Appendix C: Guide for using available flood risk data in applying the sequential test

1 Introduction

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.

1.1 Summary of changes to the sequential test

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, 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	New Policy Wording (July 2021)
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)	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. If not, these tests will need to be re-visited on a local authority-wide basis.

1.2 Requirements for the sequential test

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 2 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 4-1 and Table 4-2 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.

1.3 The exception test

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 exception test may be required. 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).

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, the Local Planning Authority 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.

2 Sources of flooding in the sequential test

2.1 River (fluvial) risk

2.1.1 Recommendations for using river flood risk in the sequential test

The Environment Agency Flood Map for Planning and any available detailed hydraulic models should be used to consider river flood risk in the sequential test.

It is recommended that the sequential test considers river flood risk as follows:

- 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, 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. The approach to climate change for this SFRA is set out in Section 5 of the Main Report.

2.2 Surface water flood risk

2.2.1 Available data to assess surface water flood risk

The Environment Agency's Risk of Flooding from Surface Water (RoFSW) mapping is available to assess surface water flood risk. The following points should be considered when using the RoFSW mapping:

- The mapping based on a generalised modelling methodology. It is 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.
- It 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.

The nature of surface water flooding differs from that of river flooding:

- 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.
- Surface water 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.

2.2.2 Recommendations for using zone maps for surface water flooding

The following approach is recommended to consider surface water flood risk:

- Use the 1% AEP 2070s Upper End climate change 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 1% AEP 2070s Upper End climate change surface water extent as the higher risk zone. This is potentially a slightly more conservative approach but as the predicted 1% AEP 2070s Upper End 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”.

The proposed approach is relatively simple and enables an appropriate level of sequential selection to be made. It is not completely aligned with the river and sea zones (this is however 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 167 of the NPPF. For these reasons it is recommended.

2.3 Groundwater flood risk

2.3.1 Available data to assess groundwater flood risk

Two sources of groundwater mapping have been made available for use within this SFRA:

- British Geological Survey (BGS) Groundwater flood susceptibility maps
- JBA Groundwater Emergence Map

The following points should be considered when using the available groundwater mapping datasets:

- 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 a risk based approach.
- The 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 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. This dataset is not publicly available, but the mapping is shown in Appendix E of this Level 1 SFRA.
- 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.

2.3.2 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). 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.

2.4 Sewer flood risk

2.4.1 Available data to assess sewer flood risk

The following data was available for use within this SFRA to assess sewer flood risk:

- Thames Water historic flooding incidences
- Thames Water Drainage and Wastewater Management Plan (DWMP)

The historic flooding incidences are only available at postcode level and thus mapping does not define the spatial extent or location of sewer flooding.

Mapping within the DWMP does not enable execution of risk based sequence.

2.4.2 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.

The data resolution provided in Thames 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.

Where possible the historic flooding incidences and DWMP information should be used to inform the scope of site specific FRAs.

2.5 Reservoir flood risk

2.5.1 Available data to assess reservoir flood risk

Table 2-1 sets out the available mapping data to assess reservoir flood risk and associated considerations.

Table 2-1: Reservoir flood mapping and considerations for its use within the sequential test.

Available Mapping	Considerations for making use of mapping in the sequential test
Environment Agency "Wet day" and "Dry day" reservoir inundation extents	• The “wet day” mapping shows the predicted extent 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.

Environment Agency Reservoir Flood Extents - Fluvial Contribution	• Shows where the impact of "wet day" reservoir flooding affects the fluvial flood extent. This 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.
	• The mapping does not provide climate change information on future flood risk and provision of such mapping is unlikely based on the existing methodology.

2.5.2 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 Reservoir Flood Mapping 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.

2.6 Canal flood risk

2.6.1 Available data to assess canal flood risk

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. No canal mapping data was provided by Basingstoke Canal Authority for this SFRA.

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.

2.6.2 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. 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

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.

4 Summary of the sequential test methodology

Table 4-1: 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)	EA's Flood Zones (FZs) 2 and 3a use a risk-based approach. Functional Floodplain (FZ3b) is displayed using the best available model data, see Section 4.4.1 of the Main Report for details of the models used. Where model data is not available, Fluvial FZ3a is used as a proxy for FZ3b.	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.	4.4 – Fluvial Flood Risk 5.3.1 – Fluvial climate change Council's Interactive Mapping Portal (surreyheath.hub.xmap.cloud) Appendix D – Summary of Flood Risk
Surface Water	Greater than 1% AEP 2070s Upper	N/A	Less than 1% AEP 2070s Upper	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	The use of the 0.1% AEP surface water zone implicitly includes an allowance for climate change when considering higher risk	4.5 – Surface water flooding 5.3.2 – Surface water climate change

