

Appendix C: SFRA User Guide: Sequential test methodology

1. Introduction

1.1 Background

The aim of this appendix is to discuss the availability and limitations of data for assessing the risk from different sources of flooding both now and in the future within the sequential test, including a user guide for the Council to use the data supplied in the SFRA through the application of the sequential test for different sources of risk.

Section 3 describes the implications of including different sources of flooding both now and in the future in the sequential test. It also highlights matters to be considered and identifies a preferred approach. Table 5-1 and Table 5-2 provide a user guide for the Council to use to apply the sequential test for each source of flood risk and signposts to relevant sections of the SFRA.

1.2 Summary of changes

The NPPF was revised in July 2021 (and last updated in December 2024). This revision changed the requirements for the sequential test. Paragraph 174 of the NPPF (December 2024) states 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 173) should be used *‘in areas known to be at risk now or in future from **any form of flooding.**’*

Prior to the changes, the NPPF only required consideration of river and sea flood risk when applying the sequential test (Table 1-1).

Table 1-1: Changes in policy wording in the NPPF for applying the sequential test.

Previous Policy Wording	The aim of the sequential test is to steer new development to areas with the lowest risk of flooding (the PPG 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
New Policy Wording (July 2021)	The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source (The PPG has not yet been updated to describe how this exercise should be performed)

The sequential test now requires that all sources of 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.

In addition, the PPG now also notes that where neighbourhood plans are considering proposing development, they should address how this would be consistent with the local planning authority's application of the sequential test and if necessary, the exception test for the plan. If not, these tests will need to be re-visited on a local authority-wide basis.

1.3 What happens next

Where required, a Level 2 SFRA or site-specific Flood Risk Assessment (FRA) 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 circumstances where the proposed approach requires more detailed consideration of surface water drainage in the Level 2 SFRA, Severn Trent Water (responsible for sewerage) will be consulted to confirm 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 Sequential test

The sequential test, based on the sequential approach, was originally conceived to direct proposed new development to locations that did not rely on Flood Risk Management features, so they are inherently safe and do not place a burden on future generations. The test was previously performed 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. This provided a logical conceptual basis for the placement of proposed new development that would not require 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 are no reasonable alternatives. An obvious circumstance being proposed is town centre development in locations of high flood risk, as it is not possible to redevelop town centre sites unless they remain in the town centre. In circumstances where the sequential test has been performed and it is not possible for development to be located in areas with a lower risk of flooding, 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 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 2024 NPPF recommends that application of the sequential test applies to any source of flooding. The updated PPG: Flood risk and coastal change paragraph 23 further states: "Other forms of flooding need to be treated consistently with river and tidal flooding in mapping probability and assessing vulnerability, so that the sequential approach can be applied across all areas of flood risk". The general implications of these are summarised as follows:

- The sequential test 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 but comparable mapping of this specific type and quality is not available for other sources; for river and sea flooding the risk zones are 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 or use of

proxies) 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, both now and in the future, as this is fundamental to establishing a logical “risk sequence”.

Section 3 describes the implications of including different sources of flooding both now and in the future in the sequential test. It also highlights matters to be considered and identifies a preferred approach.

2.2 Exception test

Table 2 of the PPG sets out the requirements for the exception test but does not reflect the need to avoid flood risk from sources other than rivers and the sea. There is no guidance on how to consider other sources of flood risk. The exception test should only be applied, following the application of the sequential test, in the following instances:

- 'Essential infrastructure' in Flood Zone 3a or 3b
- 'Highly vulnerable' development in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)
- 'More vulnerable' development in Flood Zone 3a (this is NOT permitted in Flood Zone 3b)

While the exception test is not explicitly required for sites at risk from other sources of flooding, Hinckley and Bosworth Borough Council should follow a similar principle where sites are proposed that are at risk from other sources of flooding, carefully weighing up the wider benefits of development against the risk, ensuring that site users can be kept safe through the lifetime of the development and ensuring residual risk can be safely managed.

The exception test in the SFRA provides additional evidence to demonstrate that the principle of development can be supported at a proposed site and shows that the sustainability benefits of the development to the community outweigh the flood risk.

