

Milton Keynes City Council Level 1 SFRA – Methodology in support of Performing the Sequential Test

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Client

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Purpose

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1 Introduction

1.1 Background

This technical note provides a way forward on formalising the arrangements for the flood risk information used to support the preparation of the Sequential Tests for Milton Keynes City Council. The approach is as a result of instruction from Milton Keynes City Council. The need to address this matter arises from changes to the NPPF in July 2021 and the revisions to the accompanying Planning Practice Guidance in August 2022.

The scope and extent of changes to the PPG in August 2022 require that additional analysis and mapping is prepared so the content of the SFRA addresses the new matters introduced in the updated guidance and provides the evidence to support that preparation of the Sequential Test.

This document addresses the use of flood risk information in the performance of the Sequential Test with the aim of confirming that the LLFA and Environment Agency are in agreement with the proposed flood risk approach, but does not include the consideration of wider planning issues, as set out in the Sustainability Appraisal.

1.2 Summary of changes

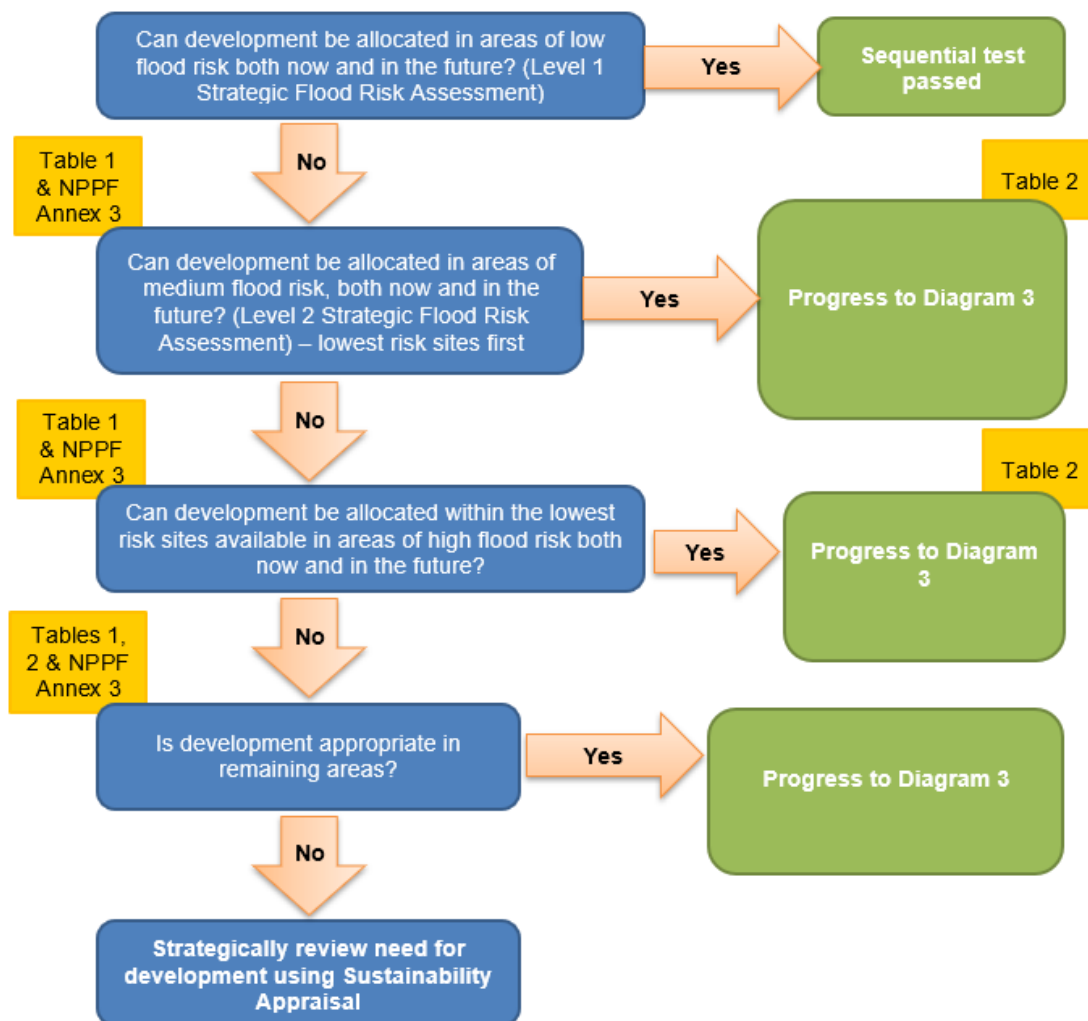
Paragraph 168 of the NPPF has been changed such that the Sequential Test must now “*steer new development to areas with the lowest risk of flooding **from any source**. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach (as described in Paragraph 167) should be used in areas known to be at risk now or in the future from **any form of flooding**.*”

