Flood Risk & Drainage (DRAFT)

Planning Advice

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1.0 Policy

1.1 Under the Flood and Water Management Act (FWMA), Lead Local Flood Authorities (LLFA) have responsibility for managing local flood risk (surface water, groundwater and ordinary watercourse) within their areas and maintaining a register of flood risk assets. The Act places a duty on Flood Risk Management Authorities to co-operate with each other. Warwickshire County Council (WCC) as LLFA works closely with the Environment Agency (EA) to ensure consistency between local and national plans.

1.2 On the 24 March 2015 the Government laid a statutory instrument making LLFA's a statutory consultee on surface water drainage by adding a consultation requirement to Schedule 4 of the Development Management Procedure Order. This came into effect on 15 April 2015. This means that it is mandatory for Local Planning Authorities (LPAs) to consult with LLFAs on all "major" planning applications. The Flood Risk Management team within WCC, which is part of Planning and Development Group, exercises the LLFA role on behalf of the Council.

The definition of "major" development is given in the recent statutory instrument that made LLFAs a statutory consultee - The Town and Country Planning (Development Management Procedure)(England) Order 2015.

"major development" means development involving any one or more of the following:

(a) the winning and working of minerals or the use of land for mineral-working deposits;

(b) waste development;

(c) the provision of dwelling houses where -

(i) the number of dwelling houses to be provided is 10 or more; or

(ii) the development is to be carried out on a site having an area of 0.5 hectares or more and it is not known whether the development falls within sub-paragraph (c)(i);

(d) the provision of a building or buildings where the floor space to be created by the development is 1,000 square metres or more; or

(e) development carried out on a site having an area of 1 hectare or more.

2.0 Standard Pre-Application Advice

2.1 WCC LLFA comment on major applications with surface water drainage and encourage developers to contact us for pre-planning advice and guidance. However, at present WCC is not able to provide bespoke pre-application advice for all requests. In these cases, the best information we currently hold is freely available online. If your searches and consultation raise further issues that you would like to discuss in more detail, please email the Flood Risk Team on frmplanning@warwickshire.gov.uk.

(a) The updated Flood Map for Surface Water (uFMfSW) and other flood maps are freely available on the Environment Agency website. It is expected that these are used alongside the other resources available to help locate development away from areas at risk of flooding.

(b) The current Strategic Flood Risk Assessment (SFRA) for Warwickshire is available on our website and contains details of our historic flooding records and other flood risk information relevant to planning. http://www.warwickshire.gov.uk/sfra.

(c) A Surface Water Management Plan (SWMP) and Local Flood Risk Management Strategy (LFRMS) are currently in production for Warwickshire. These documents will hold more detailed information of historic flooding and planning matters, both are due for publication in early 2016.

(d) As we have only recently begun maintaining formal records of historic flooding incidents, if the SFRA and upcoming documents do not hold details of flooding in the vicinity of the site, this does not necessarily indicate that there have not been any historic flood events in the area. As such, we suggest that you carry out further consultation to fully inform your Flood Risk Assessment (FRA). The relevant District or Borough Council may hold more detailed information, as may the parish council or residents around the proposed development area. Results of further consultation should be included within your FRA, and any issues raised should be considered in the drainage design for the site.

Where the development site is less than a hectare in size, we would still expect the developer to produce a drainage strategy / FRA report to ensure that the proposed development will not adversely affect the local management of flood risk and to ensure that the development will not increase flood risk to others.

2.2 Information on our standard requirements for FRA's is detailed in our Surface Water Drainage Pro-forma for New Developments (Refer to Appendix A). This document also gives details of what we consider when we assess planning applications at various stages throughout the planning process. The Environment Agency has produced flood risk standing advice for local planning authorities which is available on the GOV.UK website at: https://www.gov.uk/flood-risk-standing-advice-frsa-for-local-planning-authorities.

3.0 Surface Water Discharge

3.1 In accordance with Part H of the Building Regulations the surface water drainage system should where feasible discharge into an at-source infiltration system such as a soakaway or infiltration basin. Where ground or site conditions do not allow infiltration, the next most desirable discharge is to a suitable watercourse. Where such sustainable methods are not possible, the applicant must provide evidence and investigate the possibility of discharging into the public sewer system via a separated surface water system and not into foul or combined sewers.

To ensure that there is sufficient capacity within the surface water sewer system, we recommend consulting Severn Trent Water at your earliest convenience and, where necessary, undertake a sewer capacity assessment to ensure there is sufficient capacity within the sewer.

Each of the following options has different considerations.

(a) Infiltration / Soakaway

If the application is proposing to discharge to soakaways or make use of other infiltration systems, percolation tests should be submitted to the LLFA in accordance with BRE Digest 365 or CIRIA guidance R156. Additionally, information on groundwater levels should be included. There should be a minimum of 1 metre between the base of the infiltration device and water table to protect groundwater quality and ensure groundwater does not enter infiltration devices. Soakaways should be no closer than 5m to the foundations of adjacent buildings and must not be located in contaminated areas, and the 'half drain down time' must be no greater than 24 hours (1440 minutes). Infiltration features should have a positive high level overflow or an alternative means of managing exceedance flows.