3. Sources of flooding in the sequential test

3.1 River (fluvial) risk

3.1.1 Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the sequential test
Rivers	Flood Map for Planning and detailed models	<ul style="list-style-type: none"> The sequential test can be carried out using the Fluvial Flood Zones for present day low (Flood Zone 1), medium (Flood Zone 2) and high risk (Flood Zone 3a) as previously was the case. The Flood Zones for this SFRA are set out in Section 4.4.1 of the Main Report. Where detailed models are available and where practical, Future Flood Zones 2 (0.1% AEP event), 3a (1% AEP event) and 3b (3.3% AEP defended) should be assessed with the latest climate change allowances. Elsewhere proxies should be used. The approach to climate change for this SFRA is set out in Section 5 of the Main Report. Generalised modelling is used to delineate Flood Zones where there is no detailed modelling or where it is not practicable to use detailed modelling.

3.1.2 Recommendations for using river flood risk in the sequential test

- For present river flood risk, the Flood Zones 1, 2 and 3a and 3b should be used.
- For future river flood risk, the Flood Zones with climate change allowances should be used where there is detailed modelling, and it is practicable to use these. The approach to climate change in this SFRA is set out in Section 5 of the Main Report and Appendix B: Data Sources.
- Where generalised modelling has been used to delineate Flood Zones and where not practicable to use detailed modelling, Flood Zone 2 should be used as a proxy for Flood Zone 3a with climate change and Flood Zone 3a should be used as a proxy for Flood Zone 3b with climate change. If a development site is located within close proximity of Flood Zone 2 using generalised modelling, then an assessment of climate change for this zone may be required at the Level 2 SFRA stage.

3.2 Surface water flood risk

3.2.1 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 (3.3% AEP, 1% AEP and 0.1% AEP), although the uncertainty associated with the predicted outlines for the respective probabilities is high. • Does not always include allowance for drainage features such as culverts and can over or underestimate flooding where there are linear features such as embankments. • Unlike the Zone maps for river flooding the surface water mapping makes an allowance for the assumed performance of a local drainage system. • Normal profile of extent and shape of surface water flooding is a “dendritic” pattern that follows low lying topography and is not an extensive blanket, as is most often the case for river flooding. • The flood risk is normally more likely to be relatively short lived and much more localised than would be the case for river 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.

3.2.2 Recommendations for using zone maps for surface water flooding

- Use the 0.1% AEP surface water flood extent mapping to define a simple zoning scheme that identifies higher risk and lower risk zones.

Surface Water mapping does not strictly describe 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 and is filtered to remove shallow depths of water. 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 “lower risk surface water flood zone”.

The decision has been made to use the 0.1% AEP surface water extent as the higher risk zone. This is a potentially a slightly more conservative approach but as the predicted 0.1% AEP 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 do not in fact exist. The proposed approach will direct development to areas at low risk in a similar way to the fluvial Flood Zone 1 and will not preclude development in the surface water higher risk zone provided that an FRA is performed to demonstrate that the risks in the higher risk zone can be appropriately managed.

The application of the test would logically be accompanied by a commitment to be made in the Plan Policy that all proposed development on sites identified for allocation would be preferentially placed in the “lower risk surface water flood zone”. In circumstances where it is not possible to place all proposed development in the “lower risk surface water flood zone” or where encroachment on land affected by surface water flood risk cannot 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 and enables an appropriate level of sequential selection to be made. It is not totally aligned with the river and sea zones (but this is appropriate as the mapping is not based on the same parameters), but from a practical perspective it is strongly aligned with the sequential approach defined in Paragraph 172 of the NPPF (December 2024). For these reasons it is recommended.

3.3 Groundwater flood risk

3.3.1 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 Also: JBA Groundwater Emergence Map	<ul style="list-style-type: none"> • BGS mapping does not show the likelihood or risk of groundwater flooding occurring, i.e., it is a hazard and consequence-based product and does not enable application of risk based approach. • JBA groundwater emergence map does potentially enable a risk-based approach to be taken as it depicts different levels of risk. However, this is based on the risk of emergence of groundwater and not surface flooding due to groundwater and it should be noted that the location of highest risk of emergence might not be coincident with the location at highest risk of flooding. The analyses performed to prepare the mapping are all for a 1% AEP event

Source of Flooding	Available Mapping	Implications of making use of mapping in the sequential test
		<p>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 with these datasets 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 of elevated groundwater levels might be higher, but it would not be easy to defend. • 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.

