Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	
Location	Greenfield Mill, Oldham
Site area (ha)	32.27
Watercourse	Chew Brook
EA Model used	River Tame, 2018 and 2020 Fletchers Brook Model (developed for this study)
Existing use	Mix of greenfield and brownfield – existing industrial units
Existing site flood risk vulnerability classification (NPPF)	Less vulnerable
Proposed use	Mixed use including residential
Proposed development flood risk vulnerability classification (NPPF)	More vulnerable
Proposed development impermeable area (ha)	32.27

Flood outlines (present day)

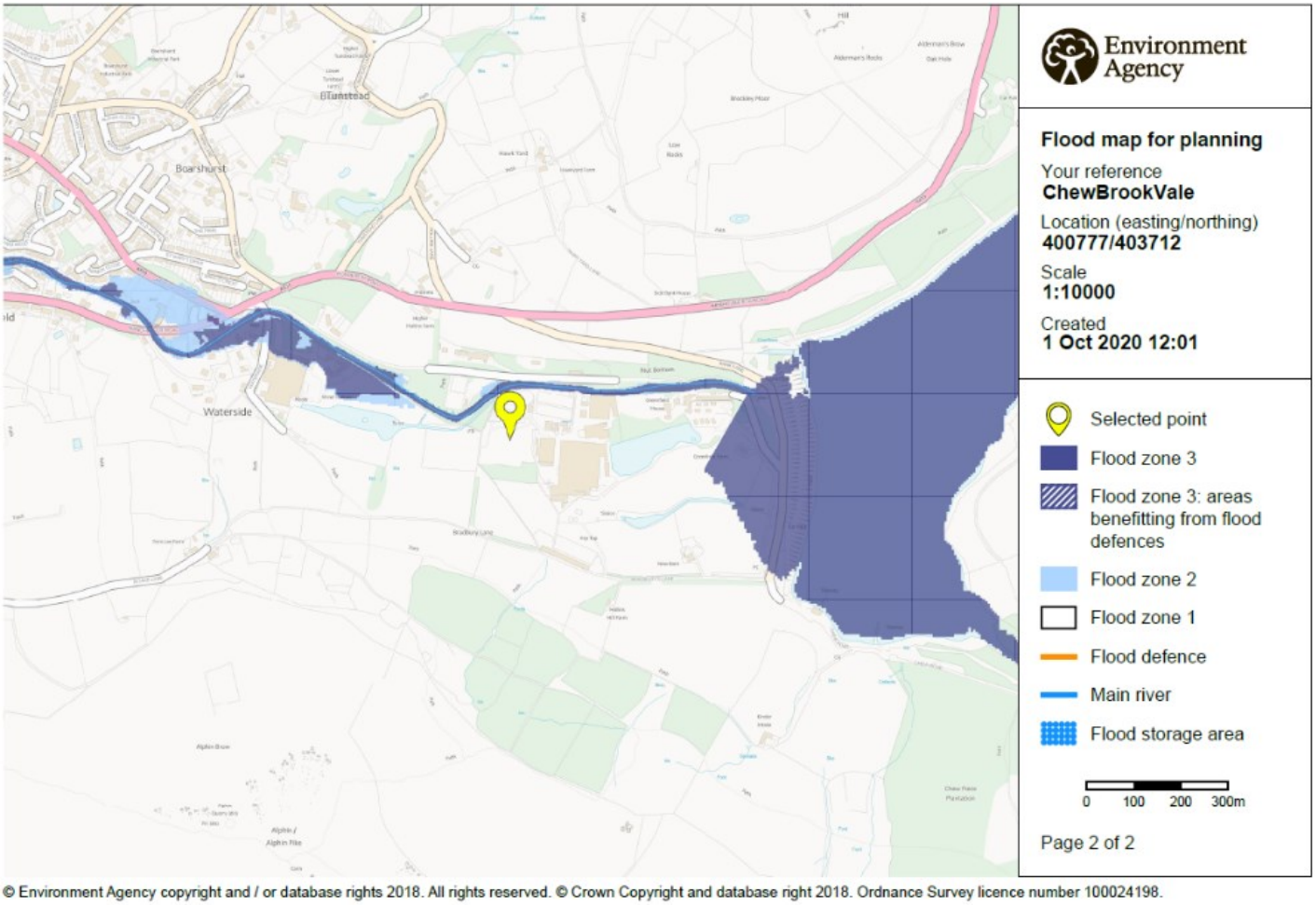


Figure 1: Flood zone mapping (Flood Map for Planning) taken from https://flood-map-for-planning.service.gov.uk/

The Flood Map for Planning Flood Zone 3 abruptly cuts across the site. The EA has confirmed that this section of the flood zone is erroneous and is not representative of actual risk in this area. The Tame 2018 model upstream boundary for Chew Brook is located on the spillway of the reservoir, upstream of the eastern site boundary.

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)

