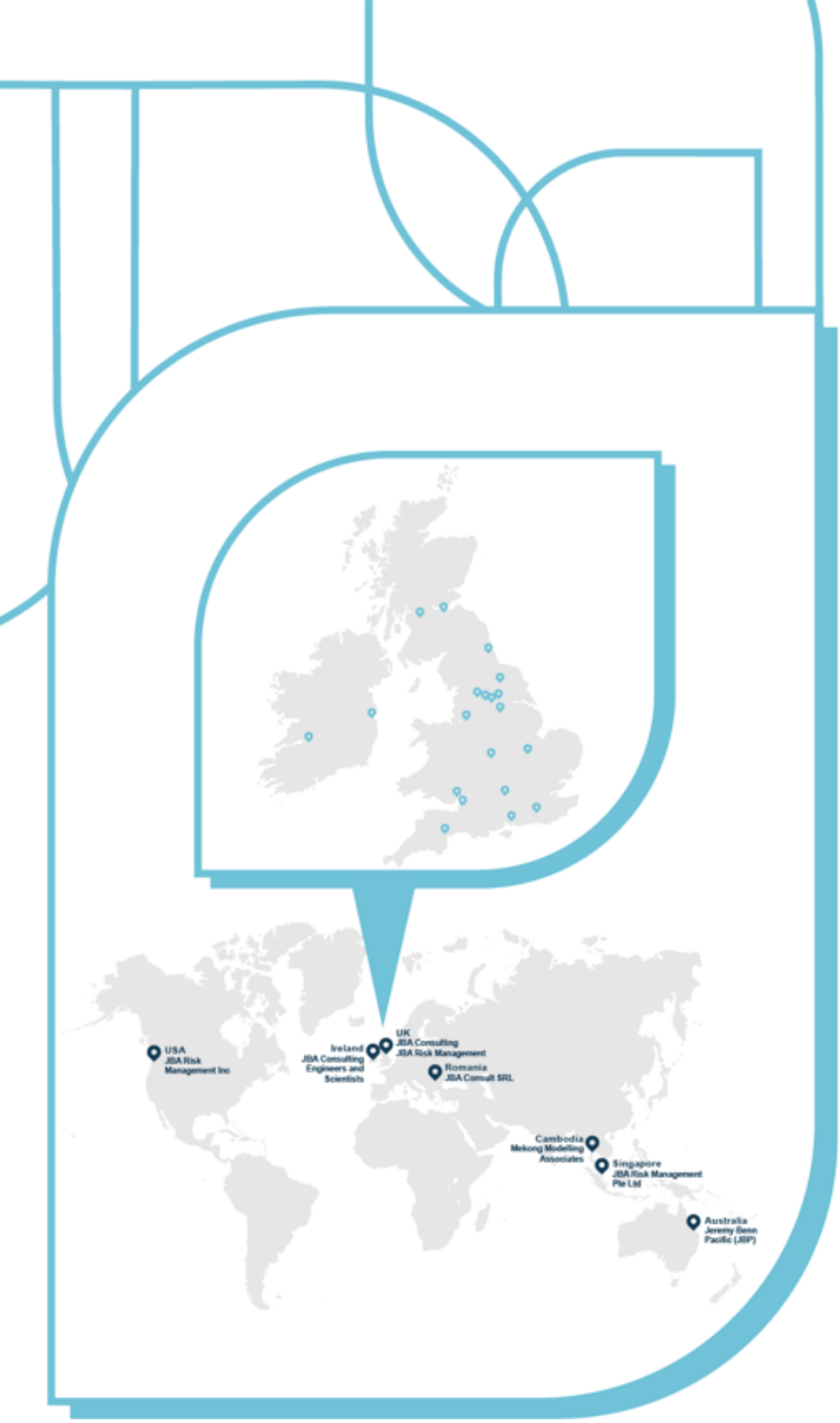
3 Para 178 National Planning Policy Framework 2024

authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

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Bradford Level 2 Strategic Flood Risk Assessment - Site H1010

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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Contract

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This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Laura Thompson of JBA Consulting carried out this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H1010. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2025) and is therefore familiar with the terminology used in this report.

1.1 Site H1010

- Location: Otley Road, Baildon
- Existing site use: Brownfield
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.5 hectares
- Proposed development impermeable area: 0.45 hectares
- Watercourse: River Aire (main river)
- Environment Agency (EA) river model: Leeds FAS Kildwick to Esholt 2022
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Subject to the exception test as more vulnerable development proposed in Flood Zone 3a
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk
    - Modelling of latest EA climate change allowances for peak river flows and peak rainfall intensities

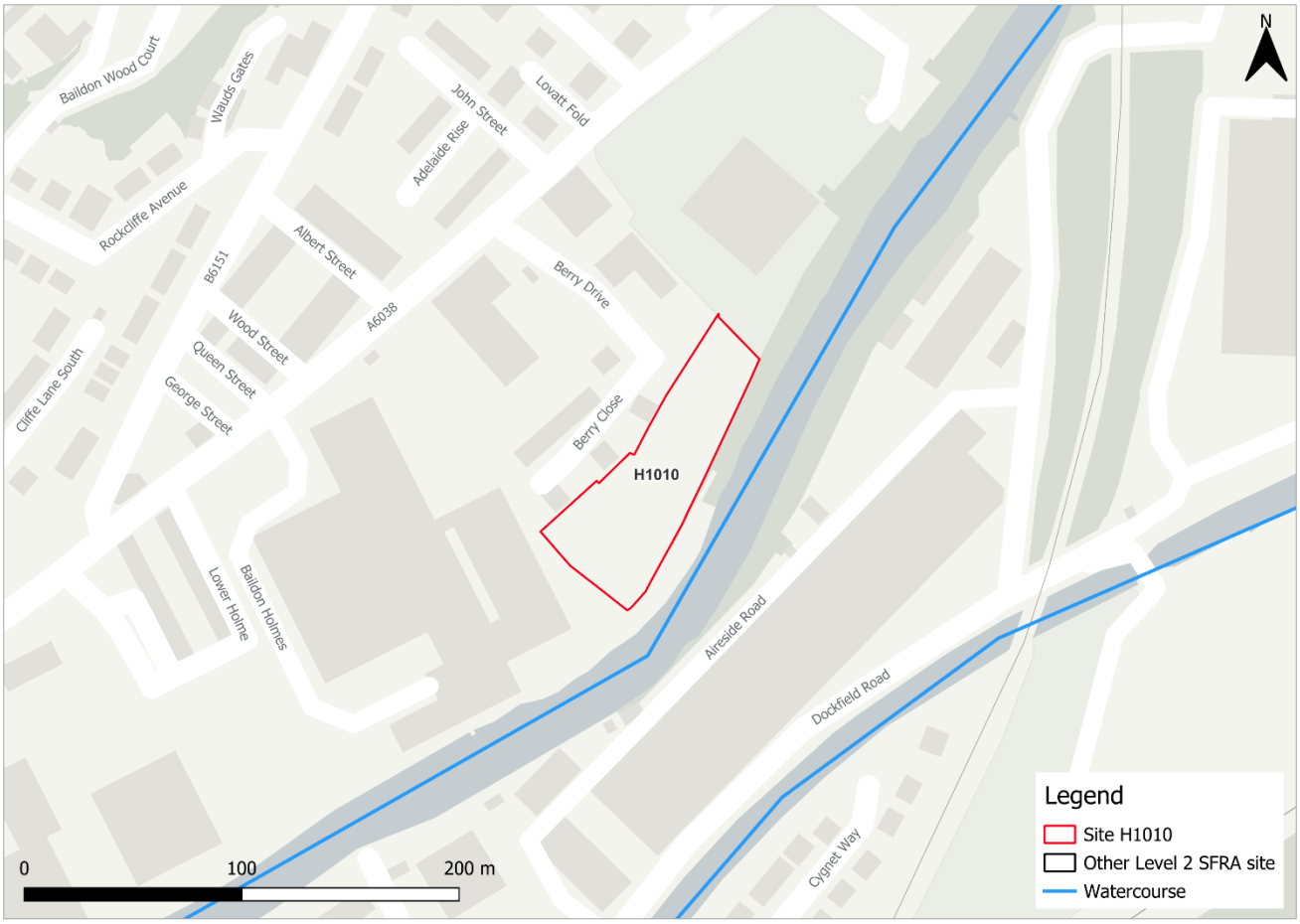


Figure 1-1: Existing site location boundary

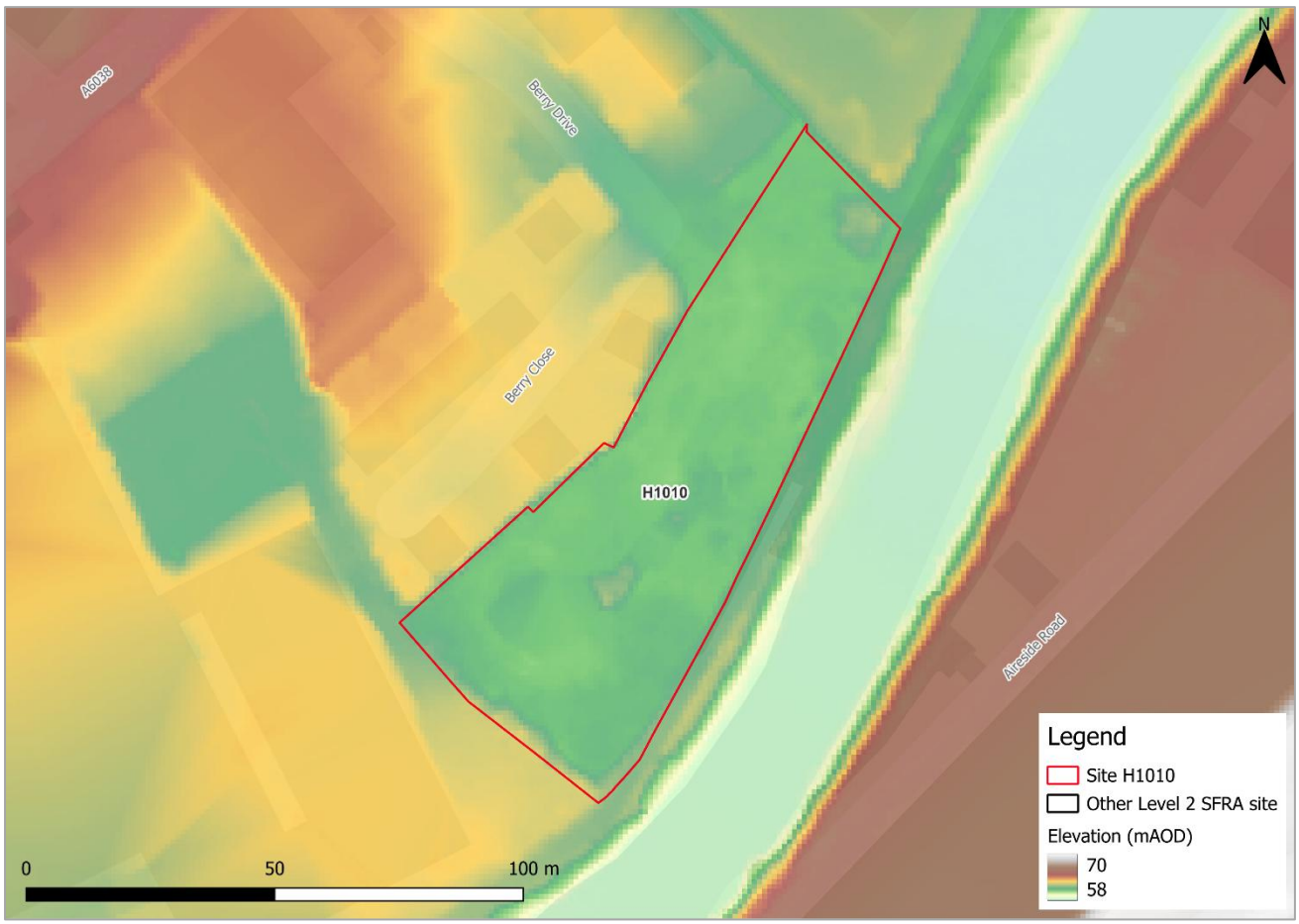


Figure 1-2: Topography



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (September 2024) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3) or the impacts of climate change (Section 2.2).

Fluvial flood risk to the site comes from the River Aire adjacent to the eastern site boundary. The River Aire is a designated main river. Functional floodplain is present along the eastern boundary of the site. The area of functional floodplain onsite should be left free of development. The functional floodplain in this location is based on the 3.33% AEP defended event from the Leeds FAS Kildwick to Esholt 2022 model. The northern and central areas of the site are situated within Flood Zone 3a and therefore at high risk. The remaining area of the site is within Flood Zone 2 and therefore at medium risk.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
0	38	58	4

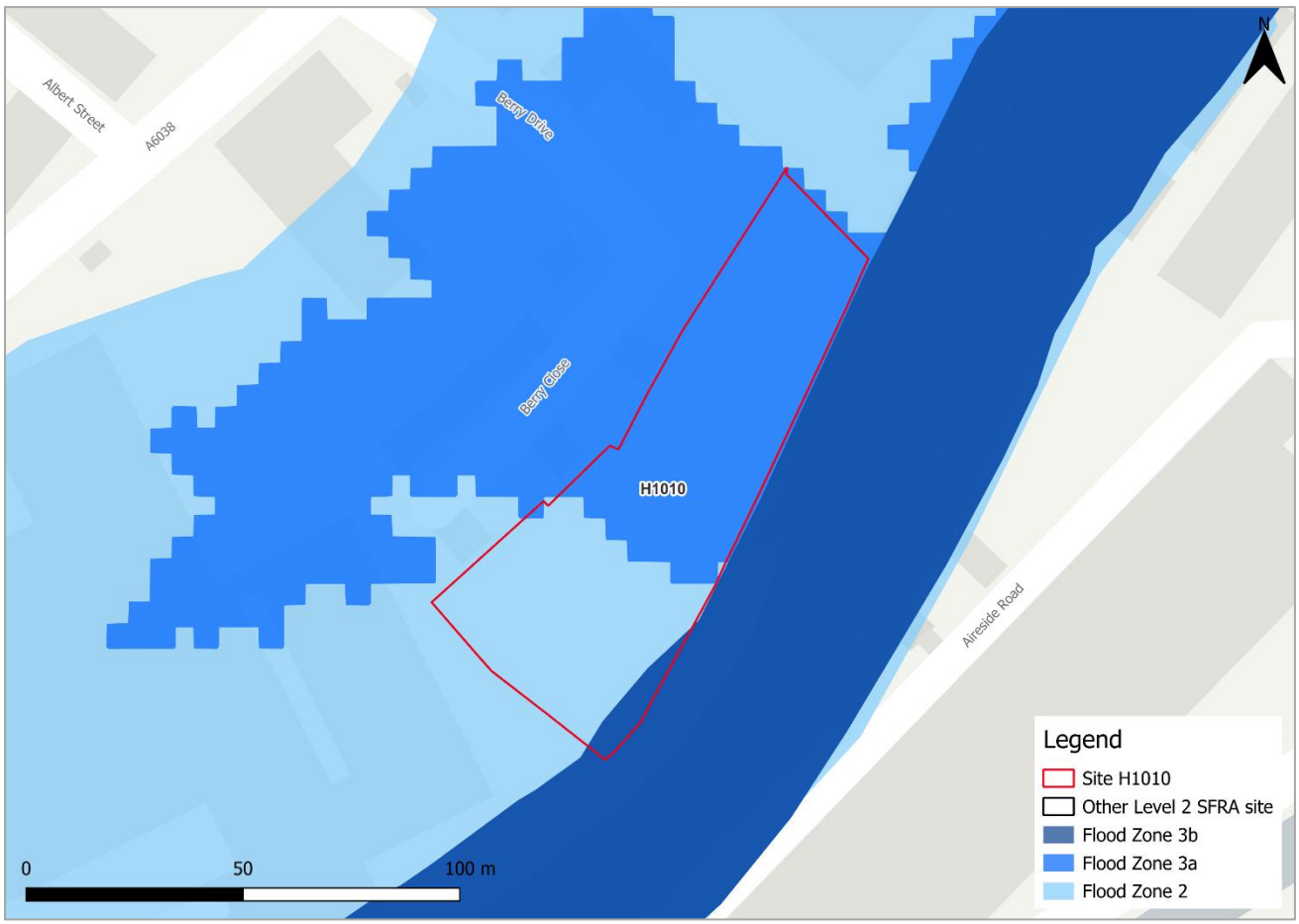


Figure 2-1: Existing risk from rivers to the site

2.1.2 Leeds FAS Kildwick to Esholt 2022 model outputs

Figure 2-2 shows the modelled flood depths for the 1% AEP undefended event which is the event Flood Zone 3 of the Flood Map for Planning is based on. Modelled risk to the site is the same as that shown by Flood Zone 3a, impacting the northern and central areas of the site. Maximum flood depths within the site are modelled to be significant, between 0.6 and 0.9 m, however this is only within a small area of the site. Modelled flood velocities are generally low across the area at risk (Figure 2-3), with velocity rarely exceeding 0.25 m^3/s. This is reflected in the modelled flood hazard being either 'very low hazard' or 'danger for some' across the area at risk (Figure 2-4). Safe access and escape routes may be challenging to achieve during this event. Section 2.3.1 discusses the defended model outputs.

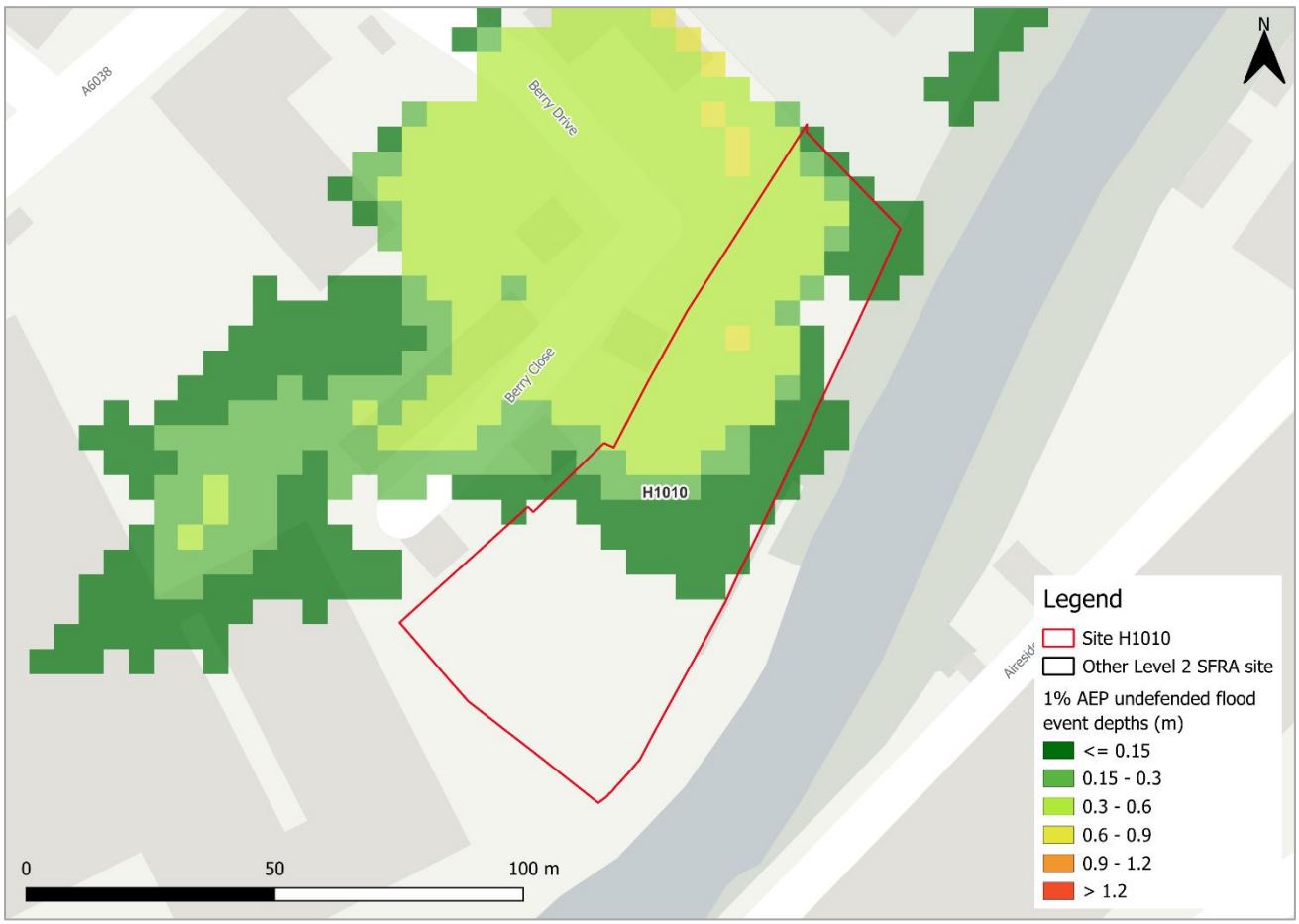


Figure 2-2: Flood depths for 1% AEP undefended flood event

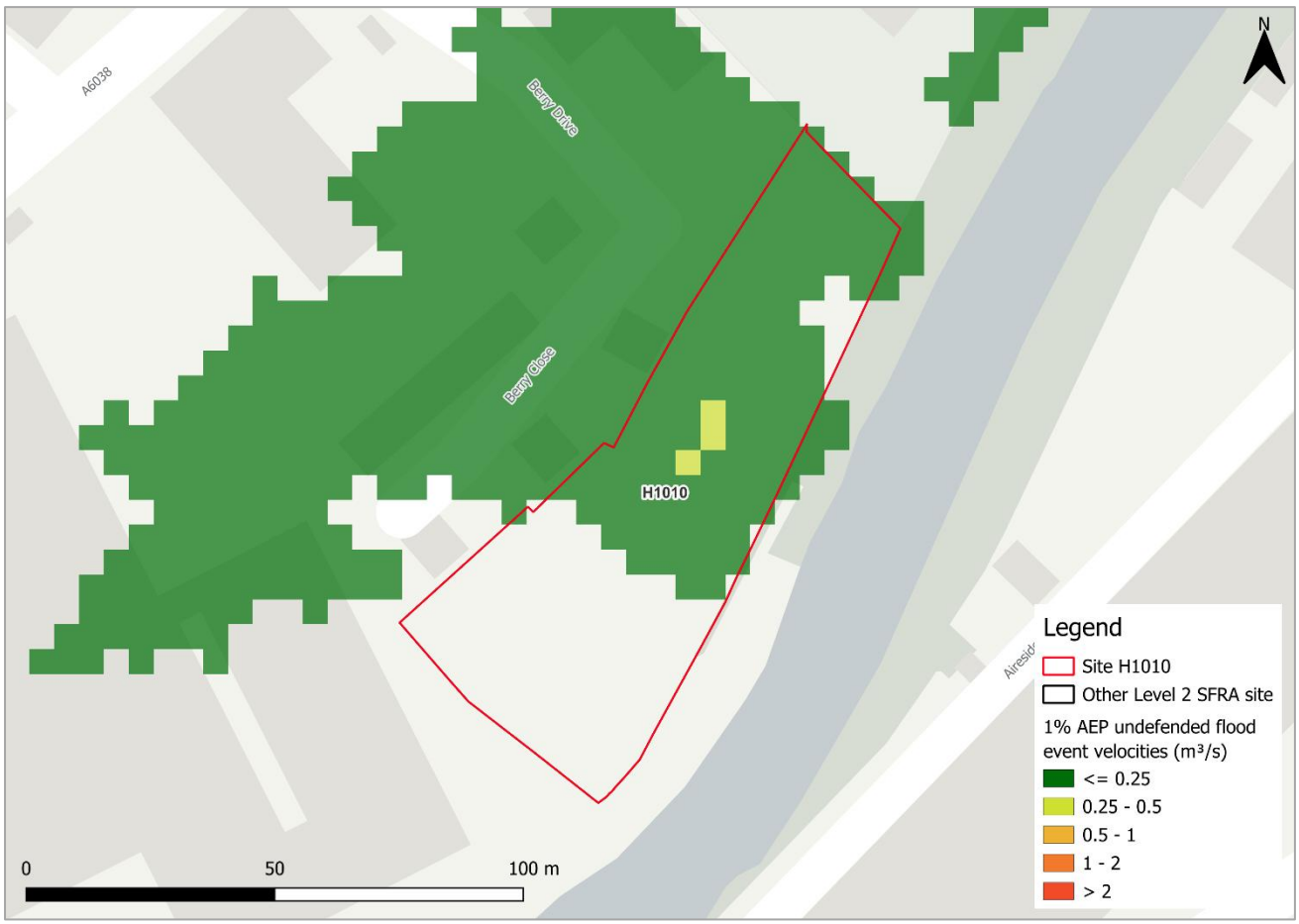


Figure 2-3: Flood velocities for 1% AEP undefended flood event

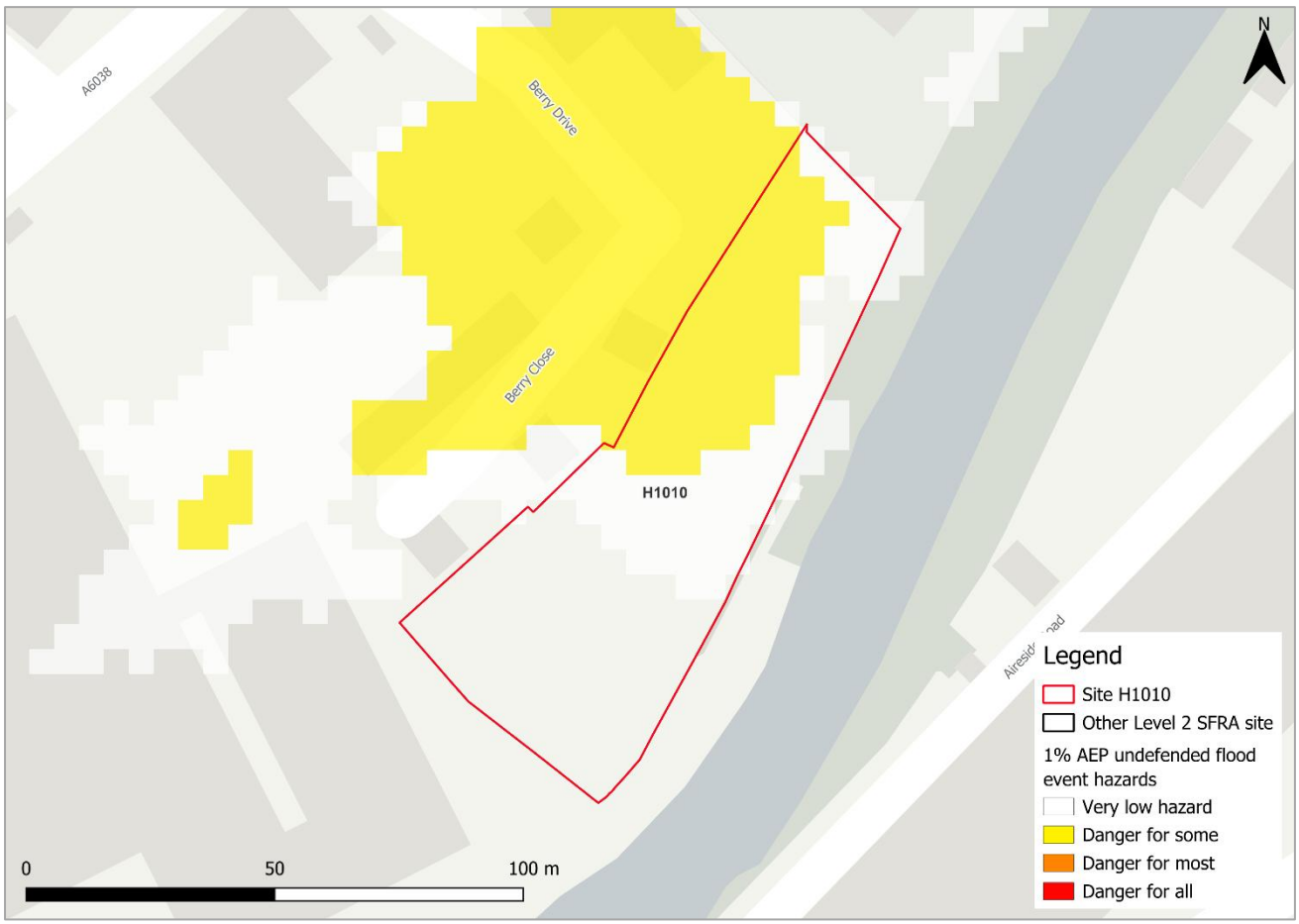


Figure 2-4: Flood hazard[1] for 1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Aire have been modelled without flood defence infrastructure in place. This allows for direct comparison with the existing risk of the Flood Map for Planning. Section 2.3.1 discusses the defended model outputs.

With consideration of the EA's SFRA guidance, the latest climate change central and higher central allowances have been modelled as shown in Table 2-2.

The EA's SFRA guidance states that SFRAs should assess the central allowance for less, more, and highly vulnerable development, and also water compatible development. The higher central should be assessed for essential infrastructure.

1 Fluvial hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%

The functional floodplain plus climate change dataset indicates that the area of functional floodplain onsite is likely to increase to a greater extent than the present day Flood Zone 3a in the future.

Figure 2-5 shows the onsite modelled flood depths for the 1% AEP undefended event +23% for climate change. Risk is modelled to be greater in both extent and depth in comparison to present day conditions. Maximum depths within the area at risk are significant, between 0.9 and 1.2 m. Flood velocities are modelled to increase significantly, with maximum velocities between 1 and 2 m^3/s (Figure 2-6). This indicates the flood water within the site is likely to be fast moving, posing a greater risk to site users. The modelled flood hazard within the area at risk is largely categorised as 'danger for some' (Figure 2-7). Safe access and escape routes remain challenging to achieve during the climate change event.

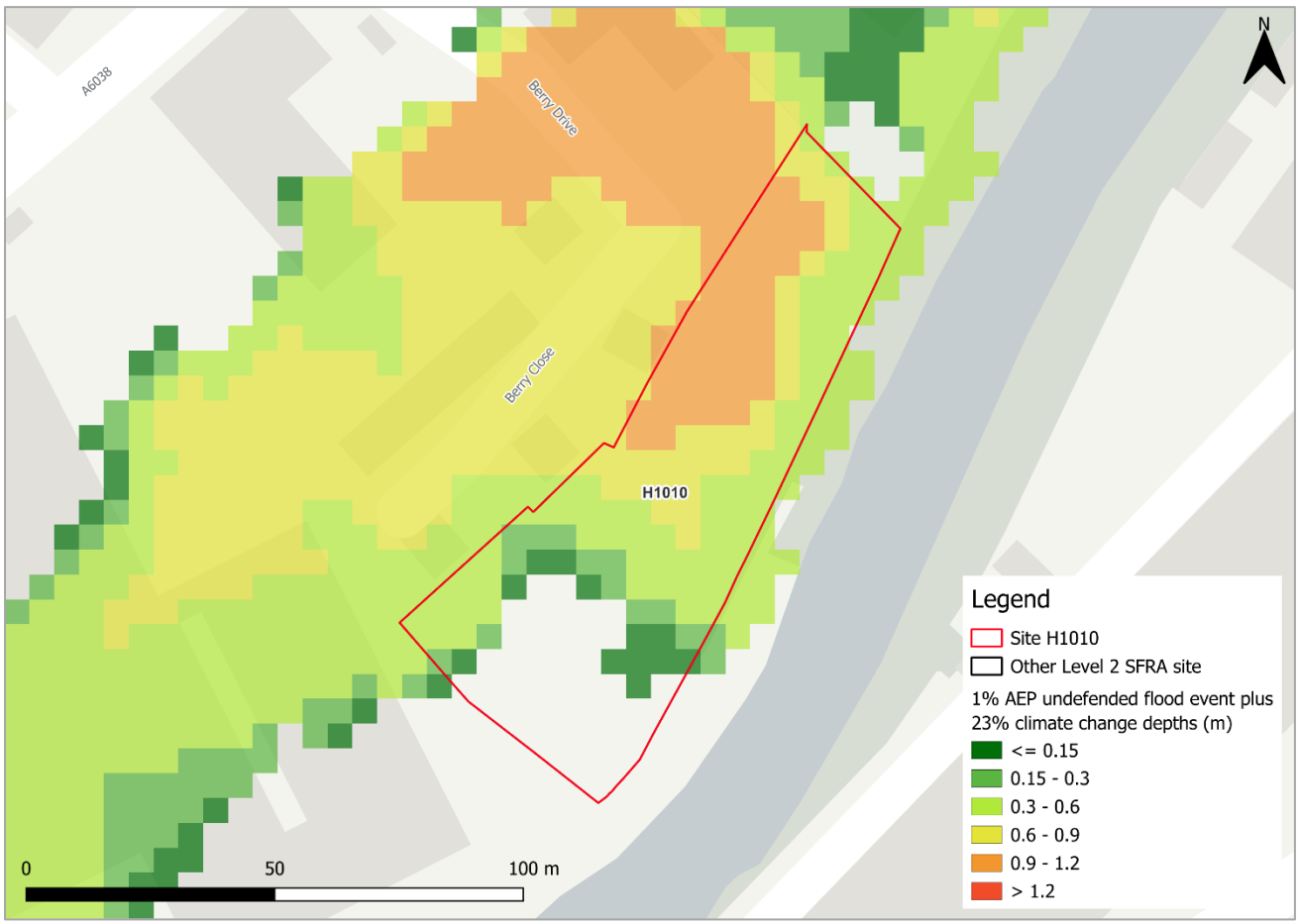


Figure 2-5: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

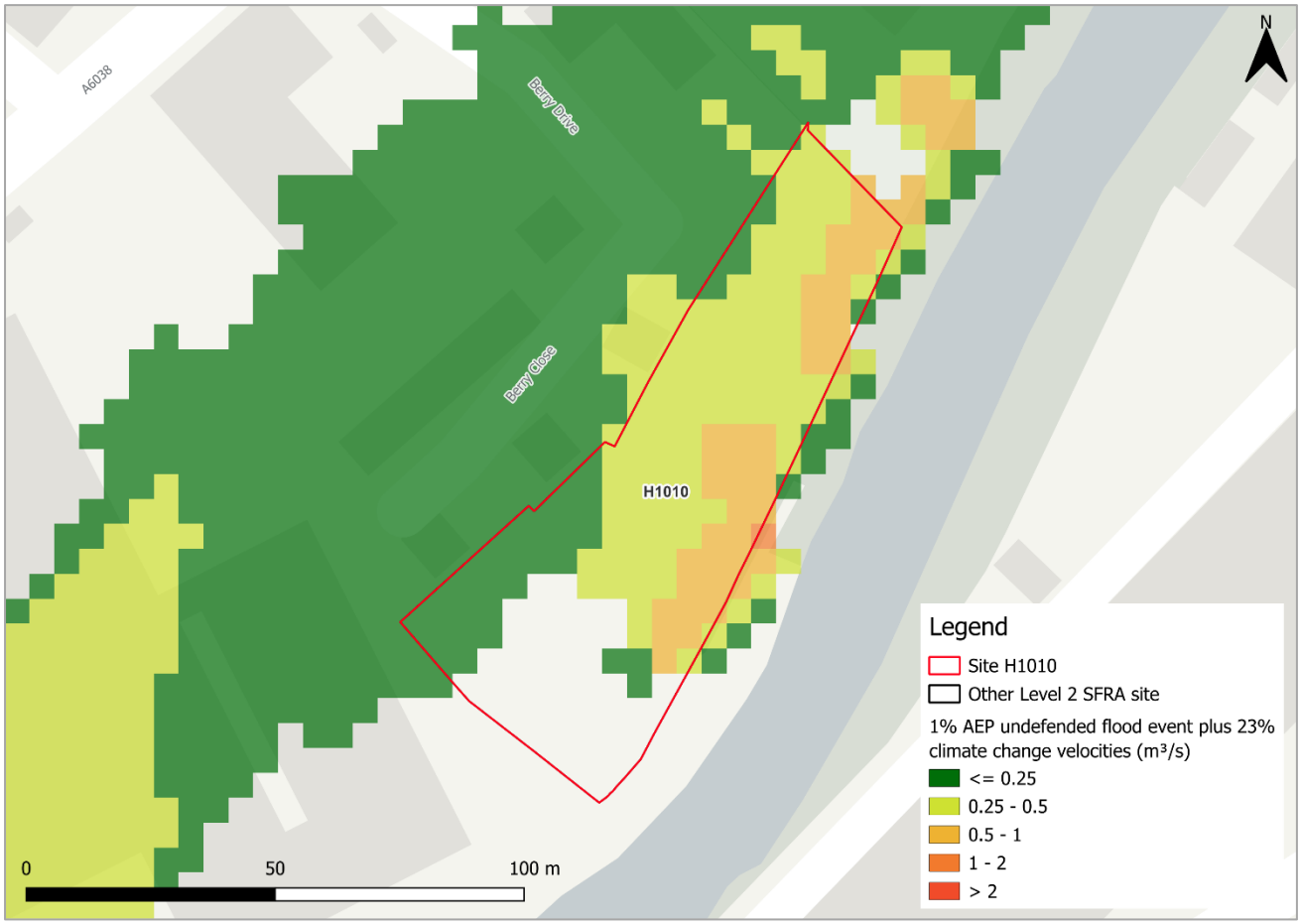


Figure 2-6: Flood velocities for 1% AEP undefended flood event +23% (central climate change allowance)

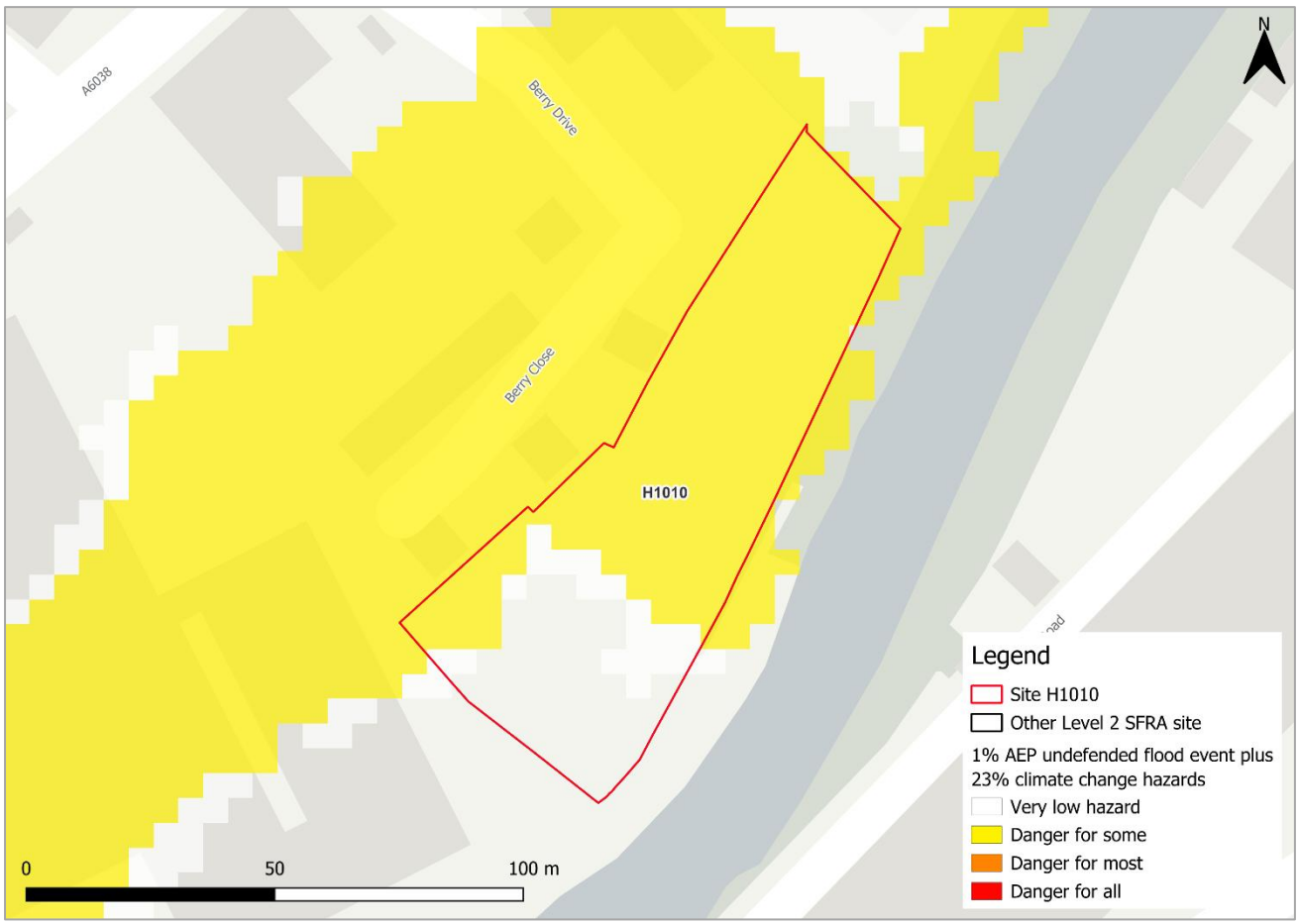


Figure 2-7: Flood hazard for 1% AEP undefended flood event +23% (central climate change allowance)

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset. This is reflected in the defended modelled flood extent and depths being very similar to the undefended event within the site (Figure 2-8). This is consistent with the modelled climate change events.