3.3.2 Recommendations for using zone maps for groundwater flooding

It is recommended that groundwater flood risk is not considered in the sequential test on the basis that the JBA groundwater emergence map does 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.

JBA groundwater emergence mapping should therefore be used in conjunction with other relevant sources of flooding such as historical records so that areas can be identified that are unlikely to be affected by groundwater flooding (low potential) and also areas where groundwater flooding is potentially a material consideration can be identified (high potential). The combination of these datasets can then accommodate an appropriate level of sequential testing. At the Level 2 SFRA stage (or for a site-specific FRA), a site-specific assessment should be performed where the potential for groundwater flooding is high.

3.4 Sewer flood risk

3.4.1 Implications

Source of Flooding	Available Mapping	Implications of making use of mapping in the sequential test
Sewer flooding risk	Severn Trent Water DG5 records and Drainage and Wastewater Management Plan (DWMP)	Only available at postcode level and thus mapping does not define spatial extent or location of sewer flooding. DWMP mapping does not enable execution of risk based sequence.

3.4.2 Recommendations for using zone maps for sewer flooding

It is recommended that the sewer flood risk is not considered in the sequential test on the basis that the available information is not of an appropriate resolution or format to support spatial comparison of risk. Where possible the DG5 and DWMP information should be used to inform the scope of site specific FRAs.

Water companies were required to publish DWMPs 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. Severn Trent Water published their DWMP in 2023. As part of the DWMP a risk-based catchment screening (RBCS) exercise has been completed, where existing, readily available data was 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 Severn Trent Water's DWMP is catchment scale and not applicable across the entire borough. 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.

3.5 Reservoir flood risk

3.5.1 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 mapping shows “wet day” and “dry day” reservoir inundation extents. The “wet day” being a reservoir breach at the same time as a 0.1% AEP 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 they do 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 have 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 "wet day" reservoir flooding affects the fluvial flood extent. This is known as the Reservoir Flood Extents - Fluvial Contribution. This can be used to identify areas where: <ul style="list-style-type: none"> ○ reservoir flooding is predicted to make fluvial flooding worse. ○ 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

Source of Flooding	Available Mapping	Implications of making use of mapping in the sequential test
		<p>(the “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 is 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.

3.5.2 Recommendations for using zone maps for reservoir flooding

It is recommended that the available reservoir flood mapping is not included in the sequential test as the available data is inappropriate to be used alongside risk mapping from other sources when performing the sequential test.

An assessment of those sites identified to be at risk of inundation should be included in the Level 2 SFRA.

The available information is not conceptually similar to the risks pertaining to river and sea flooding as it shows the worst credible case and not the risk of flooding and so does not support a logical spatial comparison of risk that can be substantiated by appropriate evidence.

The RFM Fluvial Contribution Extent can be used to identify areas where:

- reservoir flooding is predicted to make fluvial flooding worse.
- reservoir flooding is not predicted to make fluvial flooding worse.

More detailed assessment in the Level 2 SFRA will 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 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. If proposed development is located in a high hazard zone in the vicinity of an existing dam structure the implications should be considered in a Level 2 SFRA or site specific FRA and where appropriate an assessment made of whether alternative sites should be considered in accordance with the sequential test.

4. Sequential approach at a site level

For sites where only a small proportion of the site is identified as being at high or medium risk of flooding it may be possible for the sequential test to be satisfied if all proposed development can be placed in areas of low flood risk. This can be sequentially preferable to site locations where high or medium flood risk areas cannot be avoided. It should be noted that in most circumstances the flooding from different sources is likely to affect the same “low lying” location within a proposed site, and therefore site selection should usually not be based on the number of different sources of flooding that could affect a site. Also, it is not strictly appropriate to seek to suggest that flood risks from different sources can be simply combined to derive a combined risk or ranking, as the logic and likelihood of such conclusions cannot easily be evidenced by the supporting data.

5. Summary of the sequential test methodology

Table 5-1: Summary of the sequential test methodology for fluvial and surface water flooding.