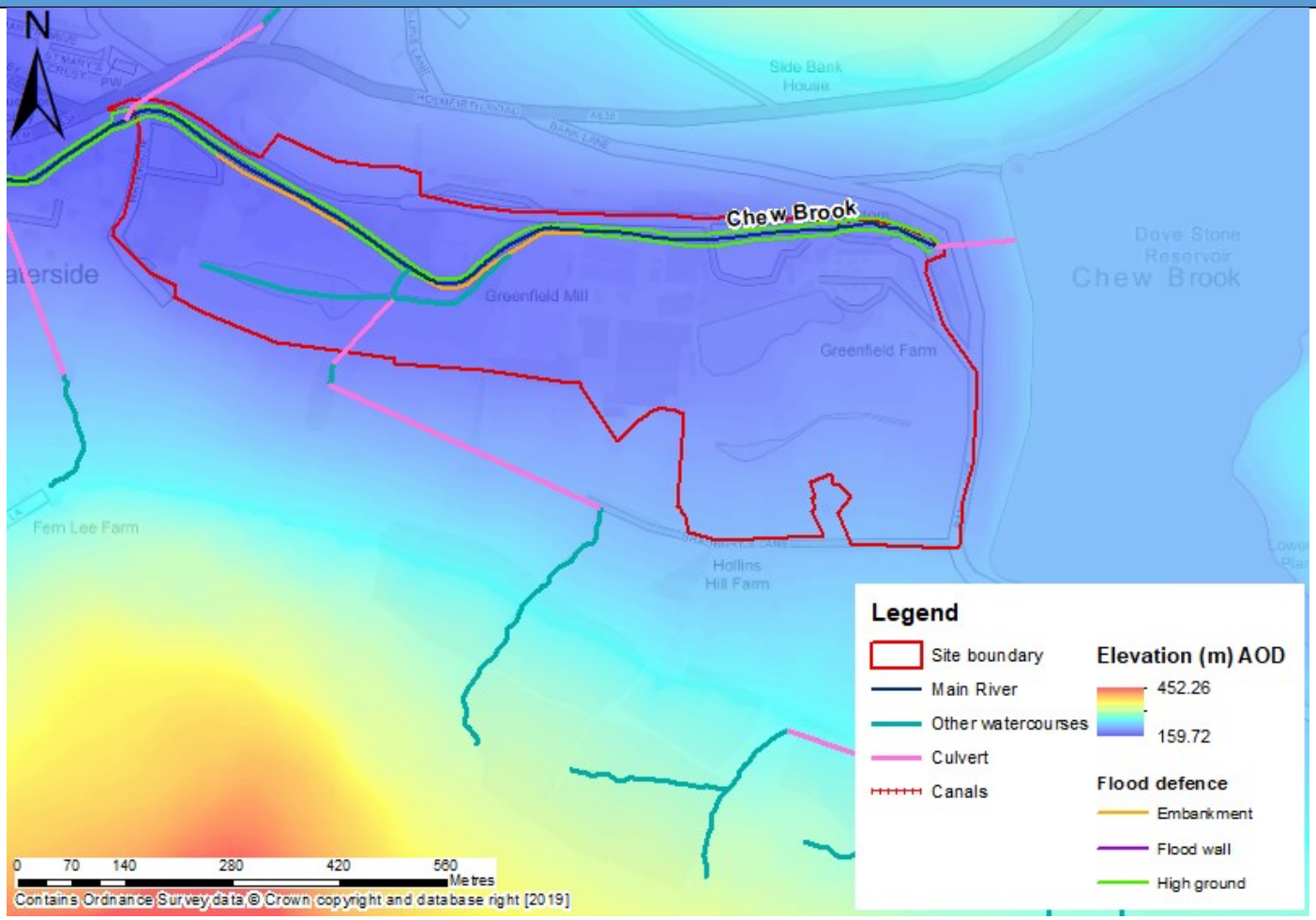


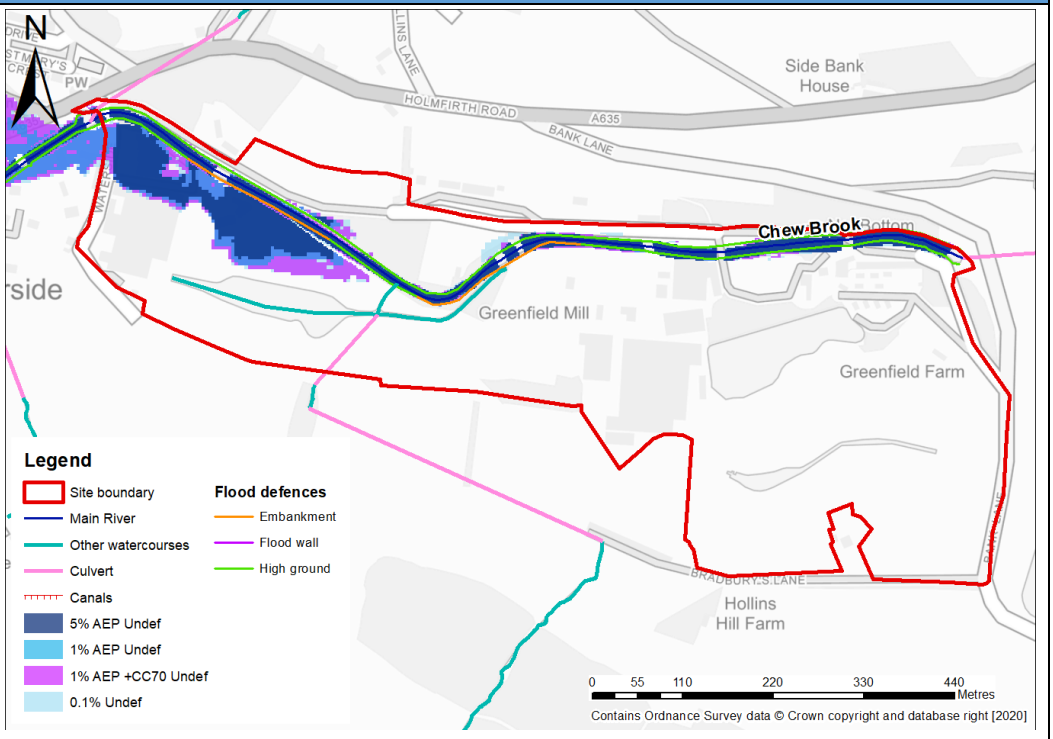
Figure 2: Site with 2 m 2017 LIDAR (elevation data)

- The elevation across the site varies substantially. The topography generally slopes down northwards from around 214 m AOD at the southern boundary to 165 m AOD at Chew Brook.
- Chew Brook flows westwards out of Dove Stone Reservoir which is situated immediately to the east of the site. The brook flows primarily through the north of the site before exiting the site on the far western boundary. There are also three waterbodies within the site boundary.
- There are three culverts onsite; one in the north-eastern corner connecting Dove Stone Reservoir to Chew Brook under Bank Lane, one in the north-western corner of the site coming in from the north and one entering the site from the south fed by Fletchers Brook. Survey of this culvert has revealed the EA's detailed river network (DRN) dataset to be erroneous in its positioning of the culvert. See Figure 4 a more likely route.

Flood Source: Fluvial

Flood Zones* (%)	Flood Zone 3b	Flood Zone 3a	Flood Zone 2	Climate Change
	8.5	1.1	2.3	11.5
Fluvial: average depth (m)	0.3	0.5	1.0	0.8
Fluvial: maximum depth (m)	0.91	1.04	1.70	1.58
Fluvial: average hazard	Moderate	Moderate	Moderate	Moderate
Fluvial: maximum hazard	Moderate	Moderate	Significant	Significant

*Based on River Tame model (2018) flood extents only (See Figure 3)

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	
Modelled fluvial risk including climate change on Chew Brook (River Tame 2018 model)	 Figure 3: Undefended modelled fluvial flood outlines for existing risk and future risk • The risk largely remains in-channel until downstream of the ordinary watercourse tributary, where the flood defence embankment is situated on the left bank. • This embankment has not been modelled as a formal EA flood defence, though its condition is known to be fair. • The 5% AEP event outline should be included in a revision of the functional floodplain. This would rule out development to land parcels A, B and C (see Figure 11). • It is thought the EA's DRN dataset (shown in Figure's 1, 2 and 3) is erroneous in its representation of the Fletcher's Brook culvert. See Figure 4 for a more probable interpretation of its route.
Historic flooding	• The site lies outside of the Environment Agency's Historic Flood Map (HFM).
Defences	• Based on the EA's Spatial Flood Defences dataset, Chew Brook is bound by areas of high ground which act as informal defences which are assessed at condition grade 3 meaning 'Fair' (Table 1.1. Conditions Assessment Manual[1]). • The left bank (southern bank) of Chew Brook is bound by two embankments which have both been assessed at condition grade 3.
Flood Warning Area	• The site lies outside of any current EA FWAs.
Natural Flood Management / Working with Natural Process	• The majority of the site is within WwNP tree planting areas. Woodland creation can significantly delay the timing of the peak runoff in headwater catchments which could therefore benefit communities downstream.
Observations, mitigation options & site suitability: fluvial	• **Given the change in use and therefore vulnerability of the site, the developer will need to show, through an FRA, that future users of the development will not be placed in danger from flood hazards throughout its lifetime. It is for the applicant to show that the change of use meets the objectives of the Framework's policy on flood risk. For example, how the**