As part of the detailed design stage, further infiltration tests may be requested taking into account the final location of the infiltration feature/s.

(b) Watercourse

If the application site is discharging into an Ordinary Watercourse, the applicant must make an assessment of the route which the water will take when leaving the site. Further information may need to be provided on whether the watercourse will be able to convey the proposed discharge rate and volume if it is known to be sensitive to increased discharge or has had past flooding problems.

Discharge into any watercourse will need to consider whether the velocity of the discharge causes any erosion impacts on the channel. Effects on erosion downstream of the discharge point should also be considered.

Where the proposals include works or alterations to a watercourse, it may require consent from the LLFA where it is an Ordinary Watercourse, or from the Environment Agency where it is Main River. Such consent is required to avoid increasing flood risk both locally and to those upstream and downstream of the proposed works. Consent is still required even if the applicant has secured Planning Permission and/ or other consents that may be required.

Consultation with the Lead Local Flood Authority is advised to discuss any requirement for land drainage consent as part of the development design process. The consent application should be sent to flooding@warwickshire.gov.uk and fee for each structure is payable (currently £50 per consent).

It is possible that a watercourse running through a site does not have an associated Flood Zone shown on the Environment Agency flood maps. This is because the models used for developing the EA Flood Zones did not include catchments under 3km^2. In these cases, the applicant should have the watercourse modelled as part of the FRA, to ensure that all sources of flood risk have been appropriately assessed as part of the FRA, with appropriate flood resilient/resistant measures proposed as and where necessary. Refer also to maintenance strip section 8.0.

4.0 Surface Water Discharge Rates

4.1 Whilst we recommend that the applicant consults with all the relevant Risk Management Authorities at their earliest convenience, (WCC, Severn Trent Water, EA), should a Risk Management Authority indicate that a receiving water body / surface water sewer has sufficient capacity to accommodate a certain discharge rate, if the proposed discharge rate is greater than the equivalent runoff rate for the site then we reserve the right to overrule the recommendation by other Risk Management Authority, to ensure that the discharge from the site does not exceed the runoff rate from the pre-developed site.

4.2 In the event that the discharge rates have been agreed in principle by the EA prior to WCC becoming a Statutory Consultee, we will require written confirmation of the agreement which shall include: the discharge rate, the person(s) who agreed the rate(s), and the date of the agreement.

4.3 A permitted discharge rate for surface water from the site should be calculated or demonstrated in one of the following ways.

4.4 Undeveloped (Greenfield Sites)

a) Discharge to the ground through infiltration will be at the rate found through percolation tests around the site (see earlier section on infiltration 3.1(a)).

   For discharge into a Main River or an Ordinary Watercourse, the discharge rate will be based on the calculated pre-development (greenfield) runoff rate for the site. The greenfield rate will be based on the proposed impermeable areas and is not to include public open spaces or gardens. The methodology in the EA/Defra document "Preliminary Rainfall Runoff Management for Development (W5-074/A/TR/1)" latest edition should be used as the basis for calculations (long term storage of SC030219-Section 7, EA). For a simple control structure this will be based on the QBAR rate.

b) If complex controls are to be used for control of discharge rates (not our preferred method), calculations for the greenfield runoff rate should be provided for the 1 in 1 year, 1 in 30 year, 1 in 100 year return periods and 1 in a 100 year plus an allowance for climate change.

4.5 Brownfield Development Sites

4.5.1 In accordance with BS 8582:2013 Code of Practice (Surface Water Management for Development Sites), surface water run-off from all previously developed sites should be reduced to the equivalent greenfield run-off rate wherever possible.

4.5.2 Only where this is technically not feasible and the site is shown to benefit from a positive outfall will WCC allow the use of the existing brownfield flow rate to be used subject to a minimum of 50% betterment.

4.5.3 To establish the existing brownfield runoff rate, applicants have historically used either of the following two formulas, where 'Q' = peak flow, 'l/s' = litre per second and 'A_{imp} ha' = Impermeable area in hectares:

a) $Q=2.78x50xA_{imp}$ l/s (A_{imp} ha), or;
b) $Q= A_{imp}x50/3600$ formula.

4.5.4 The issue with the two above formulas are that the methods are more aligned to ensuring that sewers are not overtopped as opposed to providing effective flood risk management. Whilst it is a key consideration to ensure that the existing sewer networks are not overtopped, the above approach achieves very little (if anything) in the way of flood risk management and therefore WCC is highly unlikely to accept brownfield discharge rates based on the either of these two equations.

4.5.5 To establish an acceptable brownfield discharge rate, WCC recommends that a minimum of 50% betterment is applied to the lowest value based on the following assessments.

a) Establish if the site is currently positively drained; if so, estimate the full bore discharge from the site using the existing drainage details.

b) Estimate using either the rational method or modified rational method, using the industry standard figure of 35 mm/hr as recommended in Part E of the CIRIA Guidance document X108 *'Drainage of development sites*'.

