



reduce run-off rates for existing developed sites. Early liaison with CDC and the Environment Agency should be undertaken to consider viable options for onsite drainage.

- Attenuation up to the 1% annual probability event plus climate change.
- Consideration of the existing groundwater regime.
- For large developments (>1 ha), it is recommended that the FRA should propose a schedule to monitor groundwater levels from the conception to the completion of a proposed development. This schedule should ideally include a scheme for monitoring groundwater levels for a year post development to ensure that there is no alteration to the groundwater regime.³¹
- For smaller developments (<1 ha), developers should also be able to demonstrate through an appropriate assessment that a proposed development does not adversely impact the local groundwater regime.
- Basements should not be used for habitable purposes in Flood Zone 2. Where basements are permitted for commercial use, access points should be situated 300mm above the 1 in 100-year plus climate change flood level, see Section 6.6.1.
- Demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures) are taken into account. People (including those with restricted mobility) should be able to remain safe inside a new development in the 1 in 1000-year; and rescue and evacuation of people from a development is practicable up to a 1 in 1000-year event, see Section 6.6.3.
- The proposed development should be set back from the watercourse with a minimum strip of 8m of undeveloped buffer zone to allow for maintenance, see Section 6.9.

Any proposed development will be required to provide evidence that the Sequential Test, and if required the Exception Test, have been passed. A preliminary FRA, using data from the SFRA, PFRA and any necessary further modelling work (where detailed modelling has not already been provided as part of the SFRA), will be required to ascertain the level of flood risk for Sequential Test purposes. It is strongly recommended that the Sequential Test, and, if necessary, the Exception Test be satisfied before the FRA detailing design and mitigation measures is commenced.

Further information on the details to be provided within the FRA can be found in the [Environment Agency's FRA Guidance Note 3](#)²⁸, [CIRIA report C624](#)²⁹, and the [PPS 25 Practice Guide](#).

6.3.3 Flood Zone 3a

Water-compatible uses and less vulnerable development are allowed in this Flood Zone, following application of the Sequential Test. Highly vulnerable development is not permitted, and essential infrastructure and more vulnerable development need to pass the Exception Test. Essential infrastructure should be designed and constructed to remain operational and safe for users in times of flood.

Where, due to wider sustainable development reasons, there are no other suitable sites available in lower risk zones then an assessment of the residual risk within Flood Zone 3 is required. For developments to proceed; it must also be shown that the development will not increase flood risk elsewhere through a loss of storage or conveyance. Flood risk must be reduced or kept at current levels.

A detailed FRA must be undertaken by a suitably qualified professional. It is required to provide evidence that the Sequential Test, and if required the Exception Test, have been passed. A preliminary FRA, using data from the SFRA, PFRA and any necessary further modelling work (where detailed modelling has not already been provided as part of the SFRA), will be required to ascertain the level of flood risk for Sequential Test purposes.

It is strongly recommended that the Sequential Test, and, if necessary, the Exception Test be satisfied before the FRA detailing design and mitigation measures is commenced. The Sequential Test will already have been applied to adopted site allocations. In the case of windfall sites, developers should speak to the local planning authority to confirm whether developer or planning

³¹ Note: This measure is not compulsory, but in areas where sites are potentially vulnerable to ground water flooding an assessment of this risk will need to be considered. CDC has recommended this approach.
2016s3821 Cotswold SFRA Update Final (May 2016)



authority will undertake the sequential test. However, there will be a presumption against development within Flood Zone 3a and 3b.

The following should be included within a FRA for developments within Flood Zone 3a:

- Assess risk from all sources of flooding (e.g. fluvial, surface water, sewer, and groundwater) for the lifetime of the development (accounting for climate change. Provide a detailed assessment of the risk using hydraulic modelling, surface water modelling or groundwater investigations as appropriate.
- Proposed developments located in proximity to formal defences, water retaining structures (reservoirs or canals) will require a detailed breach and overtopping analysis to ensure that the residual risk can be managed for the lifetime of the development. The nature of the breach analysis should be discussed with the Environment Agency and CDC as required, see Section 6.9.
- Recommend mitigation measures in response to any identified flood risk, such as:
 - Floor levels should be situated above the 1 in 100-year plus climate change predicted maximum level with a minimum freeboard of 300mm, see 6.6.2.
- Any new 'More Vulnerable' development, particularly involving the creation of new residential units, will require dry access and egress up to the 1 in 100 year flood event, with an allowance for climate change over the lifetime of the development, see Section 6.6.3.
 - Demonstration that flood resilience/ resistance and emergency escape measures have been incorporated where appropriate. This includes flood defences, flood resilient and resistant design, effective flood warning and emergency planning are acceptable, see 6.6.2.
 - Sequentially design the site to locate the built element of the development away from the source of flood risk, see section 6.3.7.
 - Substitute less vulnerable development types for those incompatible with the degree of flood risk see Section 6.3.8. Appropriate space should be allocated within the site for SuDS.
- Ensure that flood risk is reduced overall, for example that:
 - Flood flow routes are preserved
 - Floodplain storage capacity is not reduced, and where necessary is compensated for on a level for level basis using land on the edge of the floodplain and above the 1% annual probability (1 in 100) with an allowance for climate change flood extent.
- Assess the impact of proposed development upon surface water drainage following any increase in impermeable area. This should include the potential impact upon areas and receiving watercourses downstream, and recommend the approach to control surface water discharge.
- Demonstrate that a proposed development can reduce flood risk elsewhere through the addition of SuDS, to control the potential impact new development may have on the surface water run-off regime see Section 0. The following minimum drainage requirements should be adhered to:
 - Reduce surface water runoff, where this is not feasible at a minimum greenfield discharge rates should be met.³²
 - Attenuation up to the 1% annual probability event plus climate change.
 - Consideration of the existing groundwater regime.
- For large development (>1 ha), the FRA should propose a schedule to monitor groundwater levels from the conception to the completion of a proposed development. This schedule should include a scheme for monitoring groundwater levels a year post development to ensure that there is no alteration to the groundwater regime.

³² Note: for some sites it may not be feasible to meet this requirement in highly constrained brownfield sites. In these circumstances, early liaison with CDC and the Environment Agency should be undertaken to consider viable options for onsite drainage.



- For smaller developments (<1 ha), developers should also be able to demonstrate through an appropriate assessment that a proposed development does not adversely impact the local groundwater regime.
- Basements should not be used for habitable purposes in Flood Zone 3. Where basements are permitted for commercial use, access points should be situated 300mm above the 1 in 100-year plus climate change flood level, see Section 6.6.1.
- The proposed development should be set back from the watercourse with a minimum strip of 8m of undeveloped buffer zone to allow for maintenance.

Further information on the details to be provided within the FRA can be found in the [Environment Agency's FRA Guidance Note 3](#)³³ and the NPPF Planning Practice Guidance.

6.3.4 Flood Zone 3b – the Functional Floodplain

The functional flood plain is defined as “land where water has to flow or be stored in times of flood.” Only water-compatible uses are allowed in this Flood Zone. Essential infrastructure can be permitted after the Exceptions Test is passed. Essential Infrastructure is defined as essential transport infrastructure (including mass evacuation routes); and strategic utility infrastructure (including electricity generating power stations, grid and primary stations). However, utility infrastructure may not be appropriate, considering the events at the Mythe Treatment Works, Castlemeads electricity sub-station and the near flooding of the Waltham electricity sub-station. Therefore essential infrastructure built within the functional floodplain should:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage;
- Not impede water flows; and
- Not increase flood risk elsewhere.
- Not impact upon the groundwater regime

Flood Zone 3b should be considered as the 1 in 20 year flood extents where these have been modelled and mapped. Where the 1 in 20 year extents have not been mapped, a precautionary approach should be followed and Flood Zone 3 should be considered as equivalent to the functional floodplain (see Map 1).

CDC should be seeking risk reduction on any sites within Flood Zone 3b. When such land comes up for redevelopment, planning applications should strive for:

- Removal of buildings, culverts and other structures, and restoration of the functional floodplain, including linkage between the watercourse and floodplain.
- Changing the land use to a less vulnerable classification.
- Changing the layout and form of the development (e.g. reducing the building footprint).
- Preserving flow routes.
- Improving conveyance/storage, e.g. replacing solid building with floodable structures.
- Sequential approach to design of site (see Section 6.3.7)

6.3.5 Taking account of climate change

At all stages of the development process it is important to understand not only the current flood risk to a site but also the flood risk for the lifetime of the development, taking into account the future impact of predicted climate change.

Flood Zone 3a plus climate change (Map 1) is based on existing information (see section 3.2.3 for more details on how the Flood Zone 3a plus climate change was produced) and provides a starting point for applying the Sequential Test. However, more detail using up to date recommended allowances will be required for any site-specific FRA.