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291126/scho0509bqat-e-e.pdf

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	

	operation of any mitigation measures can be safeguarded and maintained effectively through the lifetime of the development (Para 048 Flood Risk and Coastal Change PPG).
	• Figure 11, inserted at the end of this report, shows the Site Concept Plan available at the time of this assessment.
	• The Flood Map for Planning shows a large area of flooding from Dove Stone Reservoir. This part of the flood zone is not representative of actual risk. The EA has confirmed this to be a remnant of older broadscale modelling and should terminate at the downstream end of the reservoir.
	• The updated modelling from the Tame 2018 model (Figure 3) shows that land parcels A, B, and C of the concept plan are at risk from each modelled event shown. B and C are proposed for residential and A for employment. The areas within the 5% AEP event outline should not be developed and ideally would be left as open space to flood naturally and store water.
	• Land parcels A, B and C should be relocated to elsewhere in the site boundary. Or further work should be carried out to assess how floodwaters can be diverted around or controlled through each land parcel.
	• The DRN shows that Fletcher's Brook watercourse flows into the site via a culvert from the south before opening up and entering Chew Brook. This watercourse is an ordinary watercourse and has not previously been modelled.
	• Dove Stone Reservoir is located upstream of the site and can be considered as a residual risk. Details on residual risk from the reservoir are provided below from United Utilities who own the reservoir.
	• Based on the presence of the unmodelled Fletcher's Brook watercourse and the location of the reservoir, it was decided that additional flood risk evidencing work was required to further inform the Exception Test for the site. The additional works, detailed below, help to provide a more robust evidence base for achieving sustainable development at the site at the Local Plan and GMSF Examination stage.
	• Additional to this Level 2 SFRA, the GMCA commissioned:
	  ○ Hydraulic 2D flood modelling, accounting for climate change, of Fletcher's Brook, including generation of up to date hydrological inputs,
	  ○ Survey of the open channel and structures, and CCTV survey of the culverts to inform the flood modelling,
	  ○ Culvert blockage scenario modelling of the Fletcher's Brook culvert, entering the site from the south, with its inlet at Bradbury's Lane
	  ○ Modelling of the emergency draw-down arrangements for Dove Stone Reservoir,
	  ○ Assessment of updated 2020 EA Reservoir Flood Map model outputs.
	• This additional work on Fletcher's Brook is described in the next section and the Dove Stone Reservoir work is detailed in the Reservoir section further on.
	• There are also several small single waterbodies on the site, however, judging from the Concept Plan, these waterbodies are to be integrated into the site layout. Residual risk from these waterbodies should be investigated at the FRA stage.
	• Development should seek to remove redundant structures/culverted sections, where possible, to reduce flood risk and improve WFD status.
	• The developer or site owner must find out which permissions and licences are required to maintain, repair, build or remove anything in or around

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)

Chew Brook, the Fletcher's Brook culvert and the onsite waterbodies. Without appropriate permissions and licences the developer/site owner may be subject to a fine or imprisonment.

- **Safe access and egress routes must be available at times of flood. Provision for safe access and egress routes would need to be demonstrated in any planning application and any associated masterplan.**

Fluvial Modelling: Fletcher's Brook

Modelled fluvial risk of Fletcher's Brook, 2020 (this section should be read alongside the Technical Modelling Note submitted with this Level 2 Report)

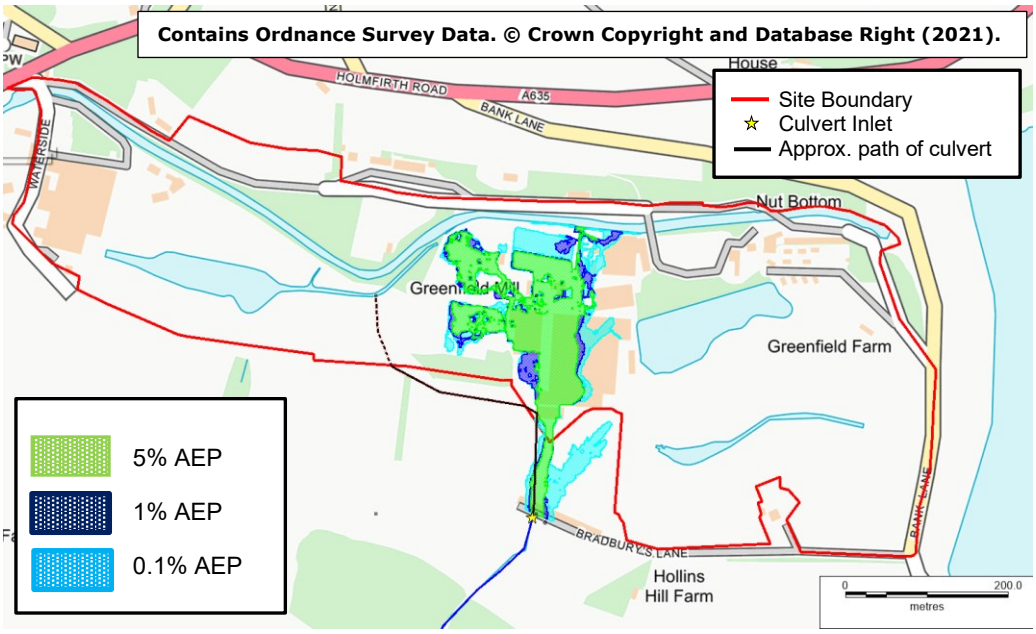


Figure 4: Modelled fluvial flood outlines for Fletcher's Brook – 5%, 1% and 0.1% AEP events

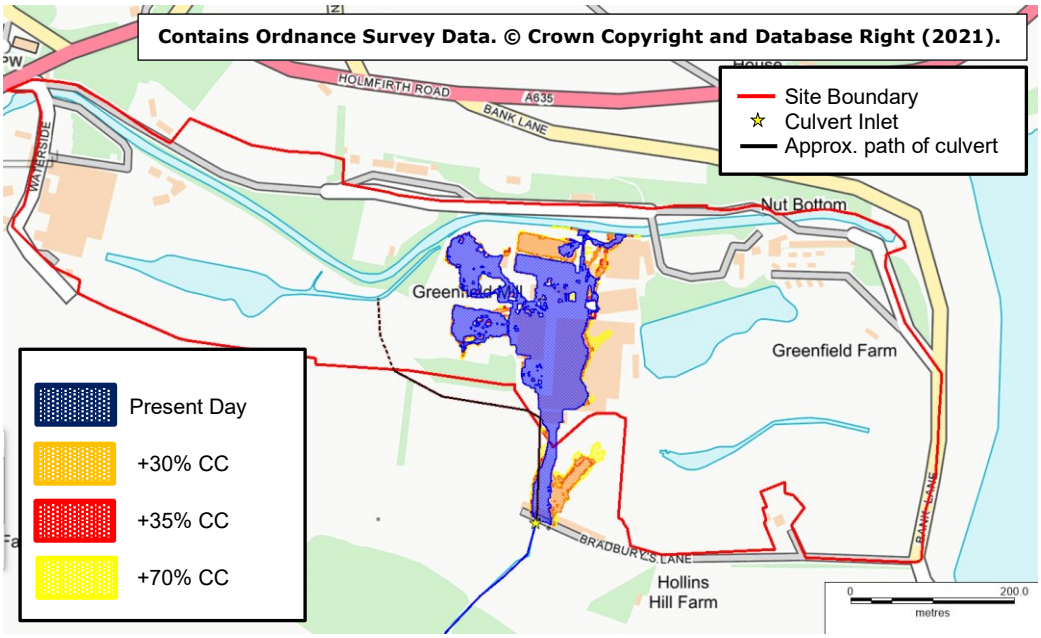


Figure 5: Modelled fluvial climate change outlines for Fletcher's Brook for 1% AEP event

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)