Source of Flooding	High Risk	Medium Risk	Low Risk	Present Day Data	Future Risk Data	Relevant sections of the SFRA
Fluvial	Greater than 1% AEP (1 in 100 year) (FZ3)	Between 1% and 0.1% AEP (1 in 100 and 1 in 1000 year) (FZ2)	Less than 0.1% AEP (1 in 1000 year) (FZ1)	<p>EA's Flood Zones (FZs) 2 and 3a use a risk-based approach.</p> <p>Functional Floodplain (FZ3b) is displayed using the best available model data, see Section 4.4.1 of the Main Report and Appendix B for details of the models used.</p> <p>Where model data is not available, Fluvial FZ3a is used as a proxy for FZ3b.</p>	<p>Use Flood Zones 2, 3a and 3b with climate change allowances where available. Use the defined proxy approach where climate change allowances are not available, set out in Section 5.3.1 of the Main Report.</p>	<p>4.4 – Fluvial Flood Risk</p> <p>5.3.1 – Fluvial climate change</p> <p>Appendix A – GeoPDF Mapping</p> <p>Appendix E – Summary of Flood Risk</p>
Surface Water	Greater than 0.1% AEP	N/A	Less than 0.1% AEP	<p>Different assumptions are used to derive surface water risk than is the case for fluvial 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 flooding. Therefore, a precautionary approach should be taken so development is located in areas of lower flood risk. This approach will require that sites where</p>	<p>The use of the 0.1% AEP surface water zone implicitly includes an allowance for climate change when considering higher risk areas.</p>	<p>4.5 – Surface water flooding</p> <p>5.3.2 – Surface water climate change</p> <p>Appendix A – GeoPDF Mapping</p>

Source of Flooding	High Risk	Medium Risk	Low Risk	Present Day Data	Future Risk Data	Relevant sections of the SFRA
				proposed development is located in a higher risk surface water zone, and do not clearly show that development can be achieved away from the flood risk, are assessed in more detail in a Level 2 SFRA or site specific FRA.		Appendix E – Summary of Flood Risk

Table 5-2: Summary of the sequential test methodology for groundwater, sewer, reservoir, and canal flooding.

Source of Flooding	Assessing Risk	Present Day Data	Future Risk Data	Relevant sections of the SFRA
Groundwater	Screening to be undertaken to assess the potential susceptibility of all sites to groundwater flooding. Additional information required via a Level 2 SFRA or site specific FRA where susceptibility is considered to be high.	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 sites where groundwater flooding potential is identified to be high should be identified and assessed in a Level 2 SFRA or site specific Flood Risk Assessment. The implications for sequential selection of alternative locations should be considered at that stage.	(not available)	4.7 – Groundwater flooding Appendix A – GeoPDF Mapping Appendix E – Summary of Flood Risk
Sewer	Assessment of potential susceptibility of sites to sewer flooding to be undertaken via a Level 2 SFRA or site specific FRA utilising available data from historic flood records and DWMP.	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, further assessment will be undertaken at a Level 2 SFRA where significant risk from sewers is noted. This may be through historical sewer flood records and additional information from water companies. The implications for sequential selection of alternative locations should be considered at that stage.	(not available)	4.6 – Sewer flooding

Source of Flooding	Assessing Risk	Present Day Data	Future Risk Data	Relevant sections of the SFRA
Reservoir	Screening to be undertaken to identify sites where development is proposed in a high hazard zone. Additional information required via a Level 2 SFRA or site specific FRA where susceptibility is considered to be high.	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 development is proposed in a high hazard zone will be identified and assessed in a Level 2 SFRA or site specific FRA. The implications for sequential selection of alternative locations should be considered at that stage.	(not available)	4.9 – Flooding from reservoirs Appendix A – GeoPDF Mapping Appendix E – Summary of Flood Risk
Canal	Screening to be undertaken to identify where development is in close proximity to canals. Additional information required via a Level 2 SFRA or site specific FRA where there is the potential for flood risk from canal breach or failure.	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. Therefore, a precautionary approach should be taken and sites identified to be within 100m of a canal should be assessed in a Level 2 SFRA or site specific FRA. The implications for sequential selection of alternative locations should be considered at that stage.	(not available)	4.8 – Flooding from canals

Offices at

Bristol
Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Leeds
Limerick
Newcastle upon Tyne
Newport
Peterborough
Portsmouth
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

Registered Office
1 Broughton Park
Old Lane North
Broughton
SKIPTON
North Yorkshire
BD23 3FD
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
Follow us:  

Jeremy Benn
Associates Limited

Registered in England
3246693

JBA Group Ltd is
certified to:
ISO 9001:2015
ISO 14001:2015
ISO 27001:2013
ISO 45001:2018