4.6 Cross-catchment discharge

4.6.1 We recommend that where possible surface water should not be discharged cross catchment to a new receiving watercourse unless there is sound justification for the reasons of the cross catchment discharge.

4.6.2 If a cross catchment discharge cannot be avoided, we will require a technical justification for the reasons of the cross catchment discharge, together with an assessment of the capacity of the receiving watercourse to ensure that the additional flows will not increase the flood risk elsewhere.

5.0 Attenuation

5.1 Dependent on the surface water discharge rate, on site attenuation may be required to meet a restricted flow rate. If a flow retention device or storage structure is used along with a flow control device, we require calculations to demonstrate that it is adequately sized for various return periods.

5.2 Attenuation ponds should ideally have 1 in 4 bank slopes and as minimum 1 in 3, including a safety bench 3m wide to allow future routine maintenance work. Educational signs or boards should be erected giving customers details on the purpose of the pond. A form of life-saving equipment should be erected such as lifebuoys. A RoSPA (Royal Society for the Prevention of Accidents) Risk Assessment should be provided.

5.3 Elevated attenuation features should be avoided, but where necessary should be designed and specified to avoid collapse, seepage and piping. Overtopping scenarios should be modelled to ensure that exceedance flows do not increase flood risk elsewhere.

5.4 Oversized Attenuation Pipes/Culverts

5.4.1 WCC does not consider oversized pipes or box culverts as sustainable drainage. If infiltration is not feasible at the site, alternative sustainable drainage should be used, with preference for above-ground solutions.

5.4.2 Surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management. Sustainable Drainage Systems (SuDS) are an approach to managing surface water run-off which seeks to mimic natural drainage systems and retain water on site, as opposed to traditional drainage approaches which involve piping water off-site as quickly as possible.

5.4.3 SuDS involve a range of techniques including methods appropriate to impermeable sites that hold water in storage areas e.g. ponds, basins, green roofs, etc., rather than just the use of infiltration techniques. Support for the SuDS approach is set out in the National Planning Policy Framework (NPPF).

6.0 Adoption and Maintenance

6.1 The adoption and maintenance of all drainage features are a key consideration to ensure the long term operation at the designed standards.

6.2 To facilitate any future maintenance activities, we strongly recommend that all storage systems are placed within areas of public open space.

6.3 At the detailed design stage we will require the adoption and maintenance of all drainage features to be duly considered.

6.4 Prior to the discharge of the surface water drainage condition/s, we will require evidence that an appropriate adoption/maintenance "in principle" agreement is place between the developer and the relevant maintenance company/adopting body.

7.0 Flow Conveyance through the Site

7.1 WCC has a preference of swales rather than piped networks. The use of the checked dams can reduce final attenuation volumes and provides improved water quality, habitat and amenity benefit.

7.2 Pumping Stations

7.2.1 This is the least preferred method of disposal of surface water and all alternative methods should be fully considered and confirmed to be not technically feasible before WCC will consider a pumped surface water drainage strategy.

7.2.2 Should either a foul or surface water pumping station be necessary to manage either foul or surface water from the site, we would strongly recommend that the pumping station is located outside of the Flood Zone 2 and 3 extents (i.e. within Flood Zone 1) and outside of all areas susceptible to surface water flooding as shown on the uFMfSW.

7.2.3 We strongly recommend that the Pumping Station(s) are located appropriately so that the Cordon Sanitaire from the Pumping Station(s) does not adversely affect air, noise or odour quality of either the existing or proposed development. It is recommended that the Cordon Sanitaire extents are located wholly within the development site to prevent any adjacent land from being uninhabitable/undevelopable.

7.3 Exceedance flows

7.3.1 Information on how exceedance flows will be managed on site should be provided. These flows may be a result of a system failing or being overwhelmed and should be contained within the development so that it does not increase flood risk elsewhere.

7.3.2 Overland flows and flood water should be managed to be safe and not enter any buildings or disrupt emergency access routes. The volumes, depths, velocity and extent should be modelled and mapped on a topographical plan of the site. If flooding is extensive, the hazard should be considered in line with the latest guidance from the Environment Agency/Defra.

7.4 Overland flows from outside the development

7.4.1 Where it is possible that the site will receive overland flows from adjacent parcels of land, we would recommend that some form of cut-off drainage is provided to prevent flooding to the new development. Consideration should be given as to whether this flow will be connected to the on site attenuation - this will require upsizing as required.

8.0 Maintenance Strips Adjacent to Watercourses and Water Bodies

8.1 A maintenance strip is an area of land maintained in permanent vegetation that helps control soil and water quality and has other environmental benefits. Physical separation of activities from the watercourse maintains bank vegetation which helps to maintain temperatures and leaf litter inputs, enriches the riparian habitat and promotes connectivity between the watercourse and its floodplain.