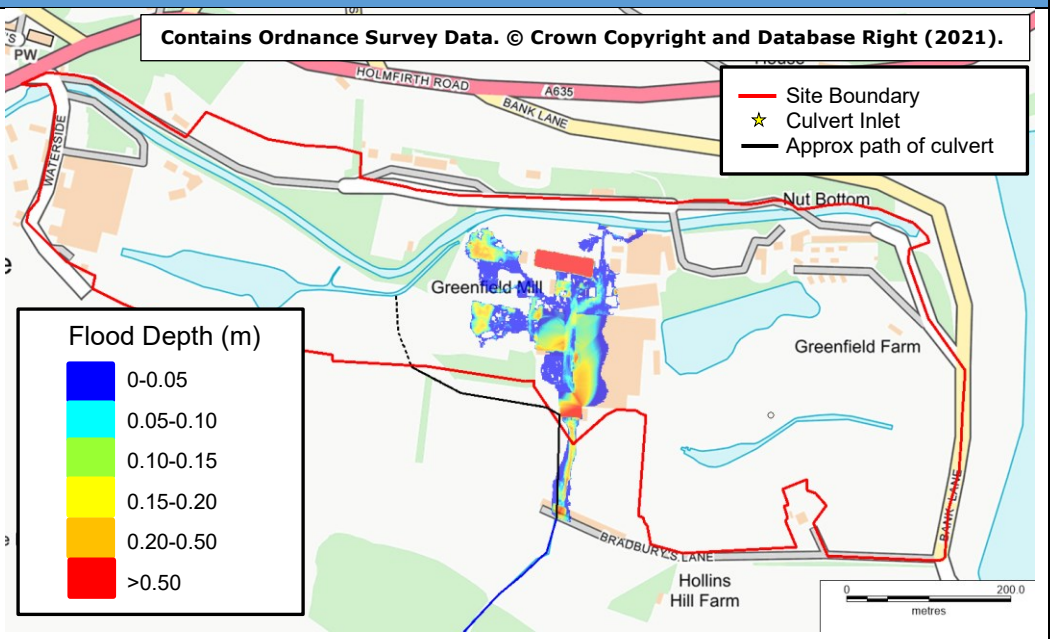


Figure 6: Modelled 1% AEP event fluvial flood depths for Fletcher's Brook

- The onsite survey of the site and the watercourse revealed that the DRN representation of the culvert is incorrect. Based on the survey information, OS mapping, aerial photography and LIDAR, the course of the culvert has been redefined as shown in the above Figure's 4, 5 and 6.
- The open channel flows northwards down a steep hillside and into the culvert under Bradbury's Lane which, continues through a purpose built gap between the houses. It is also clear that the culvert outlet is not into Chew Brook but an adjacent ditch which feeds the existing pond to the west.
- The culvert is modelled to surcharge in all modelled events causing floodwater to flow through the wall gap and road grille at Bradbury's Lane and flow in a northward direction onto the site. This suggests that the site has a low threshold of flooding from Fletchers Brook. The presence of the gap in the buildings opposite the culvert entrance is suggestive that the buildings may have been designed with the potential flood risk in mind.
- The modelling shows that floodwater overtops at the culvert inlet and is modelled to flow through the aforementioned gap in the buildings on the northern side of Bradbury's Lane and continue downslope in a northerly direction towards the existing factory buildings within site parcel H of the indicative concept plan (Figure 11). Upstream of the onsite buildings, the flow route is likely following the original (pre-culvert) course of the watercourse and is narrow, shallow (typically <0.2 metres deep) but fast moving (>1 m/s). Once the floodwater reaches the factory buildings on the valley floor, there is some lateral spreading off the main northerly flow route and floodwater starts to fill topographic depressions (including industrial tanks and existing ponds) on the lower floodplain, which can fill to depths in excess of one metre. Across the modelled events, only a minor volume of floodwater is modelled to reach the banks of Chew Brook so almost all the floodwater that is modelled to overtop the culvert collects and ponds on site parcel H.
- Overtopping is modelled to last for approximately one hour and inundation of the site is modelled to occur rapidly once overtopping has commenced within the small flashy catchment. Therefore, a gauged flood warning system is unlikely to be feasible to cover for this source of flooding.
- Site parcel H is proposed for a mixed use of residential, commercial, leisure and retail and therefore more vulnerable. The modelling shows a large proportion parcel H to be at risk from Fletcher's Brook. A large area is it risk from the 5%

AEP event, which would normally be designated as functional floodplain where development of any type is permitted (unless water compatible). It is thought the majority of the existing buildings in parcel H may be demolished and the land regraded somewhat. However, no development should take place within the modelled 5% AEP flood extent, or the 1% AEP event if possible. The 1% AEP event depths are however generally shallow therefore it may be possible to raise finished floor levels above the 1% event level plus freeboard. Compensatory storage would have to be found onsite.

- It is worth noting that overtopping of the culvert is modelled to last for approximately one hour and inundation of the site is modelled to occur rapidly once overtopping has commenced due to the catchment being small and flashy. Therefore, a gauged flood warning system is unlikely to be feasible from a access and egress point of view.

Modelling Limitations

- The catchment is ungauged so there is a high level of uncertainty in the flow estimates.
- The CCTV survey was not comprehensive due to culvert access issues.
- Surcharging of manholes along Bradbury's Lane culvert was not included in the model because only 0.19m3/s is currently modelled to pass through the culvert during flood events and the risk is focussed on the inlet capacity to the culvert. However, if a solution is found in regard to surcharging at the inlet, it would then be necessary to ensure that the flood risk was not simply being transferred further down the culvert system to surcharging manholes through future modelling.
- It is assumed that the only access to the culvert system is via the upstream catchment. Therefore, any runoff from the catchment downstream of the culvert entrance is not accounted for in the model. This could lead to additional surface water flooding or surcharging of the culvert.
- Any drainage of hard-standing areas is not included in the modelling, which could lead to an overprediction of the fluvial flood risk.
- Some subjectivity had to be applied to the modelling of the wall gaps through which floodwater must pass to access the site.
- The hydraulic model requires a minimum flow to maintain model stability, whereas the modelled watercourse was largely dry when surveyed. Therefore, the model may overestimate the initial water level during the design events, however the volume of water involved is nominal relative to the peak of the 1% AEP event.

Indicative Mitigation Options

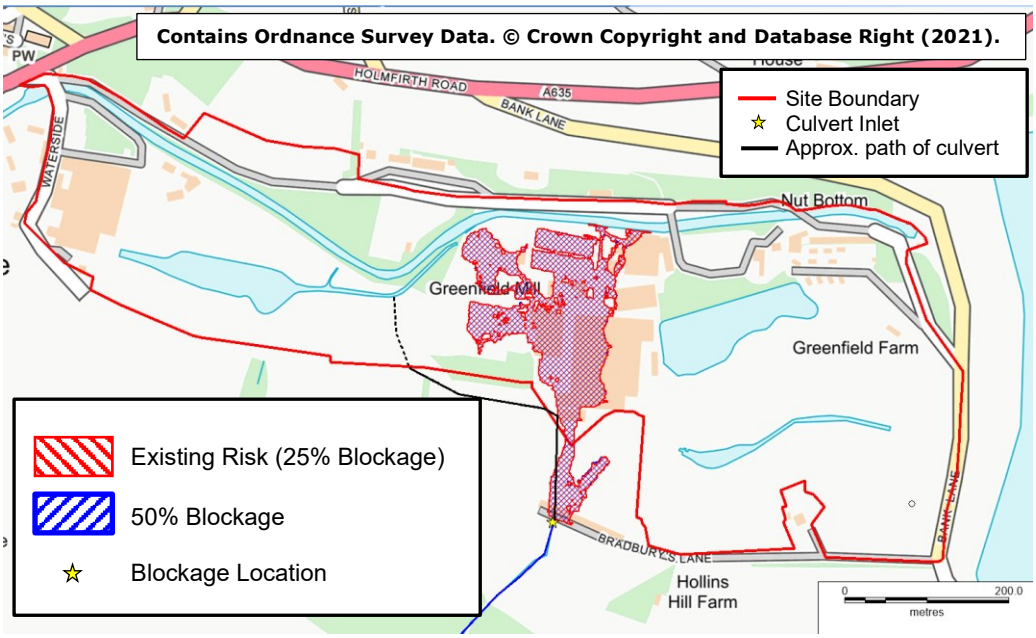
- If this modelling is to be accepted as the baseline model behind any future FRA, it is recommended that some further work be undertaken to verify the model predictions, including:
    - Consultation with the residents of Bradbury's Lane on their observations of the frequency and severity of flooding (overtopping) from the Bradbury's Lane culvert.
    - Walking survey of the watercourse to ensure there is no evidence of upper catchment flow being diverted away from the modelled watercourse.
- Upsizing of the culvert inlet shown in the survey photograph below may help to reduce surcharging by increasing capacity and also by reducing the likelihood and severity of blockages occuring.
- Wider benefits of this approach may be a reduction in flood risk to the houses on the northern side of the road and also flooding to the highway.