Prior to the changes to the NPPF the requirement was set out as follows and only required consideration of river and sea flood risk when applying the Sequential Test:

Previous Policy Wording	New Policy Wording (July 2021)
<p>The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding (<i>the Planning Practice Guidance advised that the exercise should be performed using the flood zones, as describe river and sea flood risk assuming there are no flood risk management measures or defences in place</i>)</p>	<p>The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding from any source (<i>The Planning Practice Guidance has not yet been updated to describe how this exercise should be performed</i>)</p>

The August 2022 PPG application of the Sequential Test diagram (Figure 1-1) shows that flood risk should preferably be considered in terms of low, medium and high-risk areas, both now and in the future. To address this requirement it is necessary to explicitly consider the effects of climate change when performing the Sequential Test. It is important to recognise that the new guidance advises that the Sequential Test can no longer be performed by simply using the present day Flood Zones describing river and sea risk.

Figure 1-1: Diagram 2 in PPG



1.3 What happens next

The approach proposed by JBA Consulting has been adjusted based on recommendations from the LLFA and Environment Agency on the basis that it will be supported in principle at Examination by the LLFA and Environment Agency.

The content of the SFRA will be prepared on the basis of the agreed approach.

The Level 2 SFRA (should it be required) will involve more detailed consideration of surface water drainage, reservoir flooding and groundwater than was the case prior to the NPPF and PPG updates. The implications of this have not been assessed in this document.

In some circumstances the proposed approach will require more detailed consideration of surface water drainage requirements in the Level 2 SFRA. At this stage it might be necessary and appropriate to engage more closely with Anglian Water (responsible for sewerage) in circumstances where there is long term reliance on the performance of existing drainage systems affected by lack of capacity as a consequence of climate change effects (increased rainfall intensities and depths).

2 Summary of influential changes to the NPPF and implications for Sequential and Exception Tests

2.1 Summary of implications of changes

The Sequential Test was originally conceived to direct proposed new development to locations that did not rely on Flood Risk Management features so they inherently safe and don't place a burden on future generations. This was achieved using a set of "Zone" maps that showed the extent of river and sea flooding for circumstances where no defences were present for events with high, medium and low probability. Following this approach delivers new development that will not require future investment in flood risk management.

The test process recognised that in some circumstances it would not be possible to locate development in locations outside of medium and high-risk flood Zones, as there were no reasonable alternatives. In circumstances where the Sequential Test has been performed but is not satisfied the policy requires that the Exception Test is performed. The Exception Test is a two-part process that requires preparation of evidence to demonstrate that development proposals at risk of flooding deliver wider sustainability benefits and that it can be made safe for the intended lifespan (thus it is a requirement to demonstrate that proposed development will be safe under climate change conditions).

The updated NPPF requires the application of the Sequential Test to any source of flooding. The general implications of this are summarised as follows:

- The Sequential Test (July 2021) must be based on mapping that enables decision making according to a prioritisation based on a risk-based sequence (for river and sea flooding national mapping is available that describes low, medium and high risk flood zones for river and sea flooding based on the assumption that no flood risk management features are present).
- The other sources of flood risk that can potentially be included in the Sequential Test are surface water, groundwater, sewer flooding and reservoir flooding (or other water impounding features such as canals).
- It follows that proposed new development placed in locations at high or medium risk from flooding from other sources now and in the future (*note that the explicit requirement to include climate change in the test, as set out in the August 2022 PPG will require the preparation of additional modelling and mapping*) should be accompanied by evidence that the Exception Test can be satisfied (in a Level 2 SFRA).

