Drainage Guidance for Cornwall Council

This Guidance considers the impact that drainage can have on flood risk. It complements Cornwall Councils Strategic Flood Risk Assessment - Level 1(SFRA 1) which considers wider flood risk. This Guidance provides advice on:-

- The location of known Critical Drainage Areas where the flood risks from surface water run-off are likely to be most significant*;*
- standards we expect to be achieved for surface water drainage;
- the content of a Flood Risk Assessment (FRA) when considering surface water drainage;
- Sustainable Drainage Systems (SUDS);
- sources of further information.

The main parts to the Guidance are:-

- A surface water drainage consultation matrix for both Cornwall Council and Applicants – this indicates the applications on which we wish to be consulted.
- Technical information for those involved in the design and assessment of systems.
- Critical Drainage Area summary sheets identifying known problems in individual catchments.

This Guidance is based on ground conditions in Cornwall generally being suitable for soakaway and infiltration. We therefore generally promote the drainage hierarchy of Building Regulations 2000 in *H3: Rainwater Drainage,* where drainage by infiltration should be utilised unless it is not *reasonably practicable* to do so.

This is not intended to be prescriptive as there will be opportunities where other SUDS features such as ponds and basins will offer wider sustainability benefits. Where infiltration is not used we will seek a SUDS system that as a minimum addresses flood risk and water quality issues. Where possible habitat should also be created. The density and layout of development should allow space for SUDS to increase the value and amenity of a site rather than defaulting to a piped system.

It is important to assess the impacts of run-off when drainage systems block or their design is exceeded. Therefore greater emphasis is placed on designing for exceedance and the assessment of overland flow routes.

This Guidance has been written to cross reference and be compatible with the *Code for Sustainable Homes*. Consequently there is now a requirement to address run-off volume as well as discharge rates through the provision of long-term storage. As sustainable alternatives, rainwater harvesting and grass roofs are encouraged.

It is intended to work with but not replace our national *Flood Risk Standing Advice* which can be found on our website, www.environment-agency.gov.uk

The National Flood Risk Standing Advice must still be referenced for our position and comments on development within the Flood Zones and for those sites close to Main Rivers and flood defences.

Contents

Feedback
We value any comments and feedback that you may have regarding this document. Please e-mail: **dfrcornwall@environment-agency.gov.uk** with **Cornwall Drainage Guidance** in the subject box.

1 – Introduction

Background

Many catchments in Cornwall are small and steep. This can make them prone to run-off from short, heavy rainfall events. Other catchments suffer from tide locked conditions. Development can reduce the ability of the ground to absorb water, giving rise to a typical 10-fold increase both the rate and volume of surface water run-off. Climate change predictions indicate that frequency and intensity of short, heavy rain storms will increase, leading to further flood risk.

Planning Policy Statement 25 (PPS 25) – *Development and Flood Risk* intends that development reduces flood risk by incorporating SUDS. As well as flood risk, these systems can reduce the adverse effects of urban stormwater on the environment. SUDS do this by:

- reducing run-off rates and volumes;
- maintaining groundwater recharge;
- protecting water quality by reducing pollutant concentrations and containing accidental spillages;
- enhancing amenity and aesthetic value in developed areas;
- providing wildlife habitat.

Ground conditions in Cornwall are generally suitable for soakaway and infiltration. We therefore promote the drainage hierarchy of Building Regulations 2000 in *H3: Rainwater Drainage*. The requirements of this is that rainwater shall be;

"discharged to one of the following, listed in order of priority: a) an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable, (b) a watercourse; or, where that is not reasonably practicable, (c) a sewer."

It is important to note that drainage by infiltration should be utilised unless it is not reasonably practicable to do so. However where SUDS features such as ponds and basins offer wider sustainability benefits these should also be considered. Where infiltration is not used we will seek SUDS that as a minimum address flood risk and water quality issues. Therefore the density and layout of development should allow space for SUDS, rather than defaulting to a piped system which attenuate run-off but provide little other benefit.