8.2 Maintenance strips alongside watercourse and water bodies are important in protecting and promoting biodiversity and in improving water quality and run-off. As the name suggests, they are also necessary to allow access to the watercourse for maintenance purposes. The effectiveness of maintenance strip will be influenced by the width of the buffer, its characteristics (slope, vegetation and soil type), and how is it is managed.

8.3 Widths of Maintenance Strips

8.3.1 The optimum width of a maintenance strip adjacent to watercourses will be affected by the width of the watercourse, site conditions and topography. Maintenance strips should be proportional to the bed width of the watercourse and should be minimum of 6m with up to 15m for major watercourses. Where the ground is steeply sloping, run-off will be faster and a wider strip will be required.

8.3.2 For sites bordering still water (i.e. attenuation basins and ponds) and safety bench of a minimum of 3m should be provided, depending on the size of the water body with larger areas having a wider strip.

8.3.3 For ditches, a maintenance strip is still required, but for smaller ditches there is some discretion to reduce the maintenance strip to a minimum of 5m depending on requirements for access for maintenance.

8.3.4 Where possible, maintenance strips should be retained with open space for the developments to ensure long term protection.

8.3.5 The table below provides guidelines only as to the width which will be dependent on site conditions such as nature and topography of the surrounding land. Wet, poorly-drained soils and steep slopes (>10°) will require larger maintenance strips.

Width of Watercourse	Width of Maintenance Strip
Less than 1m	6m
1-5m	6-12m
5-15	12-20
15+	20m +

9.0 Culverted Watercourses

9.1 Many of the watercourses in Warwickshire have been heavily modified over time. Watercourses may have been culverted, straightened, narrowed, disconnected from their floodplains by land raising, and the shape of the channel may have been artificially altered.

9.2 Where a watercourse passes through a development site, an opportunity exists to restore the watercourse to a more natural condition, for example by opening up culverts, reinstating a natural, sinuous channel and restoring the functional floodplain (places where water is designed to flow or be stored at times of flood). Doing so can help to reduce flood risk, improve water quality, benefit biodiversity and add amenity value.

9.3 Culverts also destroy wildlife habitats, damage natural amenity and interrupt the continuity of the linear habitat of a watercourse. Culverts can also impact on water quality due to the change in structure of the watercourse bed and removal of natural systems to benefit water quality. Furthermore it is harder to identify and remove misconnections which also have an impact on water quality. This is contrary to Paragraphs 109 and 118 of NPPF.

9.4 Fish and other species need to move up and downstream in search of spawning areas, food, shelter from predators and protection from flood and pollution events. Tributaries are vital in the role that they play in the larger river catchment health. Culverts are actively discouraged as they produce a number of insurmountable problems for fish and other riverine organisms and also cause other effects on the natural hydromorphology of a stream.

9.5 Where a watercourse passes through a site (open or in culvert) the developer should demonstrate that they have considered the above matters in developing their proposals for the site.

9.6 We recommend that where feasible, all culverted watercourses which pass through a site should be opened (de-culverted) unless it is demonstrated that it is not technically feasible to do so.

9.7 If a culverted watercourse is to be retained within a development site, then its condition and capacity needs to be surveyed and proven to be appropriate for the lifetime of the development. Due consideration of likely loading etc. on crossing structures also needs to be taken into account.

9.8 To facilitate maintenance activities/repair works, we would strongly recommend that no buildings/structures are located above the culverted watercourses.

9.9 The consideration of an application will also take into account the fact that, while a pipe may allow the flow of water, it is not able to provide the storage capacity of an open ditch in times of heavy rain and may be more difficult to maintain.

9.10 However WCC recognises that there may be instances where culverting is unavoidable, such as short sections to accommodate highway access. WCC prefer a single span bridge rather than a culvert, i.e. keeping a more natural embankment to facilitate habitat. If a culvert is required, it should be a minimum length. Oversized box culverts sunk 300mm below bed level are preferred to round pipe sections. If a development involves constructing anything, such as a dam, weir, headwall or culvert, which may affect the flow in a watercourse, a written consent of WCC under

Section 23 of the Land Drainage Act must be obtained. This consent is in addition to any planning or building regulation approvals that maybe required. Refer also to Modelling of Watercourses Section 14.0.

9.11 Sewers

9.11.1 If the proposal is to discharge into public sewers, the site must be drained through a separated system as per the sewers for adoption guidance. We will require evidence of a point of connection, a permitted discharge rate, and a capacity check of the system from Severn Trent Water. If it is a new connection into the public sewer system, we also require evidence of a S106 agreement with Severn Trent Water to do so.

9.11.2 Surface water should never be discharged into a foul sewer and where possible, not into a combined sewer. We advise that surface water should discharge to a separated surface water system, or preferably to an at-source sustainable drainage system such as a soakaway. If this is not possible, the applicant should seek further advice from Severn Trent Water to agree a suitable solution.

9.11.3 If the development is close to or over a public sewer, we advise that the applicant should contact Severn Trent Water to discuss whether there is a requirement for an easement protection or a build-over agreement.