A basic requirement for the Sequential Test to be performed is that appropriate, competent mapping can be prepared to enable logical comparison of the flood risk from different sources at alternative locations, as this is a fundamental requirement to establish a logical "risk sequence".

The following summary:

- describes the implications of including any source of flooding in the Sequential Test;
- highlights matters to be considered; and
- identifies a preferred approach.

2.1.1 River and sea risk – now and in the future

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Rivers and sea (there is no risk of flooding from the sea in Milton Keynes)	Flood Map for Planning and detailed models	<ul style="list-style-type: none"> • The Sequential Test can be carried out using the Flood Map for Planning for present day low (Flood Zone 1), medium (Flood Zone 2) and high risk (Flood Zone 3) as previously was the case. • Where detailed modelling is available, future Flood Zones 2 (0.1% AEP event), 3a (1% AEP event) and 3b (now the 3.3% AEP) will be assessed with climate change allowances. It should be noted that there may be instability issues running the 0.1% AEP event with climate change allowances. • The fluvial models may experience instabilities during 0.1% AEP plus climate change runs which may mean that results cannot be prepared. • Generalised modelling (JFlow) is used to delineate Flood Zones where there is no detailed mapping, but does not include climate change data or risk mapping.

Recommendations for using river and sea flood risk in the Sequential Test

- For present river flood risk, the EA’s Flood Zones 1, 2 and 3a and 3b should be used. This is reflective of flood risk primarily from ‘main rivers’ and somewhat upstream ordinary watercourse. For smaller catchments the flood risk from surface water is considered to provide a reasonable proxy for river flooding and this is included in the Sequential Test.
- For future river flood risk, the EA’s Flood Zones 2, 3a and 3b with climate change allowances (19% and 30%) should be used.
- Where generalised modelling (JFlow) has been used to delineate Flood Zones, Flood Zone 2 should be used as a proxy for Flood Zone 3a with climate change. If a development site is located within Flood Zone 2 using generalised modelling then an assessment of climate change for this zone can be undertaken at the Level 2 SFRA stage. To address Environment Agency concerns Flood Zone 3a should be used as a proxy for the Climate Change Flood Zones 3b.

- The Environment Agency’s national team have been consulted and confirmed that they recommend that future Flood Zones 2, 3a and 3b are assessed as part of the Sequential Test.

2.1.2 Surface water flood risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Surface Water	Risk of Flooding from Surface Water (RoFSW)	<ul style="list-style-type: none"> • Mapping based on a generalised modelling methodology. • Generally suitable for showing surface water flow routes at different probability flood events (1 in 30, 1 in 100 and 1 in 1000), although the uncertainty associated with the predicted outlines for the respective probabilities is high. JBA Consulting have run the 1 in 1000 year plus 40% climate change, 1 in 100 year plus 40% climate change and 1 in 30 plus 35% allowances. • Doesn’t always include allowance for drainage features such as culverts and can over or under estimate flooding where there are linear features such as embankments. • Unlike the Zone maps for river and sea flooding the surface water mapping makes an allowance for the assumed performance of a local drainage system. • Normal profile of extent and shape of flooding is a “dendritic” pattern that follows low lying topography and is not an extensive blanket, as is most often the case for river and sea flooding. • The flood risk is likely to be relatively short lived and much more localised than would be the case for river and sea flooding (most likely being caused by local high intensity short duration rainfall events). • It is likely that in many circumstances surface water flood risk zones based on the surface water mapping could affect a relatively small proportion of a proposed allocation site, but in practical terms this might not in itself be a factor that demonstrates that the principle of development could not be supported.