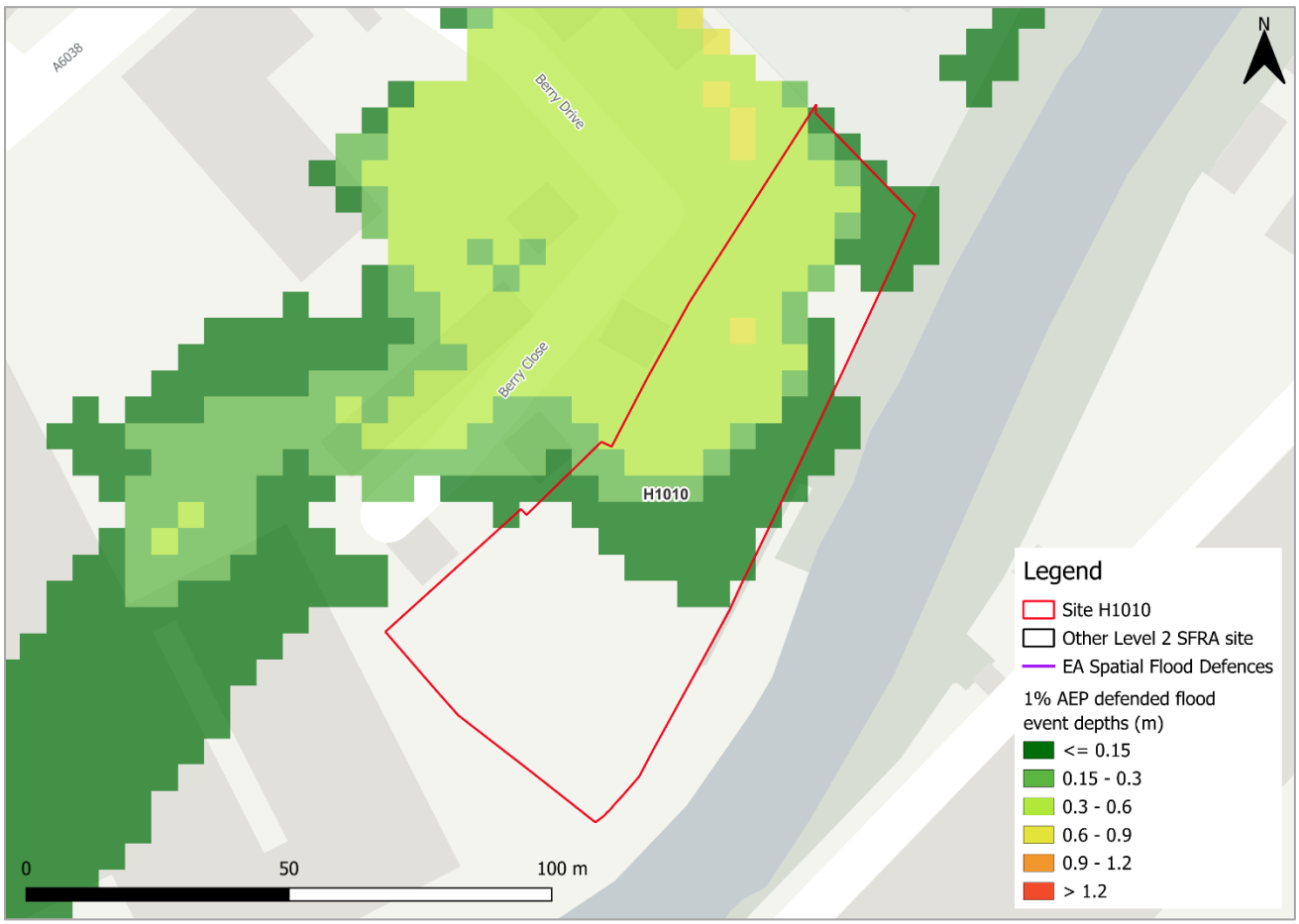


Figure 2-8: Flood depths for 1% AEP defended flood event

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. There are no applicable areas that could benefit the site.

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-9 which shows the entire site has been subject to flooding in the past. The RFO dataset indicates that these historic events have occurred as a result of the channel capacity of the River Aire being exceeded in October 2000, February 2002 and most recently in December 2015.

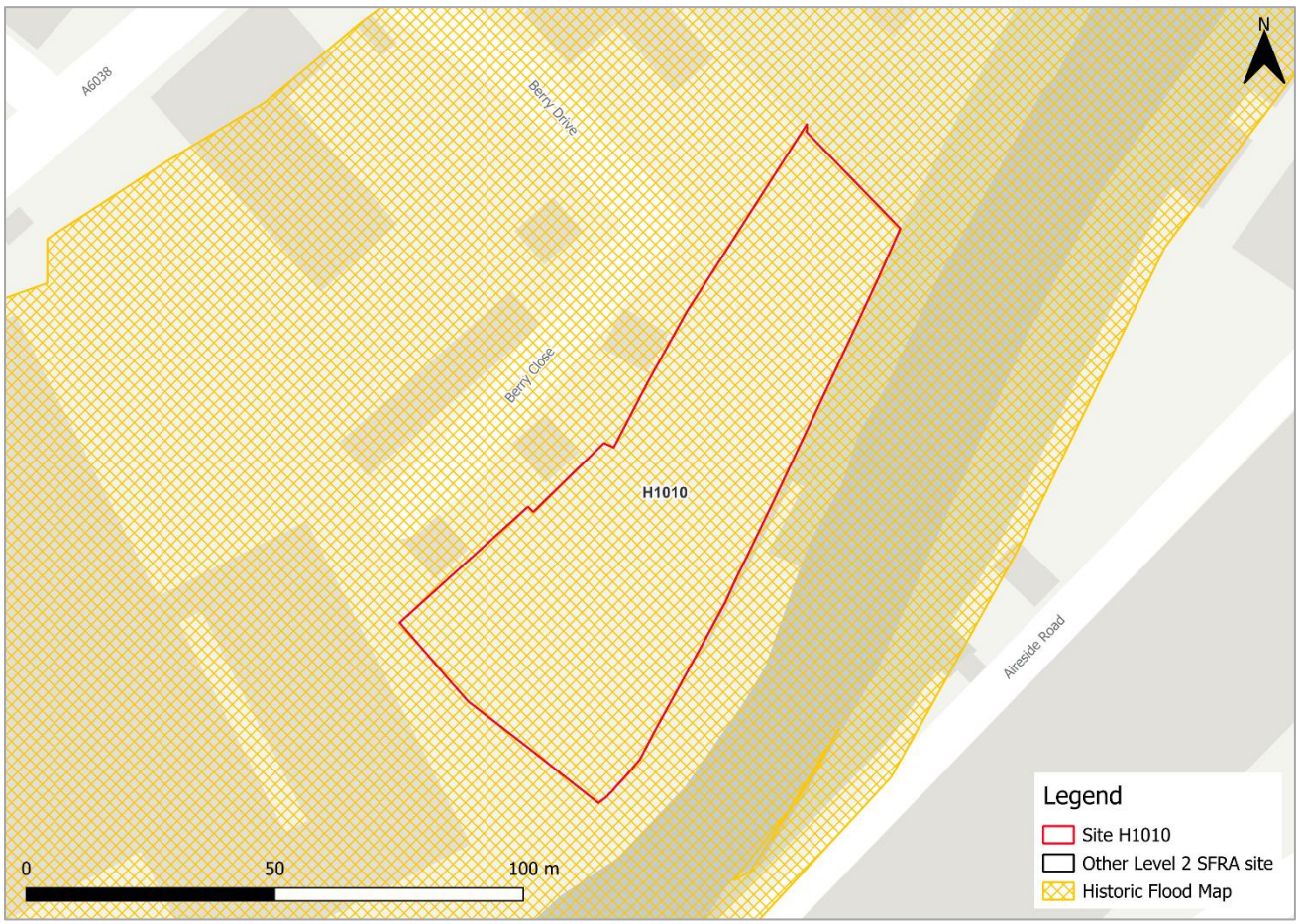


Figure 2-9: Recorded historic flood events onsite and around the site

2.5 LLFA flood incidents

The LLFA have records of 12 flood incidents taking place to the northwest of the site, which occurred in 2015 and another incident to the north of the site, which all occurred in 2015. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site associated with these incidents.

2.6 Flood warning and access and escape routes

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The entire site is located within a FWA, namely 123FWF119 - River Aire at Shipley.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. The entire site is also located within a FAA, namely 123WAF961 - Middle River Aire catchment.

Based on available information, safe access and escape routes would likely be challenging to achieve during a flood event.

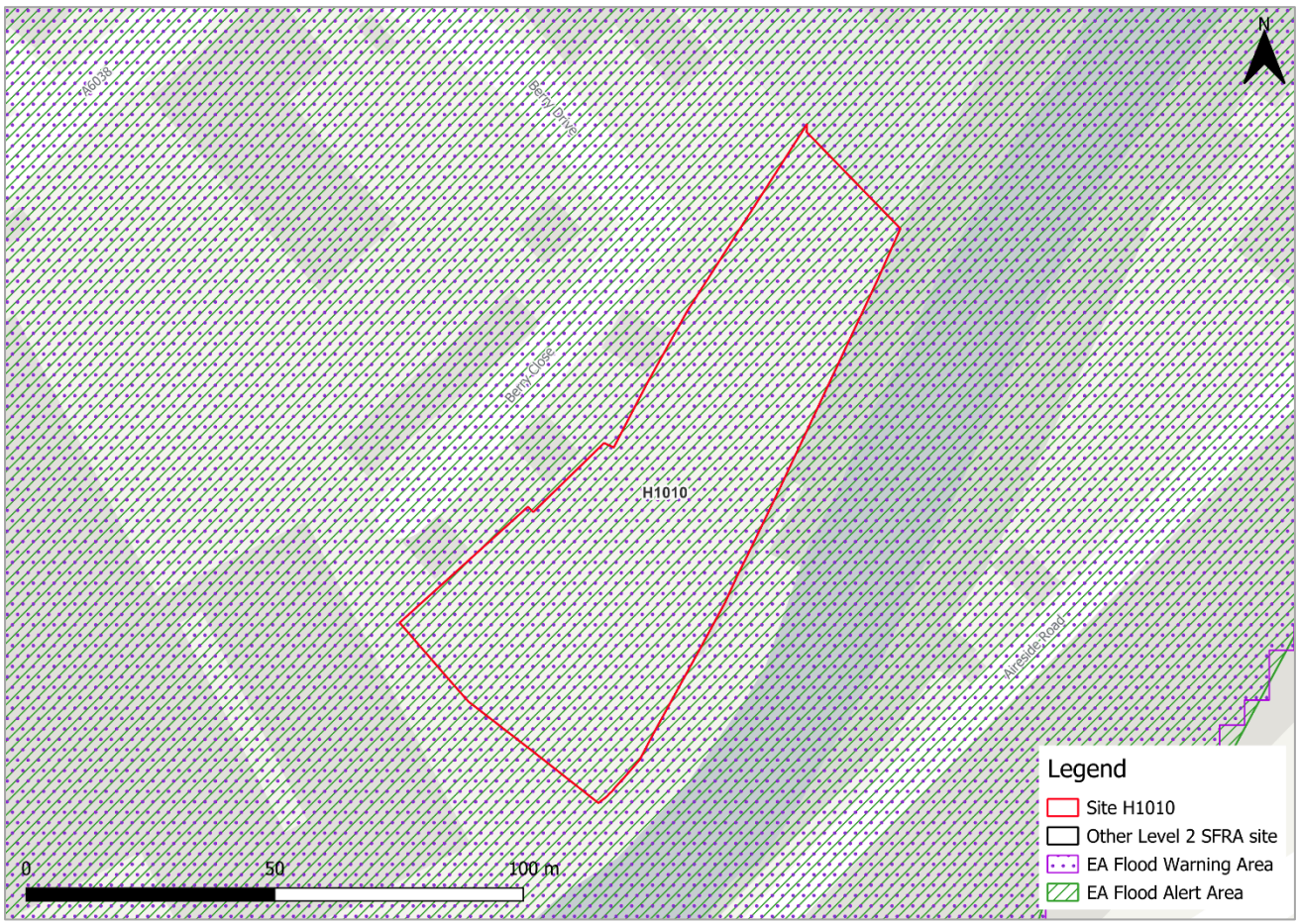


Figure 2-10: EA Flood Warning Areas and Flood Alert Areas

2.7 Observations, mitigation options and site suitability - fluvial

- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
- Given the change in use and therefore vulnerability of the site, the FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).
- The site is modelled to be within the functional floodplain along the eastern boundary of the site, adjacent to the River Aire. Development is not permitted within the functional floodplain. If feasible, this area would be used as a green / blue corridor which can provide multifunctional benefits providing ecological, social and amenity value.
- If the development of the site involves any activity within 8 metres of the River Aire, a flood risk activity permit may be required from the EA in addition to planning permission. For non-tidal main rivers, a flood risk activity permit may be required if the development of the site is within 8 metres of a riverbank, flood defence structure or culvert.
- The northern and central areas of the site are modelled to be at risk from fluvial sources (according to the Leeds FAS Kildwick to Esholt 2022 model) in the 1%

AEP undefended scenario, to the same extent as Flood Zone 3a. The remainder of the site is within Flood Zone 2.

- Given the site is more vulnerable and within Flood Zone 3a, and also within the 1% AEP undefended event modelled flood outline, the site must be subject to and must pass the exception test.
- Given the site as at high and medium risk from the River Aire, and future risk with climate change is modelled to be significant, it is recommended that this site is not redeveloped for more vulnerable uses.
- There may be an option for ground floor parking or other less vulnerable uses (i.e. non-residential such as shops, restaurants, offices) and for habitable dwellings to be situated on the first floor and upwards. However, safe access and escape routes must be available at times of flood, even for above ground floor accommodation. The site is modelled to be at increased risk from the functional floodplain in the future, to a greater extent than the existing Flood Zone 3a, potentially ruling out any development of the site.
- The 1% AEP event with an allowance for climate change is what the EA considers to be the design event for a development to mitigate fluvial flood risk. The majority of the site is shown to be at risk in the 1% AEP undefended +23% climate change event.
- Were any plans for development to proceed, the site-specific FRA must show that development will be safe for its lifetime taking account of the vulnerability of its users, including for appropriate evacuation procedures and flood response infrastructure are in place to manage the fluvial risk associated with the extreme flood event.
- EA flood warnings and alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.
- Based on available information, ideally this site would be converted to open space and used as a multifunctional greenspace for flood storage, amenity use and to provide environmental / ecological benefits.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map (November 2024), surface water risk to the site is predominantly very low. Approximately 16% of the site is at high surface water risk. A further 13% of the site is at medium risk and a further 9% is at low surface water risk, as shown in Table 3-1.

In the high risk event, surface water risk is confined to an area of ponding within a topographic low spot within the north of the site. This area of ponding is modelled to increase in extent in the medium and low risk events. The risk area is within the fluvial Flood Zone 3a area.

Greatest flood depths within the site in the medium risk event are between 0.3 and 0.6 m (Figure 3-1) with hazard largely categorised as moderate, and a small area modelled to be significant (Figure 3-2). Safe access and escape routes via Berry Close/Berry Drive may be challenging to achieve given the modelled surface water flood depths along this route.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
62	9	13	16

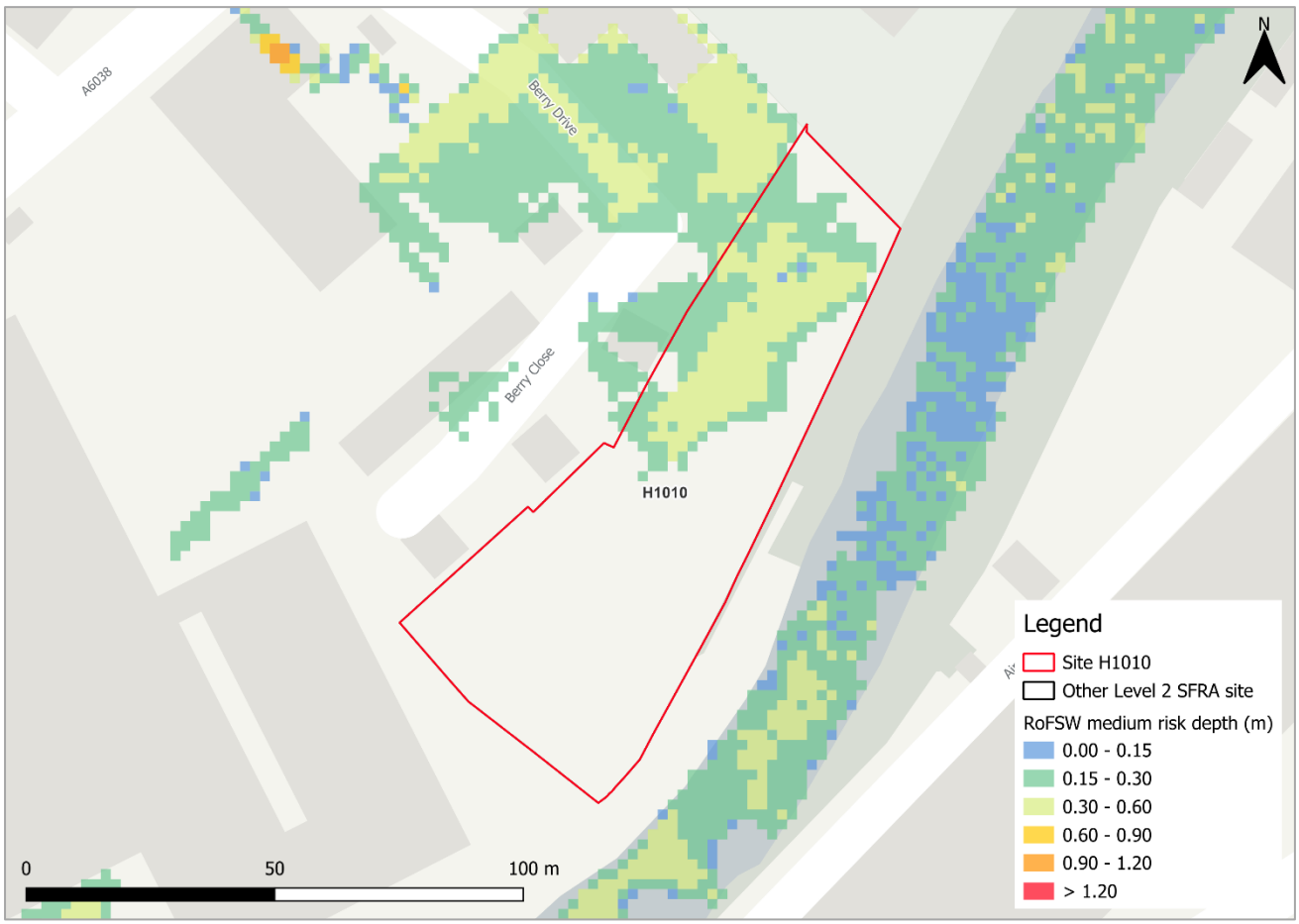


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

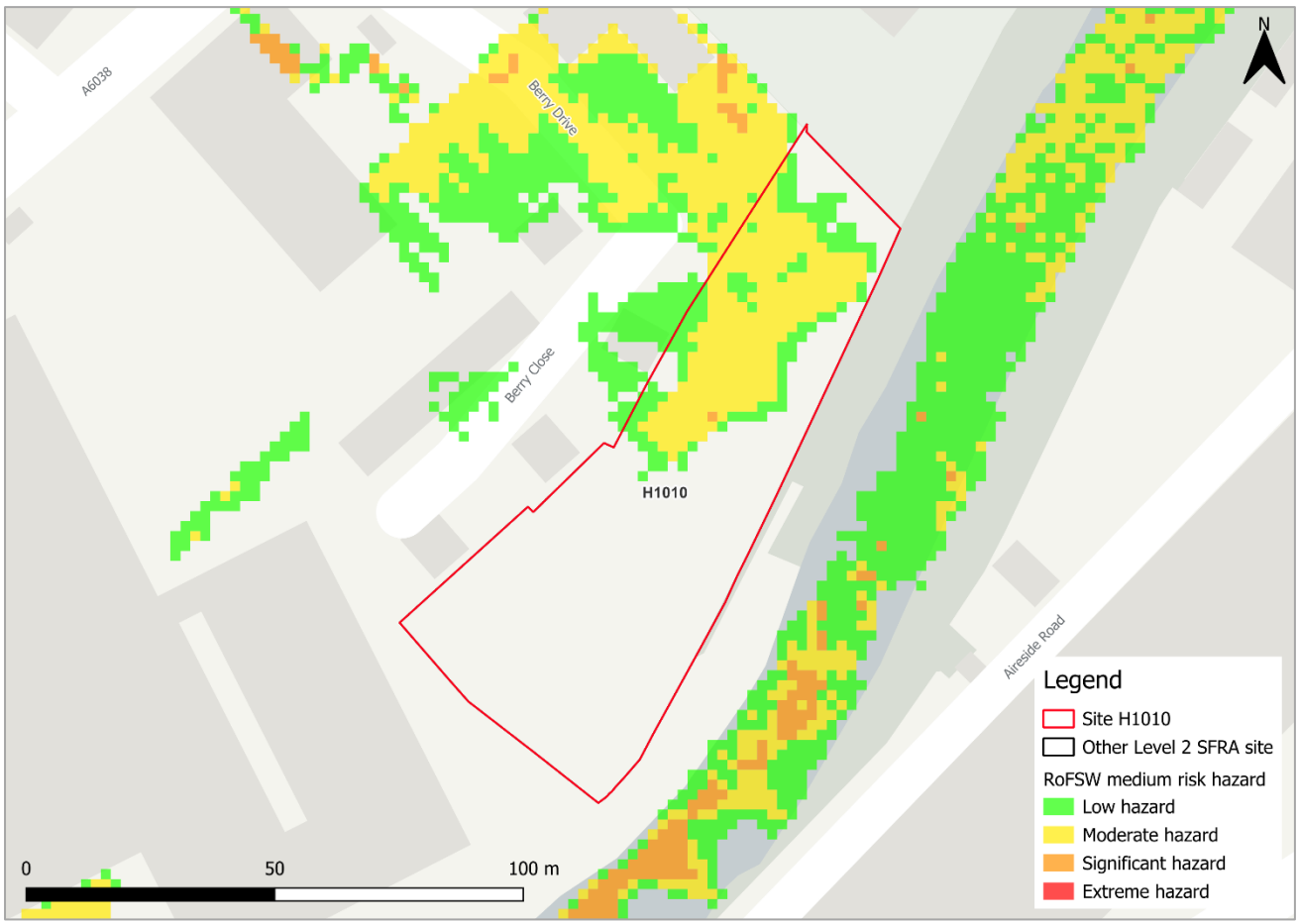


Figure 3-2: Medium risk event surface water flood hazard[2] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event plus 45% climate change. Risk is modelled to be greater than for present day conditions, with

2 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

the medium risk climate change event showing a similar level of risk to the present day low risk event. Maximum depths are modelled to be between 0.6 and 0.9 m, with areas of hazard categorised as significant (Figure 3-4). Safe access and escape routes remain challenging to achieve during the climate change event.

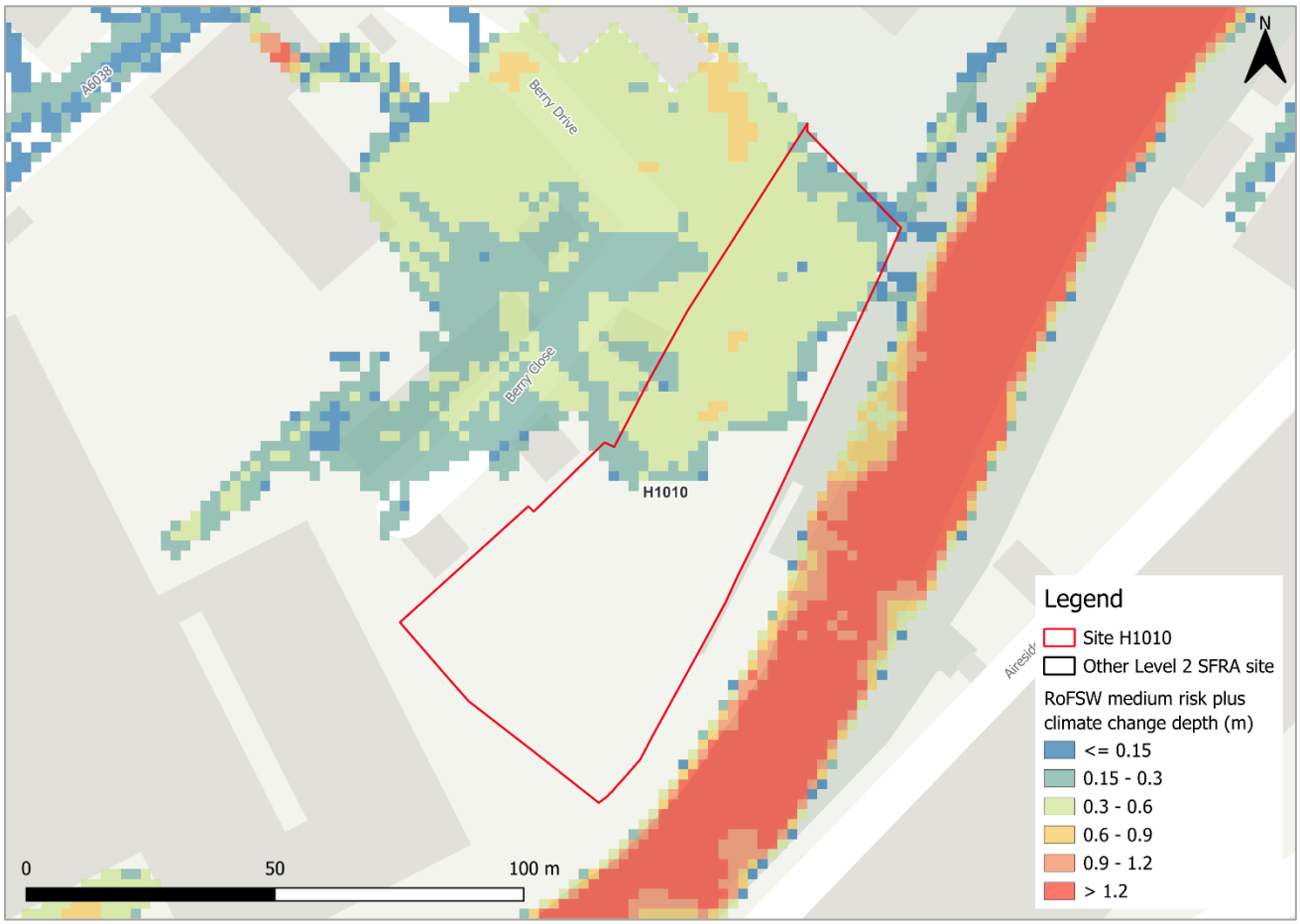


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

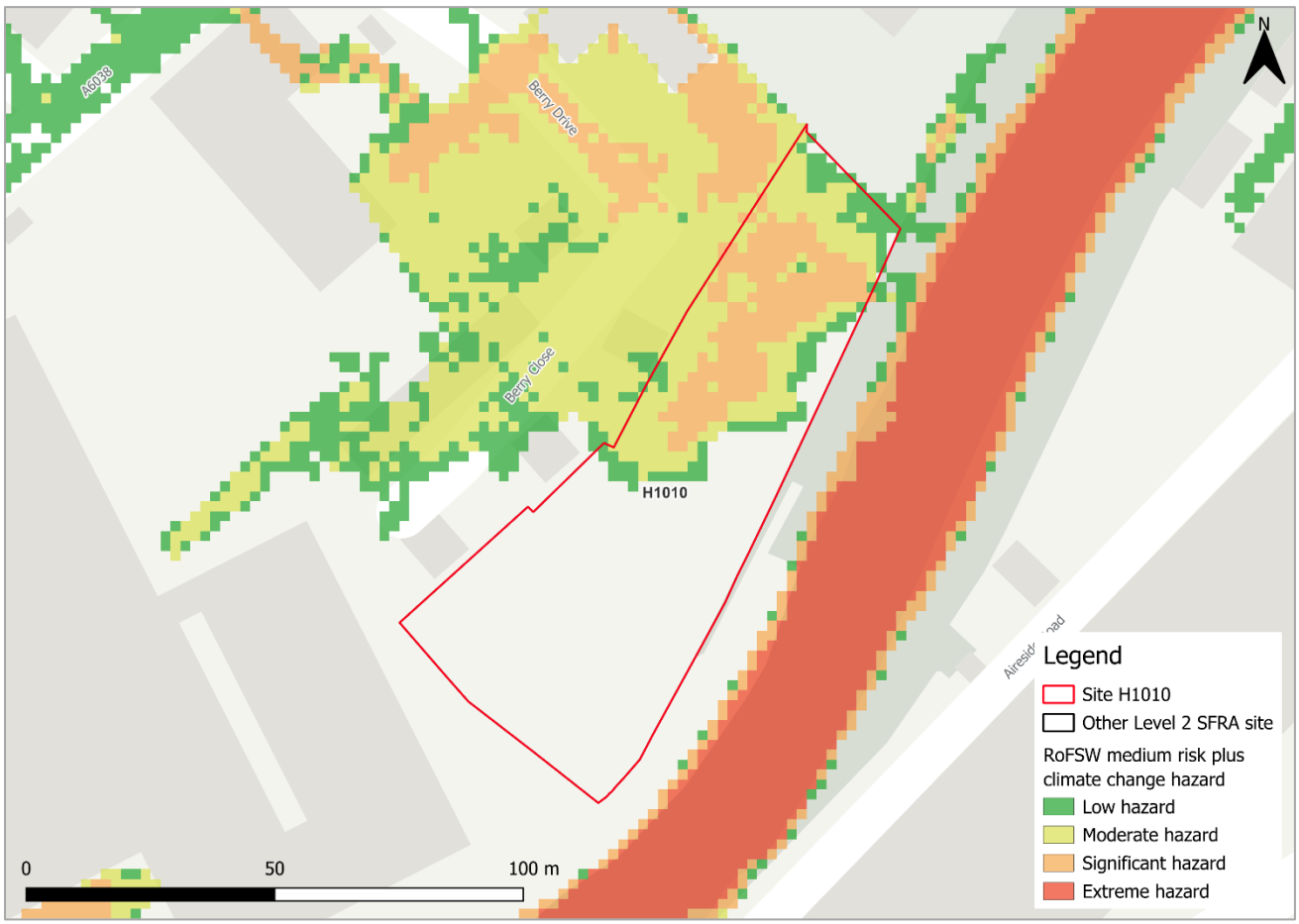


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- The areas at surface water flood risk are within the fluvial risk areas and should therefore be included within any mitigation solutions for fluvial risk.
- Current risk is significant within the north of the site. Topographic depressions should be considered and included in site design and ideally left in place to flood naturally when required. Any regrading of land must include for like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- Safe access and escape routes would likely be challenging to achieve based on the modelled surface water flood depths along Berry Close.
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA. Runoff volumes must not exceed existing brownfield rates and, if possible, betterment should be achieved.
- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or

assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[3]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The entire site is located within an area where there is no risk of groundwater emergence. Groundwater conditions may therefore be suited to infiltration SuDS.

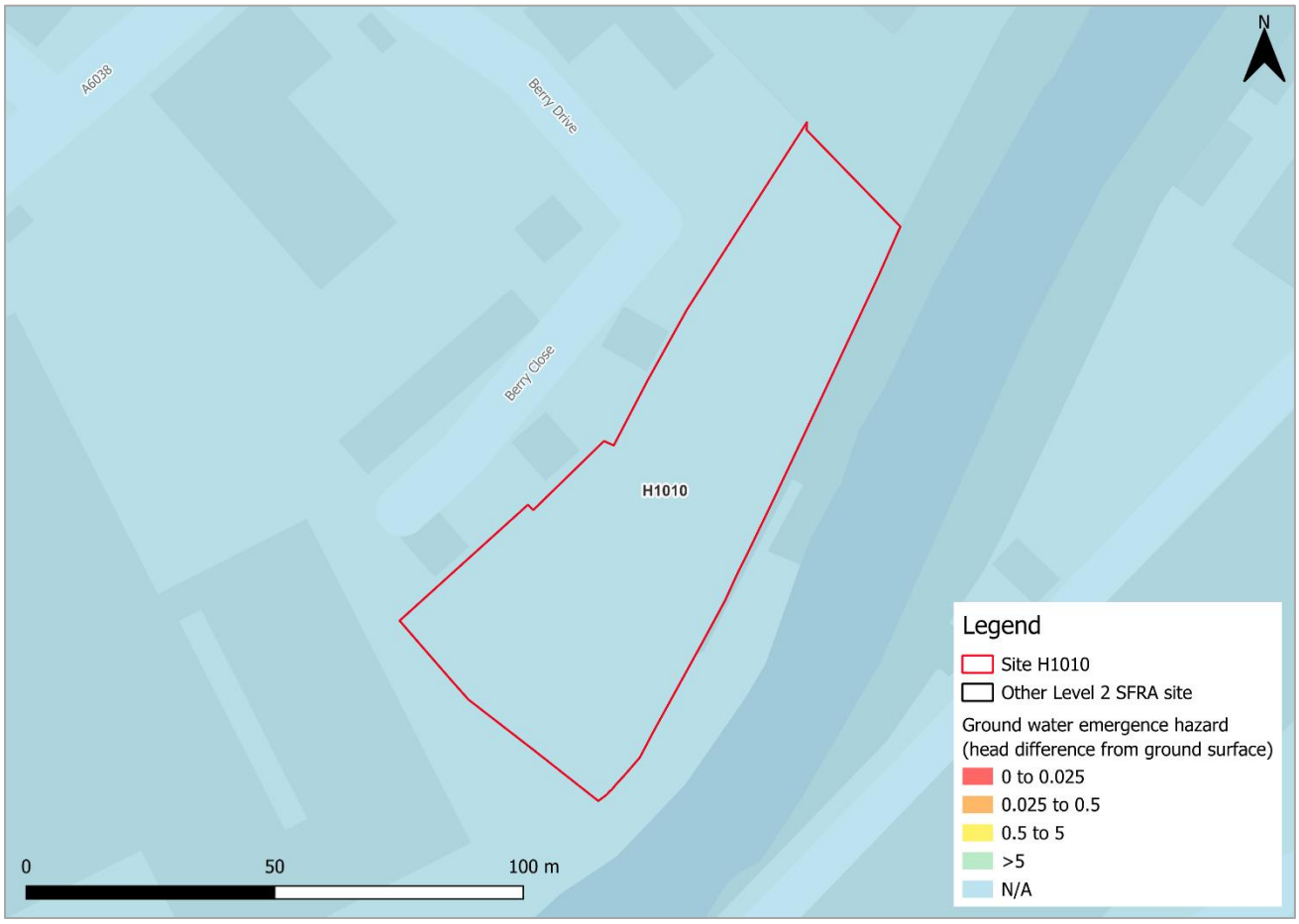


Figure 4-1: JBA 5m Groundwater Emergence Map

3 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

5.1 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-1 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is potentially at risk from 17 reservoirs. Of these 17 reservoirs, 14 are located within Bradford, two located within North Yorkshire and one located within Pendle. These are operated by either Yorkshire Water Services Ltd, the National Trust or the City of Bradford Metropolitan District Council.