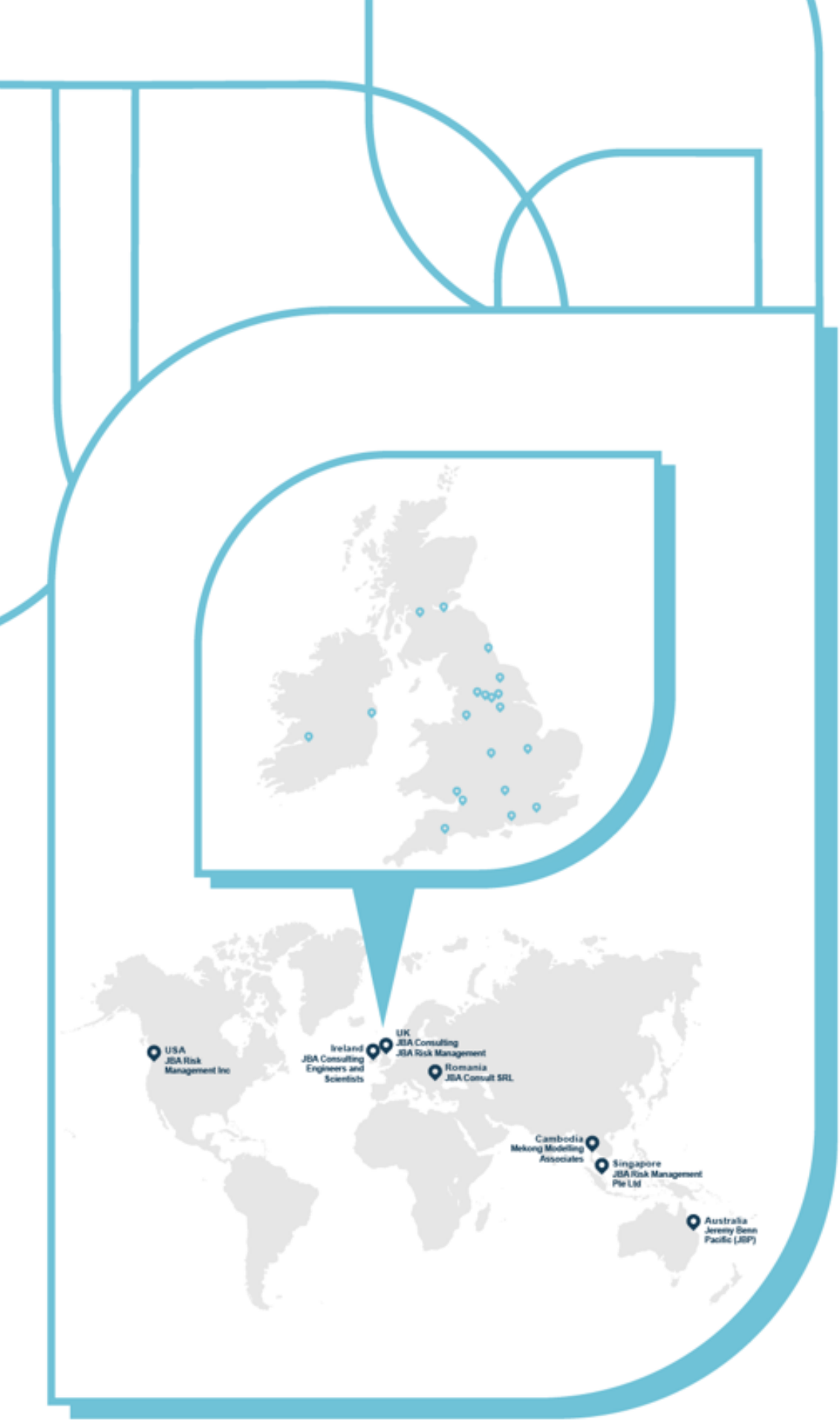
Source of Flooding	High Risk	Medium Risk	Low Risk	Present Day Data	Future Risk Data	Relevant sections of the SFRA
	End Climate Change		End Climate Change	of high medium and low flood risk that are comparable with the risk zones for river flooding. Therefore, a precautionary approach should be taken so development is located in areas of lower flood risk. This approach will require that sites where 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.	areas.	Council's Interactive Mapping Portal (surreyheath.hub.xmap.cloud) Appendix D – Summary of Flood Risk

Table 4-2: Summary of the sequential test methodology for groundwater, sewer, reservoir, and groundwater 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 Council's Interactive Mapping Portal (surreyheath.hub.xmap.cloud) Appendix D – Summary of Flood Risk Appendix E – JBA Groundwater Emergence Mapping
Sewer	Assessment of potential susceptibility of sites to sewer flooding to be undertaken via a Level 2 SFRA or site specific FRA utilising available	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	(not available)	4.6 – Sewer flooding

Source of Flooding	Assessing Risk	Present Day Data	Future Risk Data	Relevant sections of the SFRA
	data from historic flood records and DWMP.	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.		
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 Council's Interactive Mapping Portal (surreyheath.hub.xmap.cloud) Appendix D – 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	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	(not available)	4.8 – Flooding from canals

Source of Flooding	Assessing Risk	Present Day Data	Future Risk Data	Relevant sections of the SFRA
	specific FRA where there is the potential for flood risk from canal breach or failure.	or site specific FRA. The implications for sequential selection of alternative locations should be considered at that stage.		



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