JBA Recommendations for using zone maps for surface water flooding

- *Use the 1 in 1000 year surface water flood extent mapping to define a simple zoning scheme that identifies a high risk and low risk zone:*

This is not strictly the same conceptual risk zone as defined for river and sea flooding (even though it is associated with the same probability) as the mapping is based on different assumptions. However, it does create a product that can accommodate a form of sequential testing, as it would facilitate strategic decisions that directed development to land in a “low risk surface water flood zone”.

The decision has been made to use the 1 in 1000 year surface water extent as the high risk zone. This is a potentially a slightly more conservative approach but as the predicted 1 in 1000 surface water extents include assumptions that a proportion of the predicted flow is conveyed in pipe or channel systems the outlines could potentially underpredict the flood extents where such watercourse and drainage systems don’t in fact exist. The proposed approach will direct development to areas at low risk in a similar way to the fluvial/tidal Flood Zone 1 and will not preclude development in the surface water high risk zone provided that an FRA is performed to demonstrate that the risks in the high risk zone can be appropriately managed.

Using such mapping it is not anticipated that the Sequential Test for surface water would normally require the consideration of alternative sites at lower risk, as the widespread and dendritic nature of surface water flood risk is conceptually very different to river and sea flood risk, but in some circumstances for relatively small sites that are potentially substantially affected it is possible that alternatives should be considered (as these could potentially not satisfy the flood risk requirements of the Exception Test).

The application of the test would require a preference that all proposed development on sites identified for allocation would be placed in the “low risk surface water flood zone”. In circumstances where it is not possible to place all proposed development in the “low risk surface water flood zone” or circumstances arose where encroachment could not be avoided then it would be necessary to provide supplementary evidence that the Exception Test could be satisfied. For the purpose of the Plan this supplementary exercise could be set out in the Level 2 SFRA and might simply involve more specific requirements with respect to the scope of an FRA. The proposed approach is relatively simple, is not totally aligned with the river and sea zones, but from a practical perspective is strongly aligned with the sequential approach defined in paragraph 167 of the NPPF. For these reasons it is recommended. (See example map showing indicative zone in Appendix A).

2.1.3 Groundwater flood risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Groundwater	British Geological Survey (BGS) Groundwater flood susceptibility maps	<ul style="list-style-type: none"> BGS mapping describes the risk of groundwater emergence but does not show the likelihood or risk of groundwater flooding occurring, i.e. it is a hazard and consequence base product and does not enable the application of risk based approach. JBA groundwater map does potentially enable a risk-based approach to be taken as it depicts different levels of risk.

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
	<p>Also: JBA groundwater Flood Map</p> <p>MKCC historic flood events</p>	<p>However, this also is based on the risk of emergence of groundwater and not surface flooding due to groundwater. The analyses performed to prepare the mapping are all for a 1 in 100-year event and so provide a risk of groundwater emergence to the surface as they are based on predicted difference between groundwater level and the ground surface. Five zones are defined to describe the risk of groundwater being: at or very near ground surface; between 0.025m and 0.5m below the ground surface; between 0.5m and 5m below the ground surface; at least 5m below the ground surface; and negligible risk of groundwater flooding.</p> <ul style="list-style-type: none"> • The underlying challenge is that the data is very uncertain and could not be used with confidence unless supported by more detailed local studies. The mapping provides an indication of where risk might be higher, but it would not be easy to defend sequential decisions based on the available mapping. • Historic flood data is available from Milton Keynes Council, however this does not always list the source of flooding. In addition, it is often difficult to determine the source of historical flood events and groundwater and surface water flooding can often be confused. • There is no climate change mapping available for groundwater and in view of the uncertainty in the present day data it is unlikely that such mapping will be available in the near future.

Recommendations for using zone maps for groundwater flooding

The JBA groundwater flood map and MKCC’s historical known events dataset do not provide the confidence or certainty required to undertake the Sequential Test. As the available mapping does not provide competent evidence on the relative risk of flooding across the study area it could potentially result in inappropriate allocations if used without understanding the limitations of the data.