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)

- Blocking gaps in the wall at the culvert inlet on Bradbury's Lane. The survey photographs below show the presence of a gap in the wall, presumably there for access, and a grated hole at the pavement level, presumably there for surface water drainage from the road. Blocking this gaps could help to contain any water surcharging from the culvert from spilling onto the road and down into the site.
- As stated above, there would be wider benefits to this approach though alternative access to the field would have to be found and surface water drainage of of the highway would have to be redirected, possibly via a grid in the gulley of the highway.

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)

- Deculverting downstream of the houses may also be an option. Given the nature of the modelled flooding to the site, in that water is modelled to spread widely around the site where the topography becomes flatter, the channel would have to be incised into the ground and regraded to keep water in-bank and direct it appropriatly. Given the 0.1% AEP event is modelled to remain in-bank in the

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	
	open channel section upstream of the culvert, it is thought that this should be possible. • These suggested mitigation options are purely indicative, based on the information available at the time. These options should be fully investigated and modelled at the FRA stage when the site layout plans are being finalised. • Each option should be subject to a feasibility study and modelled both in isolation and in combination to ascertain the optimum mitigation solution.
Modelled residual risk from culvert blockage scenarios on Fletchers Brook and Chew Brook	 Figure 7: Fletcher's Brook 1% AEP + 35% climate change allowance culvert blockage scenario outlines • The impact of blocking the culvert inlet has been modelled to have almost no impact on the flood outlines and depths during both present day and future (with 35% climate change uplift) 1% AEP events. This is because (following the findings of the CCTV survey), the inlet is modelled as 25% blocked in the existing risk situation (due to the culvert only having a diameter of 300mm and the presence of metal bars and wooden slats at the inlet) and the majority of the floodwater already by-passes the culvert entrance in this scenario (i.e. only 0.19m3/s of the 1.16m3/s 1% AEP flow passes through the culvert). • The 75% blockage model became unstable however the above observation is considered to apply to increased blockage proportions. • Given the above information, one would expect to see a record of regular flooding from the culvert entrance. A (sub-)annual frequency of surcharging might be a little too regular to be a comfortable fit with the observed frequency of flooding. However, it could be that any flow through the arch opposite the inlet is not considered worthy of recording by the homeowners on Bradbury's Lane, who should be consulted on this issue, if the site redesign is to proceed.

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)

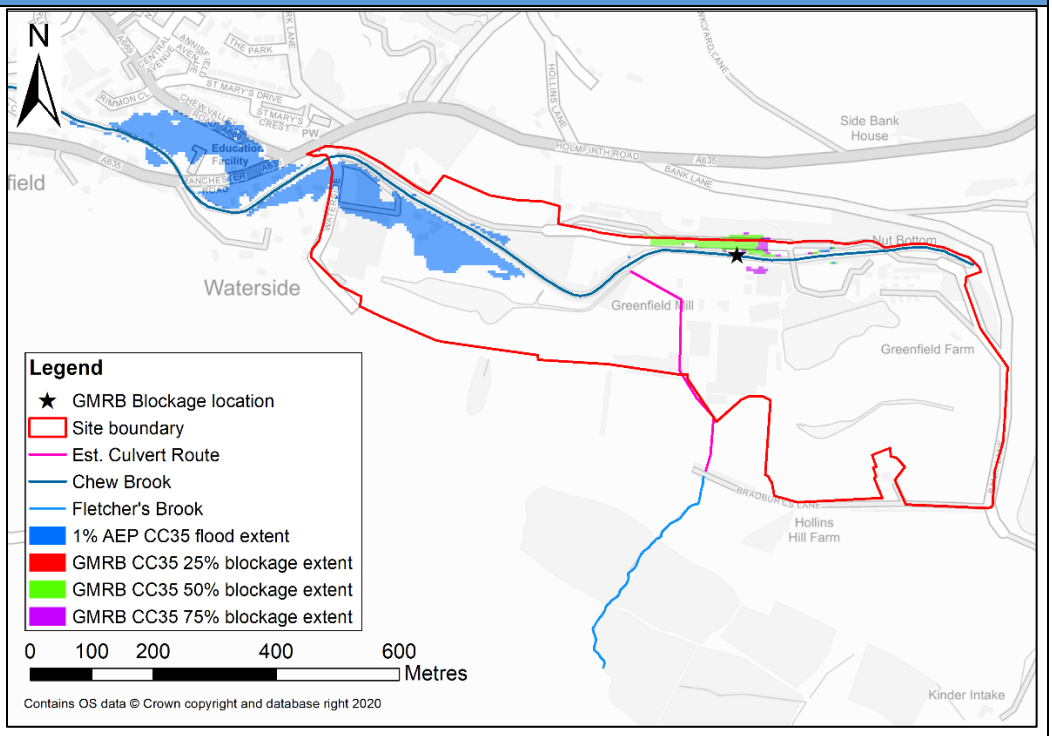


Figure 8: Chew Brook 1% AEP + 35% climate change allowance Greenfield Mill Road Bridge blockage scenario outlines