The EA's SFRA guidance states that where a proposed development site is at flood risk from a reservoir, then an assessment into whether the reservoir design or maintenance schedule needs improving should be carried out. Expert advice may be required from an all-reservoirs panel engineer. The Council should consult the relevant reservoir undertaker to ascertain whether the proposed development could affect the reservoir's risk designation, its design category or how it is operated. The Council, as category 1 responders, can access more detailed information about reservoir risk and reservoir owners using the Resilience Direct system.

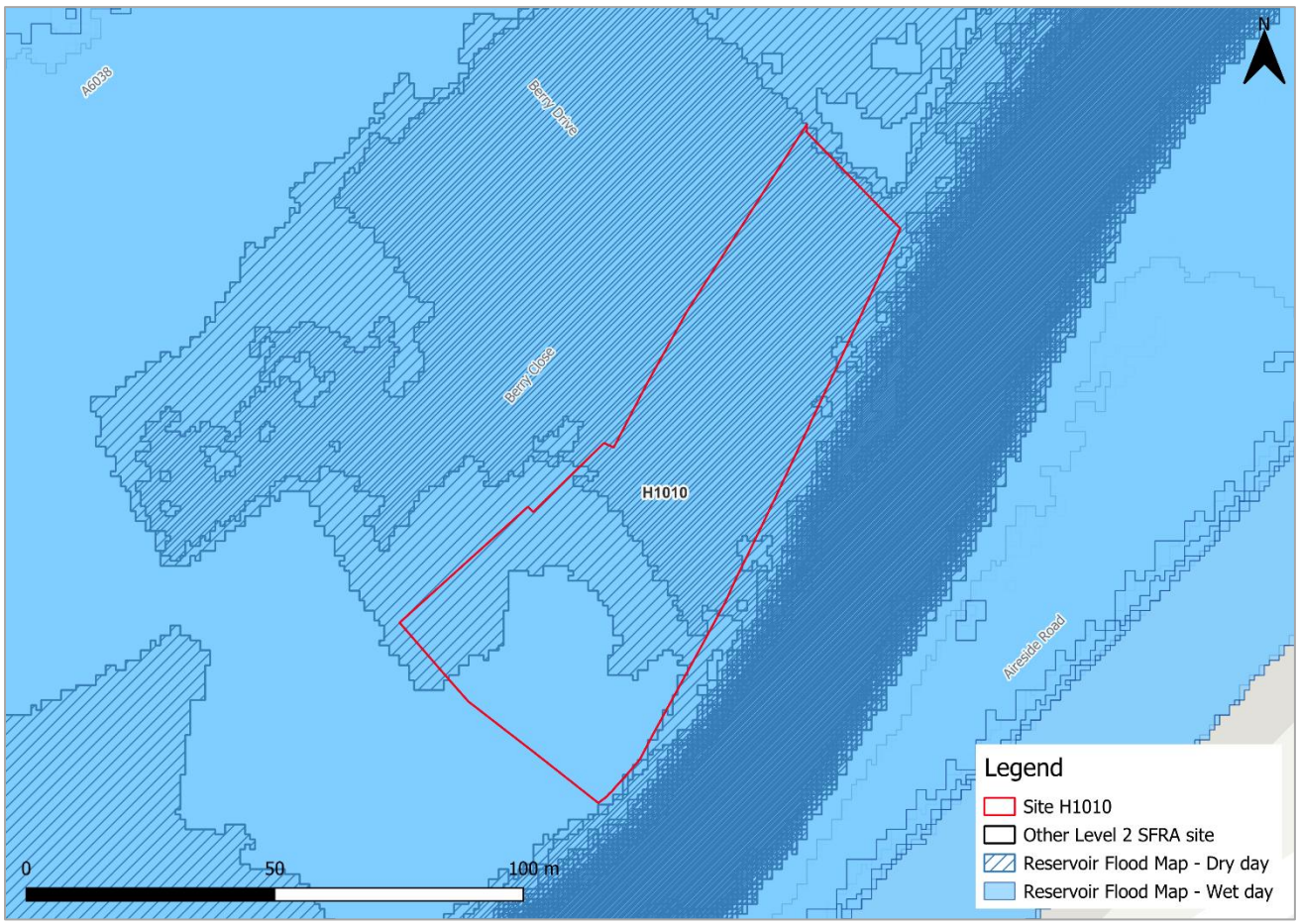


Figure 5-1: Flood risk from reservoirs

5.2 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.3 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a breach of 17 reservoirs. However, only two reservoirs impact the site in the 'dry day' flood extent, namely Graincliffe and Thornton Moor reservoirs, both located within Bradford. This indicates that the remaining 15 reservoirs are only modelled to impact the site based on the 'wet day' flood extent, which represents a prediction of the credible worst case scenario, therefore it's unlikely that any actual flood would be this large.
- Given the potential reservoir risk to the site, developers should consider[4]:

4 Reservoir flood maps: when and how to use them | Environment Agency | 2021

- Consulting with the local resilience forum for advice on emergency planning,
- Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
- Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is required to pass part b) of the exception test[5], given it is proposed for more vulnerable uses and is located within Flood Zone 3a. It must be proven that the development can be safe for its lifetime, which is 100 years for residential development. Based on the available information documented within this Level 2 SFRA, this site cannot pass the exception test given both the 1% AEP event modelled present day and future fluvial risk.

6.2 Recommendations, FRA requirements, and further work

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

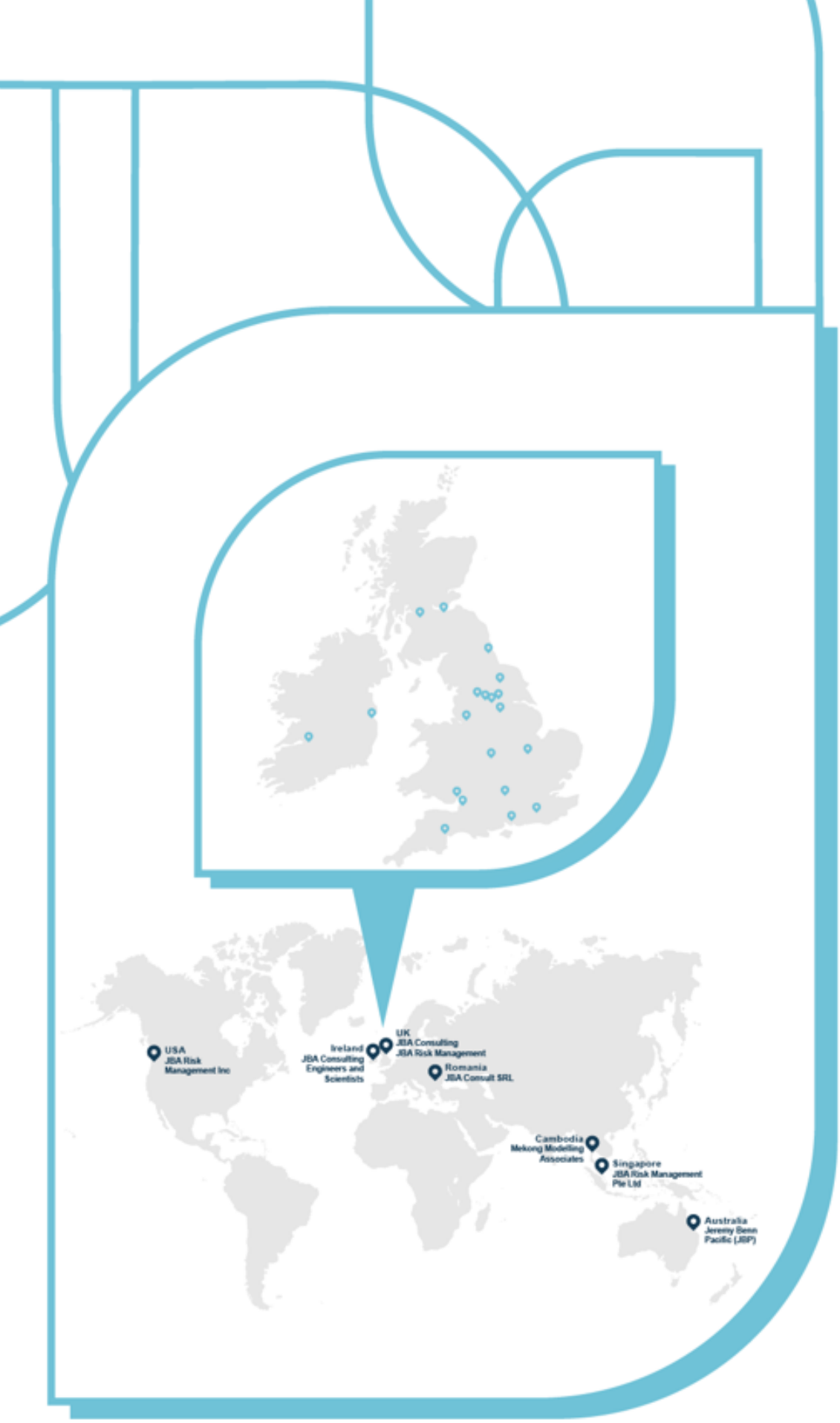
- There should be no development within the existing area of functional floodplain present on site.
- It is recommended that this site is converted to open space and used as a multifunctional greenspace for flood storage, amenity use and to provide environmental / ecological benefits, given the fluvial risk to the site in the 1% AEP plus climate change event and also the modelled impact of climate change on the functional floodplain.
- Any FRA must further consider the safe access and escape routes to the site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

5 Para 178 National Planning Policy Framework 2024

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Bradford Level 2 Strategic Flood Risk Assessment - Site H1090

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

www.jbaconsulting.com

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Contract

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This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Dominic Richardson of JBA Consulting carried out this work.

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We would like to thank the Environment Agency for their assistance with this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H1090. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2025) and is therefore familiar with the terminology used in this report.

1.1 Site H1090

- Location: Sykes Lane, Silsden
- Existing site use: Agriculture and allotments
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 5.52 hectares
- Proposed development impermeable area: 4.14 hectares
- Watercourse: River Aire / Silsden Beck (main rivers) / Leeds and Liverpool Canal
- Environment Agency (EA) river model: Leeds FAS Kildwick to Esholt 2022 and Upper Aire Tribs - Silsden 2021 model
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk
    - Modelling of latest EA climate change allowances for peak river flows and peak rainfall intensities.



Figure 1-1: Existing site location boundary

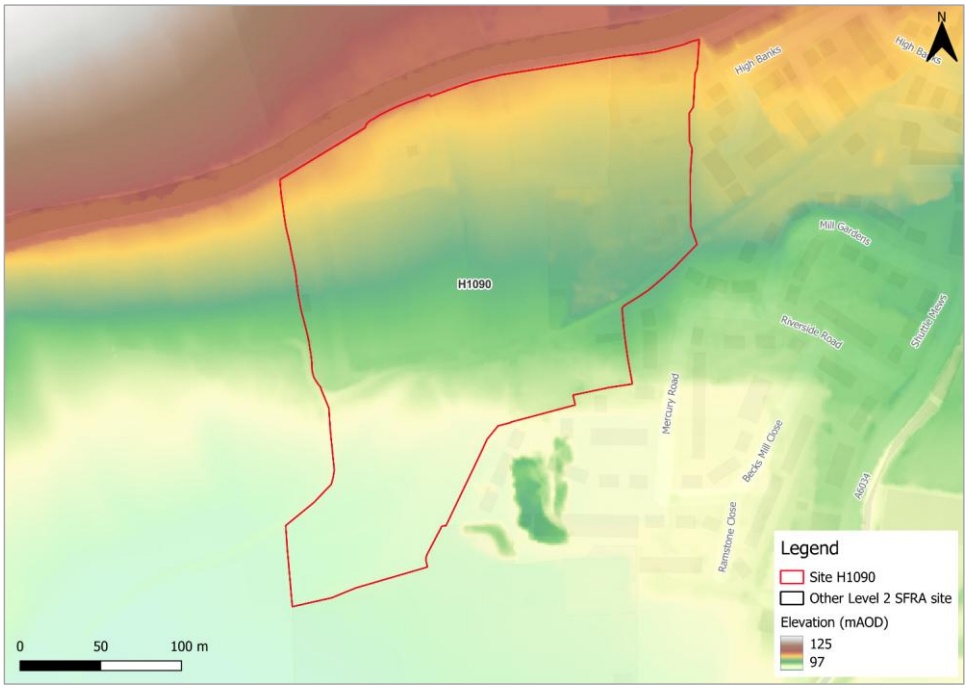


Figure 1-2: Topography

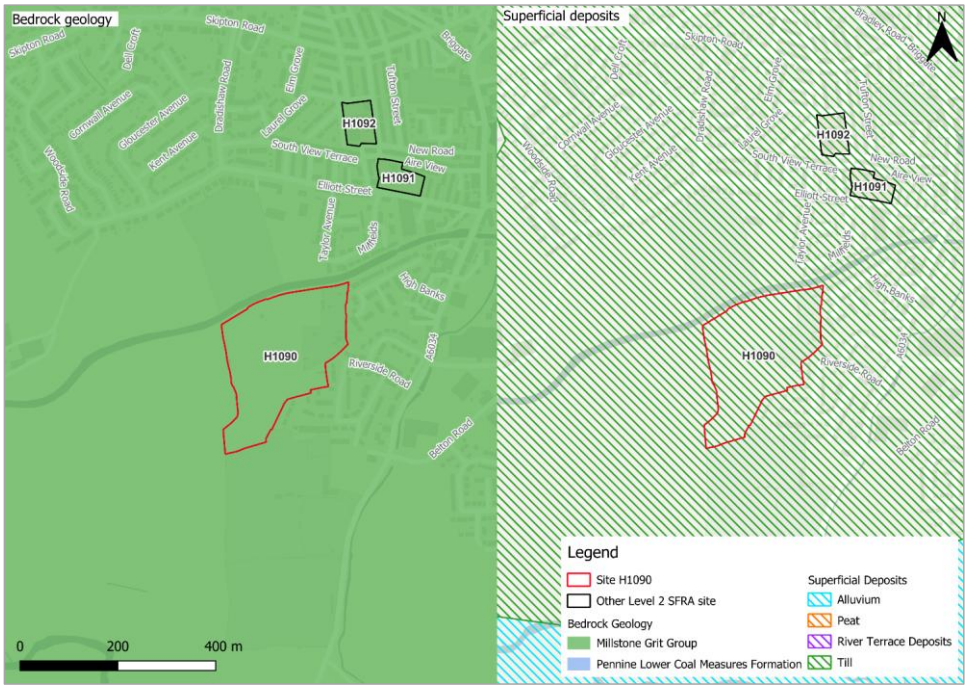


Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (September 2024) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3) or the impacts of climate change (Section 2.1.3).

Fluvial flood risk to the site comes from Silsden Beck adjacent to the southeastern site boundary. Silsden Beck is a designated main river and is a tributary of the River Aire which is also a designated main river. The southwestern portion of the site is located within Flood Zone 2 and therefore is at medium risk of flooding.

The is modelled to be at risk from the 0.1% AEP event in both the Leeds FAS Kildwick to Esholt 2022 model and the Upper Aire Tribs - Silsden 2021 model. However, Flood Zone 2 of the Flood Map for Planning is based on the Upper Aire Tribs - Silsden 2021 model and not the Leeds FAS Kildwick to Esholt 2022 model.

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The northern boundary of the site is also adjacent to the Leeds and Liverpool Canal bank. A flood model for the canal is not known to be available.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
92	8	0	0

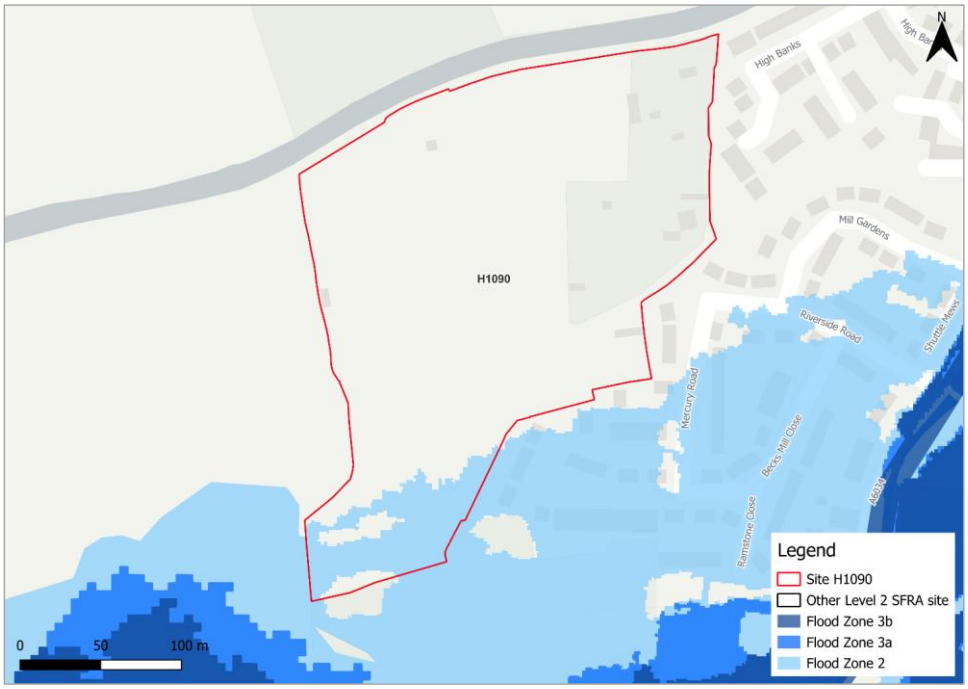


Figure 2-1: Existing risk from rivers to the site

2.1.2 2021 Upper Aire Tribs - Silsden Model Outputs

Figure 2-2 shows the modelled flood depths for the 0.1% AEP undefended event in the Upper Aire Tribs - Silsden 2021 model which is the event Flood Zone 2 of the Flood Map for Planning is based on. The southwestern corner of the site can be seen to be inundated in this event with shallow flood depths in the range of 0.15 - 0.30 m whilst maximum velocities are up to 0.95 m^3 / s. Hazard levels are generally categorised as very low. Safe access and escape routes are likely to be achievable from High Banks to the east of the site.

The site is not shown to be impacted by Silsden Beck in the 1% AEP present day event. Section 2.3.1 discusses the defended model outputs for the equivalent event.

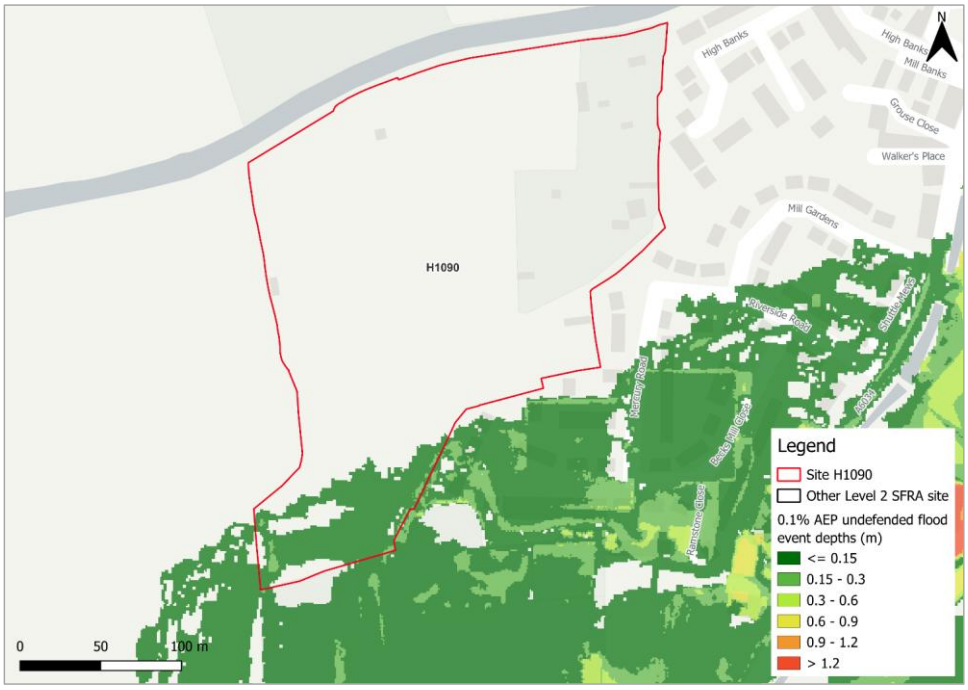


Figure 2-2: Flood depths for 0.1% AEP undefended flood event

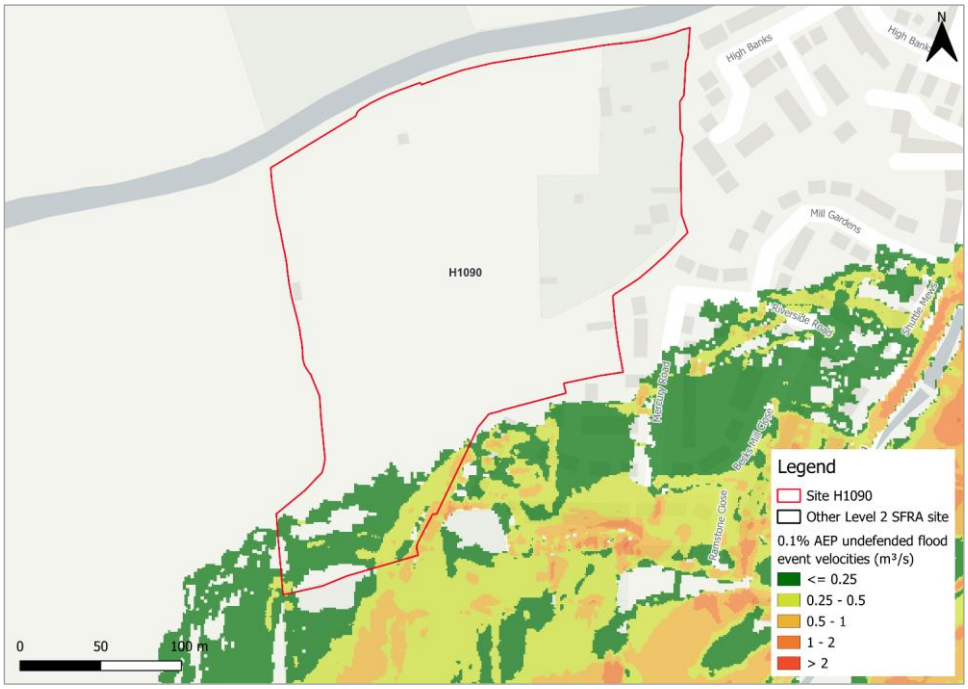


Figure 2-3: Flood velocities for 0.1% AEP undefended flood event

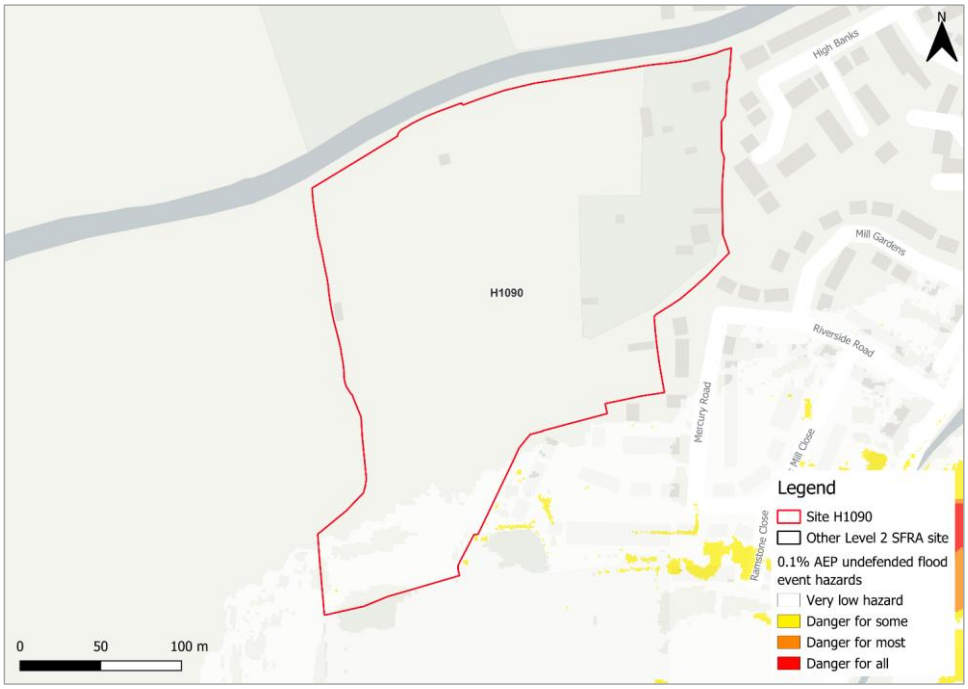


Figure 2-4: Flood hazard[1] for 0.1% AEP undefended flood event

2.1.3 2022 Leeds FAS Kildwick to Esholt - River Aire

Figure 2-5 shows the modelled flood depths for the 0.1% AEP undefended event from the Leeds FAS Kildwick to Esholt 2022 model. The risk is entirely from the River Aire which is shown to impact the southwest corner of the site with maximum depths of 0.6 to 0.9 m (Figure 2-5). Modelled flood velocities are generally low across the area at risk (Figure 2-6), with maximum velocities of 0.25 m^3/s. Modelled flood hazards are categorised as 'danger for some' (Figure 2-7). Safe access and escape routes are likely to be achievable via multiple routes to the east of the site.

The site is not shown to be impacted by the River Aire in the 1% AEP present day or climate change events. Section 2.3.1 discusses the defended model outputs.

1 Fluvial hazard ratings based on Table 4 of the SUPPLEMENTARY NOTE ON FLOOD HAZARD RATINGS AND THRESHOLDS FOR DEVELOPMENT PLANNING AND CONTROL PURPOSE – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. May 2008.

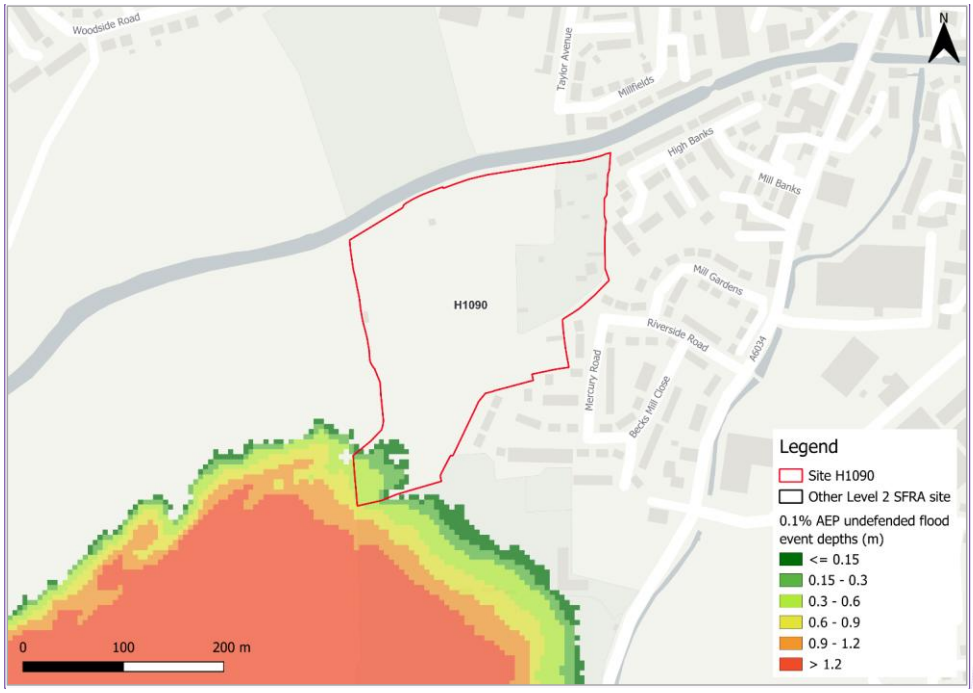


Figure 2-5: Flood depths for 0.1% AEP undefended flood event

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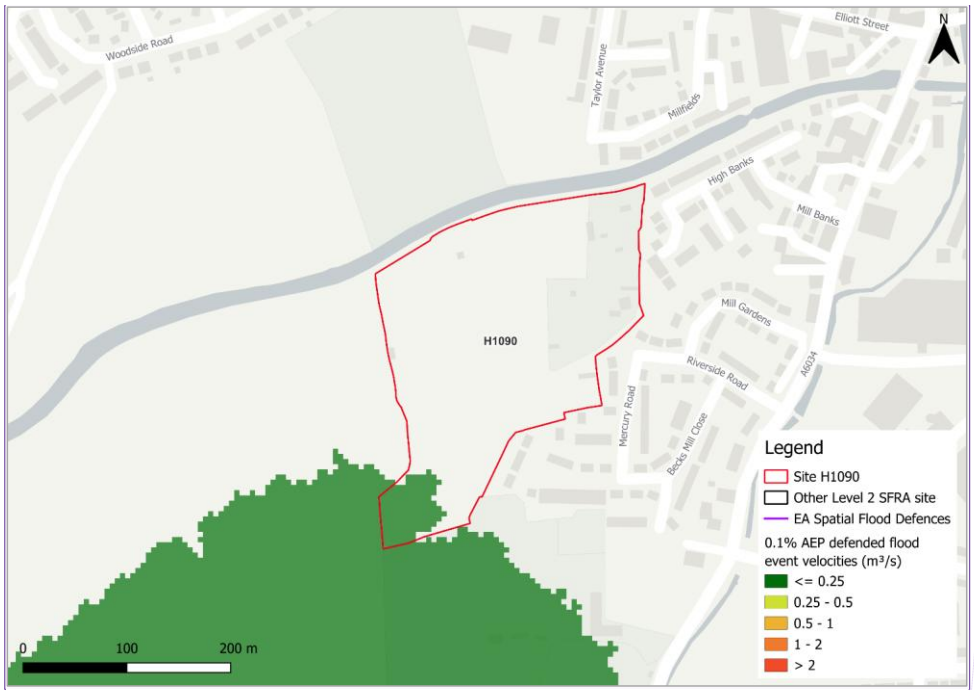


Figure 2-6: Flood velocities for 0.1% AEP undefended flood event

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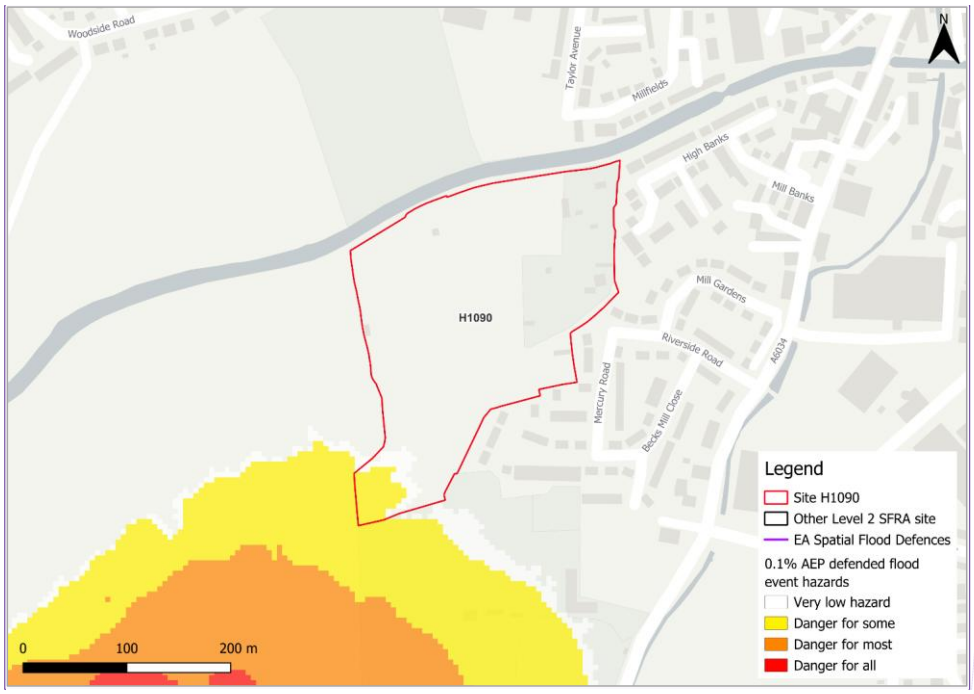


Figure 2-7: Flood hazard[1] for 0.1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the Silsden Beck and River Aire have been modelled without flood defence infrastructure in place using both available models. This allows for direct comparison with the existing risk of the Flood Map for Planning. Section 2.3.1 discusses the defended model outputs.

With consideration of the EA's SFRA guidance, the latest climate change central and higher central allowances have been modelled as shown in

Table 2-2. The EA's SFRA guidance states that SFRAs should assess the central allowance for less, more, and highly vulnerable development, and also water compatible development. The higher central should be assessed for essential infrastructure.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment (applicable to both models)

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%

2.2.1 2021 Upper Aire Tribs - Silsden Model Outputs

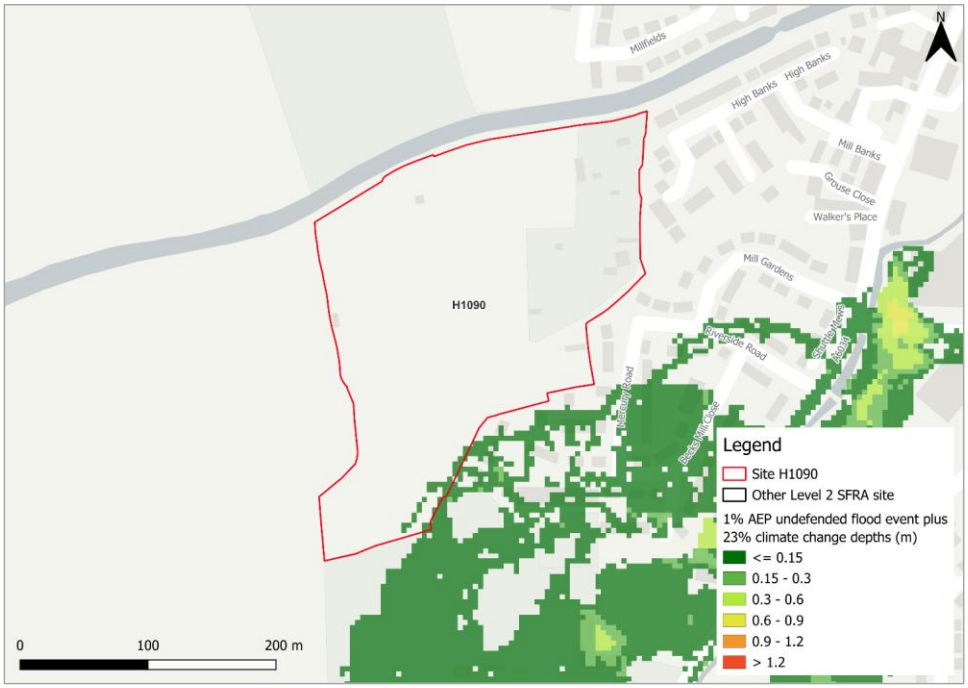


Figure 2-8 shows the onsite modelled flood depths for the 1% AEP undefended event +23% climate change for the Silsden Beck. The 0.1% AEP event could not be modelled for climate change due to model instability issues. Risk is modelled to be greater than the present day 1% AEP event though less than the 0.1% AEP present day event, with flood extents inundating an area within the site that is adjacent to the southern boundary.

Maximum site depths remain shallow

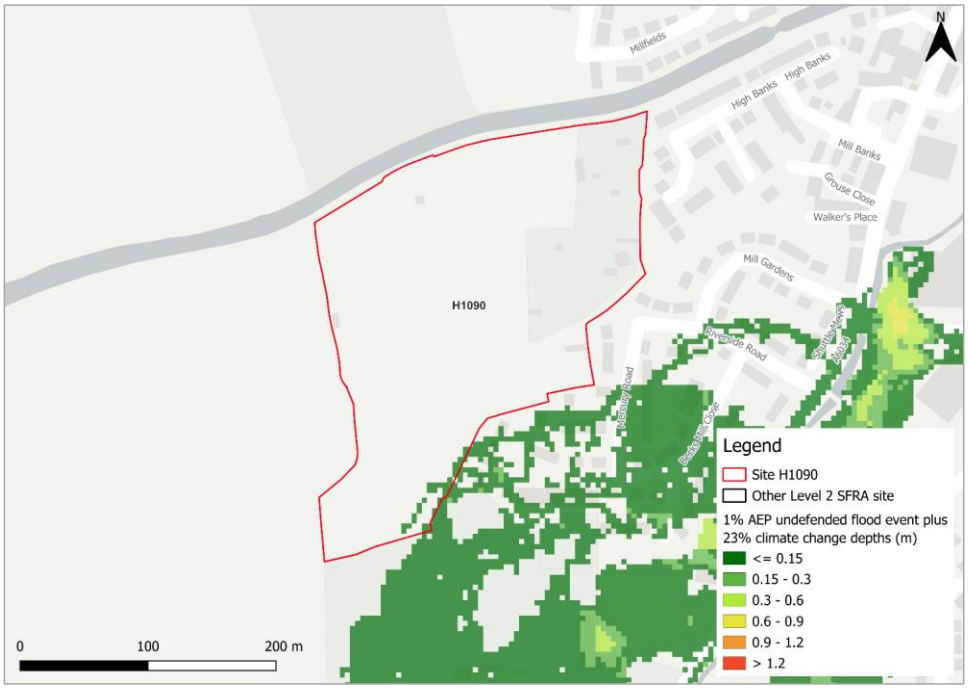


Figure 2-8) of less than 0.15m. Modelled velocities are observed of up to between 0.25 and 0.5m^3/s (Figure 2-9), although generally do not exceed 0.25 m^3/s. Hazards are considered as "Very Low" (Figure 2-10). Safe access and escape routes remain achievable via multiple routes in the east of the site.