On this basis, to account for the potential effect of groundwater flows in the study area it is recommended that initially all sites are considered to be potentially susceptible to groundwater flooding. When preparing the Level 1 SFRA consideration will be given to performing a screening exercise to seek to identify locations where flood risk would not be anticipated to present flood risk problems. So that groundwater flood risk is appropriately addressed in the sequential selection of land to be included in the plan further detailed analysis of the groundwater flood risk at each allocated site (at which it has not been possible to screen out the

risk of groundwater flooding) will be performed at the Level 2 SFRA stage to support the Exception Test and if appropriate identify locations where alternative sites at lower groundwater flood risk should be considered. This more detailed assessment will consider local conditions on a site-by-site basis for selected sites using historic, borehole, geological and LIDAR data.

2.1.4 Sewer flood risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Sewer flooding risk	Anglian Water Sewer Incident Report Form (SIRF)	<ul style="list-style-type: none"> Only available at postcode level and thus mapping does not define spatial extent or location of sewer flooding. Mapping does not enable execution of risk based sequence.

Recommendations for using zone maps for sewer flooding

It is recommended that the sewer flood risk is not considered alongside river and surface water flooding in the Sequential Test on the basis that the available information is not of appropriate resolution or format and so does not support spatial comparison of risk. This will be clearly stated in the Level 1 SFRA and where possible the DWMP and SIRF information will be used to inform the scope of site specific FRAs. Consideration of Sewer flooding will be included in the Level 2 SFRA and if possible it will be identified at this stage if this places an additional constraint on the timing or extent of development that can be implemented.

Water companies were required to publish Drainage Water Management Plans for river basin catchments across England as part of the Environment Act. The plans describe the basis for long term investment proposals by Water Companies that span for more than 25 years and set out the commitment needed to make wastewater systems safe and secure. The plans contain substantive volumes of mapping, information and data that has not previously been made available by water companies. As part of the DWMPs a risk based catchment screening (RBCS) has been completed, where existing, readily available data is used to identify where there is a current and/or potential risk or vulnerability in the sewer catchment to future changes, such as new residential development or changes in climate. This feeds into a baseline risk and vulnerability assessment (BRAVA) enabling comparison across locations based on different levels of risk.

The data resolution provided in Anglian Water's DWMP is catchment scale based on sewer catchments and applicable to the entire study area, but does not provide data that enables evaluation of comparative risk at site scale. Consequently, it is not possible to take a risk based approach using this data and it is not considered to be comparable to the river and sea flooding information. If specific spatial information becomes available on sewer flood risk that provides competent data on the spatial relative risk of flooding this will be evaluated in the Level 2 SFRA and as appropriate inform the Sequential Test process.

2.1.5 Reservoir flood risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
Reservoir flooding risk	Reservoir Flood Mapping (RFM)	<ul style="list-style-type: none"> • The latest available mapping now shows “wet day” and “dry day” reservoir inundation extents. The “wet day” being a reservoir breach at the same time as a 1 in 1000 river flood (as this is a likely time when a reservoir might fail) and the dry day shows the failure just from the water retained by the dam. • Neither set of mapping describes a risk-based scenario as it does not provide the probability of a dam failure but are intended to describe a “worst credible case”. • More detailed information on flood velocities and depths has been prepared as part of the modelling and mapping study, but this is not publicly available and can only be viewed by those with appropriate security classifications. The flood extents are publicly available. • A dataset exists which shows where the impact of reservoir flooding no longer affects the fluvial flood extent. This is known as a Wet Day Termination Extent. This dataset can be used to provide two zones: <ol style="list-style-type: none"> 1. Where reservoir flooding is predicted to make fluvial flooding worse. 2. Where reservoir flooding is not predicted to make fluvial flooding worse. • The mapping could be used to direct proposed new development away from locations that could potentially be affected by reservoir flood risk. However, it would not be conceptually similar to the risks pertaining to river and sea flooding and further assessment would be required to understand the magnitude of the potential hazard. • A consideration with respect to the reservoir maps is that placing new development in locations predicted to be affected by reservoir inundation could potentially change the “risk category” of the reservoir and this could result in the reservoir owner “undertaker” having to invest in substantive remedial works to demonstrate that the reservoir had the appropriate level of safety. This is not strictly related to the sequential test, but