Pre-application Advice

Incorporating appropriate drainage is easier and more sustainable if it is planned and designed in from the start of a development. We welcome pre-planning consultation to ensure that the issues are appropriately addressed at an early stage. Contact the Area Development and Flood Risk Team on **08708 506 506** or via e-mail at **dfrcornwall@environment-agency.gov.uk.**

If an application is submitted which does not achieve the standards in this Guidance, we may object to the application. Where we object we will support this at appeal. We therefore advocate pre-planning discussions to avoid this situation.

2 - Critical Drainage Areas

Summary sheets providing a map of the Critical Drainage Area, the issues and drainage requirements have been produced for each Critical Drainage Areas and are contained within Appendix O.

The Town and Country Planning (General Development Procedure Amendment No. 2, England) Order 2006 introduces the concept of Critical Drainage Areas as *"an area within Flood Zone 1 which has critical drainage problems and which has been notified… [to]…the local planning authority by the Environment Agency".*

PPS25 – Development and Flood Risk highlights that the Environment Agency should be consulted on '*areas with critical drainage problems*' (page 9 paragraph 26). The Government has made us statutory consultees for these areas.

However there is as yet no national guidance on the definition of Critical Drainage Areas. We have therefore identified catchments where evidence indicates that there will be a genuine benefit from controlling run-off rates. These Critical Drainage Areas have a combination of the following:-

- existing flood records;
- constraints on existing drainage systems;
- flood defence schemes with surface water related problems;
- sensitive receiving environments;
- the potential for development which may change drainage patterns.

These constraints mean that drainage of surface water requires extra consideration. Where Critical Drainage Areas are identified in the SFRA surface water run-off rates should be restricted to reduce flood risk. We have therefore developed a set of recommended standards that should to be followed.

In doing so we realise that in the future national guidance may result in these catchments being reclassified. Following the Pitt Review and the forthcoming Floods and Water Management Bill the requirements for drainage and the process of reviewing and adopting these is evolving. We intend that the Critical Drainage Areas will be periodically reviewed and updated accordingly. You should ensure that this version is still current by contacting us or checking the SFRA page on the planning pages of Cornwall Council Website:-

www.cornwall.gov.uk

Surface Water Management Plans

In certain catchments with significant drainage problems *Surface Water Management Plans (SWMP)* are being developed. Those catchments where SWMP are being developed are listed in Appendix O. This information can also be found on the guidance sheets or on the Critical Drainage Areas layer of the SFRA mapping on the Council's website. Background information on SWMP can be found at the DEFRA website:

www.defra.gov.uk/environment/flooding/manage/surfacewater/plans

These plans will result in integrated catchment specific strategies. Our drainage guidance may form part of these strategies and should be followed until these are finalised.

Flood Risks from Other Sources

This guidance is concerned with the management of surface water drainage from new development. When undertaking a Flood Risk Assessment, flood risks from sources such as rivers, streams (fluvial), the sea (tidal) and surrounding land (surface water flooding) should also be considered. It is therefore important to check the Cornwall Strategic Flood Risk Assessment[1] for the types of flood risk in any given area. A number of areas in Cornwall have a Community Flood Plan and / or a High Risk Community Multi-Agency Flood Plan, either extant or under development. It is important to check these plans, where they exist, as their presence indicates that following an extreme weather event, there may be a risk to life from flooding, which should be taken into account at the design stage of development in these areas.

Locations not considered as Critical Drainage Areas

Outside of Critical Drainage Areas we wish to be consulted on all applications for developments greater than 1 hectare as per our National Flood Risk Standing Advice.

For sites less than 1 hectare where we are not consulted by the LPA, this guidance provides design standards to be applied by the developer and checked by the LPA to help minimise flood risk. You may wish to consult the Environment Agency for pre-planning advice.

[1] Cornwall Council, (Dec 2009), Strategic Flood Risk Assessment Level 1; and http://mapping.cornwall.gov.uk/website/sfra

3 - Surface Water Drainage Consultation Matrix

This guidance only sets out when the Environment Agency wishes to be consulted on surface water drainage design and summarises the standards that should be met. The Environment Agency is a consultee on many aspects of development. This guidance does not provide comment on our entire remit including the other aspects of flooding such as Main River or Flood Zones, only to applications in Cornwall where we will comment on surface water drainage.