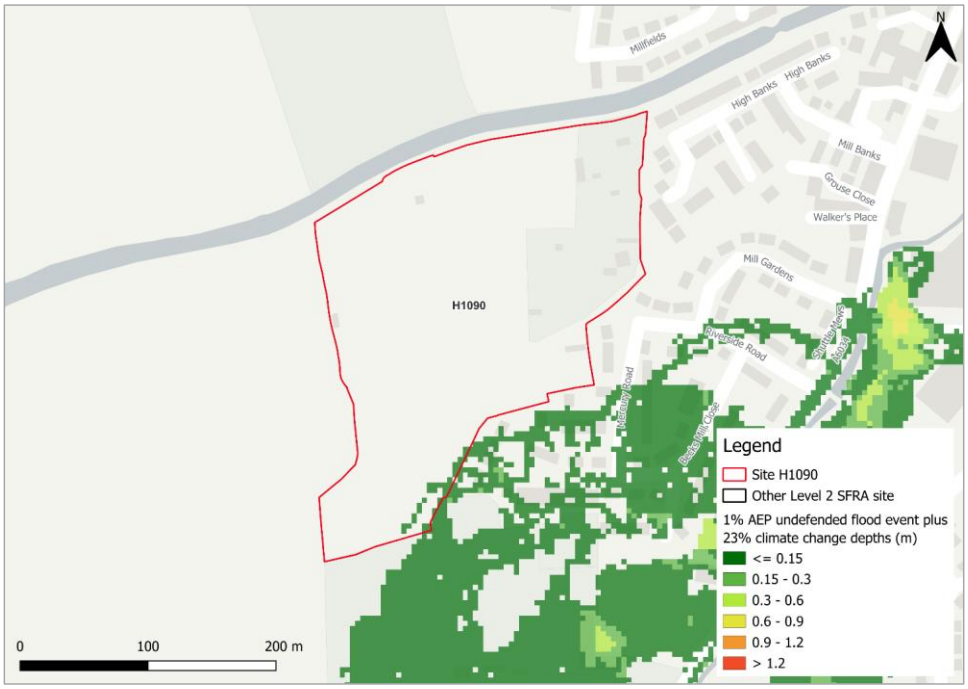


Figure 2-8: Flood depths for 1% AEP undefended flood event +23% (central climate change allowance)

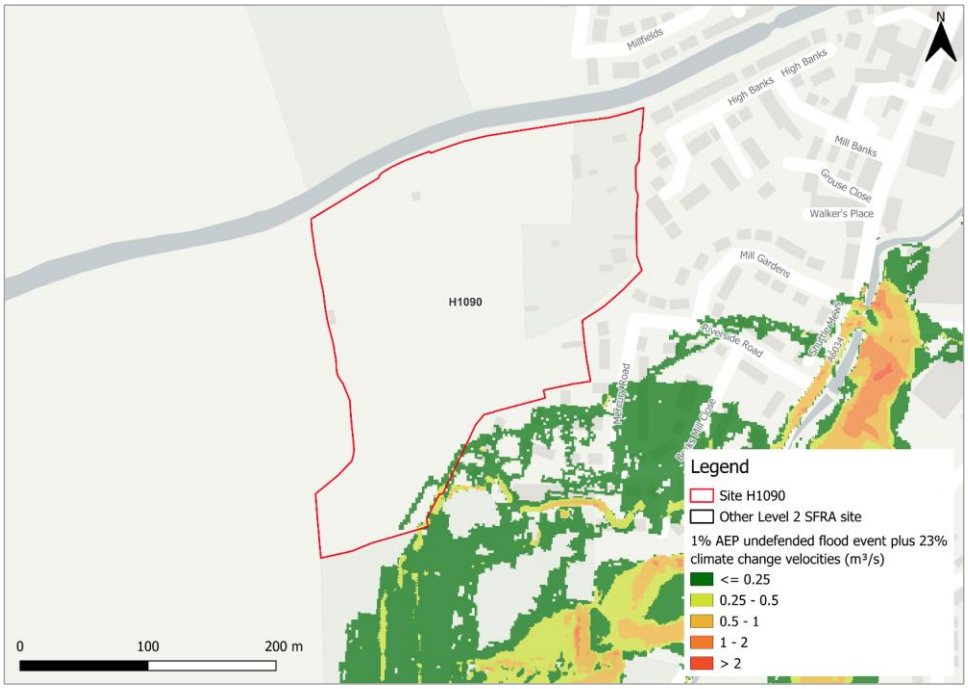


Figure 2-9: Flood velocities for 1% AEP undefended flood event +23% (central climate change allowance)

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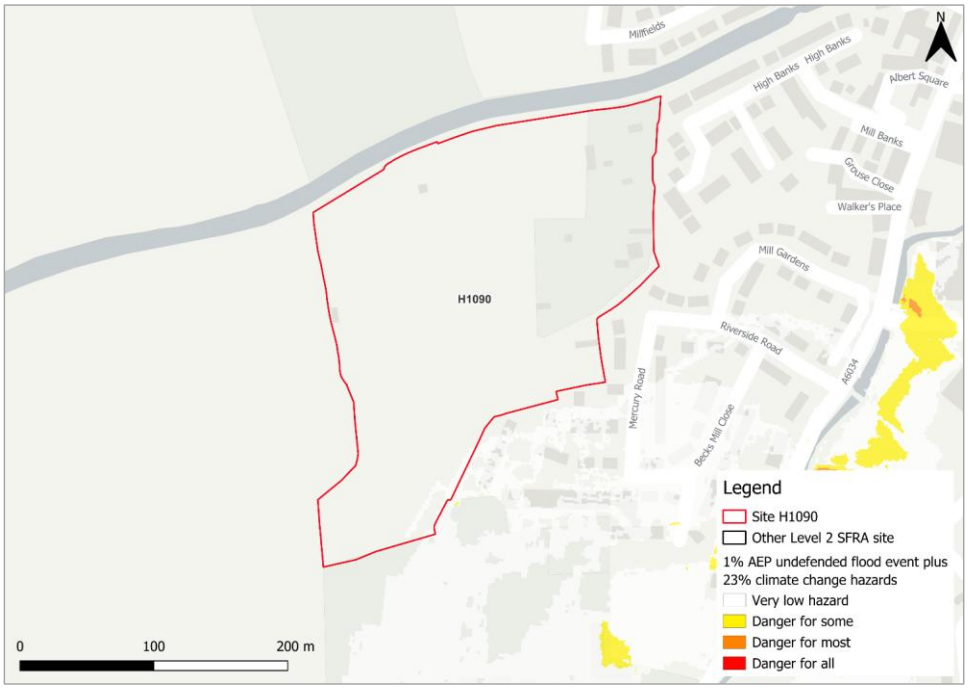


Figure 2-10: Flood hazard for 1% AEP undefended flood event +23% (central climate change allowance)

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2.2.2 2022 Leeds FAS Kildwick to Esholt - River Aire

Figure 2-11 shows the onsite modelled flood depths for the 0.1% AEP undefended event +23% climate change for the River Aire. Flood extents for the 1% AEP undefended event +23% and +31% climate change are not modelled to enter the site area. Risk during the 0.1% AEP +23% climate change event is modelled to be greater in both extent and depth in comparison to present day conditions, with flood extents inundating a greater area of the southwestern corner of the site. Maximum onsite depths remain in the range of 0.6 to 0.9 m. Modelled velocities (Figure 2-12) and hazards (Figure 2-13) remain similar to the present-day event. Safe access and escape routes remain achievable via multiple routes in the east of the site.

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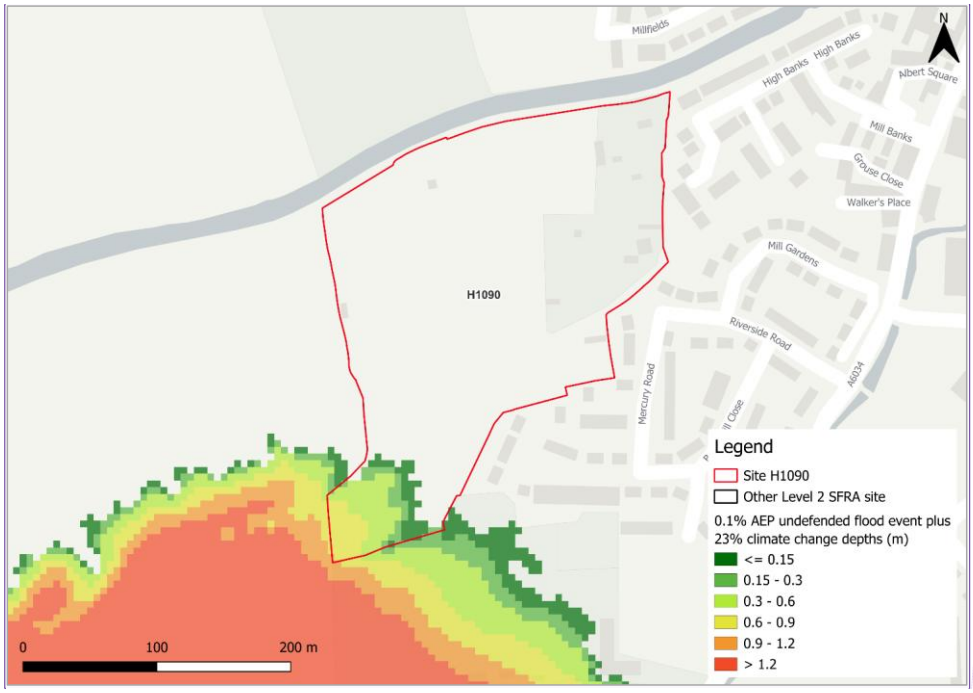


Figure 2-11: Flood depths for 0.1% AEP undefended flood event +23% (central climate change allowance)

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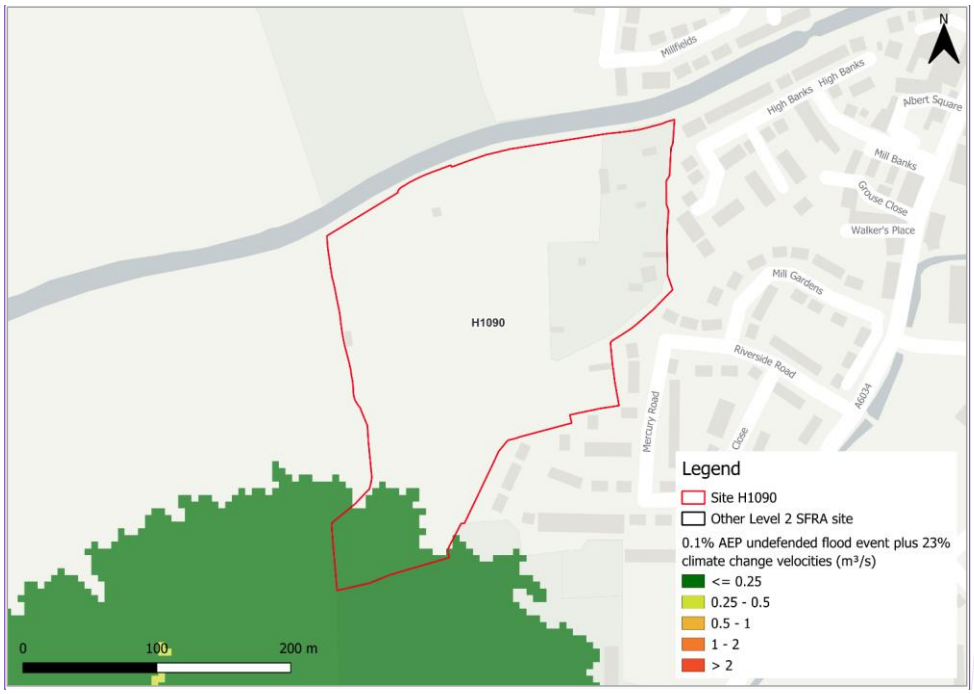


Figure 2-12: Flood velocities for 0.1% AEP undefended flood event +23% (central climate change allowance)

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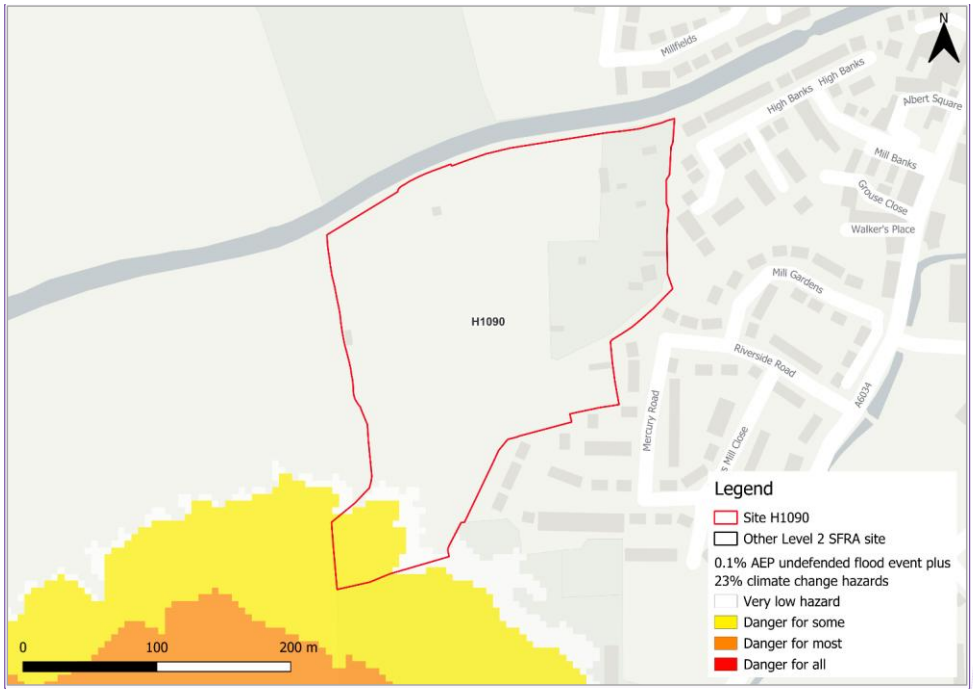


Figure 2-13: Flood hazard for 0.1% AEP undefended flood event +23% (central climate change allowance)

2.3 Flood risk management

2.3.1 Flood defences

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset. This is reflected in the defended modelled flood extent and depths being very similar to the undefended event within the site (Figure 2-14) for the Leeds FAS Kildwick to Esholt 2022 model of the River Aire. This is consistent with the modelled climate change events. There are no defended outputs for the Upper Aire Tribs model of Silsden Beck.

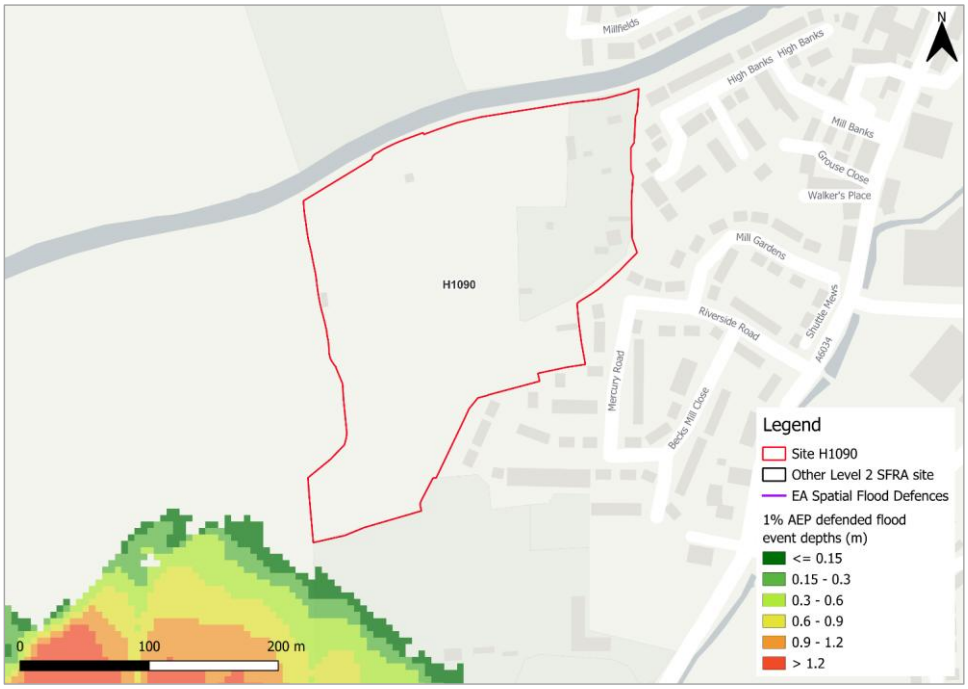


Figure 2-14: Flood depths for 1% AEP defended flood event

2.3.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. To the northwest of the site along the Leeds and Liverpool Canal, as well as extending into the north of the site, there are opportunities for riparian tree planting, indicating areas where woodland would be effective to attenuate flooding. To the west of the site and extending into the centre of the site, there is shown to be opportunities for tree planting in the wider catchment which can intercept, slow, store and filter water. To the south of the site extending into the southern corner of the site area there is potential for floodplain tree planting which can slow floodwaters and reduce flood peak height. Upstream of the site to the northwest, there is also shown to be opportunity for floodplain attenuation in the 3.3% and 1% AEP events via gully blocking. Downstream of the site to the south, it is noted that there is opportunity for run-off attenuation in the 1% AEP event as well as floodplain reconnection. These areas are shown in Figure 2-15. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

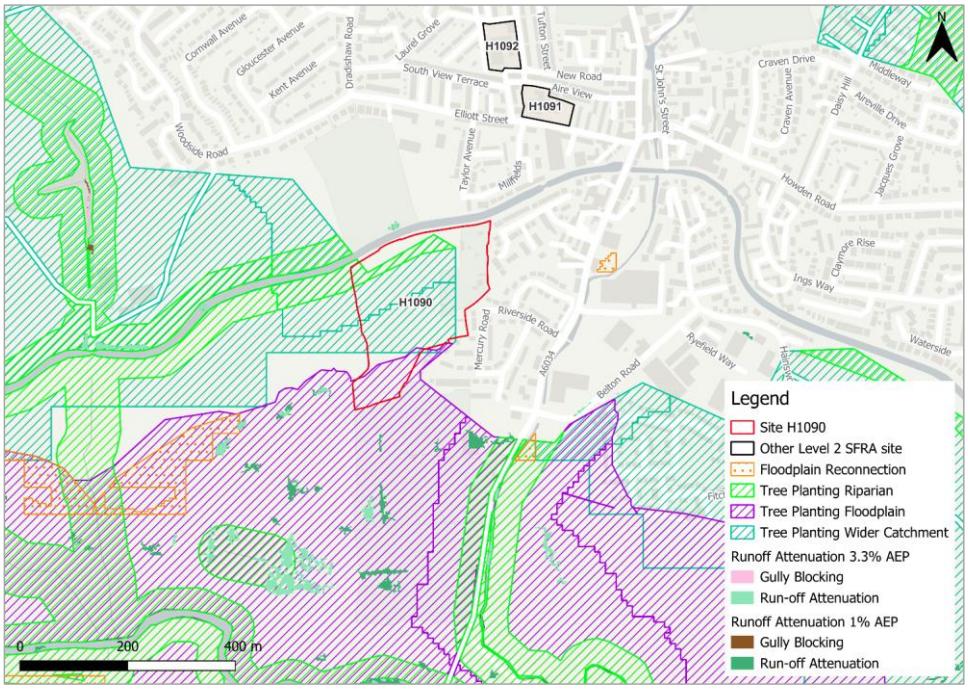


Figure 2-15 Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-16. Areas to the southeast and southwest of the site have been subject to flooding in the past and have been used to update Flood Zone 2 of the Flood Map for Planning (Figure 2-1). The RFO dataset indicates that these historic events have generally occurred as a result of the channel capacity of the River Aire and Silsden Beck being exceeded in December 1978, January 1982, February 1995, December 2015 and most recently in February 2020. In none of these events are the flood outlines recorded as entering the site area.

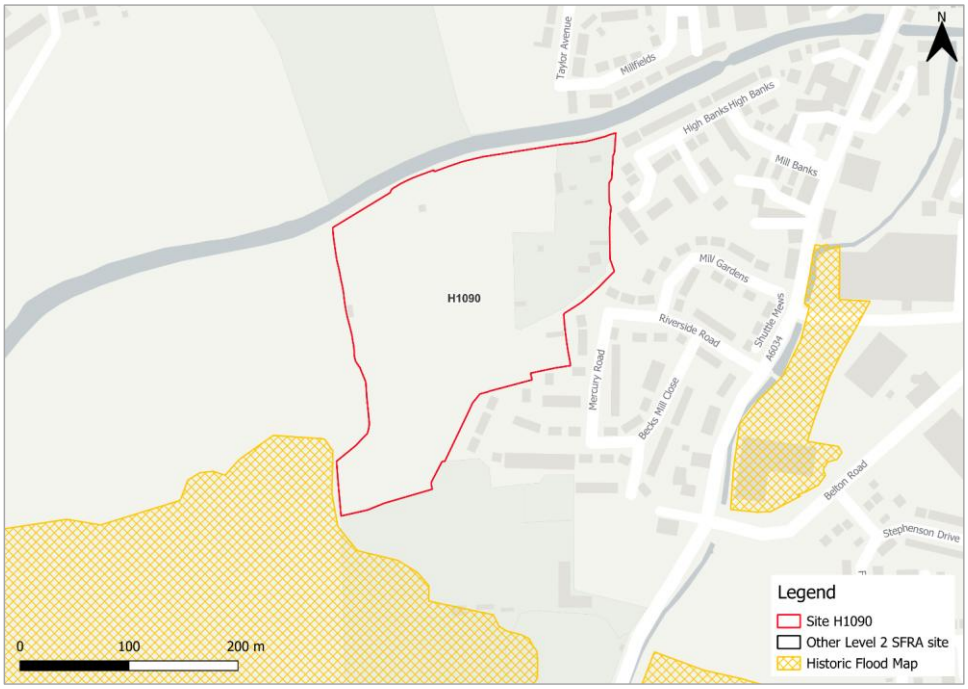


Figure 2-16: Recorded historic flood events onsite and around the site

2.5 Flood warning and access and escape routes

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The south of the site is located within an FWA, namely 123FWF741 - Silsden Beck at Silsden.

Flood Alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in an FWA. The south of the site is also located within an FAA, namely 123WAF960 - Upper River Aire catchment.

Based on available information, safe access and escape routes could likely be achieved during a flood event via High Banks to the east of the site.

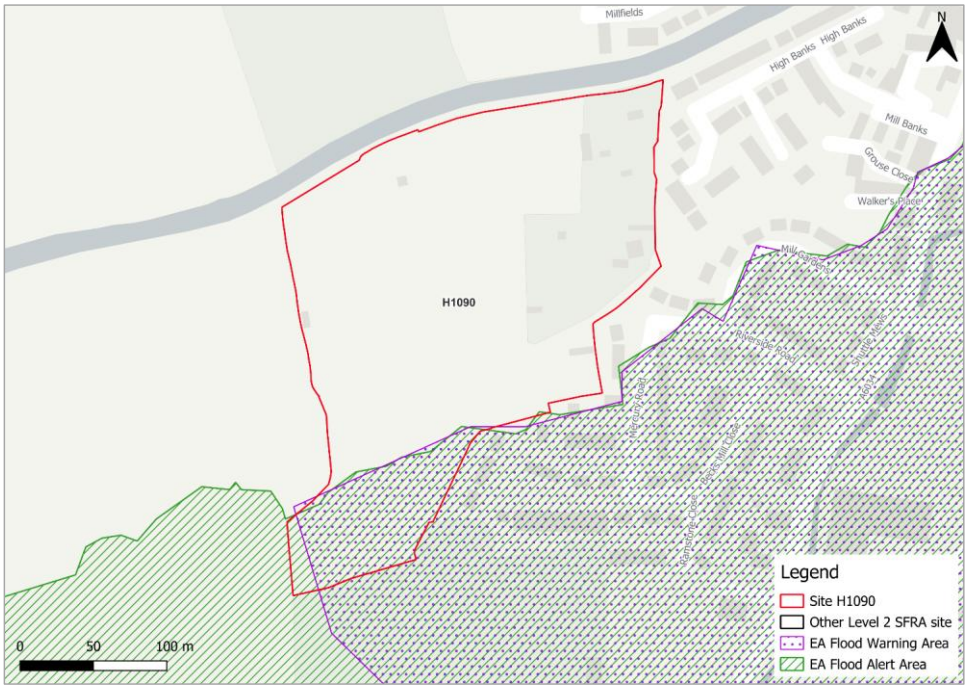


Figure 2-17: EA Flood Warning Areas and Flood Alert Areas

2.6 Observations, mitigation options and site suitability - fluvial

- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
- Given the change in use and therefore vulnerability of the site, the FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).
- The far south of the site is within Flood Zone 2 of the Flood Map for Planning indicating a medium risk of flooding. The remainder of the site is in Flood Zone 1. The onsite area of Flood Zone 2 is based on the 0.1% AEP undefended event of the Upper Aire Tribs - Silsden 2021 model with risk modelled to be from Silsden Beck. The modelled risk for the 0.1% AEP event of the Leeds FAS Kildwick to Esholt 2022 model is not included in Flood Zone 2.
- Ideally, the area within Flood Zone 2 and at risk from climate change would remain undeveloped and remain as greenspace. However, modelled flood depths and velocities are low, and hazards are very low, including for climate change, and therefore minimal mitigation should be possible to enable safe development.
- The EA must advise on whether risk from the Leeds FAS Kildwick to Esholt 2022 model is to be considered at the FRA stage.

- EA flood warnings and alerts should continue to be in place in the south of the site to ensure early evacuation of site users before an extreme flood event occurs.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map (November 2024), surface water risk to the site is predominantly very low. Approximately 1% of the site is at high surface water risk. A further 1% of the site is at medium risk and a further 13% is at low surface water risk, as shown in Table 3-1.

In the high-risk event, surface water risk is confined to an area of ponding within the east of the site along a tracked area. This area of ponding is modelled to increase in extent in the medium and low risk events, with other flood water flow routes extending into the site from the southeastern, southwestern and northeastern boundaries. The risk area in the south is within the fluvial Flood Zone 2 area.

Greatest flood depths within the site in the medium risk event are between 0.6 and 0.9 m (Figure 3-1) with hazard largely categorised as moderate, and a small area modelled to be significant (Figure 3-2). Safe access and escape routes via High Banks are anticipated to remain viable in this event.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
85	13	1	1

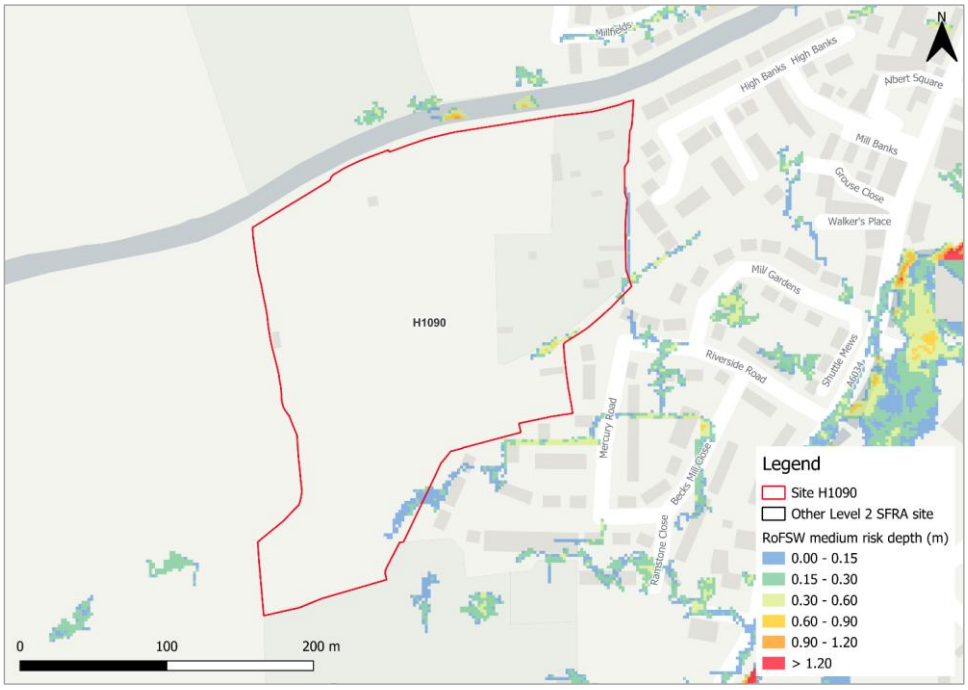


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

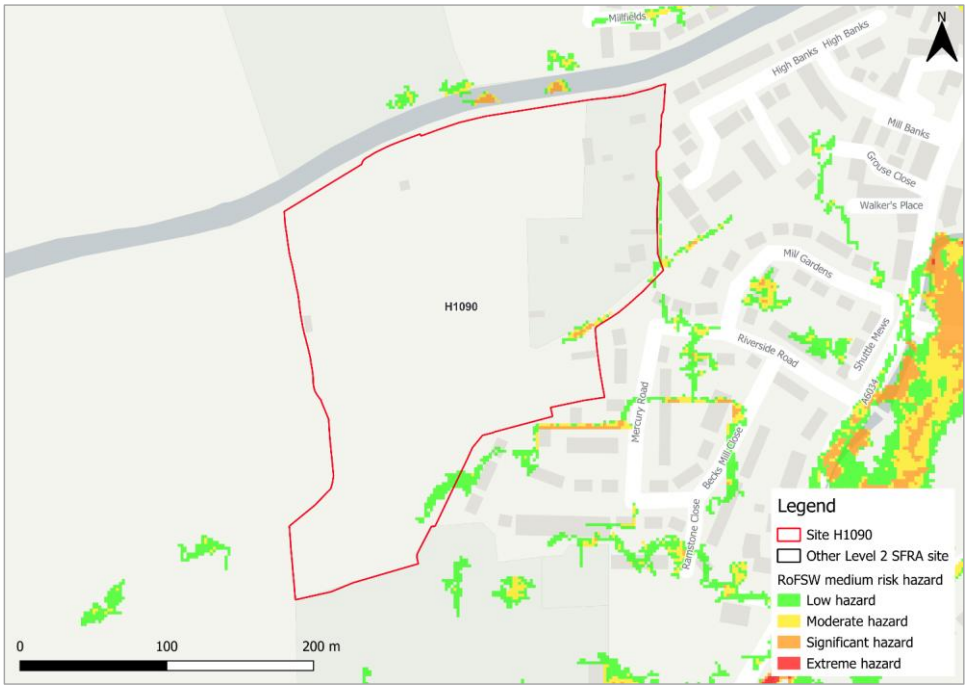


Figure 3-2: Medium risk event surface water flood hazard[2] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event plus 45% climate change. Risk is modelled to be significantly greater than for present day

2 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

conditions, with the medium risk climate change event showing a similar level of risk to the present-day low risk event. A number of flow paths are modelled to occur onsite, flowing southwards towards the recent residential development on Mercury Road and Becks Mill Close. Maximum depths are modelled to be up to 0.8 m, with areas of hazard categorised as significant (Figure 3-4). Safe access and escape routes at High Banks may remain achievable in certain areas of the northeast corner of the site.

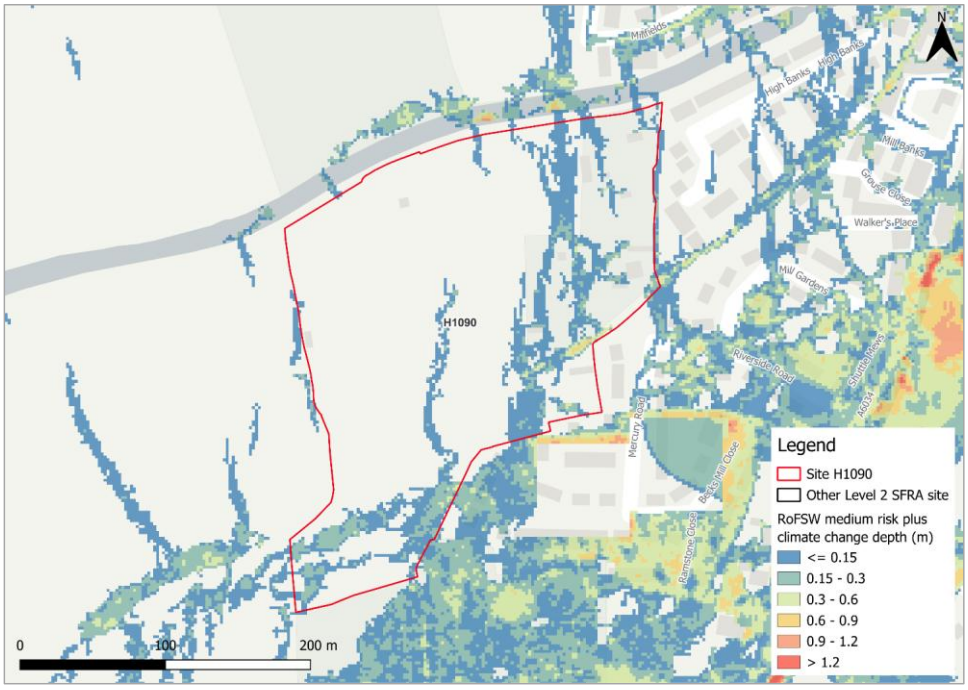


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

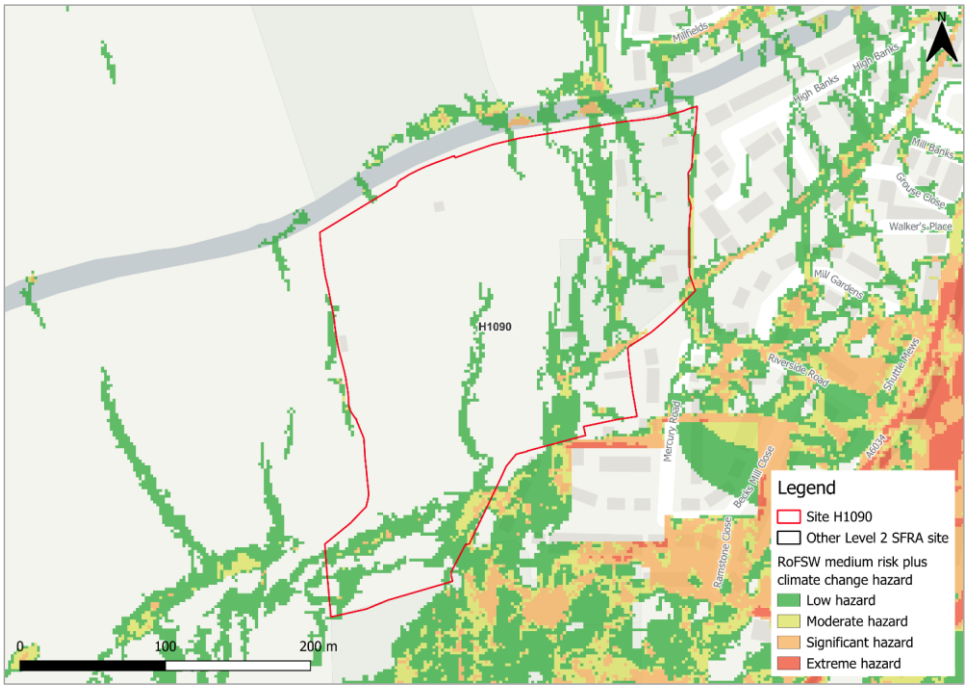


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is predominantly very low with 85% of the site being at very low surface water flood risk. Surface water in the medium risk event is confined to a small, tracked area in the east of the site.
- Surface water flood risk to the site is shown to be significantly greater in the medium risk climate change event; with flow paths and areas of ponding observed across much of the eastern and southern extents of the site. Any mitigation solutions on this site should consider the land offsite to the south and east, given many of the flow paths runoff through the site. If possible, all surface water should be retained onsite. Figure 4-1 shows that the use of infiltration SuDS onsite should be possible to retain water. However, further ground investigation would be required at the FRA stage.
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will require surface water modelling based on layout plans and detailed design and full consultation with the LLFA. Runoff volumes must not exceed existing greenfield rates and, if possible, betterment should be achieved.

- Some areas in the site to the south which are shown to be at surface water flood risk coincide with areas at fluvial risk and should therefore be included within any mitigation solutions for fluvial risk.
- Topographic depressions should be considered and included in site design and ideally left in place to flood naturally when required. Any regrading of land must include like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- Safe access and escape routes should be achievable at High Banks during the present-day event and may remain achievable in the medium risk climate change event in certain areas of the northeast corner of the site.
- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[3]. Figure 4-1 shows the map covering this site and the surrounding areas whilst Table 4-1 explains the risk classifications.