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
		<p>should be a consideration that should be appropriately managed when planning new development.</p> <ul style="list-style-type: none"> The mapping does not provide climate change information on future flood risk and provision of such mapping is unlikely based on the existing methodology

Recommendations for using zone maps for reservoir flooding

It is recommended that reservoir flooding is included in the Sequential Test. However, it will be made clear in the SFRA that the available information is not conceptually similar to the risks pertaining to river and sea flooding.

The RFM Wet Day Termination Extent will be used to define two zones:

1. Where reservoir flooding **is** predicted to make fluvial flooding worse.
2. Where reservoir flooding is **not** predicted to make fluvial flooding worse.

This will also identify locations where proposed development could result in a change to the risk designation of a reservoir. If proposed sites are located in a zone at reservoir risk it will be necessary to include a more detailed assessment in a Level 2 SFRA to understand the extent to which the flooding could be made worse and to report on the implications with respect to allocating the land for development. On that basis such an approach is recommended.

2.1.6 Canal flood risk

Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the Sequential Test
<ul style="list-style-type: none"> Canal flooding risk 	<ul style="list-style-type: none"> CRT canal embankments layer Historic flood incidents (CRT) 	<ul style="list-style-type: none"> Canals are regulated waterbodies and are unlikely to flood unless there is a sudden failure of an embankment or a sudden ingress of water from a river in areas where they interact closely. The Canal and River Trust provides a dataset on canal embankments, however this does not identify the risk of flooding in the event of a canal breach/overtopping. Historic flood data is available from the Canal and River Trust. Unless the canal is represented in the Environment Agency fluvial flood model used to define the Flood Zones mapping does not enable execution of risk based sequence.

Recommendations for using zone maps for canal flooding

It is recommended that canal flooding is not included in the Sequential Test as the probability of failure is not quantifiable as it is a residual risk. The available information for canal flooding is not conceptually similar to the risks pertaining to river and sea flooding.

Any development proposed adjacent to a canal should include a detailed assessment of how a canal breach would impact the site, as part of a site-specific FRA, and the Canal and River Trust canal embankments and flood history layers will identify this requirement. If specific spatial information becomes available on canal flood risk that provides competent data on the spatial relative risk of flooding this will be evaluated in the Level 2 SFRA and as appropriate inform the Sequential Test process.

3 Sequential approach at a site level

In cases where the proportion of the site at flood risk is small, a sequential approach at the site level would be appropriate and enable development to be located in locations at lowest risk of flooding (by avoiding high risk areas that might exist at a particular site). This involves incorporating the less vulnerable aspects of the development (according to the Environment Agency's flood risk vulnerability classification) in the areas at risk of flooding. The more vulnerable aspects would be incorporated within areas at lower risk.

It will be possible to include further assumptions with respect to how the flood risk information is assembled to perform the Sequential Test. It is probably appropriate that further refinements are made when the sites are assembled and the testing process is initiated. At that time it will be possible to modify the methodology to reflect the preferred approach.

4 Conclusions

This technical note has been prepared to formalise the arrangements to perform the Sequential Test for Milton Keynes City Council. Updates to the NPPF in July 2021 require that all sources of flooding are considered in the preparation of the Sequential Test. In addition, updates to the August 2022 PPG now require that the Sequential Test assesses all sources of flooding for low, medium and high-risk areas both now and in the future.

Prior to the changes to the NPPF, only consideration of river and sea flood risk was required when applying the Sequential Test.

A review of readily available information has been undertaken to assess suitable data sources which could be considered. A summary of the datasets to be used in the Sequential Test can be found in Appendix B.

It is recommended that Flood Zones 2, 3 and 3b are assessed both for the present day and future.