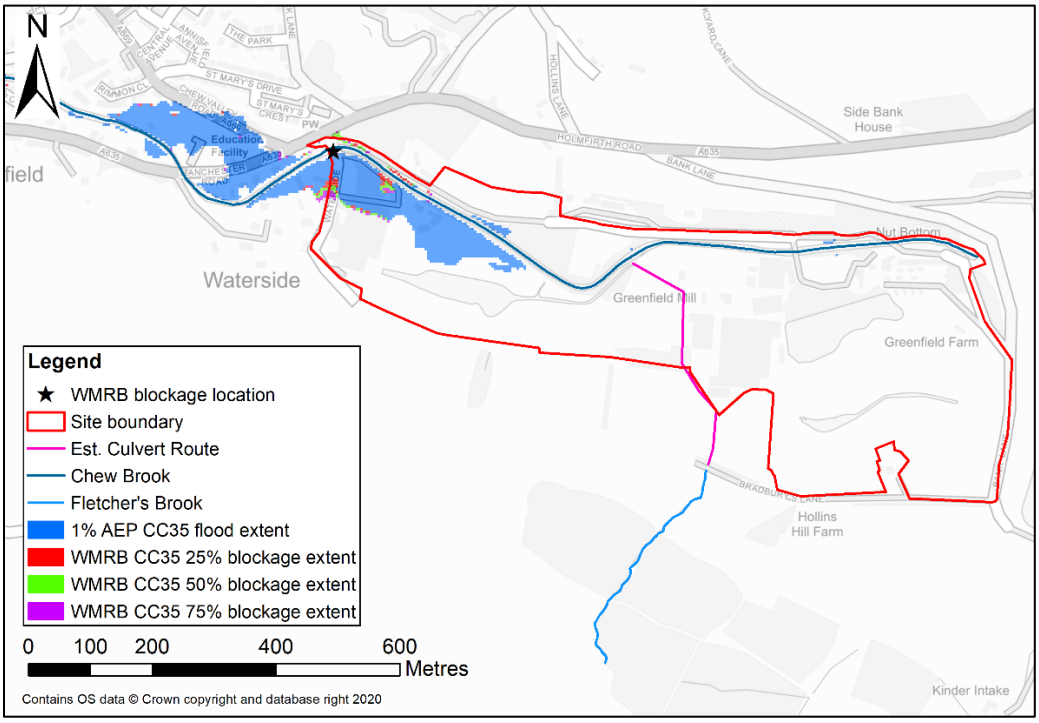


Figure 9: Chew Brook 1% AEP + 35% climate change allowance Waterside Mill Road Bridge blockage scenario outlines

- A (present day) 1% AEP event has been modelled to remain in bank in the vicinity of Greenfield Mill Road Bridge, even when a 75% blockage is applied to this structure.
- A (future) 1% AEP event with 35% uplift due to climate change is largely modelled to remain in bank in the vicinity of Greenfield Mill Road Bridge and only

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	
	a minor volume of overtopping of the left bank onto the Robert Fletchers site is modelled to occur in response to a 75% blockage of this structure (Figure 8). • There is already modelled to be some by-passing of the right bank in the vicinity of Waterside Mill Road Bridge in a (present day) 1% AEP event and applying blockages of up to 75% at this structure is only modelled to produce a minor increase in the 1% AEP flood extent across the extreme western region of the site. • A similar observation to the present day 1% AEP event can be made for the impact of blockage at the Waterside Mill Road Bridge in a (future) 1% AEP event with 35% uplift due to climate change (Figure 9). • The impact of blockages on Chew Brook is not modelled to significantly increase the 1% AEP risk to the site. This may relate to the fact that Chew Brook is an engineered outflow channel from Dove Stone Reservoir and therefore has a high capacity. **Chew Brook Modelling Limitations** • The Chew Brook blockage model was derived from the Tame (2018) model and it is a stated limitation of the Tame (2018) model that the 1D (in-channel) definition of the Tame tributaries including Chew Brook was not very high and could be improved with additional survey. Therefore, a site-specific FRA could benefit from increasing the definition of the existing Chew Brook models.
Flood Source: Groundwater	
Flood risk: groundwater	• Due to the site's proximity to Chew Brook, the groundwater levels are likely to be similar to the corresponding levels in the river. Groundwater follows topography and is unlikely to be an issue in this instance.
Flood Source: Infrastructure Failure – Reservoirs (Residual)	
Flood risk: reservoir	• Approximately 79% of the area is located within the maximum extent of flooding risk from reservoirs according to the EA's reservoir flood map with the average depth being over 2 m. Note: the RFM that is online at the time of writing (September 2020) is based on methodology devised in 2010. This will be updated with new modelling carried out in 2020. Follow the link to view the current RFM online: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map • The modelled risk through the new RFM modelling shows a much smaller area of the site to be at risk from a dam breach. • The RFM extent shows the worst credible area that is susceptible to dam breach flooding. The map should be used to prioritise areas for evacuation/early warning. • The site is located next to the Dove Stone Reservoir with Chew Brook flowing from the reservoir through the north of the site towards the west. This will be the greatest source of reservoir risk to the site. • The extent of reservoir inundation comes from three United Utilities owned reservoirs - Dove Stone Reservoir, Greenfield Reservoir and Chew Reservoir. • Much of the reservoir network is owned and managed by United Utilities who monitor and maintain reservoirs as required. United Utilities own 43 reservoirs within Greater Manchester. • The chance of reservoir failure is very rare and there is an extremely good safety record in the UK with no loss of life due to reservoir flooding since 1925. • United Utilities' ongoing management of reservoirs ensures they do not cause flooding as their presence within the network of surrounding watercourses actually reduces the impact of excess rainfall. • All United Utilities operated reservoirs are managed in accordance with the Reservoirs Act and relevant Health and Safety legislation to ensure they do not

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	
	fail such requirements. United Utilities also notes that the Environment Agency is responsible for ensuring compliance with the highlighted legislation. • United Utilities also wishes to highlight the drive for continued constructive communication with the relevant local authorities to ensure a coordinated approach to the delivery of site allocations. United Utilities are committed to continuing to work with the relevant Local Authorities and the Greater Manchester Combined Authority as site allocations progress further. • With regards Dove Stone Reservoir, the EA has stated that: o *'Dove Stone Reservoir is a Category A Dam, which is the highest category based on current downstream receptors. As UU has confirmed the proposed development will not impact their operation/maintenance liabilities, and based on the current dam categorisation, the view of our Reservoir Specialist is that the opinion of an All Reservoir Panel Engineer is not required'.* **Emergency Drawdown Modelling** • It is expected that under normal flow conditions (i.e. on a dry weather day) on Chew Brook and within the River Tame there would be no additional flood impacts to the site from an emergency drawdown event of 50% of the reservoir volume, other than an increase in water level and flow rate within the Chew Brook immediately downstream of the reservoir. • On a wet weather day, the additional flow associated with the emergency drawdown from the reservoir outlet is modelled to have minimal impact on the flood extent beyond that of the 0.1% AEP modelled fluvial event. There is a difference in flood depth of around 50 mm on average between the extreme 0.1% AEP event and the modelled wet day emergency drawdown event scenario which highlights minimal difference in flood risk in an extreme event. • The impacts of emergency drawdown flows are most likely to be felt in smaller magnitude flood events whereby the in-channel flows downstream are modelled to come slightly out of bank. The additional flow into Chew Brook from the reservoir outlet would most likely lead to some excess flooding in these scenarios however there are a number of variables which could impact the outcome of this dependant on the antecedent flow conditions within the catchment. • To summarise, under everyday conditions, no additional flood risk is anticipated as a result of emergency drawdown irrespective of the volume removed providing the flow rate does not exceed 4.86 m^3 per second. If emergency drawdown protocol needs to be implemented whilst river levels are heightened or during a flood event, the best course of action would be for the addition of the emergency drawdown flow to not exceed that of the downstream channel capacity.
Flood Source: Infrastructure Failure – Canals (Residual)	
Flood risk: canal	• There are no canals in the vicinity of this site.