We are a statutory Consultee on all planning applications greater than or equal to 1 hectare, but we do not generally provide comment on the drainage from smaller developments. However in Critical Drainage Areas we consider that we can reduce flood risk to communities by influencing the surface water drainage design for smaller developments. In doing so we are taking a risk-based approach and putting most effort into those proposals we consider will have the most impact.

Consequently we do not wish to be consulted for applications for change of use, residential extensions or non-residential extensions less than 250m². For these applicants are directed to guidance on best practice to help minimise flood risk.

To mimic the natural run-off characteristics development should drain to infiltration where possible. We therefore do not wish to be consulted on applications for sites less than 1 hectare where the accompanying FRA indicates that draining to soakaway is achievable and intended to be to the standards given in our guidance.

Where however the infiltration is not to an appropriate standard or the site is not draining to infiltration we wish to be consulted on developments of between 250m² and 1 hectare. The surface water drainage consultation matrix gives further guidance. These planning applications should be accompanied by an FRA that specifically considers surface water management, as well as the more general flooding issues.

There are five stages to using the consultation matrix:

Stage 1 – Development type:-
Development should be one of the following types:-

(A) a. Householder development or alterations
b. Non-residential extension less than 250m^2
c. Change of use

(B) Development of 1 to 3 dwellings
(C) Operational development less than 1 hectare
(D) Operational development of 1 hectare or greater

Stage 2 – Is the site within Critical Drainage Area
Refer to the constraint maps in the Cornwall Council's SFRA 1 via the planning section of their website www.cornwall.gov.uk or the summary sheets referenced in Appendix O to determine whether a site lies within a Critical Drainage Area.

Stage 3 – Is a Surface Water Management Plan (SWMP) being developed?
Those catchments where SWMP are being developed are listed in Appendix O or on the Critical Drainage Areas layer of the SFRA mapping on Cornwall Council's website. If a SWMP exists, refer to the SWMP for specific advice. If the SWMP is still being developed, you may need to contact us for catchment specific advice.

Stage 4 – Has an FRA been submitted with the application?
Paragraph E.9 of PPS25 states that an FRA is required where proposed development is in area where the Environment Agency have indicated there may be drainage problems, as per the Critical Drainage Areas.

Where an application is submitted without an FRA or the FRA does not adequately address the drainage of the site the application should not be considered as complete. If an FRA has not been submitted we recommend that you consider the application incomplete and suggest that you do not register it until an FRA has been submitted. Where the application has been submitted you may wish to ask the applicant to withdraw the application until the FRA has been completed.

Stage 5 – Refer to the surface water drainage consultation matrix to determine whether the Environment Agency wish to be consulted regarding surface water drainage.
The matrix contained within Appendix P shows in red those applications we want to be consulted on the surface water drainage design. Boxes are shown green where we do not wish to be consulted.

The matrix summarises the drainage standards. These are given in full in Section 4 and are linked to from the Matrix. When undertaking an FRA or developing a drainage design to support a planning application these full standards should be used.

4 – Detailed Drainage Standards

These are the details of what the Environment Agency expects to be achieved for surface water drainage designs. Standards are given for each cell in the Surface Water Drainage Consultation Matrix.

We are aware that our Critical Drainage Areas standards go beyond the general requirements set out in PPS25 to match the pre-development run-off rates. However PPS25 specifically identifies that there are catchments with critical drainage problems. Having identified the Critical Drainage Areas our guidance seeks to ensure that development contributes to sustainable communities by helping to reduce existing problems. Furthermore the policy aims of PPS25 given in Table D.1 for Flood Zone 1 are that developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

In areas not identified to be Critical Drainage Areas we recognise that there is still the need for relatively tight constraints on surface water run-off due to the nature of the small fast responding catchments in Cornwall. The drainage standards recommended are in line with the expectations of PPS25 and CIRIA C697.