It is recommended that the Environment Agency's 1 in 1000-year Risk of Flooding from Surface Water flood extent mapping is used to define a simple zoning scheme that identifies a high risk and low risk zone. It should be noted that the Risk of Flooding from Surface Water map includes an allowance for drainage (a flood risk management feature), so this is not strictly the same conceptual risk zone as defined for river and sea flooding (even though it is associated with the

same probability). However, it does create a product that can accommodate a form of sequential testing, as it would facilitate strategic decisions that direct development to land in a “low risk surface water flood zone”. For future river flood risk, JBA Consulting have run the 1 in 1000 year plus 40% climate change, 1 in 100 year plus 40% climate change and 1 in 30 plus 35% allowances and these should be used.

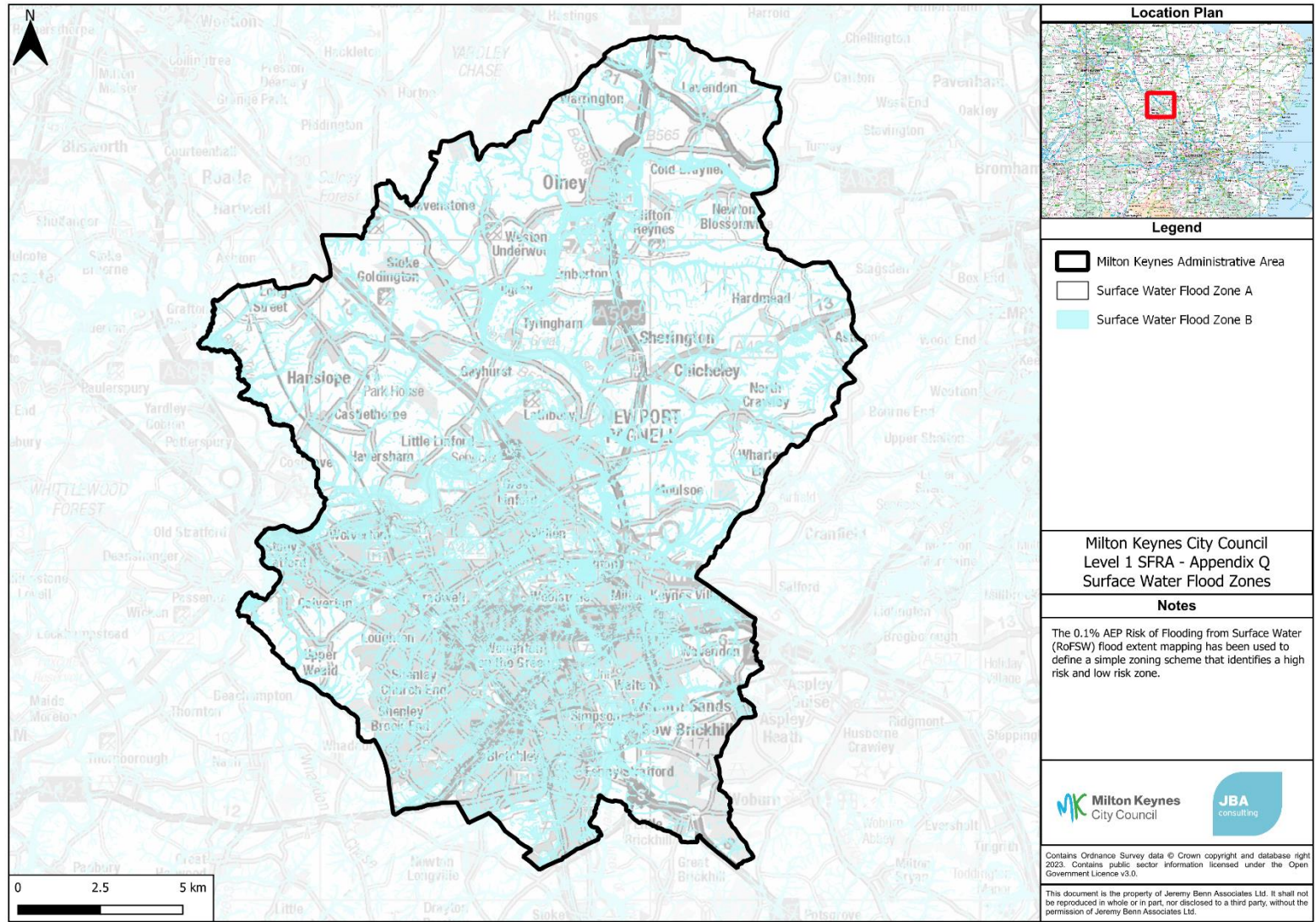
A potential high risk zone will be prepared for reservoir flood risk and if allocated sites are located in such zones then the implications should be addressed in a Level 2 SFRA.