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)

Flood Source: Surface Water

Surface Water Flood Risk to Proposed Development Site

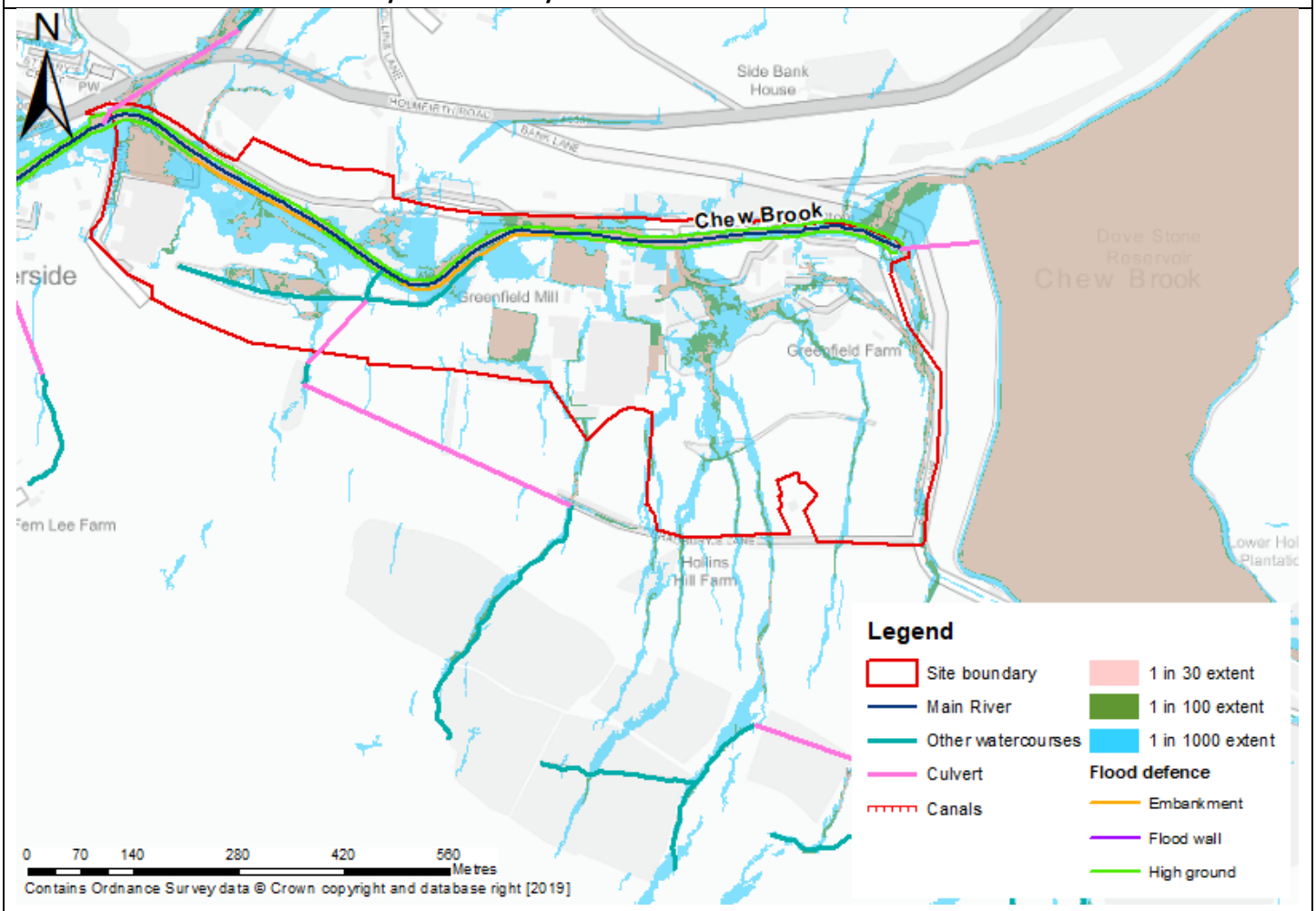


Figure 10: Surface water risk to the site (Risk of Flooding from Surface Water map)

Existing development: Risk of Flooding from Surface Water map (%)	High Risk (1 in 30 AEP outline)	Medium Risk (1 in 100 AEP outline)	Low Risk (1 in 1000 AEP outline)
	10.06	14.89	33.38
Surface water flooding depths	Max: >1.20m	Max: >1.20m	Max: >1.20m
Surface water hazards	Max: Significant Mean: Significant	Max: Significant Mean: Significant	Max: Significant Mean: Significant
Surface water flood risk to development site	• Approximately 15% of the site is at risk of surface water flooding in the 1% AEP event to a maximum depth greater than 1.2 m. • There is localised ponding of surface water throughout the site in both the 1% and 3.33% AEP events. These areas of ponding tend to occur in and around the current waterbodies and in several square shaped areas, possibly purpose built to hold surface water. Confirmation should be sought from the current landowner. Much of the surface water is constrained by existing buildings. • There are a number of surface water flow routes onsite which start offsite from the south from Bradbury's Lane, one of which comes from the culvert inlet		

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	
	Fletcher's Brook. A larger flow route enters the site from Bank Lane on the eastern site boundary. • Existing safe access and egress routes exist at points along Bradbury's Lane for the area of the site south of Chew Brook. From the north, access to Holmfirth Road must be gained across existing greenfield.
Climate change	• The current day 0.1% AEP outline provides an indication of the likely increase in extent of the more frequent events. • The 0.1% AEP outline extends to cover just over 33% of the site with several additional flow paths being created from the south and running down to the ponded areas and Chew Brook. The main surface water flow path is that of Chew Brook with risk along the whole course from both banks. • Safe access and egress would be difficult to achieve. Alternative arrangements would have to be made.

Mitigation options & site suitability: surface water	**This section is based on the supplied indicative concept plan for the site (see Figure 11).**
	• **Land parcel H is a concern as there are large areas of ponding caused by surface water and also from the Fletcher's Brook culvert. The land is currently constrained by the existing layout which is likely to change with demolition of existing buildings and regrading of the land. Other concerns are for the flow route adjacent to Bank Lane which runs freely to existing development to the east of the proposed boutique hotel; and parcels B and C are at risk from the 3.33% and 1% AEP events. Chew Brook also acts as a major flow route, particularly in the longer term, based on the 0.1% AEP event. Development plans must include an 8 metre no development buffer along Chew Brook.**
	• **Given the constraining of surface water by current development, it is likely that the behaviour of surface water will change significantly depending on what parts of the site are cleared. Surface water modelling should be carried out based on post site clearance and pre-development to ascertain natural flow paths. If possible, natural flow paths should be designed into the site layout, using appropriate SuDS, or diverted to suit development layout, without increasing risk offsite.**
	• **A full drainage strategy would be required, before the FRA stage, 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 the proposed layout included in the concept plan.**
	• **UU states the following requirements:**
	  ○ **Applicants will be expected to manage surface water through sustainable drainage features that provide multi-functional benefits as opposed to a reliance on underground conventional piped and tanked storage systems.**
	  ○ **The design of new development should consider the inclusion of water efficiency measures in the development of new buildings as a way to further reduce flood risk. New development can become more resilient to climate change by encouraging water efficiency measures including green roofs, water saving and recycling measures to further minimise flood risk. Such a proactive approach is designed to adapt new development to climate change, whilst additionally having due consideration for water use in Greater Manchester.**
	• **Runoff rates should not exceed current rates and if possible, betterment of existing rates should be aimed for. For the purposes of this assessment, the required volumes of attenuation have been calculated below based on an assumed 85% impermeable area and limiting greenfield runoff rate of Qbar (l/s). Based on the total area of parcels A-H defined on the Indicative**