10.0 Water quality and The Water Framework Directive (WFD)

10.1 The Water Framework Directive (WFD) was adopted in October 2000, came into force in December 2000 and was transposed into UK law in 2003. The aim of the Directive is to establish a framework for the protection of inland surface waters (including streams, rivers and lakes), transitional waters (estuaries), coastal waters and groundwater. It seeks to ensure that all aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands, meet 'good status' by 2015.

10.2 The specific objectives of the WFD are as follows.

- Prevent deterioration in the classification status of aquatic ecosystems, protect them and improve the ecological condition of waters.
- Achieve at least good status for all waters by 2015. Where this is not possible, good status should be achieved by 2021 or 2027.
- Promote sustainable use of water as a natural resource.
- Conserve habitats and species that depend directly on water.
- Progressively reduce or phase out release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment.
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants.
- Contribute to mitigating the effects of floods and droughts.

10.3 To implement the WFD, the Environment Agency has developed River Basin Management Plans (RBMPs), these are plans for protecting and improving the water environment. They describe the main issues for the water environment within each river basin district. They tell us, at a local level, which actions and measures we and others need to implement to achieve the objectives of the WFD.

10.4 Where a proposal will have a negative impact, the planning application should be accompanied with a WFD Compliance Assessment.

10.5 Bypass separator / treatment

10.5.1 If the proposals include the addition of over 30 parking spaces, we would recommend that a bypass separator or another form of treatment is used to reduce the pollutants in the surface water discharge. A minimum of two treatments will need to be provided and gullies will not count.

10.6 Water Quality

10.6.1 The level of pollution found within surface water runoff will depend on the nature of the development from which it arises, the time since the last rainfall event and the duration and intensity of rainfall.

10.6.2 An appropriate “train “of SuDS components must be installed to reduce the risk of pollutants entering watercourses via runoff from development sites. Following the SuDS Management Train hierarchy a series of drainage techniques should be designed into the development layout. The design should be achieve a system where pollution is incrementally reduced at each stage.

10.6.3 Treatment options to address pollution issues include:

- Infiltration
- Filtration
- Detention basins/Ponds
- Permanent ponds

10.6.4 These options reduce pollution by either filtering out pollutants or reducing flow rates to encourage deposition of any contaminants. Polluted surface water runoff should not run directly into permanent ponds in order to protect biodiversity and amenity, and to prevent maintenance problems caused by heavy silts and oil. Penstock/isolation valves to be fitted upstream and downstream of we features.

10.6.5 The minimum number of treatment stages required within the SuDS train will depend on the nature of the site.

Source of Runoff	**Minimum Treatment Stages***
Roofs, playing fields	1
Residential roads, parking Areas, commercial zones	2
Waste and industrial sites, Loading bays and HGV parks	3 or more

* *may need to be increased if discharging to sensitive groundwater/watercourse*

10.7 Bio-diversity Net Gains

Sustainable Urban Drainage solutions have the opportunity to assist with National Planning Policy Framework objectives to ensure biodiversity net gains. The Council welcomes schemes that assist in this objective. For more information please contact planningecology@warwickshire.gov.uk.

11.0 Urban Creep

11.1 Urban creep is the conversion of permeable surfaces to impermeable ones over time, e.g. surfacing of front gardens to provide additional parking spaces, extensions to existing buildings, creation of large patio areas. Much research has been carried out in to the effect of urban creep and its impact on the drainage systems which cater for urban areas. It has been shown that, over the lifetime of a development, urban creep can increase impermeable areas by as much as 10%.

11.2 Whilst we have always considered the impermeable areas proposed on new development sites and accounted for climate change we have not, previously, accounted for urban creep. An allowance for urban creep will now be required as part of the surface water drainage proposals for new development in Warwickshire. The requirement is shown below.

11.3 The consideration of urban creep should be assessed on a site-by-site basis but is limited to residential development only.

11.4 The appropriate allowance for urban creep must be included in the design of the drainage system over the lifetime of the proposed development. The allowances set out below must be applied to the impermeable area within the property curtilage:

Residential development density, Dwellings per hectare	Change allowance % of impermeable area
25	10
30	8
35	6
45	4
50	2
Flats & apartments	0

Note: where the inclusion of the appropriate allowance would increase the total impermeable area to greater than 100%, 100% should be used as the maximum. "Curtilage" means area of land around a building or group of buildings which is for the private use of the occupants of the buildings.

12.0 Phasing Large Development Sites

12.1 For large development sites with many phases, explanation of how the site will adequately consider flood risk at all stages of the development will be required, including avoiding interim developed phases that are unprotected.

12.2 Phases can only progress if adequate flood mitigation measures are in place for that particular phase. This should avoid one small phase of the site being allowed to discharge at the calculated rate for a larger part of the entire development. Adequate flood risk measures for each individual phase should be able to stand alone until the entire site is completed, without unacceptable levels of flood risk on site and without increasing flood risk off site.

12.3 Measures are to be in place to prevent siltation washing into watercourses/culverts/sewers/gullies during construction, caused by increased run-off after top-soil strip. On completion of construction works, wet features are to be de-silted and if applicable culverts/sewers are to be CCTV surveyed.