The readily available datasets for groundwater and sewer flood risk do not competently define areas of high or low risk of flooding and so do not competently support an assessment of comparative risk. To address this within the Sequential Test more detailed assessments are performed in the Level 2 SFRA to identify if it is appropriate to consider alternative locations and where possible a screening exercise performed to identify sites where the risk of groundwater flooding is anticipated to be low.

Further consultation will be sought from the LLFA and the Environment Agency for their comments on the updated methodology and continued agreement with the approach will be confirmed before the inclusion in the final version of the SFRA.

Appendices

A Example Surface Water Zone Map



B Summary of the Sequential Test methodology

Source of Flooding	High risk	Medium risk	Low risk	Justification of approach	
				Risk now	Future risk
Fluvial	Greater than 1 in 100 year (FZ3)	Between 1 in 100 and 1 in 1,000 year (FZ2)	Less than 1 in 1,000 year	EA's Flood Zones 1, 2 and 3 use a risk-based approach	
Surface Water	Greater than 1 in 1000 year		Less than 1 in 1,000 year	Different assumptions are used to derive surface water risk than is the case for fluvial and tidal flood zones. The RoFSW dataset potentially does not provide the confidence or certainty required to define areas of high medium and low flood risk that are comparable with the risk zones for river and sea flooding. Therefore, a precautionary approach should be taken so development is located in areas of low flood risk. This approach will require that sites where proposed development is located in a high risk surface water zone are assessed in more detail in the Level 2 SFRA.	
Groundwater	All sites assumed to be potentially susceptible to groundwater flooding.			Datasets potentially do not have the confidence or certainty required to provide mapping that enables a comparative assessment to be made of the risk of flooding of land from groundwater. Therefore, a precautionary approach should be taken and all potential allocation sites will be assessed for groundwater flood risk in the Level 2 SFRA and the implications for sequential selection of alternative locations considered at this stage.	
Sewer	All sites assumed to be at high risk of sewer flooding. Additional information required via the Level 2 SFRA			Datasets potentially do not have the confidence or certainty required to provide mapping that enables a comparative assessment to be made of the risk of flooding of land from sewers. Therefore, a precautionary approach should be taken and all potential allocated sites will be assessed for sewer flood risk via the Level 2 SFRA where data is available and the implications for sequential selection of alternative locations considered at this stage.	
Reservoir	Sites where reservoir flooding is predicted to make fluvial flooding worse for development in high hazard zone to be assessed in Level 2 SFRA.			Datasets potentially do not have the confidence or certainty required to provide mapping that enables a comparative assessment to be made of the risk of flooding of land from reservoirs. In addition, the reservoir flood map identifies the consequence of a reservoir breach rather than risk, so applying high, medium and low 'risk' is not possible using this dataset. Therefore, a precautionary approach should be taken and sites where reservoir flooding is predicted to make fluvial flooding worse for development or where	

Source of Flooding	High risk	Medium risk	Low risk	Justification of approach	
				Risk now	Future risk
Canal				development is proposed in a high hazard zone will be assessed in Level 2 SFRA and the implications for sequential selection of alternative locations considered at that stage.	
				Additional information required by the Level 2 SFRA.	Datasets potentially do not have the confidence or certainty required to provide mapping that enables a comparative assessment to be made of the risk of flooding of land from canals.



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