The majority of the northern area of the site is in a location where there is no risk of groundwater emergence. Groundwater conditions may therefore be suited to infiltration SuDS in these areas. Within the south of the site however, there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates here and have the capacity to flow overland and/or pond within any topographic low spots. Ground investigations will be required through the site-specific FRA to ascertain groundwater levels and conditions.

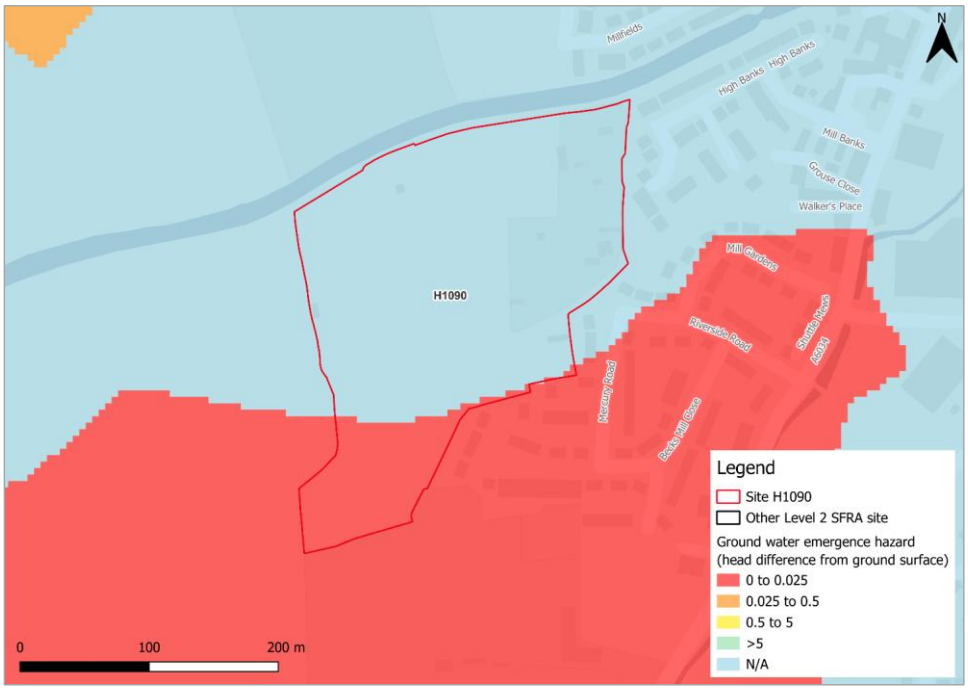


Figure 4-1: JBA 5m Groundwater Emergence Map

3 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

5.1 Flood Risk from Canals

The Leeds and Liverpool Canal runs along the northern boundary of the site. There is no known existing flood model of the canal therefore any residual risk from the canal is unknown at this stage. The canal is raised approximately 3m above the site. Therefore, the site is at potential residual flood risk from a breach of the canal system. This scenario must be investigated at the FRA stage including full consultation with the Canal & River Trust. A flood risk activity permit may also be required to develop within proximity of the canal.

5.2 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-1 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is potentially at risk from four reservoirs. Of these four reservoirs, three are located within North Yorkshire and one located within Bradford. These are operated by either Yorkshire Water Services Ltd, the National Trust or the Canal & River Trust.

The EA's SFRA guidance states that where a proposed development site is at flood risk from a reservoir, then an assessment into whether the reservoir design or maintenance schedule needs improving should be carried out. Expert advice may be required from an all-reservoirs panel engineer. The Council should consult the relevant reservoir undertaker to ascertain whether the proposed development could affect the reservoir's risk designation, its design category or how it is operated. The Council, as category 1 responders, can access more detailed information about reservoir risk and reservoir owners using the Resilience Direct system.

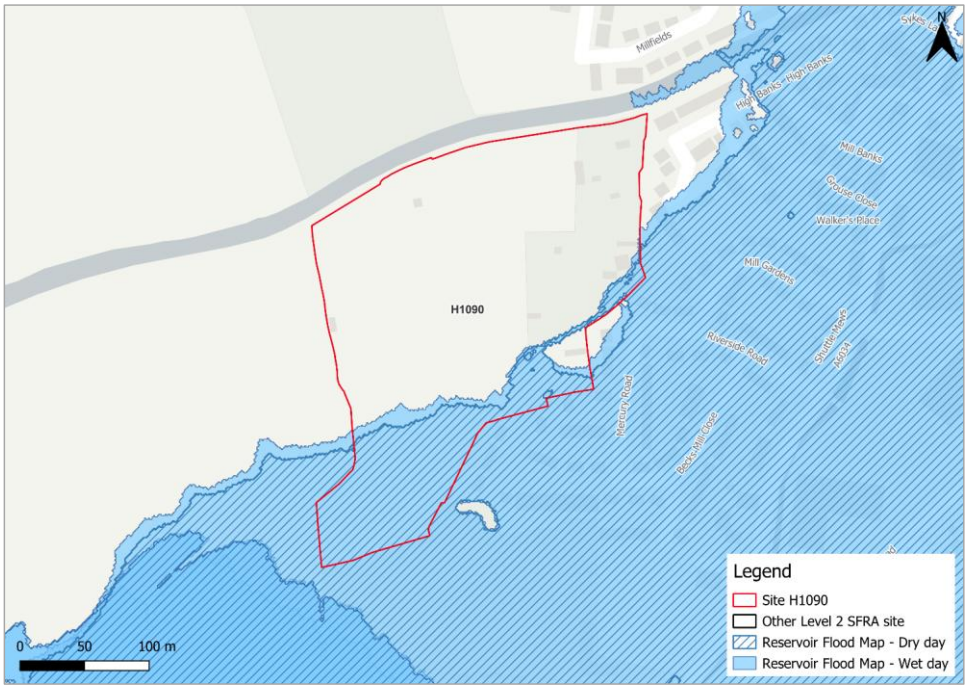


Figure 5-1: Flood risk from reservoirs

5.3 Flood risk from sewers

Commented [LT10]: Awaiting historic sewer flooding data from Yorkshire Water

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.4 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a breach of four reservoirs. However, only one reservoir impacts the site in the 'dry day' flood extent, namely Silsden reservoir, located within Bradford. This indicates that the remaining three reservoirs are only modelled to impact the site based on the 'wet day' flood extent, which represents a prediction of the credible worst-case scenario, therefore it's unlikely that any actual flood would be this large.
- Given the potential reservoir risk to the site, developers should consider[4]:

4 Reservoir flood maps: when and how to use them | Environment Agency | 2021

- Consulting with the local resilience forum for advice on emergency planning,
- Consulting with relevant reservoir owners to understand the impact development may have on their reservoirs, and
- Using this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

- The potential risk of a canal breach should be assessed at the FRA stage. This is a potential residual risk to the site which should be assessed and quantified.

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is not required to pass part b) of the exception test[5], as it is located in Flood Zone 1 and Flood Zone 2, however it must still be proven that the development can be safe for its lifetime, which is 100 years for residential development.

6.2 Recommendations, FRA requirements, and further work

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

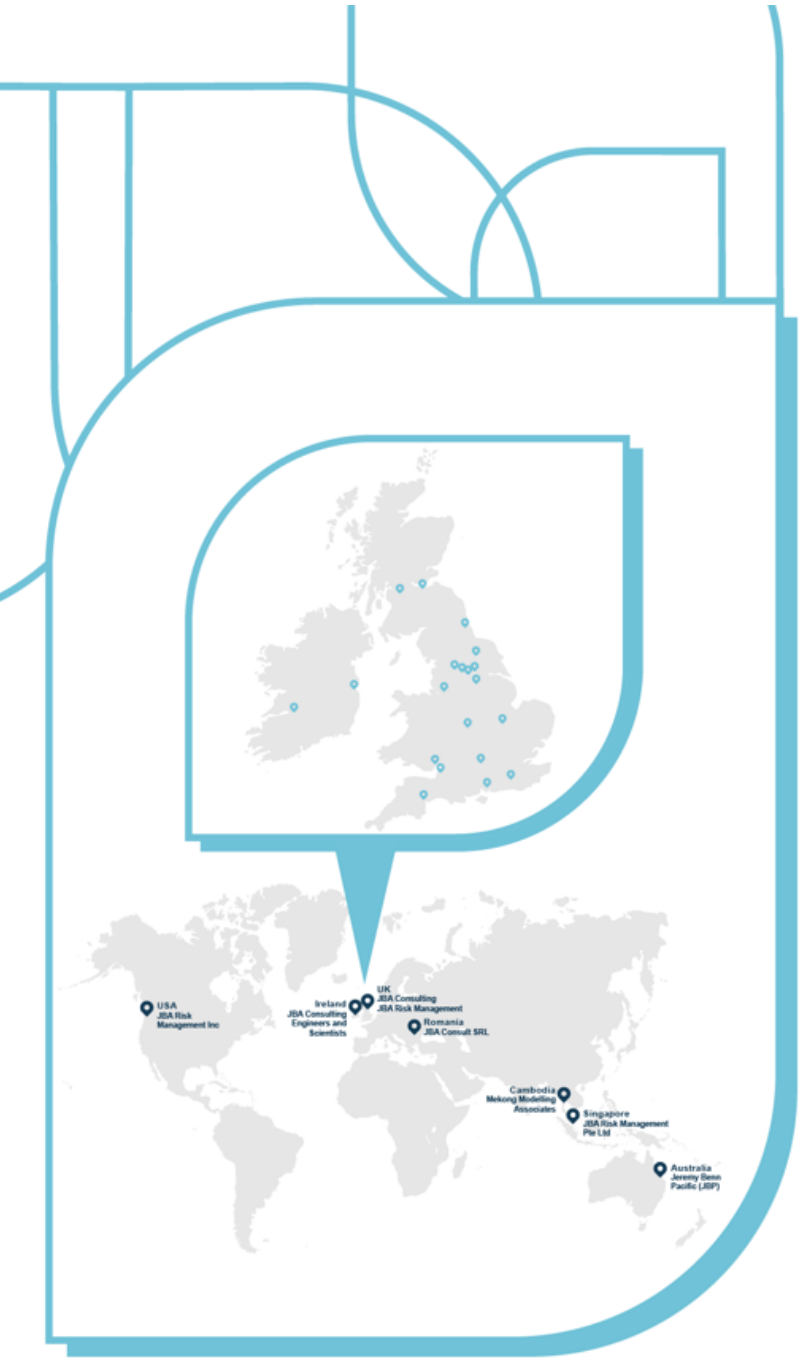
- This site could be allocated if development avoids the southern half of the site modelled to be at fluvial flood risk.
- Confirmation should be sought from the EA on which fluvial flood model should be used to further assess risk in the FRA.
- The site is also modelled to be at substantial risk from surface water flooding in the future. A drainage strategy will be required to ensure surface water is retained onsite, accounting for climate change. This may reduce developable units. This would include retention of any topographic depressions, and the flow paths observed in the climate change event. This will require detailed surface water modelling based on layout plans and detailed design and full consultation with the LLFA on required runoff rates, likely to be greenfield or betterment. The use of infiltration SuDS should be investigated.
- Residual risk from the canal should be assessed and quantified through consultation with the Canal & River Trust.
- Consultation should be had with the reservoir owners that may be affected by the development of this site.
- Groundwater conditions across the site must be investigated further through the site-specific FRA to ascertain groundwater levels and conditions.
- Any FRA must further consider the safe access and escape routes to the site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

5 Para 178 National Planning Policy Framework 2024

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Bradford Level 2 Strategic Flood Risk Assessment - Site H1092

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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Contract

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JBA Project Code	2024s1078

This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Laura Thompson of JBA Consulting carried out this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H1092. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2024) and is therefore familiar with the terminology used in this report.

1.1 Site H1092

- Location: Hothfield Junior School, Norton Street
- Existing site use: Education
- Existing site use vulnerability: More vulnerable
- Proposed site use: Residential
- Proposed site use vulnerability: More vulnerable
- Site area: 0.52 hectares
- Proposed development impermeable area: 0.46 hectares
- Environment Agency (EA) river model: N/A
- Watercourse: Bracken Hill Gill / Silsden Beck
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk
    - Modelling of latest EA climate change allowances for peak rainfall intensities

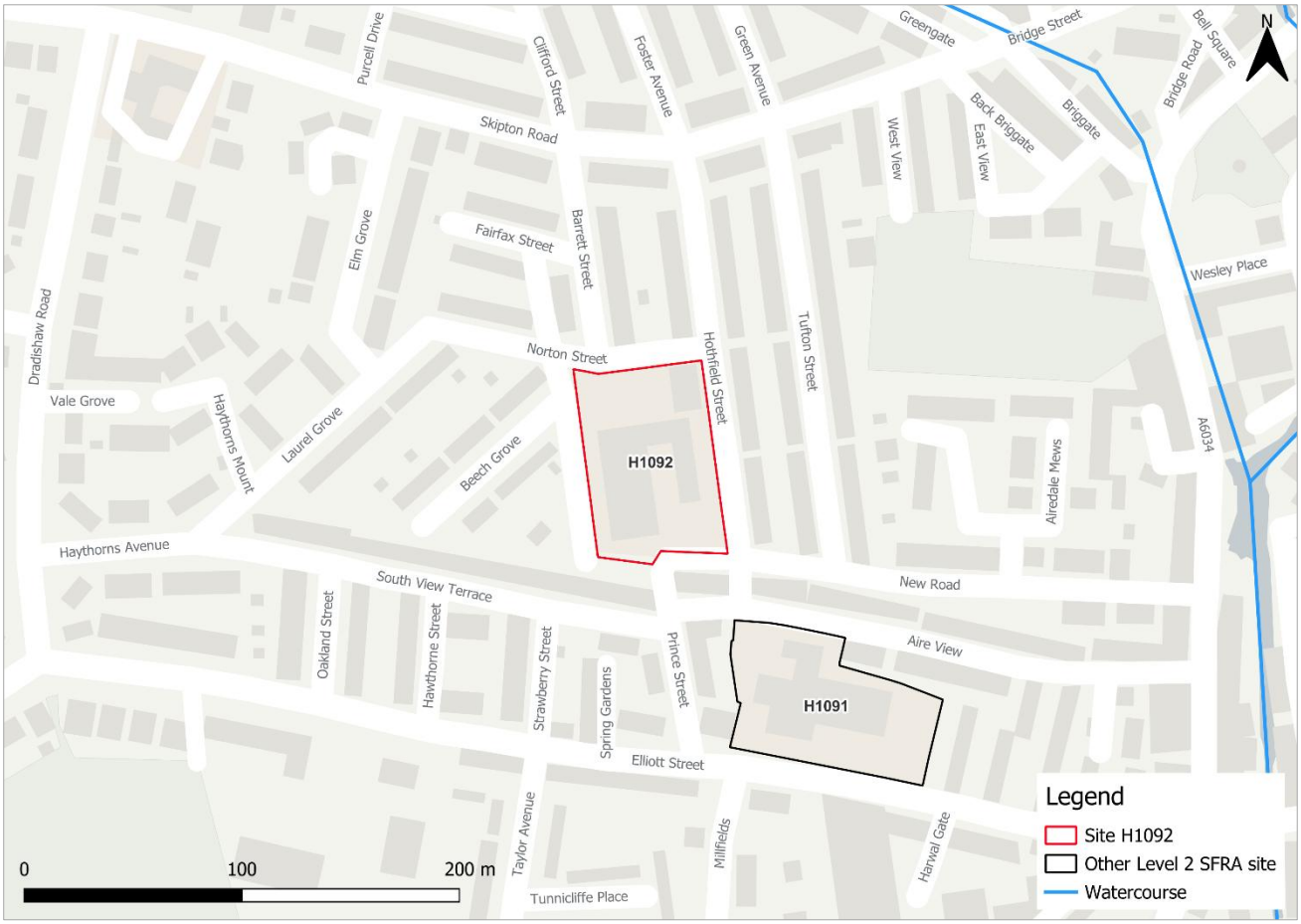


Figure 1-1: Existing site location boundary

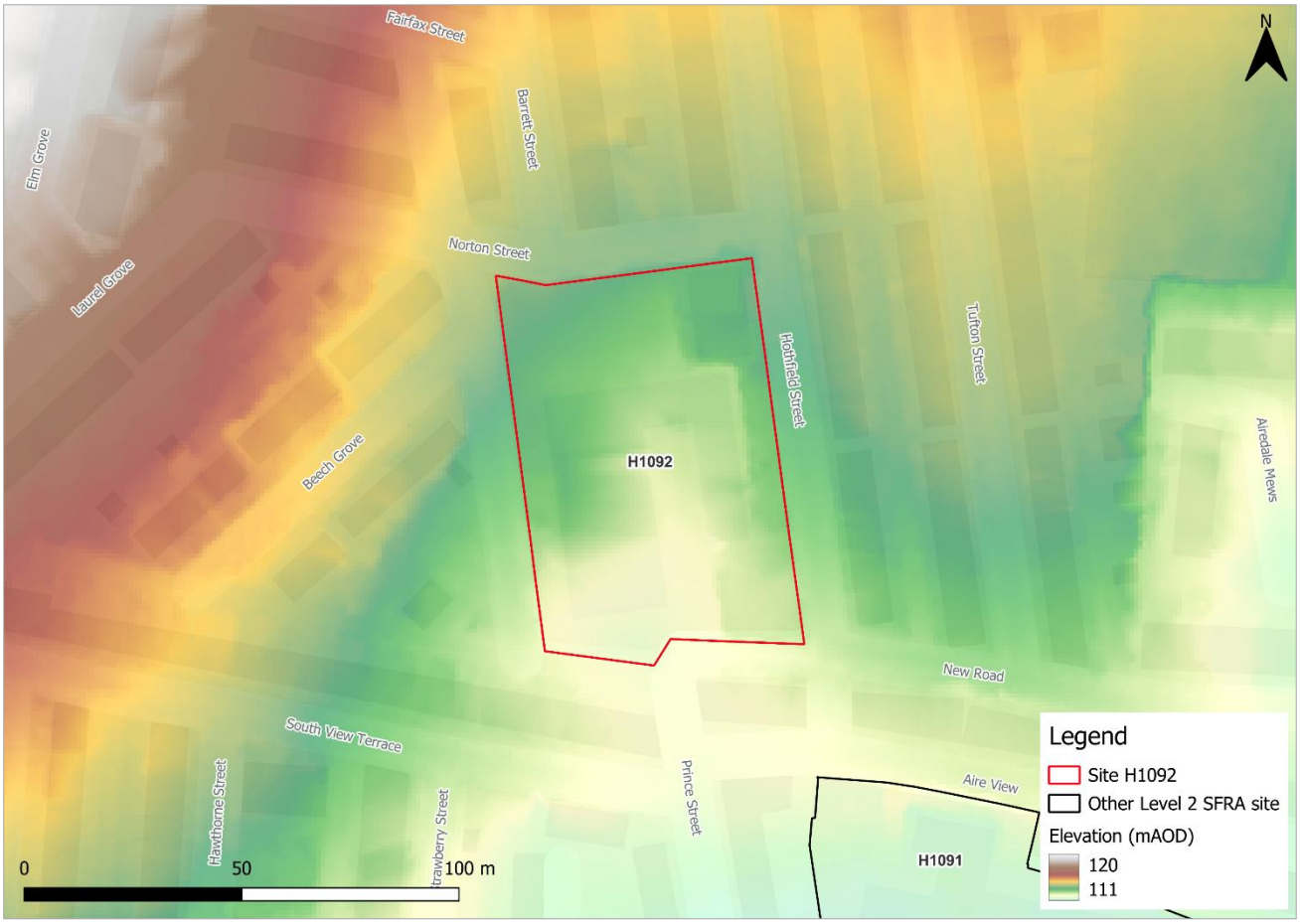


Figure 1-2: Topography



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.2) or the impacts of climate change.

The site is wholly located within Flood Zone 1 and is therefore at low risk of flooding from rivers.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
100	0	0	0



Figure 2-1: Existing risk from rivers to the site

2.2 Flood risk management

2.2.1 Flood defences

The site doesn't benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset. There are however areas of natural high ground along the banks of Silsden Beck to the east of the site.

2.2.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) to reduce flood risk to the site and surrounding areas. Upstream of the site there is mapped potential for woodland planting, which indicates where scrub and tree planting may be most effective to increase infiltration and attenuate flooding. These areas are shown in Figure 2-2. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

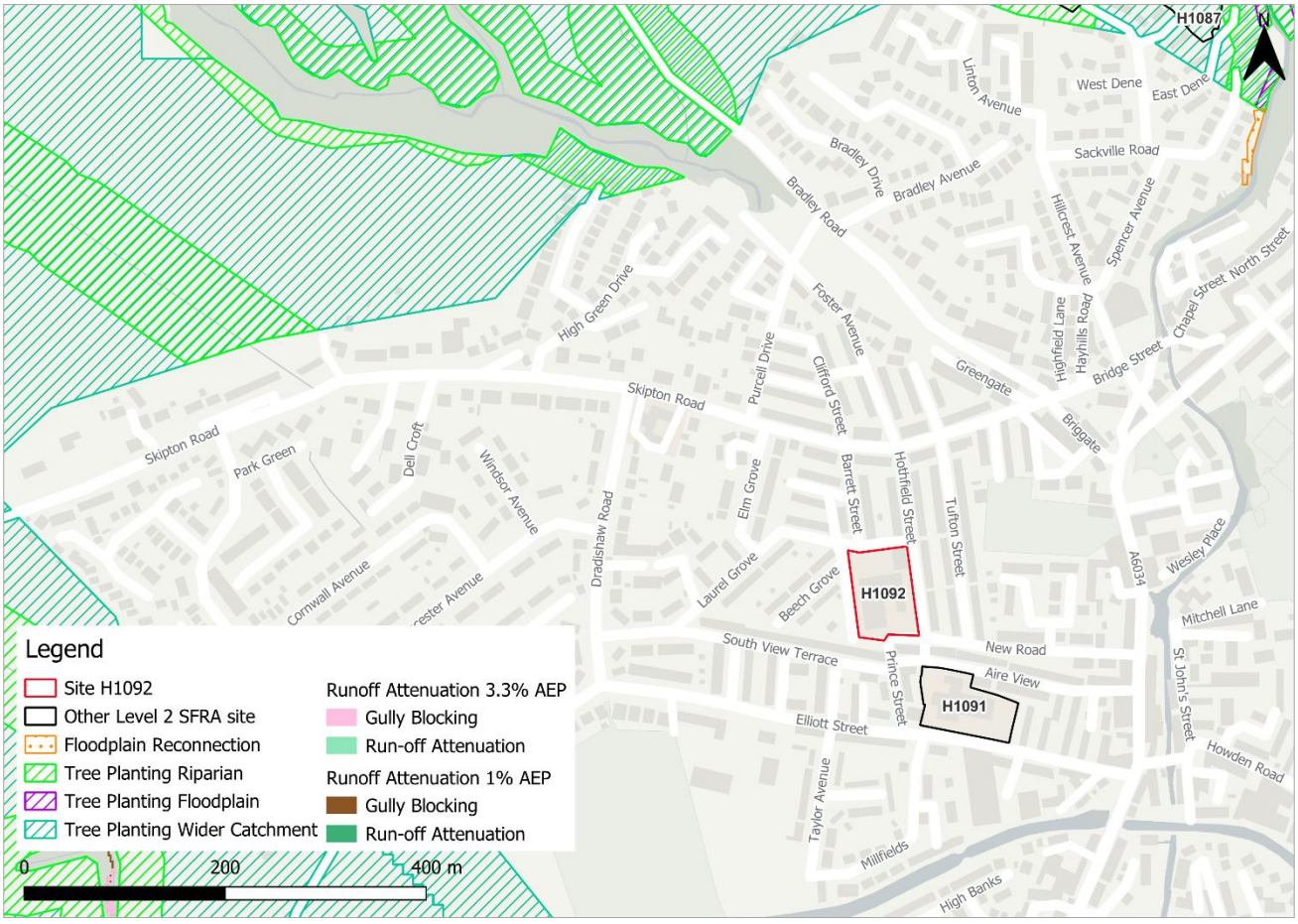


Figure 2-2: Natural Flood Management (NFM) potential mapping

2.3 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood incidents within the vicinity of the site.

2.4 LLFA flood incidents

The LLFA have records of two flood incidents south of the site, which occurred in 2015 and another incident to the north of the site, which occurred in 2014. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site associated with these incidents.

2.5 Flood warning and access and escape routes

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The site is not located within a FWA.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. This site is not located within a FAA.

Based on available information, safe access and escape routes could likely be achieved during a flood event via multiple roads surrounding the site.

2.6 Observations, mitigation options and site suitability - fluvial

- The site is wholly located within Flood Zone 1 and therefore at low risk of flooding from rivers.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map, surface water flood risk to the site is predominantly low. Approximately 10% of the site is within the high risk surface water zone. A further 7% is at medium surface water risk and a further 20% is at low surface water risk as shown in Table 3-1.

In the high risk event, surface water risk is confined to two distinct areas of ponding within topographic low spots in the north and south of the site. In the medium risk event, a flow path is modelled to develop, connecting the two areas of ponding shown in the high risk event. In the low risk event, this flow path becomes more significant in extent, however is largely shallow in depth.

Surface water risk is clearly constrained by the existing development within the site boundary. Any existing flow paths and topographic depressions should be maintained within site design.

Greatest surface water flood depths in the medium risk event are > 1.2m (Figure 3-1) with some areas of significant hazard (Figure 3-2). Safe access and escape should be achievable via School Street in all events.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
63	20	7	10



Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)



Figure 3-2: Medium risk event surface water flood hazard[1] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

1 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

Figure 3-3 shows the modelled surface water flood depths for the medium risk event +45% climate change. Risk is modelled to be greater than for present day conditions, with the medium risk climate change event showing a similar level of risk to the low risk present day event. Greatest flood depths within the site are > 1.2m, with areas of hazard categorised as significant (Figure 3-4).

Although School Street is inundated during the medium surface water risk plus climate change event, safe access and escape routes should remain achievable given the modelled shallow depths and low hazards.

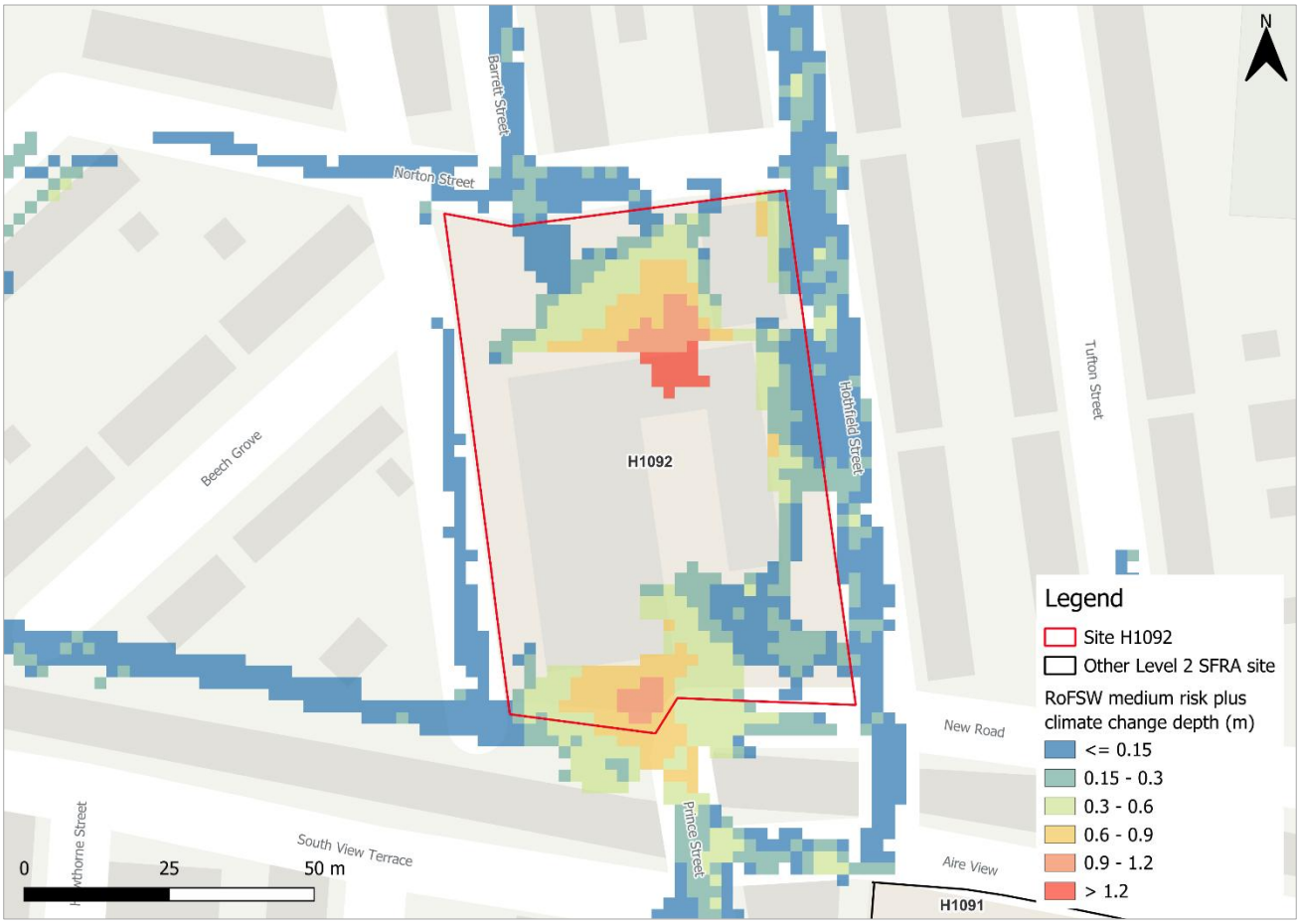


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)



Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is predominantly very low. Surface water risk in the medium risk event is confined to two areas of ponding within topographic low spots connected by a flow path and is constrained by existing development.
- In the low risk event and medium risk surface water event plus climate change, existing areas of ponding increase in extent and the flow path through the centre of the site becomes more significant.
- Any change in site layout where current buildings are to be demolished will require detailed surface water modelling. Any regrading of land must include like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- Assessment of the current drainage system in place should be carried out to ascertain any current capacity issues and whether the current system could accommodate the proposed residential development or whether further capacity will be required.
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This will

require surface water modelling based on layout plans and detailed design and full consultation with the LLFA.

- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[2]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The entirety of the site is in an area where there is no groundwater risk. Groundwater conditions may therefore be suited to infiltration SuDS.



Figure 4-1: JBA 5m Groundwater Emergence Map

2 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

5.1 Flood risk from canals

The Leeds and Liverpool Canal is located approximately 200m to the south of the site. The canal is not raised in this location therefore the site is not likely to be at risk from a canal breach.

5.2 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is not modelled to be at risk from reservoir flooding.

5.3 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded, blocked or it cannot discharge due to a high water level in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.4 Observations, mitigation options and site suitability - residual risk

- The site is not likely to be at residual flood risk.

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is not required to pass part b) of the exception test[3] as it is located within Flood Zone 1, however it must still be proven that the development can be safe for its lifetime, which is 100 years for residential development.

6.2 Recommendations, FRA requirements, and further work

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

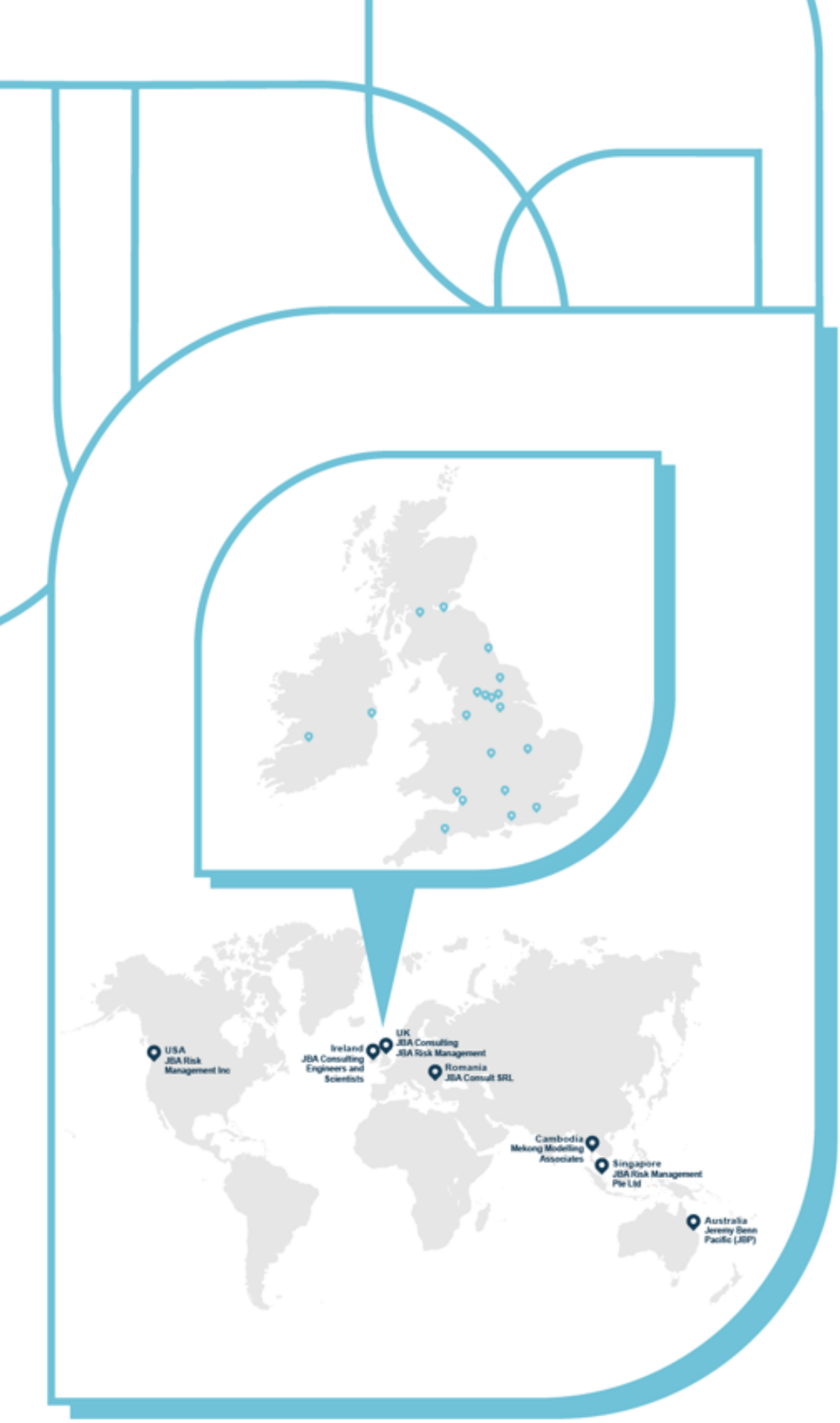
- Based on the evidence in this SFRA, it should be appropriate to develop this site for more vulnerable purposes given its location in Flood Zone 1.
- However, there is significant risk from surface water in the longer term. A detailed drainage strategy will be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development.
- Surface water should be retained onsite which may reduce units. This will require detailed surface water modelling based on layout plans and detailed design and full consultation with the LLFA on required runoff rates, likely to be brownfield or betterment. The use of infiltration SuDS should be investigated.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA online guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

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Bradford Level 2 Strategic Flood Risk Assessment - Site H1118

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

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Authorised by	Krista Keating BSc MSc CEnv CSci MCIWEM C.WEM Associate Director

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Acknowledgements

We would like to thank the Environment Agency and Yorkshire Water for their assistance with this work.

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1 Background

This is a Level 2 Strategic Flood Risk Assessment (SFRA) site screening report for the City of Bradford Metropolitan District Council (CBMDC) Local Plan Site H1118. The content of this Level 2 SFRA site screening report assumes the reader has already consulted the 'CBMDC Level 1 SFRA' (2023) and read the 'CBMDC Level 2 SFRA Main Report' (2024) and is therefore familiar with the terminology used in this report.