13.0 Photovoltaic (Solar Farm) Development Sites

13.1 For Solar Farms on entirely Brownfield sites, the impact is assumed to be nil. Therefore, we should be seeking reductions in surface water runoff from the site in the form of restricting surface water rates and providing attenuation up to the 1 in 100 year (climate change) event (minimum 50% betterment to existing rates).

13.2 For greenfield sites we would expect the developer to include the following in a FRA.

(a) Restrict vehicular movements on site to designated access tracks. In doing so, the risk of soil compaction is minimised and limited to specific locations. The applicant is to design the vehicular access tracks to be permeable (e.g. gravel medium).

(b) Specify what type of vegetation will be planted across the site and how will it be managed/ maintained in perpetuity. The ideal situation is that vegetation is grassed and is kept reasonably high or grazed by livestock. Good vegetation cover will limit the transfer of sediments and slow the flow of water.

(c) Incorporate above- or below- ground surface water attenuation features to capture runoff from the panels. There are two basic ways as follows.

(i) **IDEAL** - Gravel filter trenches positioned under the drip line of each solar panel. Typically these are French drains 300mm x 300mm filled with a granular material to capture and store runoff from the panels. These will encourage infiltration and provide betterment in terms of reducing surface water runoff.

(ii) **MINIMUM -** Above ground swales positioned strategically around the development to capture surface water runoff from the panels as water flows downslope. The exact dimensions and number of swales required will depend upon the situation, but generally, a swale will have side slopes of between 1:4 and 1:5 and a depth of 500mm with excavated material deposited on the downslope bank.

13.3 Provide attenuation measures for the areas of hardstanding (i.e. electrical infrastructure or kiosks). This should be done in the normal way (i.e. calculate Greenfield Runoff rate, calculate increase in impermeable area, conduct storage estimate to work out storage volume – bearing in mind that the restrictive rate should never be set less than 5 l/s because of the risk of pipe blockage).

14.0 Hydraulic Modelling of Watercourses

14.1 The modelling requirements of watercourses will depend on individual sites, but as a guide the following criteria should be used, although additional information maybe requested.

(i) Modelling of any ordinary watercourses on site and finished floor level to set a minimum of 600mm above the 1 in 100 year plus an allowance for residential use.

(ii) The upstream boundary should be set approximately 50m upstream of the area of interest, or at any significant overtopping structure such as a road bridge, culvert or weir.

(iii) The downstream boundary should be set not less than 100m downstream of the area of interest but should be accompanied by plus and minus 250mm sensitivity analysis.

(iv) Sensitivity analysis in the key parameters such as:

- roughness (+-20%);
- flow (+-20%);
- structure coefficients (+-10%);
- downstream boundary (+-250mm);
- blockage of key structures 20%, 50%.

15.0 Information Submission at the Outline Planning Application Stage

15.1 We appreciate that at the Outline Planning Application Stage, the full details of the development may not yet be finalised.

15.2 We also appreciate that the purpose of the outline application is to establish whether or not the proposal is likely to be approved by the Local Planning Authority (LPA), before any substantial costs are incurred, however, to enable WCC to make a fully informed planning decision, we would expect the developer to submit the following information.

(i) Evidence that all sources of flood risk have been suitably assessed with appropriate flood resilient and resistant design and construction techniques suggested as and where appropriate.
(ii) Details of any existing drainage features.
(iii) Calculations of the pre and post-development runoff rates.
(iv) Details of the proposed sustainable surface water drainage (SuDS) principles which the proposed development is likely to incorporate. It is recommended that the outline drainage strategy includes;
- The initial attenuation estimates,
- Details of the likely methods of above ground surface water attenuation in accordance with CIRIA C697 (infiltration basin, attenuation basin, swales, filter drains, water butts etc.).
- The likely surface water outfall locations.
- Details of the likely adoption and maintenance regimes for all drainage features.

16.0 Information Submission at the Reserved Matters Application Stage

To enable WCC to fully consider a reserved matters application, WCC is likely to require the following information to be submitted as part of the reserved matters application to ensure that the above ground SuDS features can be accommodated within the proposed development given the means of access, landscaping, layout and scale of the development.

(i) Outline layout plans.
(ii) Initial attenuation estimates and methods of attenuation in accordance with CIRIA C697.
(iii) Preliminary network details.
(iv) Proposed outfall arrangements.

17.0 Information Submission at the Full Application Stage and to Discharge Surface Water Conditions

17.1 At detailed design stage we would expect the developer to provide the following information.

(i) Calculations of pre- and post-development runoff rates.
(ii) A fully labelled network drawing showing all dimensions of all elements of the proposed drainage system.
(iii)Detailed network calculations that correspond to the above drawing.
(iv) Modelled results for critical storms, including as a minimum 1 in 1 year, 1 in 30 year, and 1 in 100 year, as well as 1 in 100 year + 30% allowance for climate change, and events of various durations. A submerged outfall should be used for the modelling.
(v) An electronic copy of the model should be provided to the Flood Risk Management team at WCC.
(vi) Any documentation relating to the surface water discharge rate and / or consents required.
(vii) If the drainage network is to be adopted, evidence of an agreement with the adopting body.
(viii) Details of the long term maintenance of the drainage system. We would request that any storage systems are placed within public areas and a maintenance regime is provided for the life time of the development.
(ix) A timetable for the implementation of the drainage system
(x) The applicant should also include evidence of overland flood flow routing in case of system failure. This should include the flow routes and depths/velocities of the flows. WCC reserves the right to request modelled evidence where necessary.