An FRA must demonstrate that the impact of climate change on the development has been taken into account and, if appropriate, mitigated against. Government guidance on assessing climate change in flood risk assessments (released in January 2016) can be found at:

³³ Environment Agency, FRA Guidance Note 3
http://www.environment-agency.gov.uk/static/documents/Utility/FRAGuidanceNote3_v3.1.pdf
2016s3821 Cotswold SFRA Update Final (May 2016)



<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

The guidance provides a range of climate change allowances which are dependent on location (by river basin) and timescale of development (termed 'epoch'). Different allowances are given for different epochs but it is envisaged that the '2070-2115' epoch will be appropriate for most developments (Table 6-2).

The guidance also gives several categories (termed 'central', 'higher central' and 'upper end') to test depending on the vulnerability of the development and the Flood Zone within which it is located (summarised in Table 6-3). For example for 'more vulnerable' development in Flood Zone 3a, FRAs should use the higher central and upper end estimates to assess a range of allowances.

When carrying out an FRA, it may be necessary to carry out new or additional modelling to properly test these climate change allowances. It is advisable to contact the Environment Agency to establish what is expected for any particular site, and whether any new modelling is available.

Table 6-2: Climate change allowances (% increase in river flow)

River basin district	Allowance category	Total potential change anticipated for the '2080s' (2070 to 2115)
Thames	Upper end	70%
	Higher central	35%
	Central	25%
Severn	Upper end	70%
	Higher central	35%
	Central	25%

Table 6-3: Using peak river flow allowances in FRAs

	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Flood Zone 2	Higher central/upper end	Higher central/upper end	Central/higher central	Central	None
Flood Zone 3a	Upper end	Development not permitted	Higher central/upper end	Central/higher central	Central
Flood Zone 3b	Upper end	Development not permitted	Development not permitted	Development not permitted	Central

6.3.6 Dry islands

Environment Agency guidance is that dry-islands, areas of land totally surrounded by Flood Zone 3a, should, for spatial planning purposes, be considered as Flood Zone 3a. Dry islands within Flood Zone 2 should be treated as Flood Zone 1. CDC should follow this guidance and treat them as such when carrying out the Sequential Test.

Any development planned in a Flood Zone 3a island areas must therefore pass the Exception Test and have a detailed flood risk assessment with emphasis on safe access and egress. It may also be appropriate to consider the size of the dry-island, and the duration for which access to a site is expected to be compromised. Where a dry island forms between the floodplains of two or more rivers, it may be appropriate to consider the joint probability of both watercourses being in flood at the same time.

Any new "More Vulnerable" or "Highly Vulnerable" development, particularly involving the creation of new residential units, will require dry access and egress up to the 1 in 100 year flood event, with an allowance for climate change over the lifetime of the development. Further guidance on spatial planning within dry-islands is provided in the "Flood Risk to People" report.³⁴

³⁴ <http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=12016>
2016s3821 Cotswold SFRA Update Final (May 2016)



6.3.7 Sites within more than one Flood Zone

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. In particular large development proposals may include a variety of land uses of varying vulnerability to flooding.

Where a site covers more than one Flood Zone, the sequential approach should be applied within development sites to design the site layout to reduce flood risk as much as possible.

A sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. recreational space) can be located in more high risk areas subject to appropriate management.

Low-lying waterside areas, or areas along known surface water flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives.

Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

6.3.8 Policies for existing settlements within Flood Zones 2 and 3

Below are recommendations for specific flood risk management policies within Flood Zones 2 and 3 which could be applied in order to reduce flood risk overall. There is an opportunity for CDC to incorporate these policies into site allocations and Development Management policies within the Local Plan respectively:

Reducing vulnerability: On change of use of sites, opportunities should be taken to reduce vulnerability to flooding, by promoting less vulnerable and water compatible land uses.

Layout and footprint: On redevelopment of a site, opportunities should be taken to reduce the building footprint, thus improving floodplain storage and flow paths. Also, opportunities should be considered for the allocation of SuDS to be included with the revised footprint.

Extensions: Extensions to existing properties should not be permitted in Flood Zone 3a, unless their design is flood resilient.

Residential development above shops: Residential developments above shops in Flood Zone 3 should demonstrate that dry access and egress will be maintained. Where this is not feasible, safe access should be ensured. Where safe access cannot be achieved, the production of a Flood Emergency Plan needs to be undertaken (this will be reviewed by CDC Emergency Planners).