1.1 Site H1118

- Location: The Croft, Lyon Road
- Existing site use: Agriculture
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 0.72 hectares
- Proposed development impermeable area: 0.65 hectares
- Environment Agency (EA) river model: N/A
- Watercourse: Holme Beck / Eastburn Beck
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk

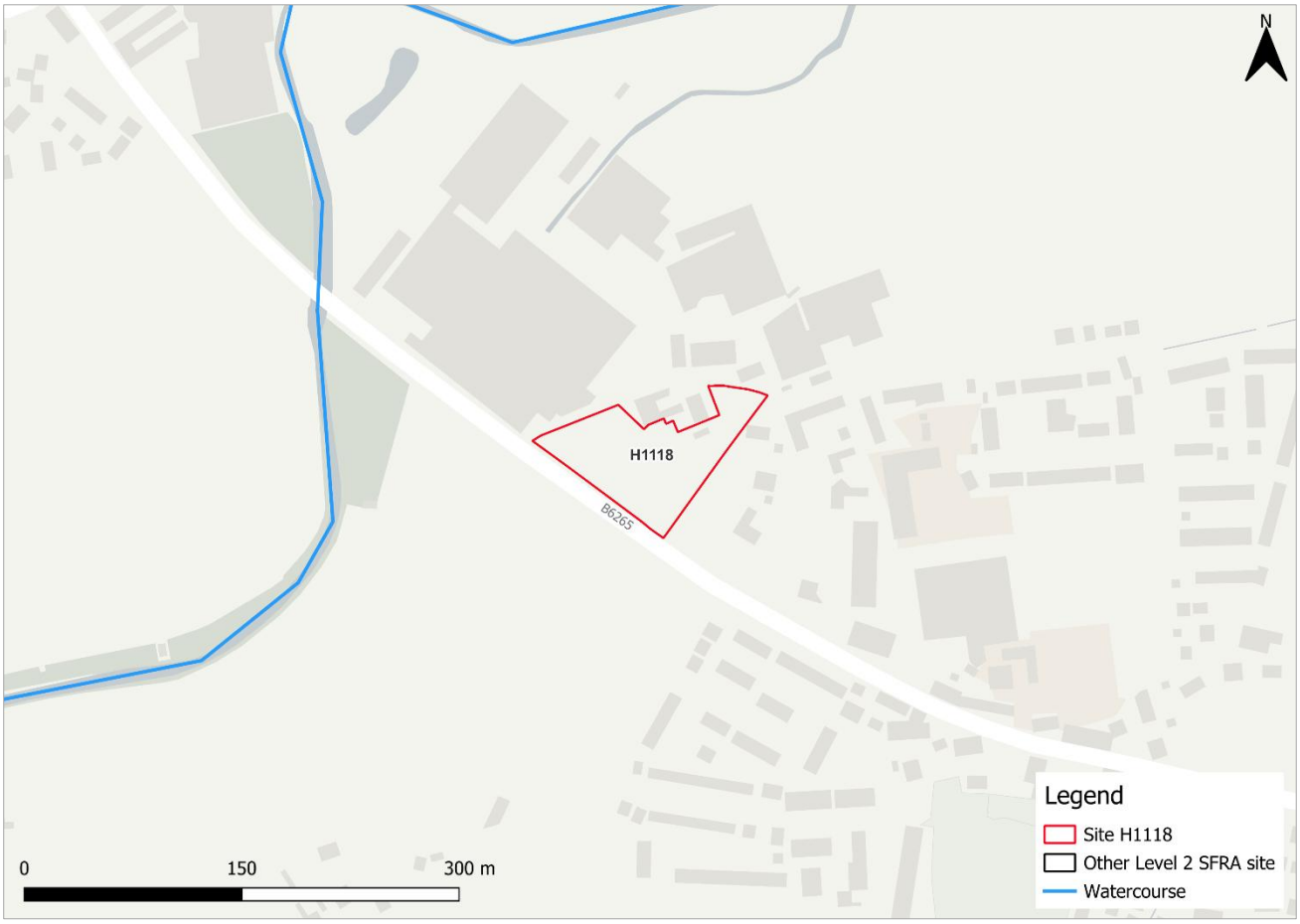


Figure 1-1: Existing site location boundary

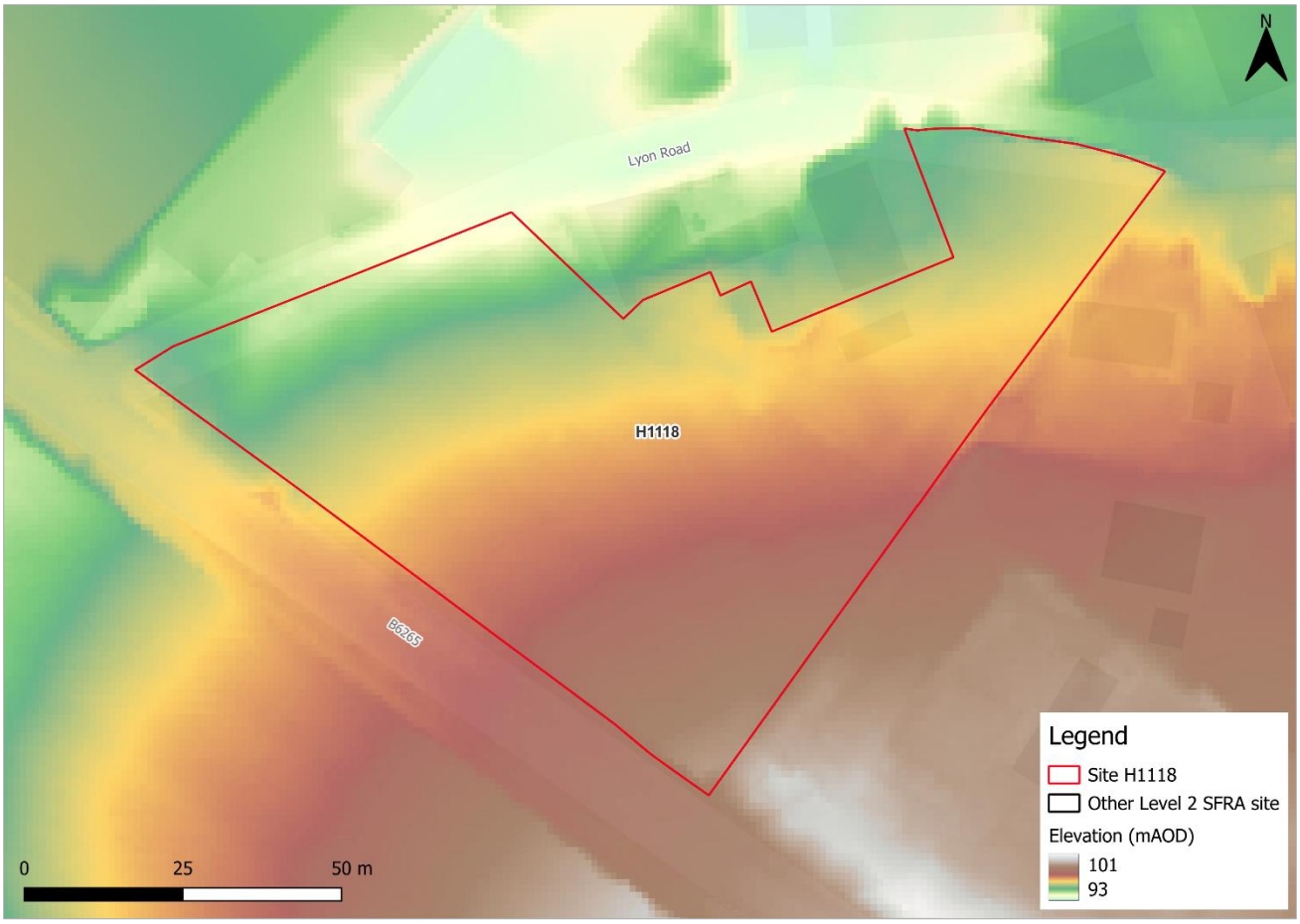


Figure 1-2: Topography



Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.3) or the impacts of climate change (Section 2.2).

The majority of the site is modelled to be within Flood Zone 1. A small area of the site along the northwestern boundary is within Flood Zone 2, indicating it is at medium risk of flooding from rivers, however this is only 5% of the total site area.

No EA model has been made available for this Level 2 SFRA. Therefore, the EA should be consulted on the data source of the Flood Map for Planning in this location. If the Flood Map for Planning is based on a detailed model of Holme Beck or Eastburn Beck, any updates to this Level 2 SFRA and/or any site-specific FRA should make use of this model to understand modelled depths and hazards within the site and the wider area to the north.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
95	5	0	0



Figure 2-1: Existing risk from rivers to the site

2.2 Impacts from climate change

The impacts of climate change on flood risk from Holme Beck and Eastburn Beck have not been modelled for this SFRA, as a model covering these watercourses was not made available for consideration. Therefore, in the absence of modelled climate change information, Flood Zone 2 of the Flood Map for Planning (based on the 0.1% AEP undefended event) can be used as a precautionary proxy for Flood Zone 3 plus climate change. Based on this approach, fluvial risk may increase in extent in comparison to present day (Figure 2-1).

The impacts of climate change must be modelled using the EA's latest allowances for peak river flows to inform whether the site can be safe for its lifetime. The EA should be consulted on the data source of the Flood Map for Planning in this location. If the Flood Map for Planning is based on a detailed model of Holme Beck or Eastburn Beck, any updates to this Level 2 SFRA and/or any site-specific FRA should make use of this model and include for the most up to date climate change allowances.

2.3 Flood risk management

The site does not benefit from any formal engineered flood defences, according to the EA's spatial flood defences dataset. There are however areas of natural high ground along the banks of both Holme Beck and Eastburn Beck to the west of the site boundary.

2.3.1 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) to reduce flood risk to the site and surrounding areas. Upstream of the site, there is potential for woodland planting to slow floodwaters, reduce flood peak height and reduce sediment delivery to the watercourse. There are also opportunities for runoff attenuation features to temporarily store water and attenuate flooding during high flows. These areas are shown in Figure 2-2. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

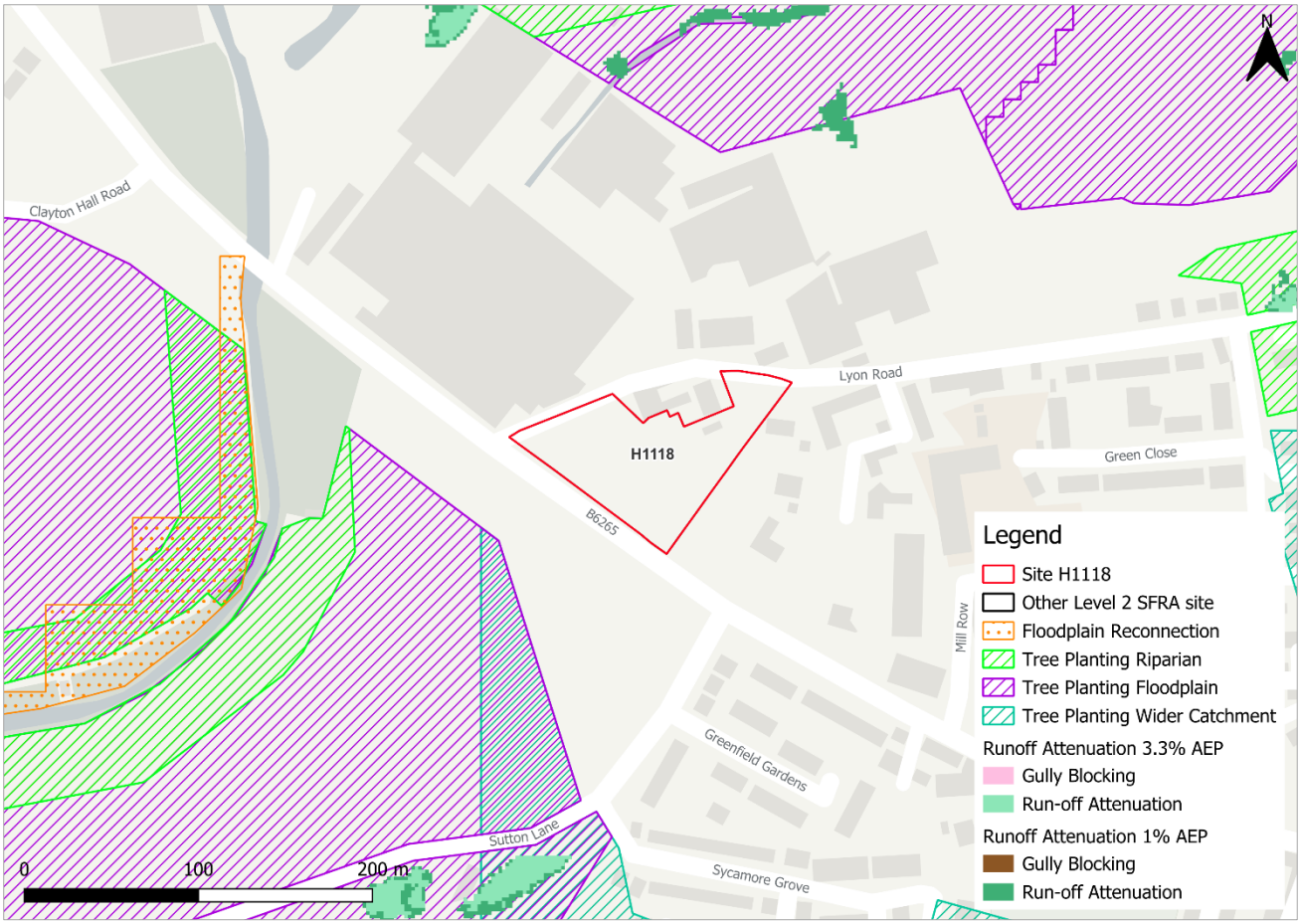


Figure 2-2: Natural Flood Management (NFM) potential mapping

2.4 Historic flood incidents

The EA's Historic Flood Map (HFM) and Recorded Flood Outlines (RFO) datasets have been considered. There are no recorded historic flood incidents within the vicinity of the site.

2.5 Flood warning and access and escape routes

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The site is not located within a FWA.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. The site is not located within a FAA.

Based on available information, safe access and escape routes could likely be achieved during a flood event via the B6265 to the south of the site.

2.6 Observations, mitigation options and site suitability - fluvial

- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
- Given the change in use and therefore vulnerability of the site, the FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).
- The site is modelled to be at risk from fluvial sources (according to Flood Zone 2 of the EA's Flood Map for Planning) in the extreme 0.1% AEP undefended scenario.
- The EA's Flood Zone 2 extent has been used as a proxy to provide a precautionary estimate of the 1% AEP undefended event plus climate change. Based on this approach, fluvial risk may increase in extent in comparison to the present day Flood Zone 3, impacting the north western boundary of the site.
- The EA should be consulted on the data source of the Flood Map for Planning in this location. If the Flood Map for Planning is based on a detailed model of Holme Beck or Eastburn Beck, any updates to this Level 2 SFRA and/or any site-specific FRA should make use of this model and include for the most up to date climate change allowances.
- Safe access and escape routes could likely be achieved during a flood event via the B6265 to the south of the site, based on available information.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map, surface water risk to the site is predominantly very low. Approximately 2% of the site is within the low risk surface water flood zone, as shown in Table 3-1.

In the low risk event, surface water risk is confined to the northern boundary of the site along Lyon Road where there is present day fluvial risk. There is no modelled surface water risk to the remaining area of the site.

Greatest flood depths within the site in the low risk event are between 0.15 and 0.3 m (Figure 3-1) with areas of hazard classified as moderate (Figure 3-2). Safe access and escape routes should be possible via the B6265 in all events.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
98	2	0	0

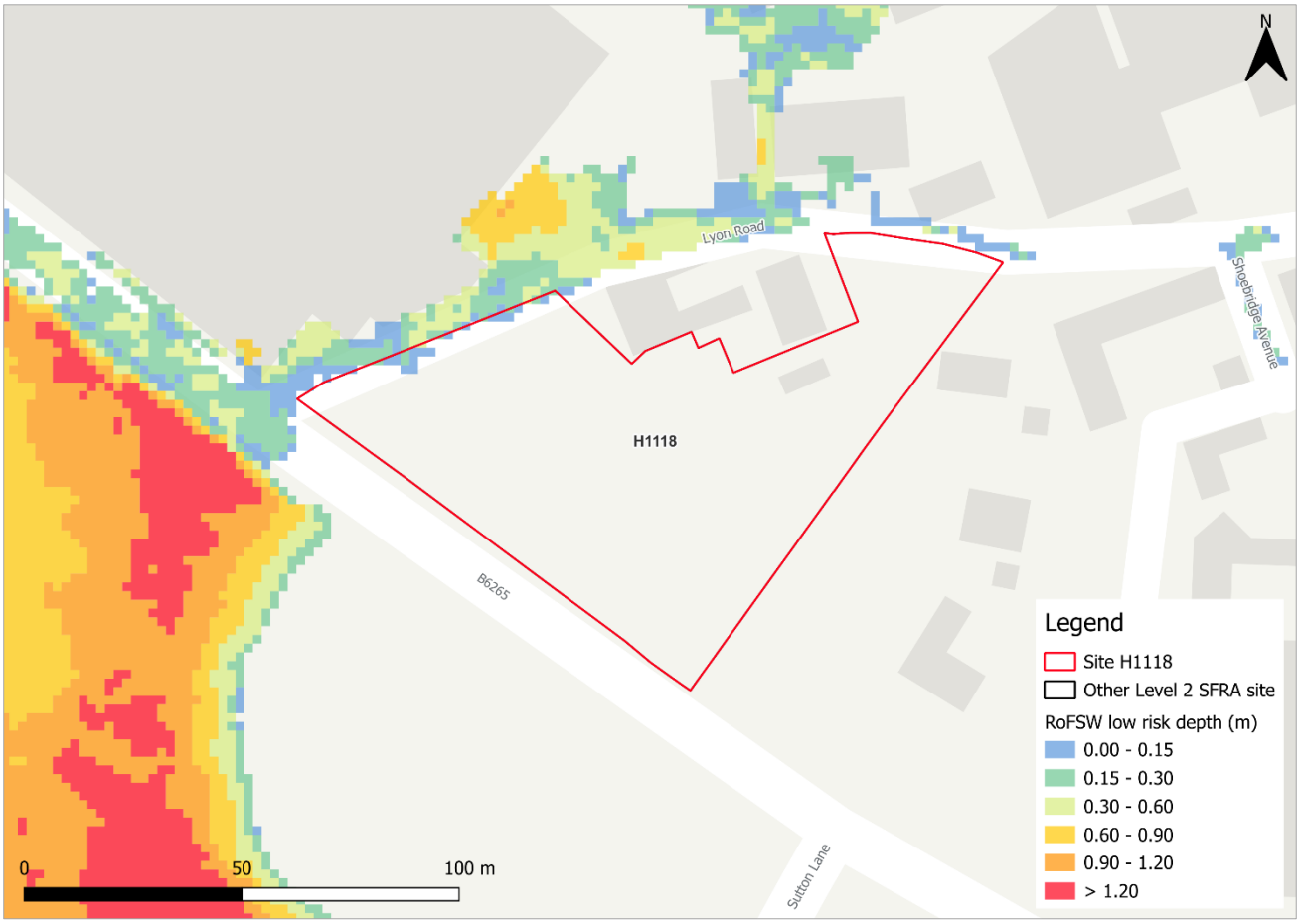


Figure 3-1: Low risk event surface water flood depths (Risk of Flooding from Surface Water map)

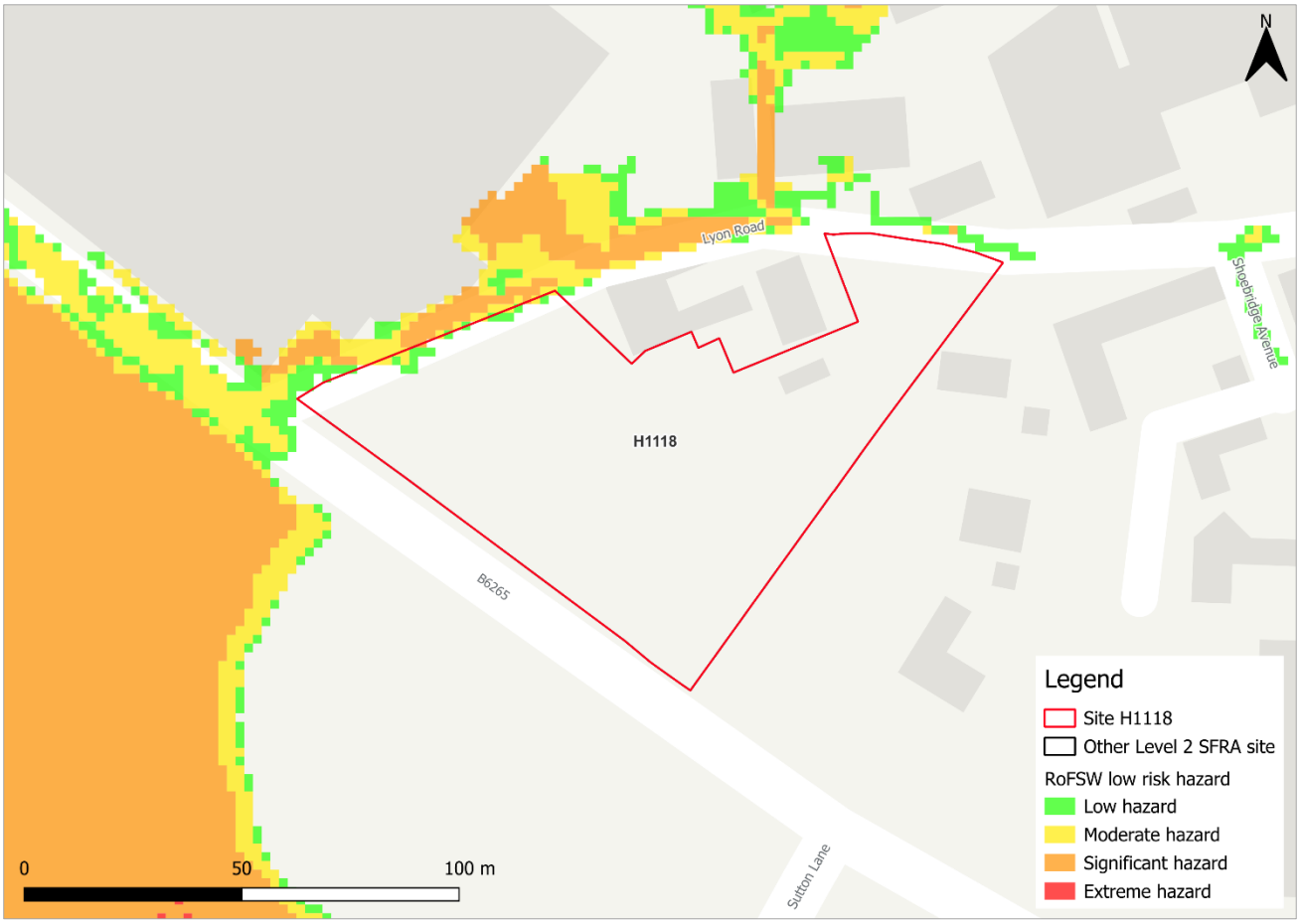


Figure 3-2: Low risk event surface water flood hazard[1] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event +45% climate change. Risk is modelled to be greater than for present day conditions, with the

1 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

medium risk climate change event showing a similar level of risk to the low risk present day event and remaining within the fluvial risk areas. Maximum depths are between 0.15 and 0.3 m with areas of hazard categorised as moderate (Figure 3-4). Safe access and escape routes should remain achievable via the B6265.

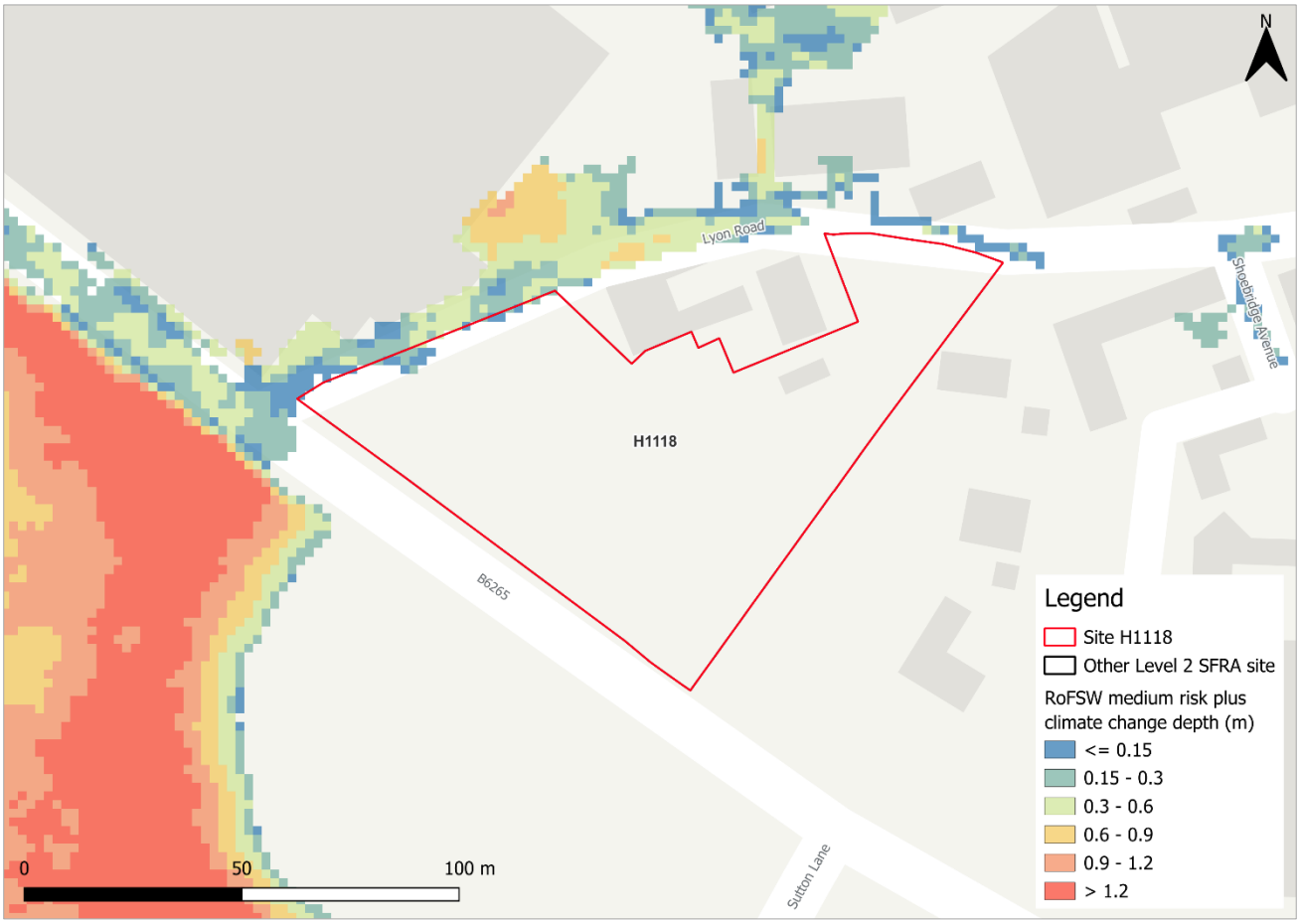


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

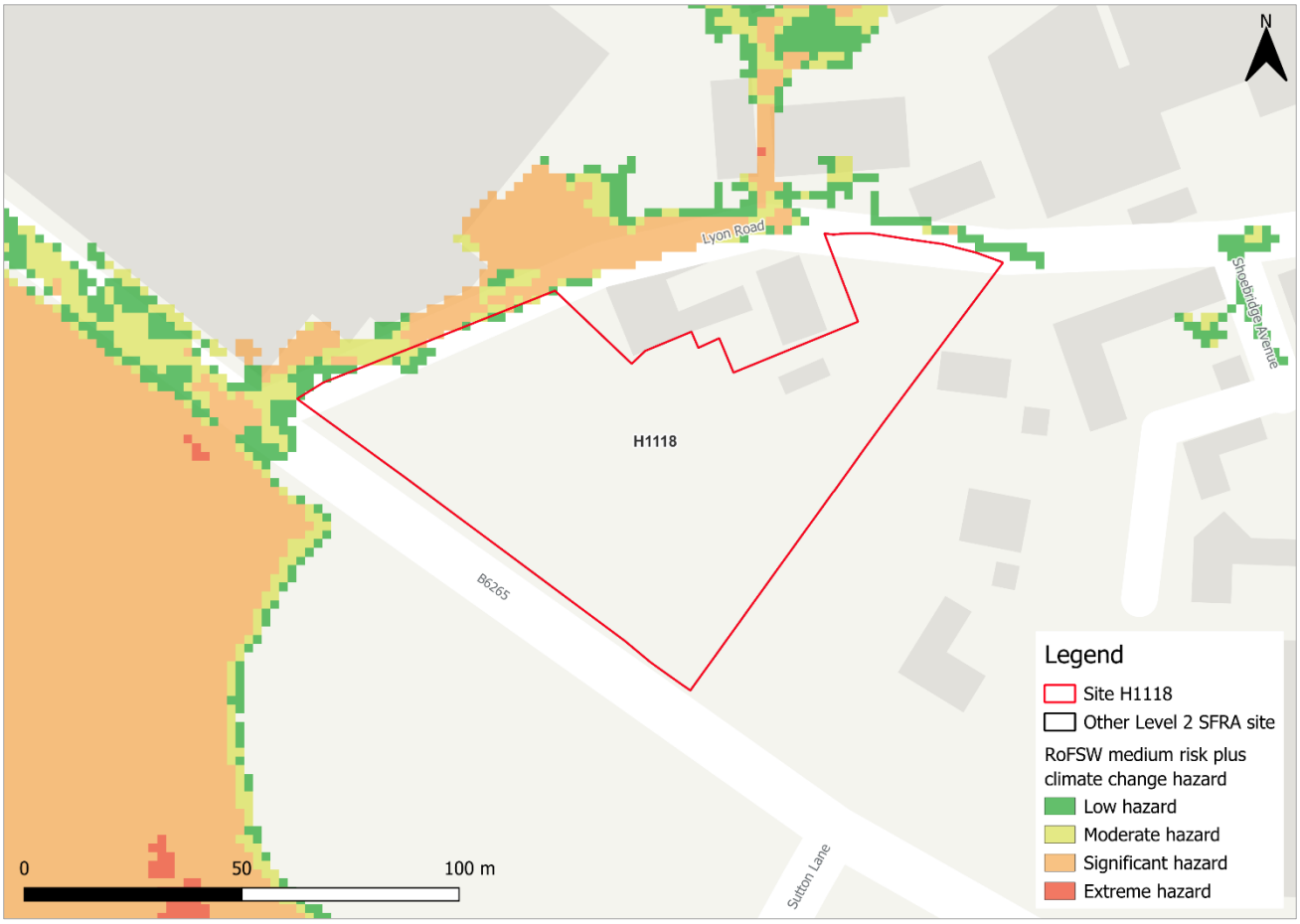


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk to the site is predominantly very low, with approximately 98% of the site being at very low risk. Surface water risk in the low risk event is confined to the northern boundary of the site. Safe access and escape routes should be achievable via the B6265 to the south of the site in all events.
- The modelled medium risk surface water climate change outputs indicate a similar risk to the present day low risk event. Safe access and escape routes should remain achievable via the B6265.
- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[2]. Figure 4-1 shows the map covering this site and the surrounding areas and Table 4-1 explains the risk classifications.

The entirety of the site is in an area where there is no groundwater risk. Groundwater conditions may therefore be suited to infiltration SuDS.



Figure 4-1: JBA 5m Groundwater Emergence Map

2 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

5.1 Flood risk from canals

The site is not likely to be at risk from a canal breach.

5.2 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-1 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is potentially at risk from Coniston Hall Lake located within North Yorkshire, owned and maintained by the owners of the Coniston Hall Estate.

The EA's SFRA guidance states that where a proposed development site is at flood risk from a reservoir, then an assessment into whether the reservoir design or maintenance schedule needs improving should be carried out. Expert advice may be required from an all-reservoirs panel engineer. The Council should consult the reservoir operator to ascertain whether the proposed development could affect the reservoir's risk designation, it's design category or how it is operated. The Council, as category 1 responders, can access more detailed information about reservoir risk and reservoir owners using the Resilience Direct system.



Figure 5-1: Flood risk from reservoirs

5.3 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded, blocked or it cannot discharge due to a high water level in the receiving watercourse.

According to Yorkshire Water's records, there have been no incidents of sewer flooding in the area over the last two years.

5.4 Observations, mitigation options and site suitability - residual risk

- The site is at potential residual risk from a breach of Coniston Hall Lake located in North Yorkshire. However, the site is impacted by the 'wet day' flood extent only which represents a prediction of the credible worst case scenario, therefore it is unlikely that any actual flood would be this large.
- Given the potential reservoir risk to the site, developers should consider[3]:
  - Consulting with the local resilience forum for advice on emergency planning,

3 Reservoir flood maps: when and how to use them | Environment Agency | 2021

- Consulting with relevant reservoir owners to understand the impact development may have on their reservoir, including for potential changes in designation, and
- Use this Level 2 SFRA to understand whether any proposed development will be safe throughout its lifetime.

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is not required to pass part b) of the exception test[4] as it is not located within Flood Zone 3a, however it must still be proven that the development can be safe for its lifetime, which is 100 years for residential development.

6.2 Recommendations, FRA requirements, and further work

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

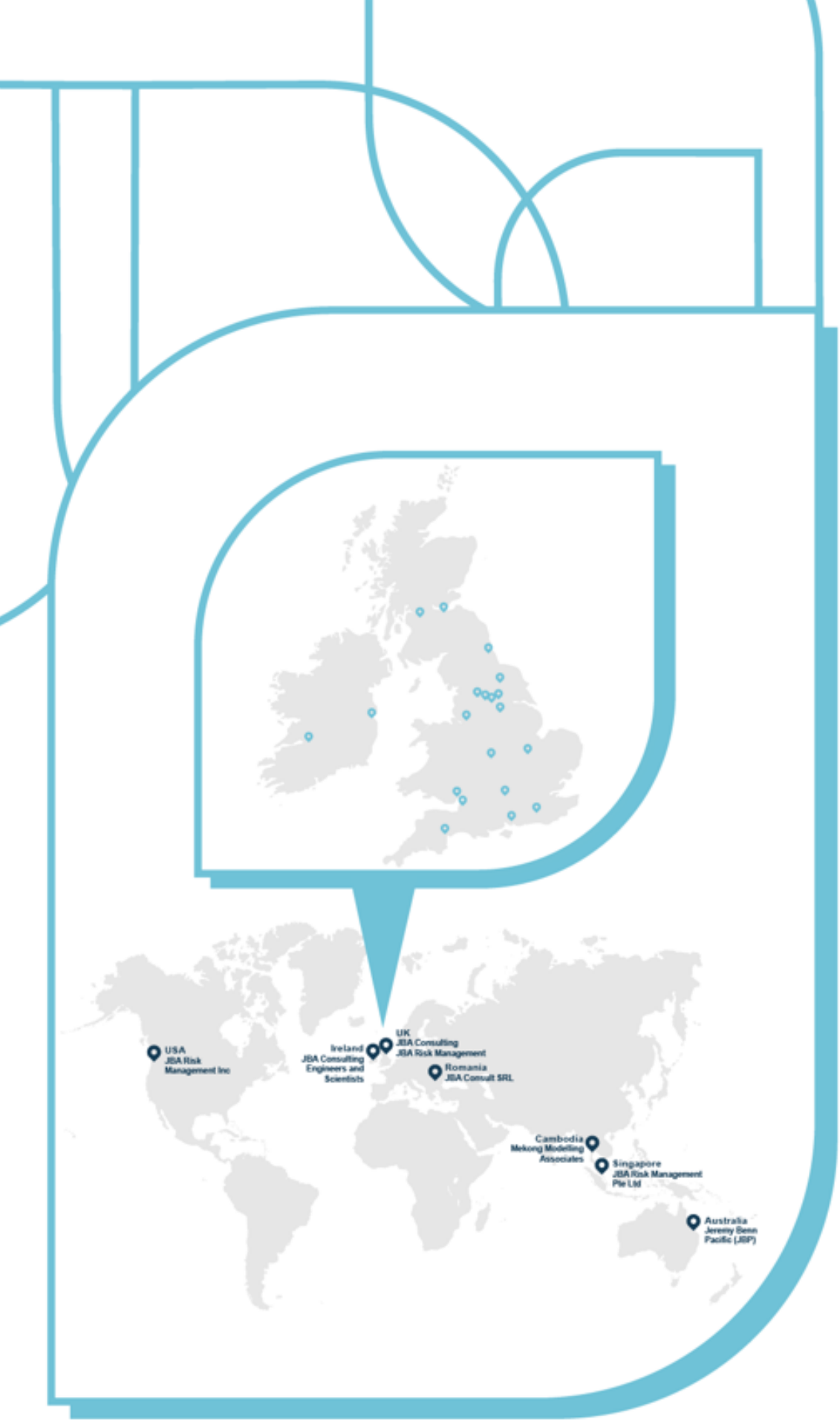
- Updated present day and climate change modelling of Holme Beck and Eastburn Beck should be used to update this Level 2 SFRA at the earliest opportunity to provide an up-to-date strategic assessment of flood risk to this site and the surrounding areas.
- This site could be allocated if development avoids the northern boundary of the site at modelled fluvial and surface water risk. However, the LPA must make it clear that this site cannot be developed until the required information detailed in this SFRA on existing and future flood risk from Holme Beck and Eastburn Beck is fully ascertained.
- Coniston Hall Estate, as owners of Coniston Hall Lake, should be consulted on potential risk to the development and in case of any changes required to the reservoir, including designation.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA online guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

4 Para 178 National Planning Policy Framework 2024

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Bradford Level 2 Strategic Flood Risk Assessment - Site H1353

Final Draft

May 2025

Prepared for:

City of BRADFORD METROPOLITAN DISTRICT COUNCIL

www.jbaconsulting.com

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Contract

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JBA Project Code	2024s1078

This report describes work commissioned by City of Bradford Metropolitan District Council (CBMDC) by an instruction dated 19 July 2024. The Client's representative for the contract was Jonathan Dicken of CBMDC. Freya Nation of JBA Consulting carried out this work.