18.0 Useful links

Preliminary Flood Risk Assessment
http://webarchive.nationalarchives.gov.uk/20140328084622/http://cdn.environment-agency.gov.uk/flho1211bvrt-e-e.pdf

Strategy Flood Risk Assessment
https://www.warwickshire.gov.uk/sfra

Local Flood Risk Management Strategy Consultation
https://askwarks.wordpress.com/2015/01/09/local-flood-risk-management-strategy-consultation/

UK Sustainable Drainage
http://www.uksuds.com/

APPENDIX A

Surface Water Drainage Pro-forma for New Developments

Surface Water Drainage Pro-forma for new developments

Developers should complete this form and submit it to the Local Planning Authority (as part of the planning application submission documents). This pro-forma is supported by the Defra/EA guidance on Rainfall Runoff Management and uses the storage calculator on www.UKsuds.com. The pro-forma should be considered alongside other supporting SuDS Guidance, but focuses on ensuring flood risk is not made worse elsewhere. This proforma is based upon current industry standard practice.

1. Site Details

Site	
Address & post code or LPA reference	
Grid reference	
Is the existing site developed or Greenfield?	
Does the surface water from the site discharge via an existing positive outfall ?	
Total Site Area served by drainage system (excluding open space) (Ha)*	

***** The Greenfield runoff off rate from the development which is to be used for assessing the requirements for limiting discharge flow rates and attenuation storage from a site should be calculated for the area that forms the drainage network for the site whatever size of site and type of drainage technique. Please refer to the Rainfall Runoff Management document or CIRIA manual for detail on this.

2. Impermeable Area

	Existing	Proposed	Difference (Proposed-Existing)	Notes for developers & Local Authorities
Impermeable area (ha)				If proposed > existing, then runoff rates and volumes will be increasing. Section 6 must be filled in. If proposed ≤ existing, then section 6 can be skipped & section 7 filled in.
Drainage Method (infiltration/sewer/watercourse)			N/A	If different from the existing, please fill in section 3. If existing drainage is by infiltration and the proposed is not, discharge volumes may increase. Fill in section 6.

3. Proposing to Discharge Surface Water via

	Yes	No	Evidence that this is possible	Notes for developers & Local Authorities
Infiltration				e.g. soakage tests. Section 6 (infiltration) must be filled in if infiltration is proposed.
To watercourse				e.g. Is there a watercourse nearby?
To surface water sewer				Confirmation from sewer provider that sufficient capacity exists for this connection.
Combination of above				e.g. part infiltration part discharge to sewer or watercourse. Provide evidence above.

4. Peak Discharge Rates – This is the maximum flow rate at which storm water runoff leaves the site during a particular storm event. Surface water should be limited to the equivalent Qbar greenfield runoff rate for all return periods wherever possible. Only where this is demonstrated to be not technically viable, would we consider a complex variable discharge rate.

	Existing Rates (l/s)	Proposed Rates (l/s)	Difference (l/s) (Proposed-Existing)	Notes for developers & Local Authorities
Greenfield QBAR		N/A	N/A	QBAR is approx. 1 in 2 storm event. Provide this if Section 6 (QBAR) is proposed.
1 in 1				QBAR is approx. 1 in 2 storm event. Provide this if Section 6 (QBAR) is proposed.
1 in 30				
1in 100				
1 in 100 plus climate change	N/A			To mitigate for climate change the proposed 1 in 100 +CC must be no greater than the existing 1 in 100 runoff rate. If not, flood risk increases under climate change. 30% should be added to the peak rainfall intensity.

Note: Should a complex flow control be the only technically viable means of limiting the discharge from the site then please refer to section 7 of this document to ensure that long term storage is provided in accordance with the requirements specified in the Environment Agency 'Science Report SC030219 Rainfall Management for Developments'.

5. Calculate additional volumes for storage –The total volume of water leaving the development site. New hard surfaces potentially restrict the amount of storm water that can go to the ground, so this needs to be controlled so not to make flood risk worse to properties downstream.

	Existing Volume (m^3)	Proposed Volume (m^3)	Difference (m^3) (Proposed-Existing)	Notes for developers & Local Authorities
1 in 1				Proposed discharge volumes (without mitigation) should be no greater than existing volumes for all corresponding storm events. Any increase in volume increases flood risk elsewhere. Where volumes are increased section 6 must be filled in.
1 in 30				
1in 100				
1 in 100 plus climate change				To mitigate for climate change the volume discharge from site must be no greater than the existing 1 in 100 storm event. If not, flood risk increases under climate change.