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)						
	Concept Plan (1141313-PL-T-100-05/2) shown in Figure 11, attenuation requirements have been calculated for an 8.99 ha development (as opposed to the 32.27 ha redline boundary).					
Surface Water Flood Risk from Proposed Development						
Proposed development limiting runoff rate: (l/sec) Qbar: 135 l/s (FEH Statistical)						
Design flood event (incl climate change)	Critical storm duration Hrs	Inflow volume m^3	Outflow volume m^3	Attenuation required m^3	Time to empty (assuming no infiltration) Hrs	Total storage required: Area (ha) and % of site area
30yr Rainfall+20%	6.5	5618	2211	3407	10.0	0.227 ha 2.527 %
30yr Rainfall+40%	8.25	7198	2807	4391	12.9	0.293 ha 3.256 %
100yr Rainfall+20%	8.75	8288	2977	5311 (1904m3 of exceedance storage)	15.6	0.354 ha 3.938 %
100yr Rainfall+40%	10.5	10311	3572	6739 (2348m3 of exceedance storage)	19.8	0.449 ha 4.997 %
Climate change	• Application of the central (20%) and upper band (40%) potential change anticipated for climate change in the table above shows the estimated attenuation volumes for the 1% AEP and 3.33% AEP rainfall events.					
Surface water: flood risk impacts from development site, mitigation & SuDS	• As part of this Level 2 Screening we have included calculations to provide an estimated land take if a pond with an assumed depth of 1.5m was included as part of the development. • Attenuation volumes are presented for the critical storm duration for the 1 in 30-year events with exceedance flows quantified up to the 1 in 100-year event. To prevent development worsening flood risk elsewhere, surface water runoff must be managed on site.					
Overall Site Assessment						
Can the second part of the Exception Test be satisfied as part of a site-specific FRA?	• **It is likely this site can pass the Exception Test, as long as the advice in this Level 2 SFRA is followed and further work, once a layout plan has been finalised, shows the site can remain safe for its lifetime.**					
Recommendation summary	• Early discussions should take place with the Environment Agency with regards to flood risk issues on this site. The Environment Agency offers early engagement through an advisory service via their website (https://www.gov.uk/guidance/developers-get-environmental-advice-on-your-planning-proposals) or by emailing the local office SPPlanning.RFH@environment-agency.gov.uk • Options for mitigating the fluvial risk from Chew Brook and Fletchers Brook and must be investigated. Land parcels A, B and C should be relocated based on risk from Chew Brook and parcel H should be reconfigured to remove any development from the 5% AEP flood extent and any residential use from the 1% AEP flood extent. • Options for mitigating the risk from Fletcher's Brook should also be assessed, including possible upsizing of the culvert inlet under Bradbury's Lane, blocking gaps in the wall above the culvert inlet to contain surcharging water within the field, possible culvert removal downstream of the houses on Bradbury's Lane.					

Site GM Allocation 18 – Chew Brook Vale (Robert Fletchers)	
	• A full drainage strategy should be formulated, based on an amended concept plan that accounts for the fluvial risk. Plans should ensure that safe access and egress routes during a flood are identified and included within the site design. Drainage arrangements should adhere to UU's requirements as directed through this Level 2 SFRA. • The concept plan should be revisited based on the Tame 2018 modelling and the Fletcher's Brook 2020 modelling before a more detailed layout plan is produced.
FRA requirements	• The FRA should fully account for the recommendations stated within this Level 2 SFRA. • The modelling should be revisited once a revised layout plan is in place. Options modelling could be carried out including for land raising and compensatory storage. • A hydrogeological assessment would be useful to ascertain the suitability of onsite infiltration SuDS for possible mitigation purposes. • The FRA should include emergency planning procedures with particular consideration to safety around the onsite watercourses and safe access and egress routes in times of flood. • Any FRA should be carried out in line with the National Planning Policy Framework; Flood Risk and Coastal Change Planning Practice Guidance; GMSF and District Council Local Plan policies; and national SuDS policy and guidelines, in the absence of any local SuDS policy or guidelines. • Throughout the FRA process, consultation should be carried out with the following, where applicable, the LPA; LLFA; emergency planning officers; EA; UU; the highways authorities; and emergency services.

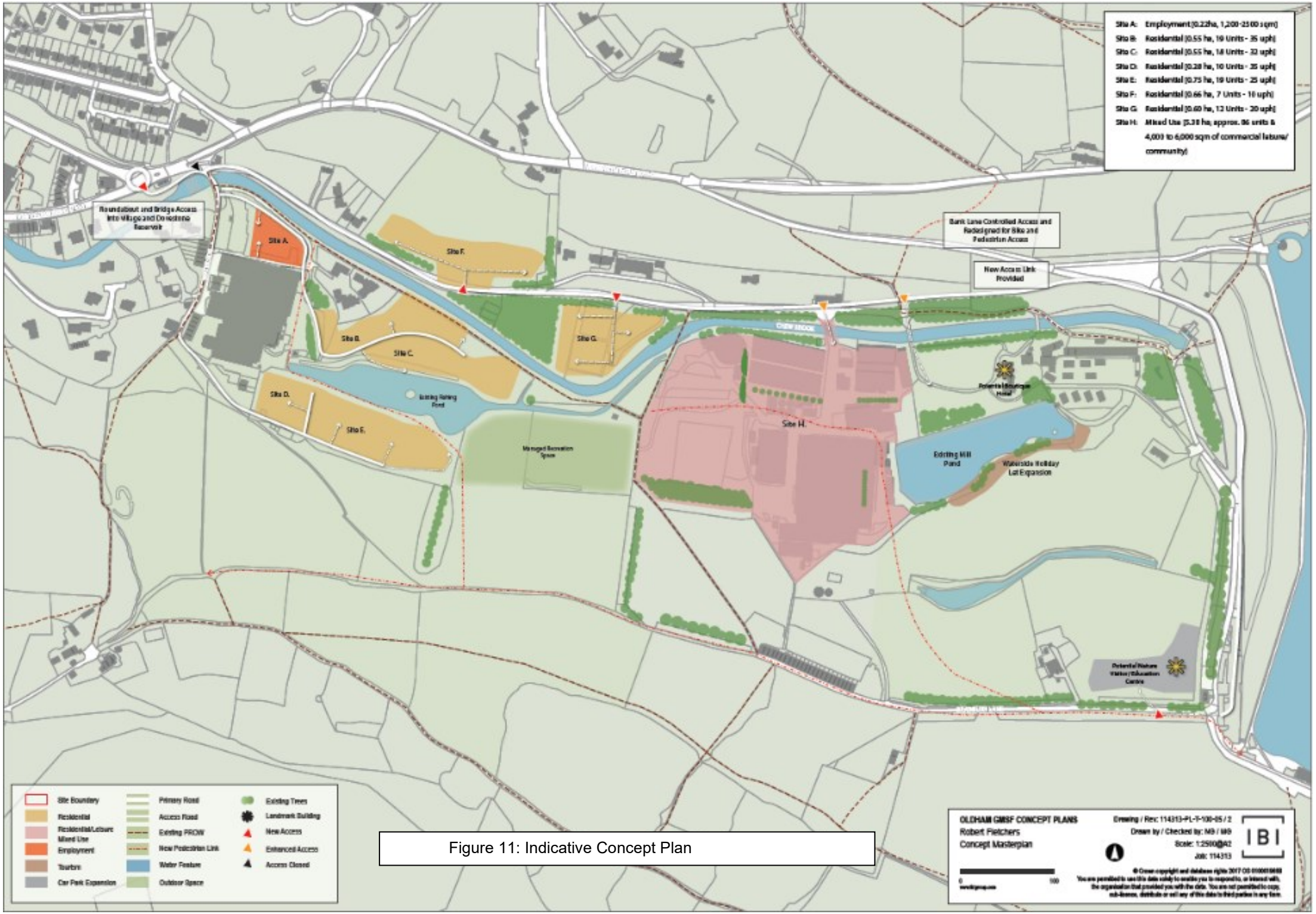


Figure 11: Indicative Concept Plan