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Acknowledgements

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1 Background

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1.1 Site H1353

- Location: Summerhill Lane, Steeton-with-Eastburn
- Existing site use: Agricultural
- Existing site use vulnerability: Less vulnerable
- Proposed site use: Housing
- Proposed site use vulnerability: More vulnerable
- Site area: 7.4 hectares
- Proposed development impermeable area: 5.5 hectares
- Watercourse: River Aire (main river)
- Environment Agency (EA) river model: Leeds FAS Kildwick to Esholt 2022
- Summary of requirements from scoping stage:
    - Level 1 SFRA recommendation was for withdrawal from allocation or more detailed assessment through Level 2 SFRA
    - Assessment of modelled fluvial flood depths, velocities and hazards
    - Assessment of surface water flood depths and hazards based on the EA's national Risk of Flooding from Surface Water dataset
    - Assessment of all other sources of flood risk
    - Modelling of latest EA climate change allowances for peak river flows and peak rainfall intensities



Figure 1-1: Existing site location boundary

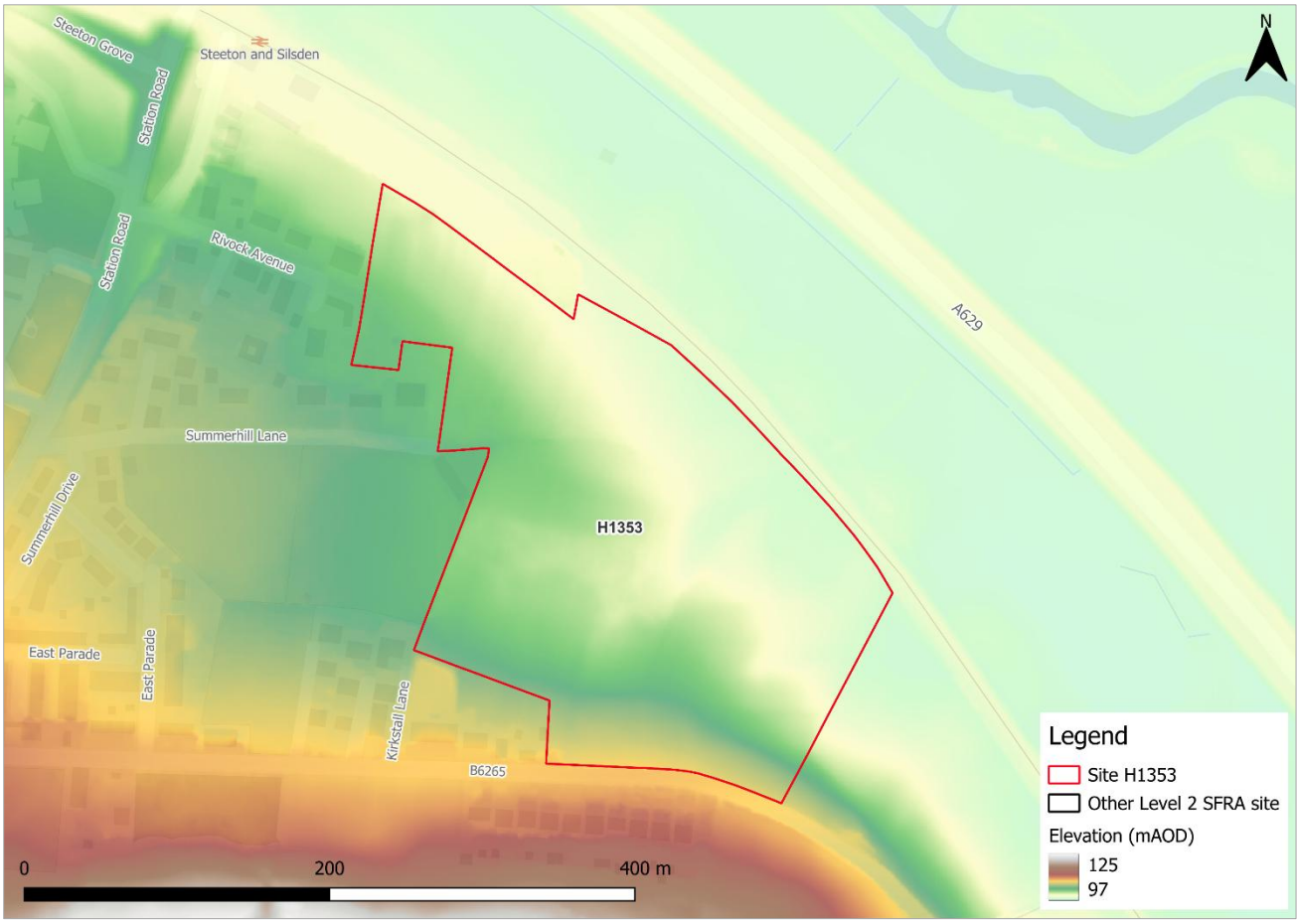


Figure 1-2: Topography

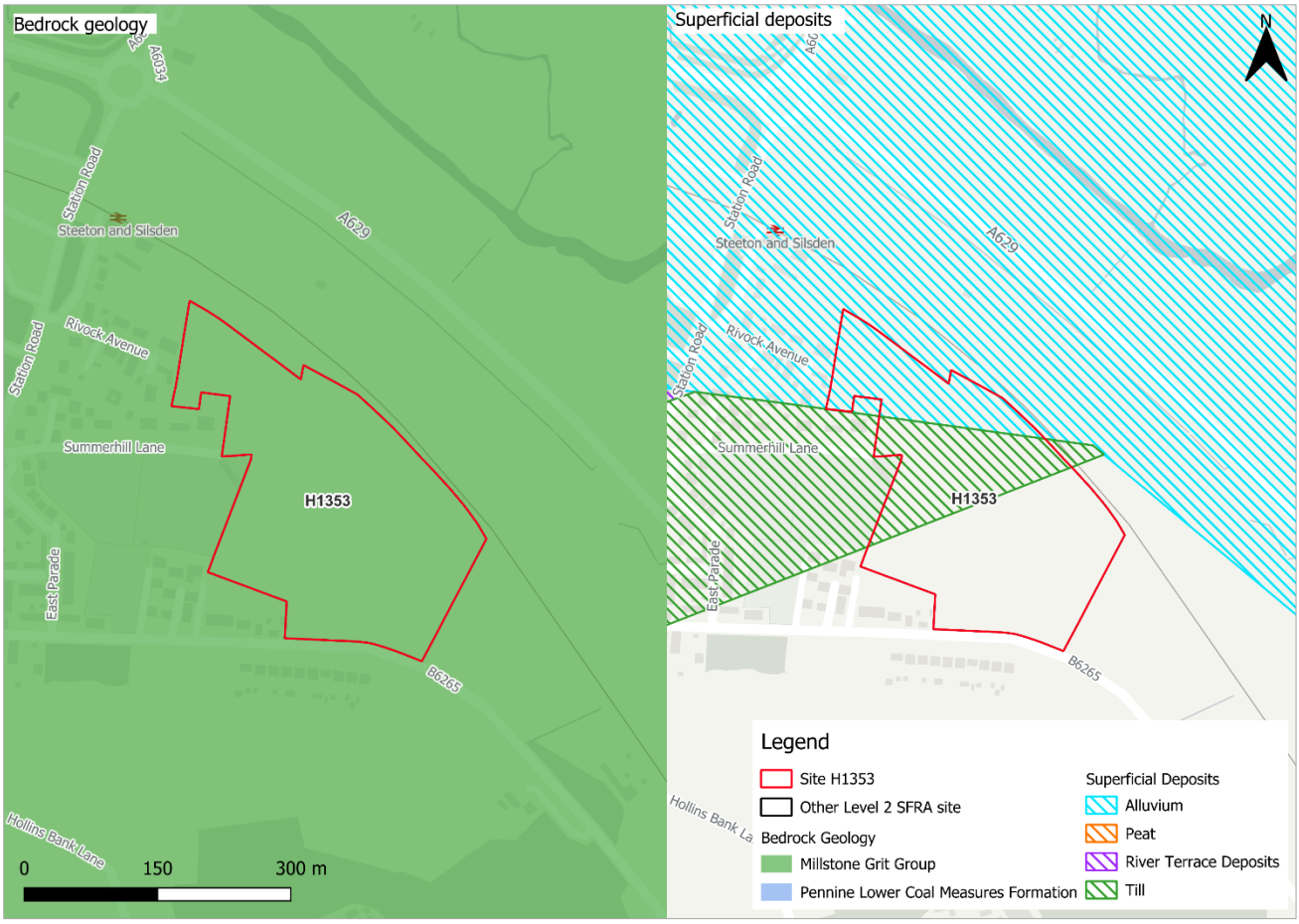


Figure 1-3: Soils and geology

2 Flood risk from rivers

2.1 Existing risk

2.1.1 Flood Map for Planning and functional floodplain

Based on the EA's Flood Map for Planning (September 2024) and Flood Zone 3b (functional floodplain), as updated in this Level 2 SFRA, the percentage areas of the site within each fluvial flood zone are stated in Table 2-1 and can be viewed on Figure 2-1. This version of the Flood Map for Planning does not consider flood defence infrastructure (Section 2.4) or the impacts of climate change (Section 2.2).

Fluvial flood risk to the site comes from the River Aire approximately 250m northeast of the site boundary. The River Aire is a designated main river. Functional floodplain is present within the eastern side of the site. The area of functional floodplain onsite should be left free of development. The functional floodplain in this location is based on the EA's Flood Storage Areas dataset. This dataset shows those areas that act as a balancing reservoir, storage basin or balancing pond. Their purpose is to attenuate an incoming flood peak to a flow level that can be accepted by the downstream channel. It may also delay the timing of a flood peak so that its volume is discharged over a longer time interval. Parts of the northeastern boundary of the site are within Flood Zone 2 and therefore at medium risk of flooding from rivers. The remainder of the site is within Flood Zone 1 and therefore at low risk of flooding from rivers.

Table 2-1: Existing fluvial flood risk based on percentage area of site at risk

Flood Zone 1 (% area)	Flood Zone 2 (% area)	Flood Zone 3a (% area)	Flood Zone 3b (% area)
74	6	0	20

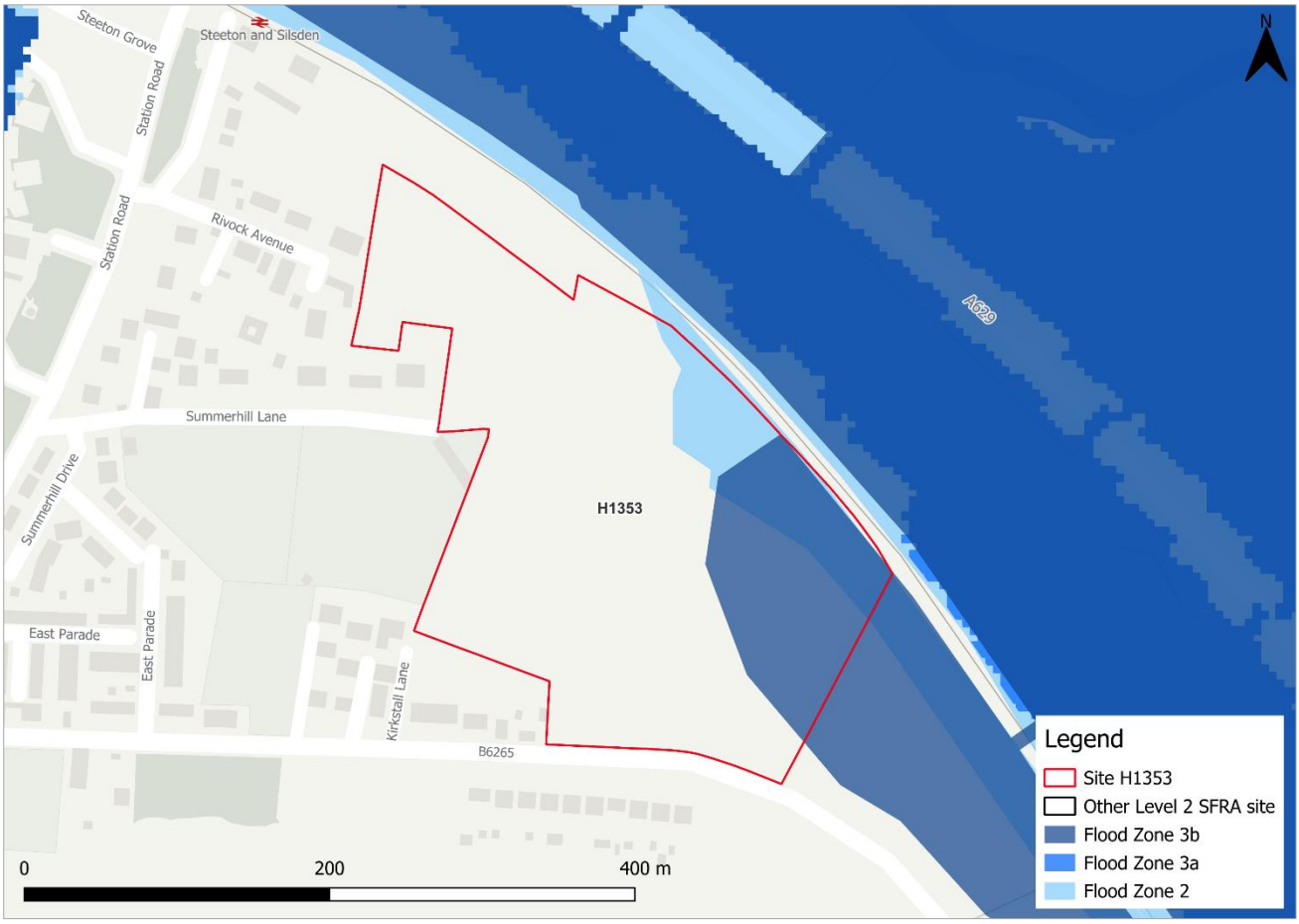


Figure 2-1: Existing risk from rivers to the site

2.1.2 Leeds FAS Kildwick to Esholt 2022 model outputs

Figure 2-2 shows the modelled flood depths for the 0.1% AEP undefended event which is the event Flood Zone 2 of the Flood Map for Planning should be based on. However, modelled risk to the site is different to that shown by Flood Zone 2, in that the modelled 0.1% AEP event is not modelled to enter the site and appears to be contained by the railway embankment. This is because Flood Zone 2 in this area is based on the EA's Historic Flood Map (HFM) dataset, the HFM is as shown in Figure 2-6. Section 2.4.1 discusses the defended model outputs.

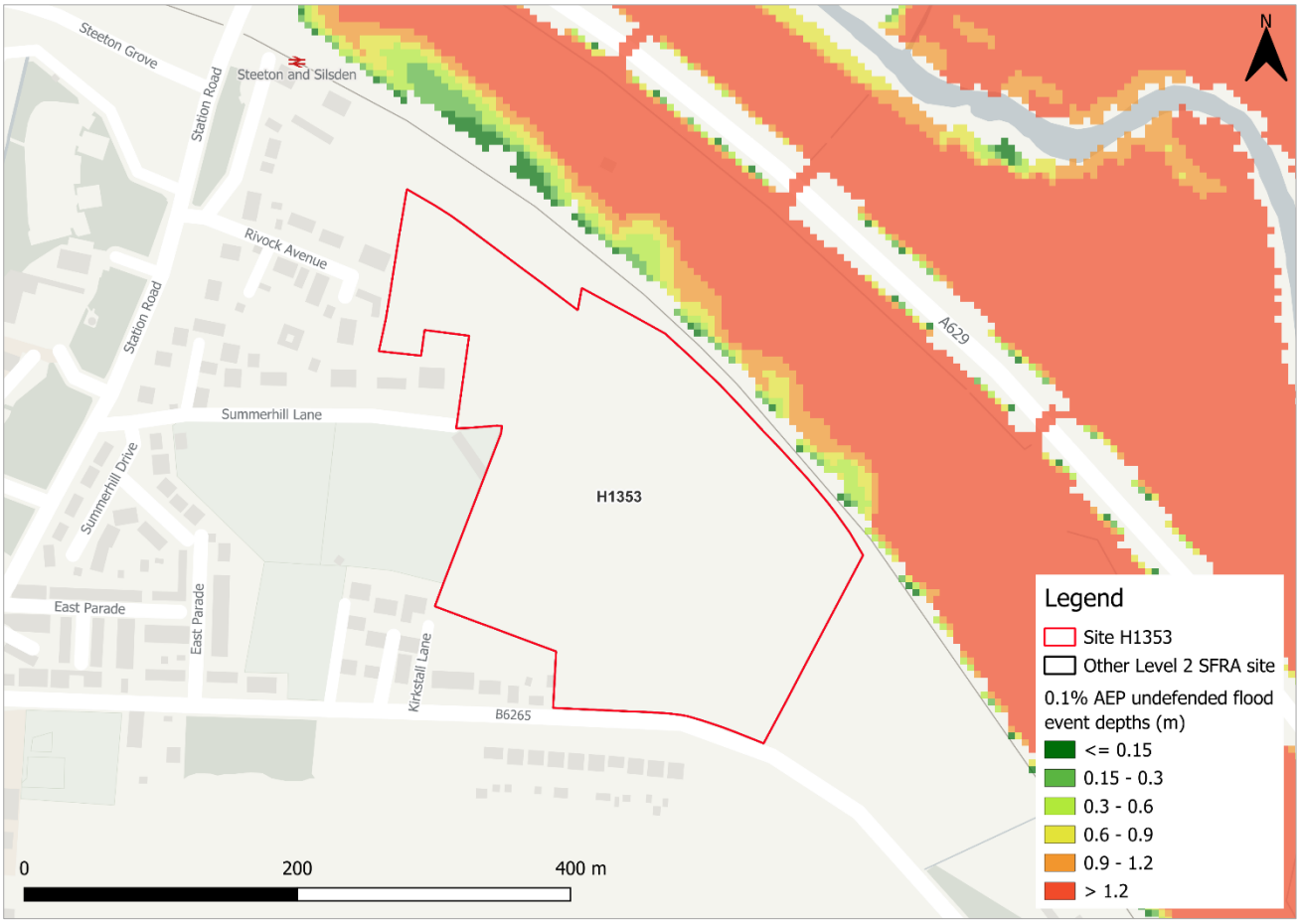


Figure 2-2: Flood depths for 0.1% AEP undefended flood event

2.2 Impacts from climate change

The impacts of climate change on flood risk from the River Aire have been modelled without flood defence infrastructure in place. This allows for direct comparison with the existing risk of the Flood Map for Planning. Section 2.4.1 discusses the defended model outputs.

With consideration of the EA's SFRA guidance, the latest climate change central and higher central allowances have been modelled as shown in Table 2-2. The EA's SFRA guidance states that SFRAs should assess the central allowance for less, more, and highly vulnerable development, and also water compatible development. The higher central should be assessed for essential infrastructure.

Table 2-2: Modelled climate change allowances for peak river flows for the Aire and Calder Management Catchment

Return period (AEP event)	Central allowance 2080s (% increase)	Higher central allowance 2080s (% increase)	Upper end allowance 2080s (% increase)
3.3% (functional floodplain)	23%	31%	51%
1%	23%	31%	51%

Figure 2-3 shows the modelled flood depths for the 0.1% AEP undefended event +23% for climate change. As with present day, flooding is not modelled to enter the site and remains behind the railway embankment. Safe access and escape routes should be achievable via Summerhill Lane or the B6265 during the climate change event.

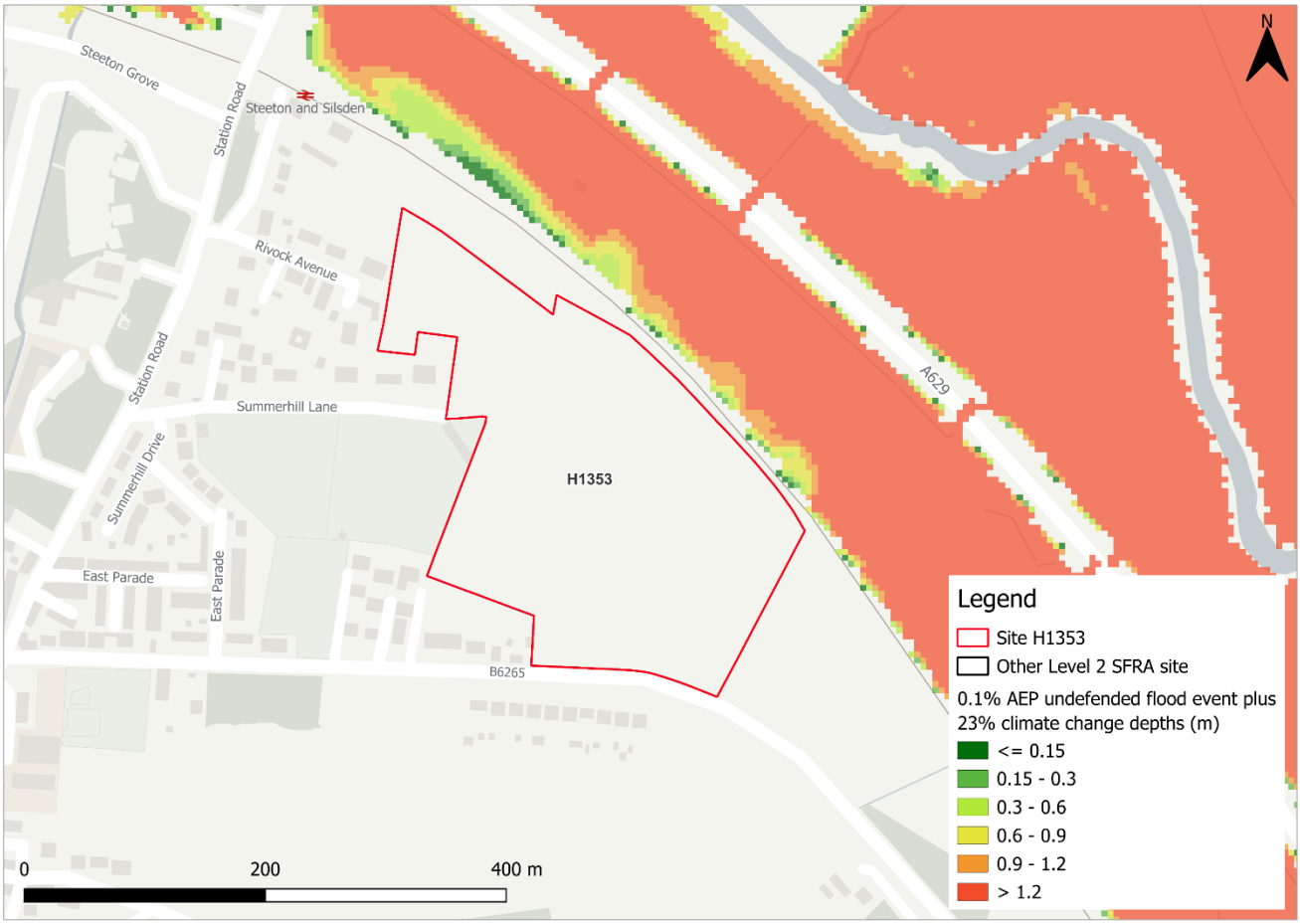


Figure 2-3: Flood depths for 0.1% AEP undefended flood event +23% (central climate change allowance)

2.3 Historic land-use mapping

Historic land-use mapping held by the LLFA indicates a watercourse along Kirkstall Lane and into the southwestern side of the site. This should be confirmed, and the exact location ascertained, through site investigation. Potential flood risk from this watercourse may need to be ascertained at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.

2.4 Flood risk management

2.4.1 Flood defences

The site is located behind engineered high ground, with a standard of protection of 80 years, according to the EA's spatial flood defences dataset. The defended 0.1% AEP

(1000-year event) modelled flood extent and depths are very similar to the undefended event (Figure 2-4) Flooding does not enter the site during either event. This is consistent with the modelled climate change events. The railway embankment to the north likely protects the site during flood events.

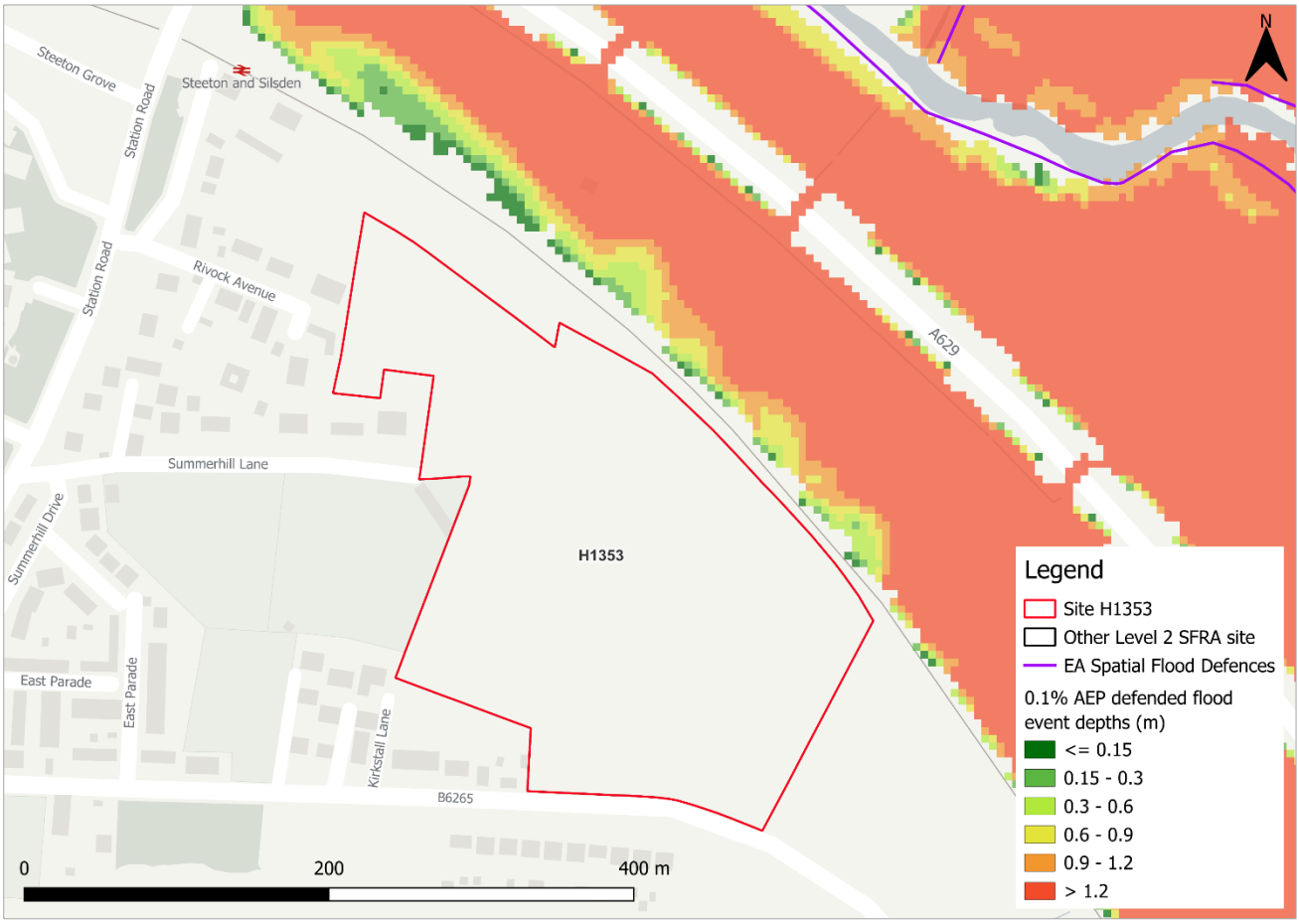


Figure 2-4: Flood depths for 0.1% AEP defended flood event

2.4.2 Working with Natural Processes

The EA's Working with Natural Processes (WwNP) dataset has been interrogated to identify opportunities for Natural Flood Management (NFM) that may help to reduce flood risk to the site and surrounding areas. Across the site, there is potential for tree planting indicating locations where woodland and floodplain planting may be possible and effective to attenuate flooding. There is also potential for runoff attenuation during the 3.3% and 1% AEP events along the northeastern site boundary and through the centre of the site. These areas are shown in Figure 2-5. The WwNP mapping is broadscale and indicative. Further investigation is required for any land shown to have potential for WwNP.

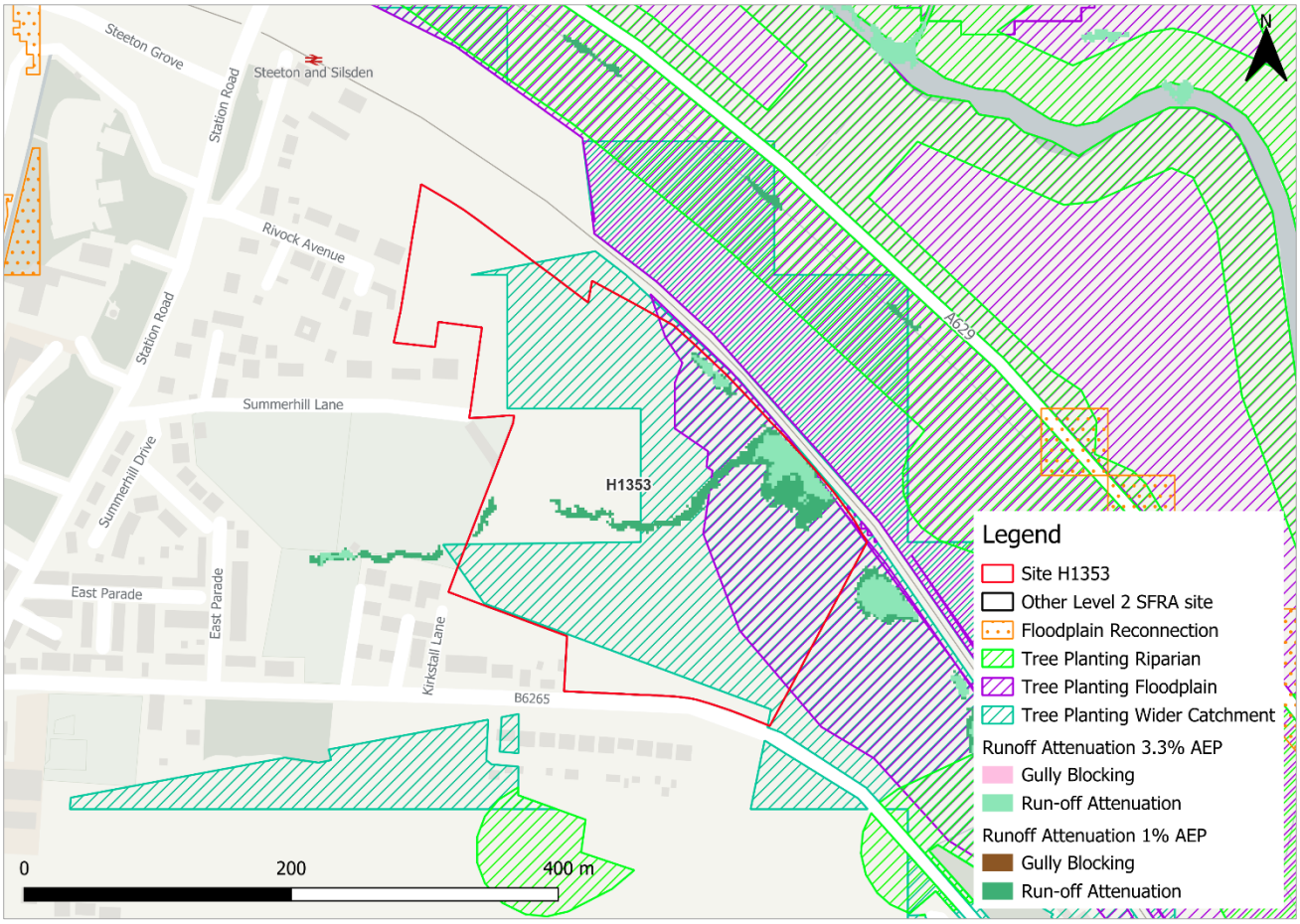


Figure 2-5: Natural Flood Management (NFM) potential mapping

2.5 Historic flood incidents

The EA's Historic Flood Map (HFM) has been considered and mapped in Figure 2-6 which shows the south eastern side of the site has been subject to flooding in the past. The RFO dataset indicates that these historic events have occurred as a result of the channel capacity of the River Aire being exceeded in October 2000 and in December 2015. The EA has included this area of the HFM in Flood Zone 2.

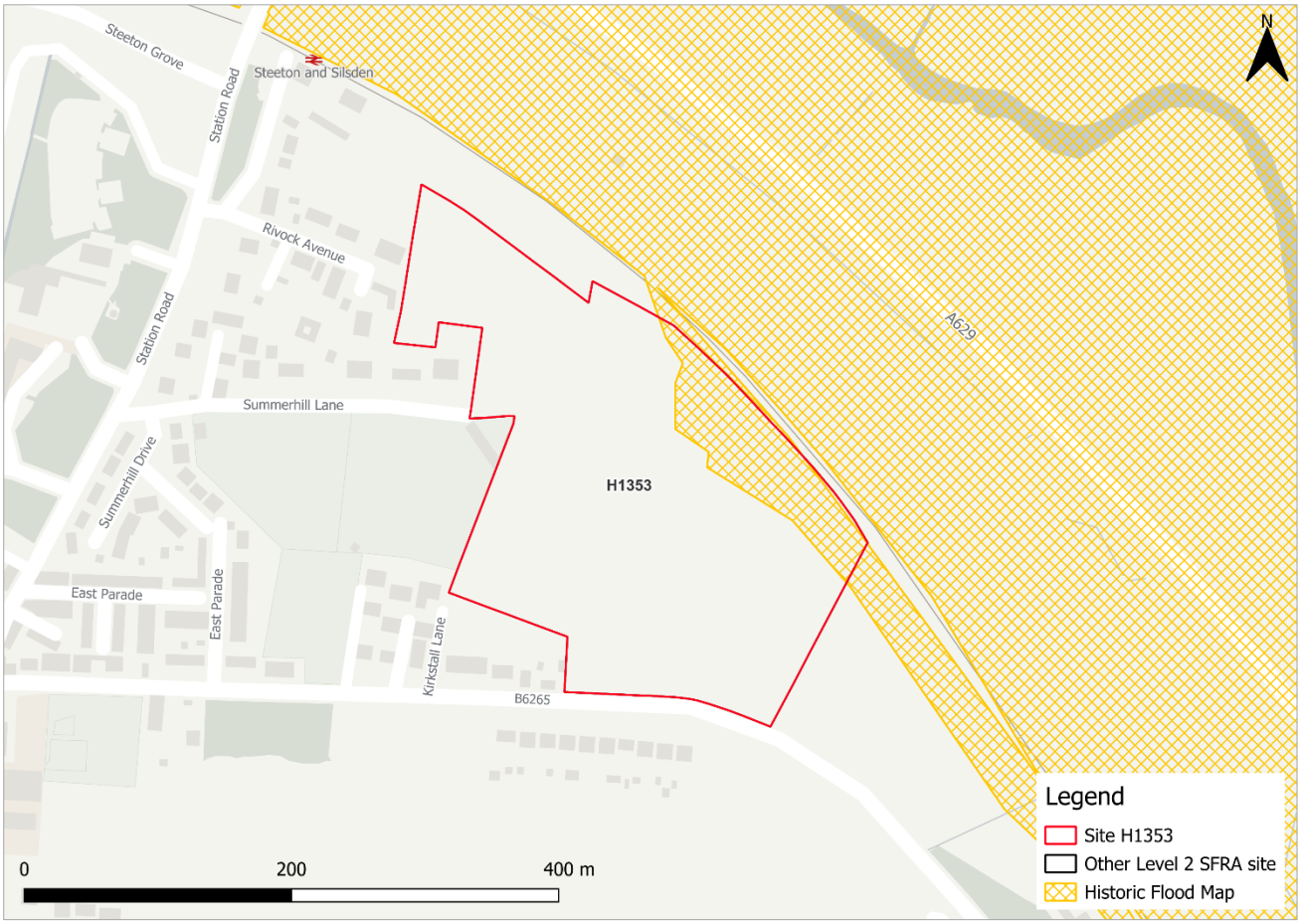


Figure 2-6: Recorded historic flood events onsite and around the site

2.6 LLFA flood incidents

The LLFA have record of two flood incidents to the west of the site, which occurred in 2003 and 2019. Developers should contact the LLFA for further information at the FRA stage, to assess potential flood risk to the site associated with these incidents.

2.7 Flood warning and access and escape routes

The EA operates a Flood Warning Service for properties located within a Flood Warning Area (FWA) for when a flood event is expected to occur. The site is not located within a FWA.

Flood alerts may be issued before a flood warning for properties located within a Flood Alert Area (FAA) to provide advance notice of the possibility of flooding. A flood alert may be issued when there is less confidence that flooding will occur in a FWA. The eastern side of the site is located within a FAA, namely 123WAF960 - Upper River Aire catchment.

Based on available information, safe access and escape routes would likely be achievable via Summerhill Lane or the B6265 during a flood event.