6.4 Surface water runoff and drainage

A FRA should consider how surface water will be managed on the development site. A preliminary drainage strategy should be fully outlined in the FRA, even at an outline application stage. Drainage strategies must consider the impact of climate change on rainfall intensity as outlined in the NPPF Technical Guidance.

Site drainage should be to SuDS infiltration systems where practicable. Where it is not practicable to drain the entire site to infiltration systems, appropriate assessments should be carried out for green and brownfield developments.

Opportunities for developing an Integrated Water Management Strategy across development site boundaries should be explored, and a catchment led approach should be adopted. An integrated approach to controlling surface water drainage can lead to a more efficient and reliable surface water management system as it enables a wider variety of potential flood mitigation options to be used. In addition to controlling flood risk, integrated management of surface water has potential benefits, including improved water quality and a reduction of water demand through rain-water recycling and reuse.

Integrated drainage systems may be considered suitable for catchments where other development is being planned or constructed, and where on-site measures are set in isolation of the systems and processes downstream.



6.4.1 Runoff rates

The design philosophy for greenfield sites requires that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites. Guidance on calculating greenfield runoff rates is given in the [Defra/EA guide to preliminary rainfall runoff management for developments](#)³⁵.

The Environment Agency will expect, where practicable, that the developer should design drainage of a brownfield site such that there is a reduction in flows from the previous usage.³⁶

6.4.2 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are management practices which enable surface water to be drained in a more sustainable manner and to endeavour to mimic the local natural drainage.

There are many different SuDS techniques which can be implemented. The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography, geology (soil permeability), and available area. The design, construction and ongoing maintenance regime of such a scheme must be carefully defined, and a clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential. Additionally, for infiltration SuDS it is imperative that the water table is low enough and a site specific infiltration test is undertaken. Where sites lie within or close to source protection zones further restrictions may be applicable, and guidance should be sought from the Environment Agency.

FRAs should consider the long-term maintenance and ownership of SuDS.

Gloucestershire County Council will become a SuDS Approval Body (SAB) by the enactment of Schedule 3 of the Flood and Water Management Act 2010, although a confirmed date for this enactment has yet to be announced. On enactment, all new development which has surface water drainage implications will potentially require SAB approval and need to conform to National and Local Standards.

Further guidance on SuDS can be found at the documents and websites below:

- [Susdrain website](#)³⁷ - online community for delivering sustainable drainage
- CIRIA documents - there are several CIRIA guides relating to SuDS, most notably The SuDS Manual³⁸, although this is currently undergoing an update. The Susdrain website is a good guide to the available documentation.
- [Environment Agency SuDS guidance](#)³⁹ - Environment Agency advice for developers
- [Interim Code of Practice for Sustainable Drainage Systems](#)⁴⁰
- [Cotswold District Council Strategic Flood Risk Assessment Level 1](#)⁴¹

Connection of surface water drainage to an existing surface water sewer should only be considered as a last resort. The sewerage undertaker should be consulted at an early stage to ensure that sufficient capacity is available in the existing drainage system.

6.5 Wastewater

Major developments and those upstream of areas where sewer flooding is known to be a problem must carry out wastewater capacity checks and should liaise with the sewerage undertaker at an

³⁵ Defra/ Environment Agency (2005) Preliminary rainfall runoff management for developments. R&D Technical Report W5-074/A/TR/1. <http://archive.defra.gov.uk/environment/flooding/documents/research/sc030219.pdf>

³⁶ Note: for some sites it may not be feasible to meet this requirement in highly constrained brownfield sites. In these circumstances, early liaison with CDC and the Environment Agency should be undertaken to consider viable options for onsite drainage.

³⁷ Susdrain website <http://www.susdrain.org/>

³⁸ CIRIA (2007) The SuDS Manual (C697)

³⁹ Environment Agency SuDS guidance <http://www.environment-agency.gov.uk/business/sectors/39909.aspx>

⁴⁰ National SuDS Working Group (2004) Interim Code of Practice for Sustainable Drainage Systems. http://www.environment-agency.gov.uk/static/documents/Business/icop_final_0704_872183.pdf

⁴¹ Cotswold District Council (2008) Strategic Flood Risk Assessment for Local Development Framework Level 1 Volume 1 - FINAL available at <http://consult.cotswold.gov.uk/portal/fp/cs/sfra/sfra1?tab=files>