6. How is Storm Water stored on site?

Storage is required for the additional volume from site but also for holding back water to slow down the rate from the site. This is known as attenuation storage and long term storage. The idea is that the additional volume does not get into the watercourses, or if it does it is at an exceptionally low rate. You can either infiltrate the stored water back to ground, or if this isn't possible hold it back with on site storage. Firstly, can infiltration work on site?

			Notes for developers & Local Authorities
Infiltration	**State the Site's Geology and known Source Protection Zones (SPZ)**		Avoid infiltrating in made ground. Infiltration rates are highly variable and refer to Environment Agency website to identify and source protection zones (SPZ)
	Are infiltration rates suitable?		Infiltration rates should be no lower than $1x10^{-6}$ m/s.
	State the distance between a proposed infiltration device base and the ground water (GW) level		Need 1m (min) between the base of the infiltration device & the water table to protect Groundwater quality & ensure GW doesn't enter infiltration devices. Avoid infiltration where this isn't possible.

	Were infiltration rates obtained by desk study or infiltration test?		Infiltration rates can be estimated from desk studies at most stages of the planning system if a back up attenuation scheme is provided.
	Is the site contaminated? If yes, consider advice from others on whether infiltration can happen.		Water should not be infiltrated through land that is contaminated. The Environment Agency may provide bespoke advice in planning consultations for contaminated sites that should be considered.
In light of the above, is infiltration feasible?	**Yes/No? If the answer is No, please identify how the storm water will be stored prior to release**		If infiltration is not feasible how will the additional volume be stored? The applicant should then consider the following options in the next section.

Storage requirements

The developer must confirm that either of the two methods for dealing with the amount of water that needs to be stored on site.

Option 1 Simple – Store both the additional volume and attenuation volume in order to make a final discharge from site at **QBAR** (Mean annual flow rate). This is preferred if no infiltration can be made on site. This very simply satisfies the runoff rates and volume criteria.

Option 2 Complex – If some of the additional volume of water can be infiltrated back into the ground, the remainder can be discharged at a very low rate of 2 l/sec/hectare. A combined storage calculation using the partial permissible rate of 2 l/sec/hectare and the attenuation rate used to slow the runoff from site.

		Notes for developers & Local Authorities
Please confirm what option has been chosen and how much storage is required on site.		The developer at this stage should have an idea of the site characteristics and be able to explain what the storage requirements are on site and how it will be achieved.

7. Please confirm

		Notes for developers & Local Authorities
Which Drainage Systems measures have been used?		SUDS can be adapted for most situations even where infiltration isn't feasible e.g. impermeable liners beneath some SUDS devices allows treatment but not infiltration. See CIRIA SUDS Manual C697.
Drainage system can contain in the 1 in 30 storm event without flooding		This is requirement for sewers for adoption & is good practice even where drainage systems are not adopted.
Any flooding between the 1 in 30 & 1 in 100 plus climate change storm events will be safely contained on site.		**Safely:** not causing property flooding or posing a hazard to site users i.e. no deeper than 300mm on roads/footpaths. Flood waters must drain away at section 6 rates. Existing rates can be used where runoff volumes are not increased.
How are rates being restricted (hydrobrake etc)		Hydrobrakes to be used where rates are between 2l/s to 5l/s. Orifices not be used below 5l/s as the pipes may block. Pipes with flows < 2l/s are prone to blockage.
Please confirm the owners/adopters of the entire drainage systems throughout the development. Please list all the owners.		If these are multiple owners then a drawing illustrating exactly what features will be within each owner's remit must be submitted with this Proforma.

How is the entire drainage system to be maintained?		If the features are to be maintained directly by the owners as stated in answer to the above question please answer yes to this question and submit the relevant maintenance schedule for each feature. If it is to be maintained by others than above please give details of each feature and the maintenance schedule. Clear details of the maintenance proposals of all element of the proposed drainage system must be provided. Poorly maintained drainage can lead to increased flooding problems in the future.

8. Evidence Please identify where the details quoted in the sections above were taken from. i.e. Plans, reports etc. Please also provide relevant drawings that need to accompany your proforma, in particular exceedance routes and ownership and location of SuDS (maintenance access strips etc

Pro-forma Section	Document reference where details quoted above are taken from	Page Number
Section 2		
Section 3		
Section 4		
Section 5		
Section 6		
Section 7		

The above form should be completed using evidence from the Flood Risk Assessment and site plans. It should serve as a summary sheet of the drainage proposals and should clearly show that the proposed rate and volume as a result of development will not be increasing. If there is an increase in rate or volume, the rate or volume section should be completed to set out how the additional rate/volume is being dealt with.

This form is completed using factual information from the Flood Risk Assessment and Site Plans and can be used as a summary of the surface water drainage strategy on this site.

Form Completed By…….....

Qualification of person responsible for signing off this pro-forma .....

Company……,.....

On behalf of (Client's details) .....

Date:…….....