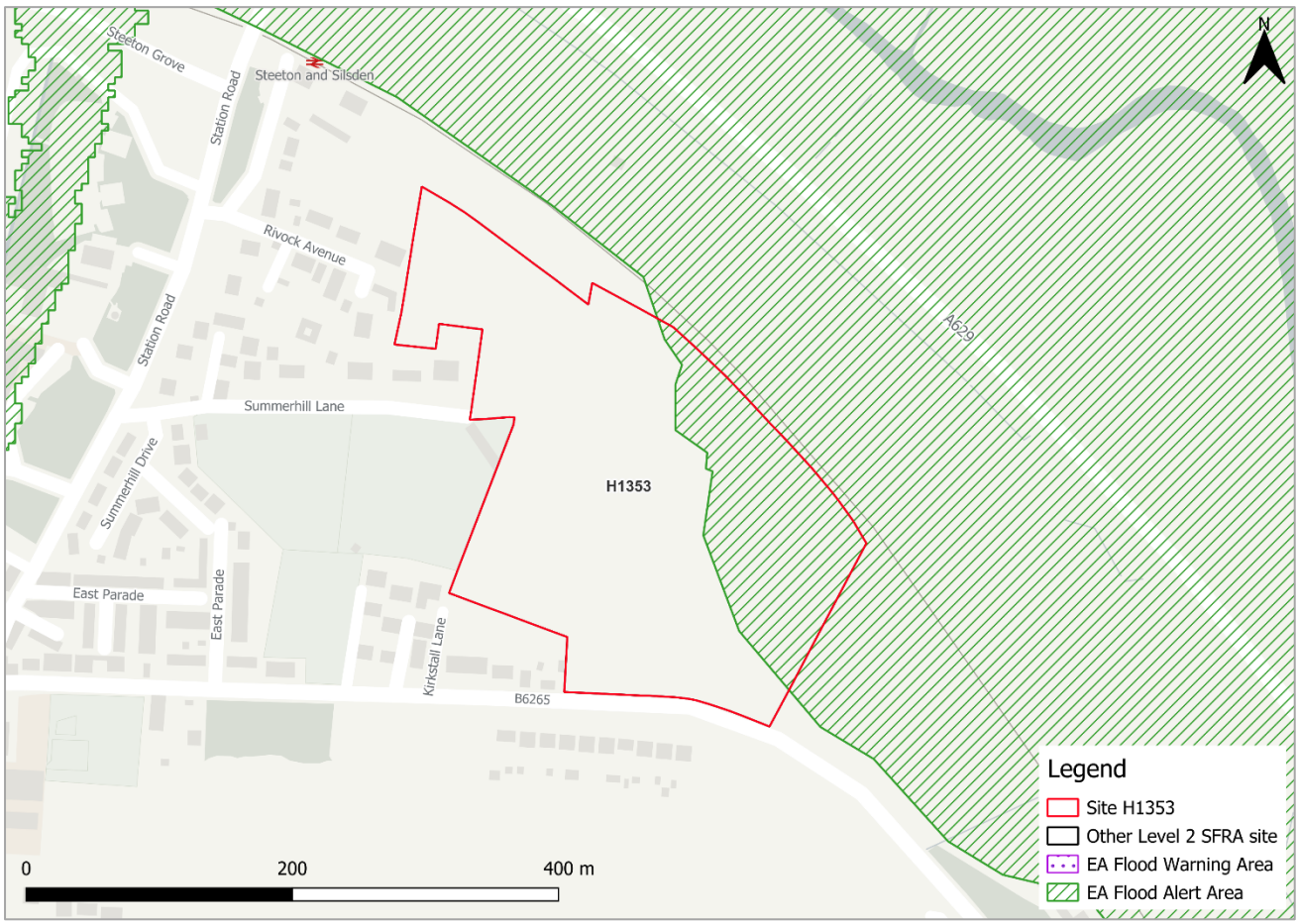


Figure 2-7: EA Flood Warning Areas and Flood Alert Areas

2.8 Observations, mitigation options and site suitability - fluvial

- The proposed development of the site would see a change in the risk classification from less vulnerable to more vulnerable, according to the NPPF.
- Given the change in use and therefore vulnerability of the site, the FRA must show that the development can be designed to be safe and that there is adequate emergency planning provision (para 014 FRCC-PPG).
- The site is within the functional floodplain along the northeastern boundary of the site, adjacent to the River Aire, based on an EA Flood Storage Area. Development is not permitted within the functional floodplain. This area must be left as open greenspace to enable it to function as a designated Flood Storage Area.
- The site is not modelled to be at risk of flooding from the River Aire despite being within Flood Zone 2 of the EA's Flood Map for Planning. Flood Zone 2 is based on the EA's Historic Flood Map in this location due to two flood events occurring in October 2000 and in December 2015.
- Potential flood risk from the watercourse shown in historic land-use mapping to enter the site may need to be ascertained at the FRA stage. No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.

- If a watercourse is identified, it may need to be modelled to quantify the risk from any culverts.
- Assuming a culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- The site-specific FRA must show that development will be safe for its lifetime taking account of the vulnerability of its users, including for appropriate evacuation procedures and flood response infrastructure are in place to manage the fluvial risk associated with the extreme flood event.
- EA flood alerts should continue to be in place to ensure early evacuation of site users before an extreme flood event occurs.

3 Flood risk from surface water

3.1 Existing risk

Based on the EA's national scale Risk of Flooding from Surface Water (RoFSW) map (November 2024), surface water risk to the site is predominantly very low. Approximately 2% of the site is at high surface water risk. A further 4% of the site is at medium risk and a further 8% is at low surface water risk, as shown in Table 3-1.

In the high risk event, surface water risk is confined to two areas of ponding within topographic low spots along the northeastern boundary of the site against the railway embankment. These areas of ponding are modelled to increase in extent and depth in the medium and low risk events. Ponding expands and joins into a flow path across the centre of the site and through the park (playing fields) to the west of the site as well as along East Parade.

Greatest flood depths within the site in the medium risk event are between 0.6 and 0.9 m (Figure 3-1) with hazard categorised as low in the flow path across the centre of the site, largely moderate within the larger area of ponding and a small area is modelled to be significant at the centre of this ponding (Figure 3-2). Safe access and escape routes via Summerhill Lane or the B6265 should be achievable given the modelled surface water flood depths along this route during the extreme event.

Table 3-1: Existing surface water flood risk based on percentage area at risk using the RoFSW map

Very low risk (% area)	Low risk (% area)	Medium risk (% area)	High risk (% area)
86	8	4	2

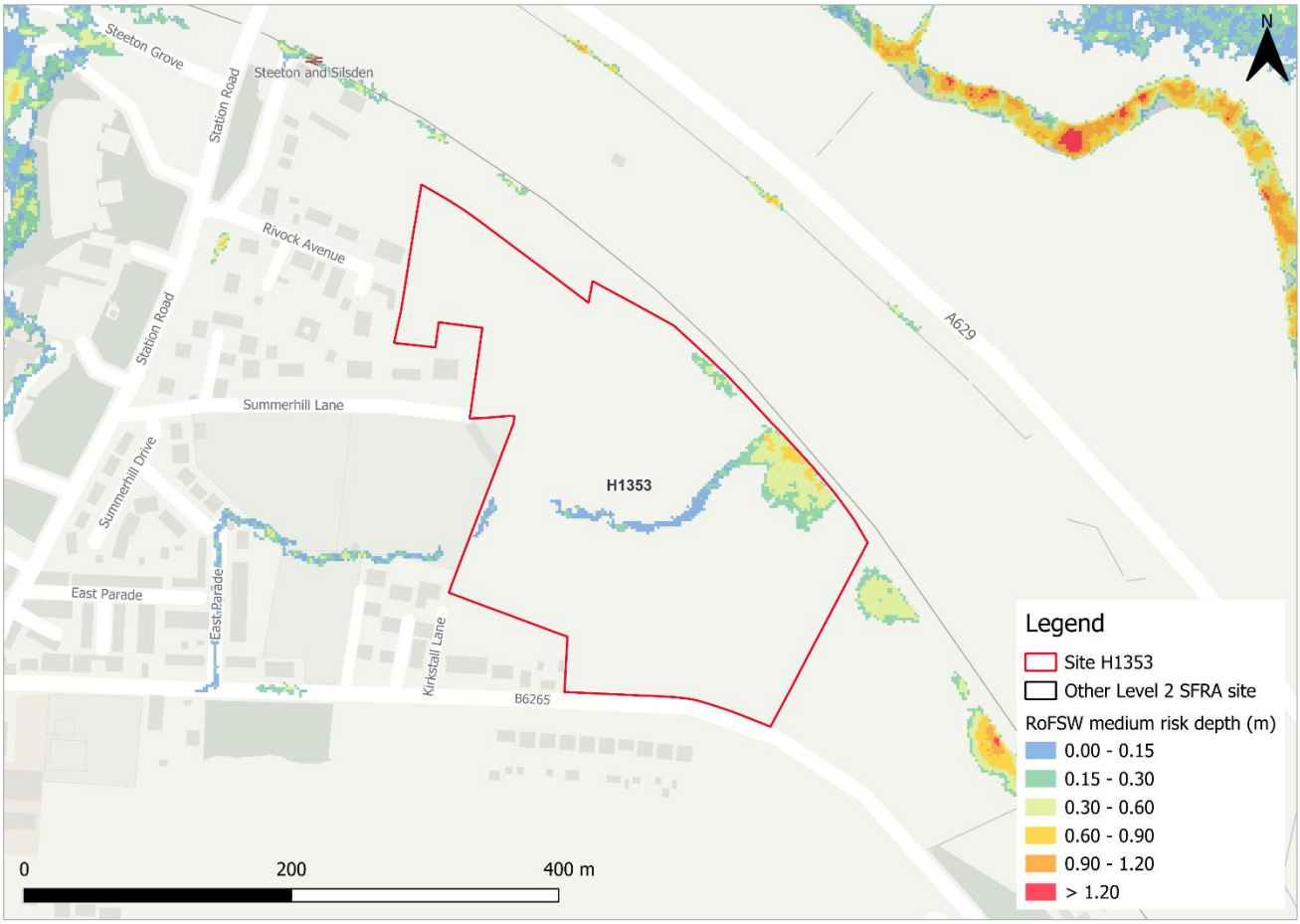


Figure 3-1: Medium risk event surface water flood depths (Risk of Flooding from Surface Water map)

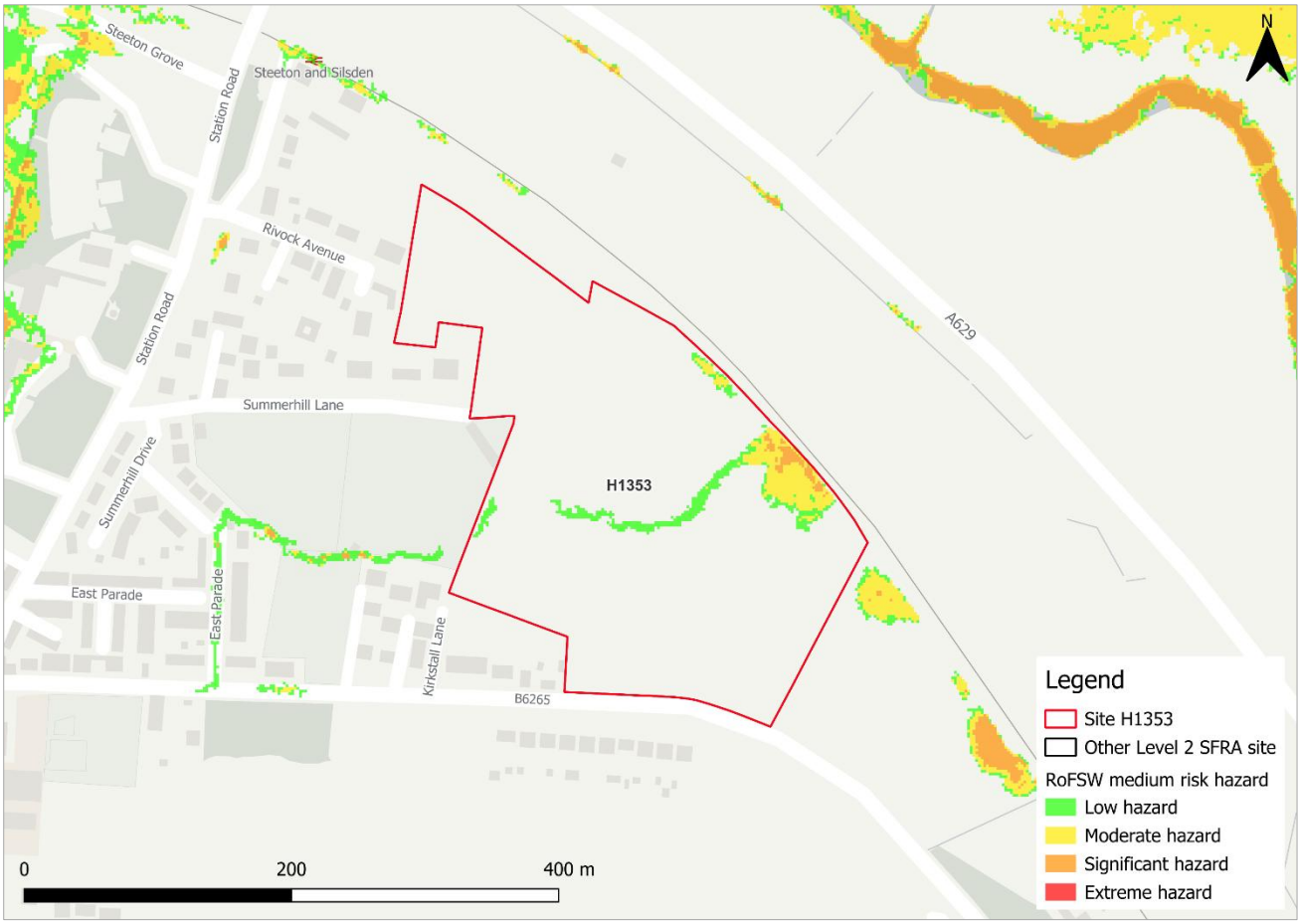


Figure 3-2: Medium risk event surface water flood hazard[1] (Risk of Flooding from Surface Water map)

3.2 Impacts from climate change

The impact of climate change on surface water flood risk has been modelled. This allows for direct comparison with the RoFSW map. With consideration of the EA's SFRA guidance, the latest climate change allowances have been modelled as shown in Table 3-2.

Table 3-2: Modelled climate change allowances for rainfall for the Aire and Calder management catchment

Return period	Central allowance 2070s (% increase)	Upper end allowance 2070s (% increase)
3.3% (high risk)	25%	40%
1% (medium risk)	30%	45%

Figure 3-3 shows the modelled surface water flood depths for the medium risk event plus 45% climate change. Risk is modelled to be greater than for present day conditions, with

1 Based on Section 7.5 Hazard rating. What is the Risk of Flooding from Surface Water map? Report version 2.0. April 2019. Environment Agency

the medium risk climate change event showing a similar level of risk to the present day low risk event. The flow path and area of ponding become significant. Maximum depths are modelled to be up to >1.2 m, with areas of hazard categorised as significant along the northwestern site boundary (Figure 3-4). Safe access and escape routes should remain achievable via Summerhill Lane or the B6265 during the climate change event.

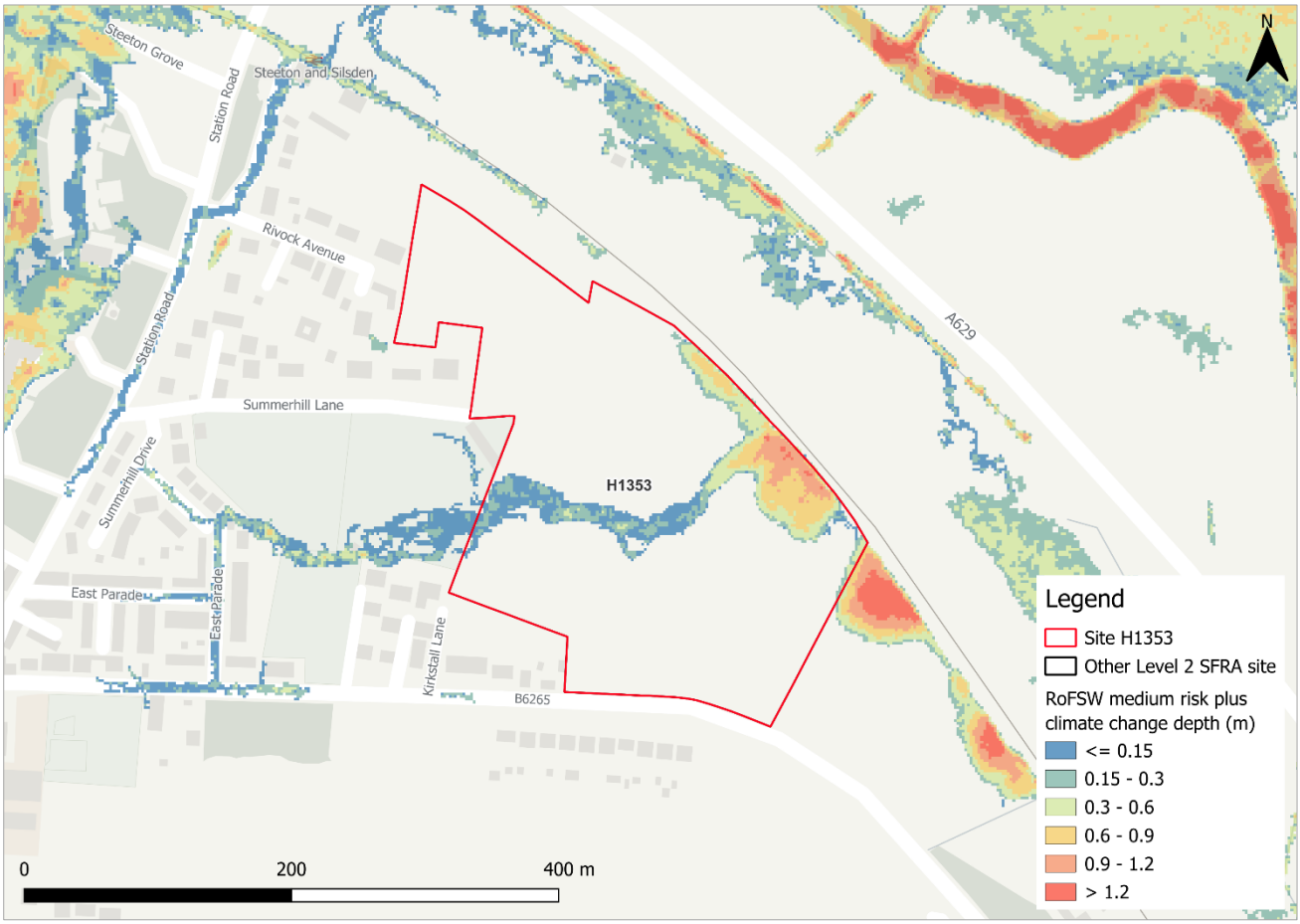


Figure 3-3: Medium risk event surface water flood depths plus 45% climate change (based on Risk of Flooding from Surface Water map)

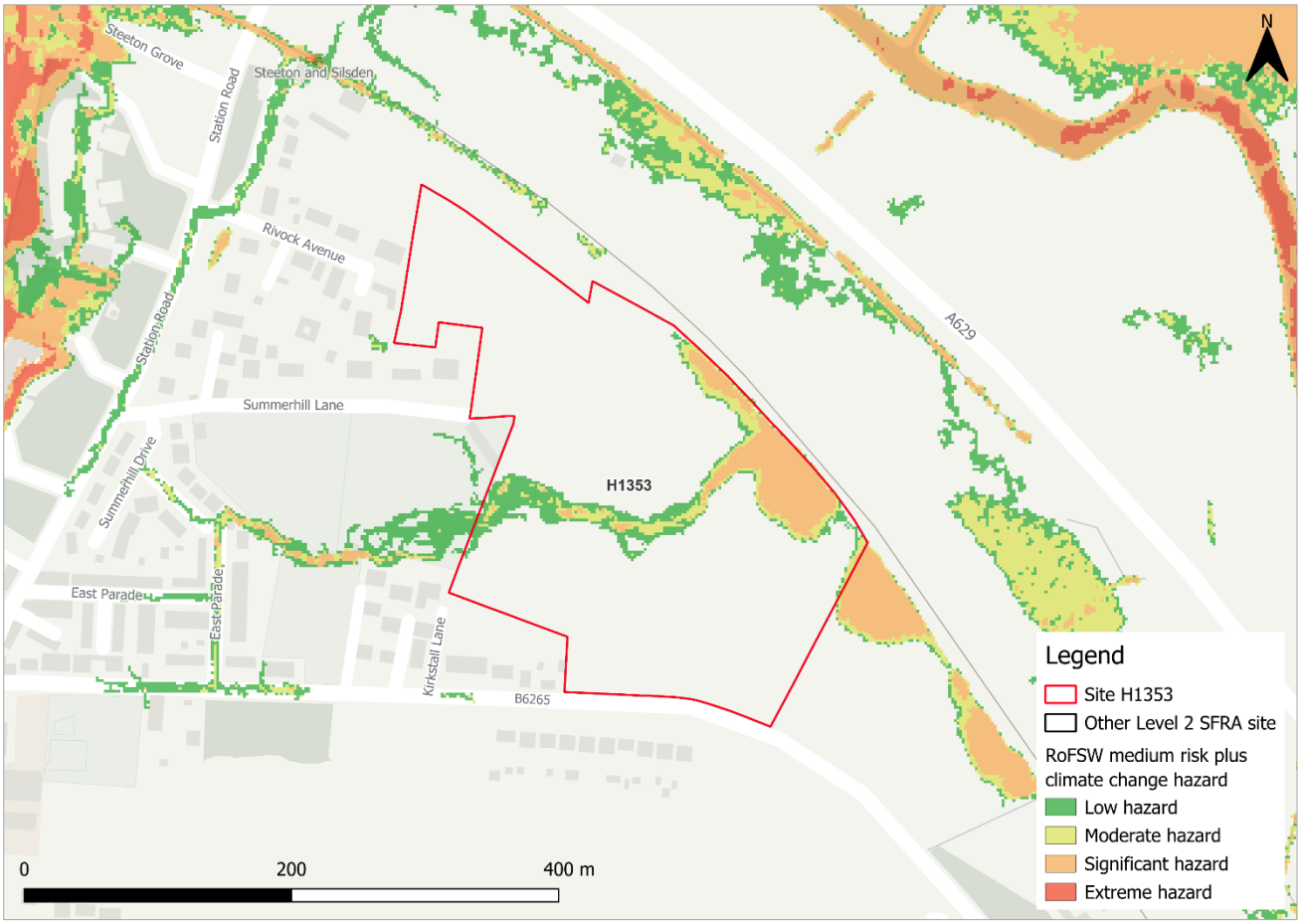


Figure 3-4: Medium risk event surface water flood hazards plus 45% climate change (based on Risk of Flooding from Surface Water map)

3.3 Observations, mitigation options and site suitability - surface water

- Current risk is significant within the northeastern area of the site and climate change is modelled to increase the flow path and area of ponding to significant levels. The flow routes and area of ponding should be considered and included in site design and ideally left in place to flood naturally when required. The area of surface water ponding is within Flood Zone 2. Any regrading of land must include like for like volumes to ensure risk is contained safely onsite for the lifetime of development.
- Safe access and escape routes should remain achievable via Summerhill Lane or the B6265 during the extreme event.
- A full drainage strategy would be required to ensure there is no increase in surface water flood risk elsewhere as a result of new development. This may require surface water modelling based on layout plans and detailed design and full consultation with the LLFA. Runoff volumes must not exceed existing greenfield rates and, if possible, betterment should be achieved.
- Note that the RoFSW map is not suitable for identifying whether an individual property will flood and is therefore indicative. The RoFSW map is not appropriate to act as the sole evidence for any specific planning or regulatory decision or

assessment of risk in relation to flooding at any scale without further supporting studies or evidence.

4 Risk from groundwater

Risk of groundwater emergence is assessed in this SFRA using JBA's 5m Groundwater Emergence Map. This dataset is recommended for use by the EA in the SFRA Good Practice Guide[2]. Figure 4-1 shows the map covering this site and the surrounding areas and. Table 4-1 explains the risk classifications.

The northern, eastern and southern perimeter of the site is located within an area where there is no risk of groundwater emergence. Along the western site boundary and within the centre of the site, there is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely. There is also a small area at the centre of the site where there is a risk of groundwater flooding to surface and subsurface assets, and of groundwater emerging at the surface locally. Groundwater conditions may therefore be suited to infiltration SuDS across the majority of the site, with the exception of the small area at the centre.

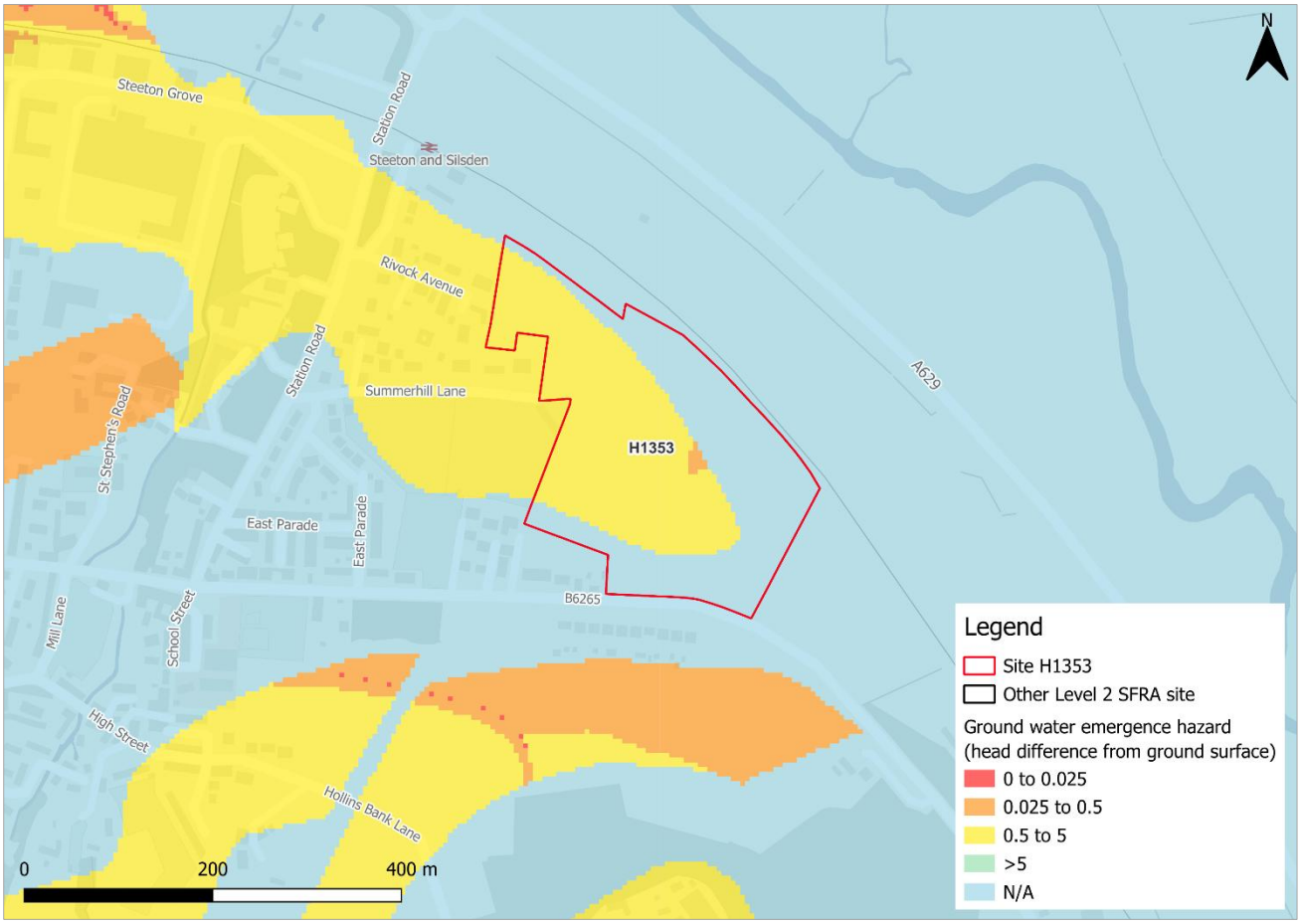


Figure 4-1: JBA 5m Groundwater Emergence Map

2 Strategic flood risk assessment good practice guide. ADEPT. December 2021.

Table 4-1: Groundwater Hazard Classification

Groundwater head difference (m)*	Class label
0 to 0.025	Groundwater levels are either at very near (within 0.025m of) the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
0.025 to 0.5	Groundwater levels are between 0.025m and 0.5m below the ground surface in the 100-year return period flood event. Within this zone there is a risk of groundwater flooding to surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
0.5 to 5	Groundwater levels are between 0.5m and 5m below the ground surface in the 100-year return period flood event There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
>5	Groundwater levels are at least 5m below the ground surface in the 100-year return period flood event. Flooding from groundwater is not likely.
N/A	No risk. This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.
*Difference is defined as ground surface in mAOD minus modelled groundwater table in mAOD.	

5 Residual risk

5.1 Potential culvert

Historic land-use mapping held by the LLFA, indicates that there may be a watercourse culverted beneath the southwestern side of the site. If a watercourse is present, there will be a residual risk of flooding to the site were there to be a culvert failure or blockage. A model for this watercourse is not available. Therefore, residual risk could not be modelled for this Level 2 SFRA.

5.2 Flood risk from reservoirs

The EA's Reservoir Flood Maps (RFM) (2021) show where water may go in the unlikely event of a reservoir or dam failure. Figure 5-1 shows the RFM in a 'dry day' and 'wet day' scenario. A 'dry day' scenario assumes that the water level in the reservoir is the same as the spillway level or the underside of the roof for a service reservoir and the watercourses upstream and downstream of the reservoir are at a normal level. A 'wet day' scenario assumes a worst-case scenario where a reservoir releases water held on a 'wet day' when local rivers have already overflowed their banks.

The site is not modelled to be at risk of flooding from reservoirs.

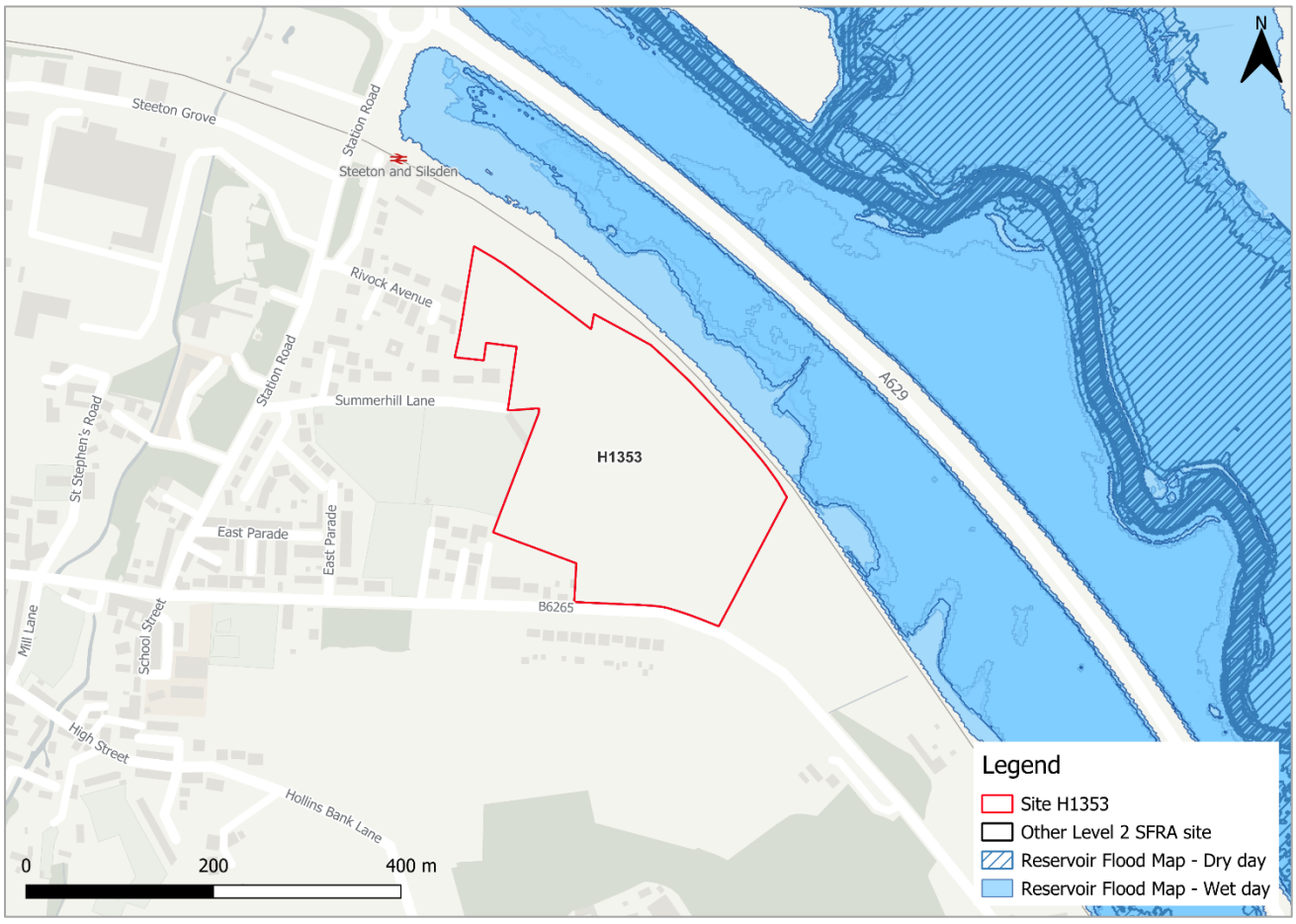


Figure 5-1: Flood risk from reservoirs

5.3 Flood risk from sewers

Flooding from the sewer network can occur when flow entering the system, such as an urban storm water drainage system, exceeds its available discharge capacity, the system becomes overloaded or blocked, or it cannot discharge due to high water levels in the receiving watercourse.

Yorkshire Water records indicate that there have been historical flood incidents in the area over the last two years. Developers should contact Yorkshire Water directly to check specific details at the FRA stage.

5.4 Observations, mitigation options and site suitability - residual risk

- The site is not modelled to be at residual risk of reservoir flooding.
- Historic mapping indicates there may be a watercourse culverted beneath the southwestern side of the site. If present, the culvert represents potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage.
- Given the historic sewer flooding in the area, developers should contact Yorkshire Water directly to check specific details at the FRA stage.

6 Overall site assessment

6.1 Can part b) of the exception test be passed?

This site is not required to pass part b) of the exception test[3], given it is proposed for more vulnerable uses and is not located within Flood Zone 3a. However, there is an area of functional floodplain onsite which must not be developed.

6.2 Recommendations, FRA requirements, and further work

Based on the evidence presented in the Level 1 SFRA (2023) and this Level 2 SFRA:

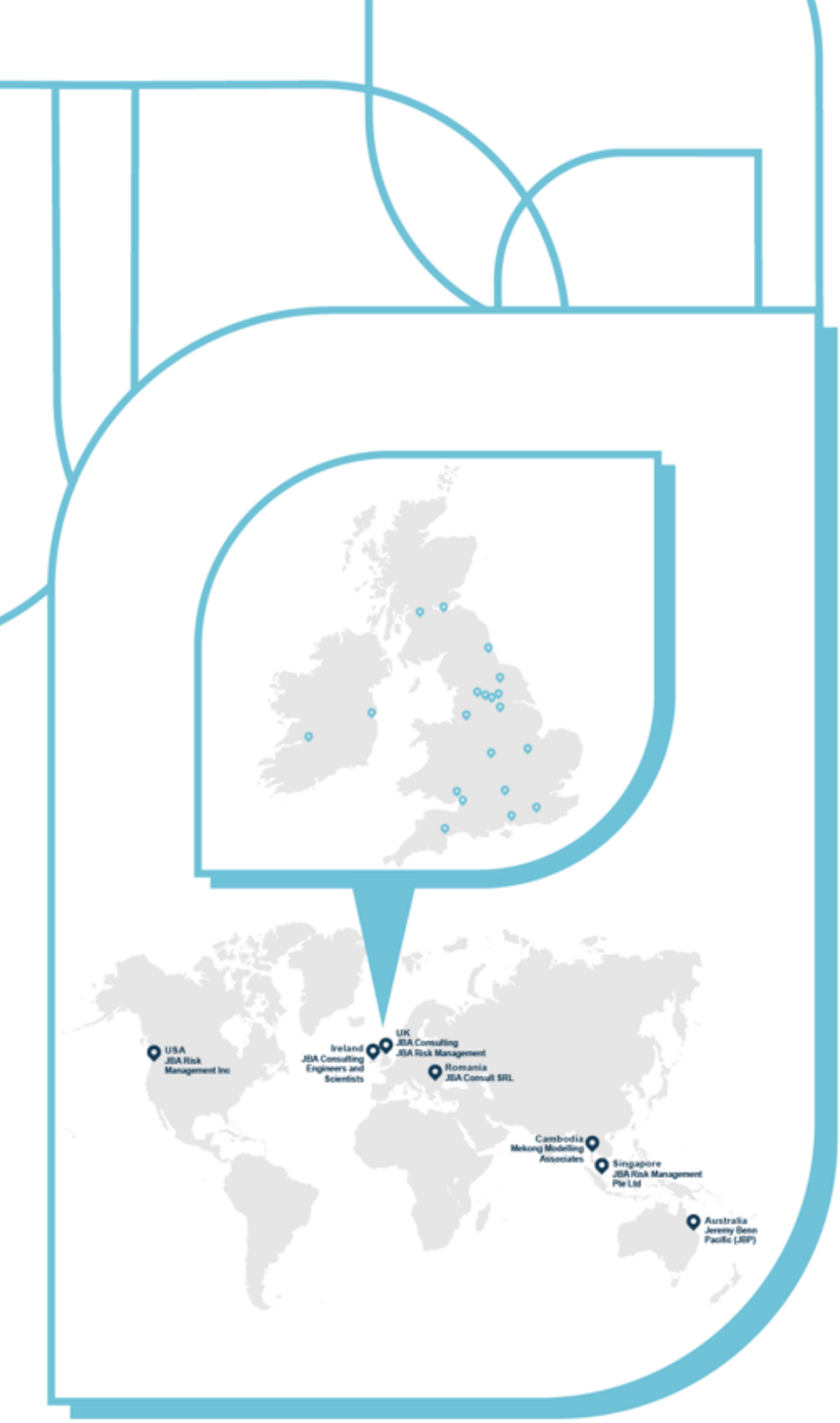
- There should be no development within the existing area of functional floodplain present on site and the area of Flood Zone 2 should also be avoided if possible The flood risk areas should remain as open greenspace.
- Historic mapping indicates there may be a watercourse culverted beneath the southwestern side of the site. If present, the culvert represents potential residual risk of flooding to the site through culvert failure or blockage. This may need to be further investigated and modelled at the FRA stage. Modelling should include for residual risk and options for culvert removal.
- No development should take place over the top of a culvert nor within 8m either side of the culverted section of watercourse.
- Assuming the culvert is located beneath the site, opportunities for opening up the culvert should be explored for inclusion in site design as a blue green corridor. This would remove any residual risk of flooding to the site as a result of culvert failure or blockage.
- A drainage strategy must plan to include the modelled surface water flow path and area of ponding within the site layout and design.
- Given the historic sewer flooding in the area, developers should contact Yorkshire Water directly to check specific details at the FRA stage.
- Any FRA must further consider the safe access and escape routes to the site.
- Any FRA should be carried out in line with the latest versions of the NPPF; FRCC-PPG; EA guidance; the CBMDC Local Plan and national and local SuDS policy and guidelines.
- Throughout the FRA process, consultation should be carried out with the following, where applicable, the local planning authority; the lead local flood authority; emergency planning officers; the Environment Agency; Yorkshire Water; the highways authorities; and the emergency services.

3 Para 178 National Planning Policy Framework 2024

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