The FRA that accompanies a planning application should include an appropriate level of detail to demonstrate that a surface water drainage scheme satisfying the recommended standards in our guidance will be achieved. In doing so we expect surface water drainage design to take into account:

- the surface water drainage hierarchy - *surface water will be expected to drain to infiltration unless it can be demonstrated that this is not feasible;*
- the SUDS ‘management train’ to minimise run-off and then using Source, Site and Regional controls to reduce pollution, flow rates and volumes;
- where infiltration is not feasible discharge rates are restricted to the recommended standards;
- provision of long-term storage for the maintenance of base flow in watercourses on larger sites not draining to infiltration;
- a system that is designed for exceedance, taking into account overland flow routes, control / containment of excess flows on site;
- effects of climate change on rainfall rates;
- water treatment to minimise the risk of contaminated water reaching a watercourse;
- control of run-off during the construction phase;
- overland flows from other land;
- future maintenance responsibilities

Critical Drainage Areas

B2-B3 - Development of 1- 3 dwellings

- Following the Building Regulations Drainage hierarchy, surface water should:-

  i. Drain to a soakaway or infiltration system designed in accordance with the SUDS Manual - CIRIA C697, using a minimum of a 30-year return period storm.

  Where an FRA demonstrates that infiltration is not possible:-

  ii. A sustainable drainage system should be provided discharging at a rate not exceeding 1.5 litres/second per dwelling, with attenuation provided up to the 30-year storm.

  (Products exist that allow individual properties to restrict run-off to this rate, using private underground storage tanks. A discharge of 1.5 litres/second is typically achieved on the commercially available systems using a proprietary device on the outlet with an orifice of around 30mm. This is combined with a sediment trap and a filter to prevent blockage. Storage is provided on the property in an underground tank or crate system, operating with a maximum depth of water of approximately 500mm. The size of the tank will need to be based on the impermeable area draining to the system. It should be noted that due to the small orifice size these systems would remain in private ownership as they are unlikely to be adopted.)

- The design must take into account the appropriate allowance for increased rainfall from climate change, based on the lifetime of the development, the guidance in Annex B of PPS25 and the PPS25 Practice Guide. This is currently an increase in rainfall intensity of 30%.

- Safe and appropriate flow routes from blockage and exceedance of the drainage system must be evaluated. This must demonstrate no property flooding or increase in flood risk either offsite or to third parties.

Critical Drainage Area - Previously Developed Site

C2–C3 - Operational development less than 1 hectare

- Following the Building Regulations Drainage hierarchy, surface water should:-

  i. Drain to a soakaway or infiltration system designed in accordance with the SUDS Manual - CIRIA C697, using a minimum of a 30-year return period storm.

  Where a FRA demonstrates that infiltration is not possible:-

  ii. A sustainable drainage system shall be provided ensuring flow attenuation, no adverse impact on water quality and where possible habitat creation.

- The total discharge from the site should aim to mimic greenfield rates. These shall be no more than the theoretical greenfield run-off rates from each of the corresponding 1, 10, 30 and 100 year storms. When these values are less than 5 litres/second, a rate of 5 litres/second can be used. Attenuation may not be necessary if the discharge is directly to coastal waters. In these cases the impact on the receiving environment in terms of habitat, erosion and water quality should be assessed.

- The design must take into account the appropriate allowance for increased rainfall from climate change. This should be based on the lifetime of the development, the guidance in Annex B of PPS25 and the PPS25 Practice Guide.

- Underground attenuation and piped sections should be designed for a minimum of the 30-year storm. **However total discharge rates from the site must still be controlled from the 100-year storm at the greenfield run-off rate from the 100 year storm.**. Attenuation of events exceeding the piped system may be achieved by temporary flooding of open spaces or car parks. If surface flooding of open areas is not appropriate, the formal drainage system should be designed to accomodate the 100 year storm.

- Safe and appropriate flow routes from blockage and exceedance of the drainage system must be evaluated. This must demonstrate no property flooding or increase in flood risk, either offsite or to third parties.

E2 - Operational development equal to or greater than 1 hectare

- Meet the standards for a development less than 1 hectare as outlined in C2 above.

- Where infiltration is not used, long-term storage must be provided to store the additional volume of run-off caused by any increase in impermeable area. This is in addition to the attenuation storage required to address flow rates, see Appendix F. Alternatively rainwater harvesting can be used to offset this volume.

- The long-term storage should discharge at a rate not exceeding 2 litres/second/hectare, as per *Preliminary rainfall run-off management for developments DEFRA / Environment Agency guidance W5-074 Revision D.*

Critical Drainage Area – Greenfield Site

D2-D3 - Operational development less than 1 hectare

- Following the Building Regulations Drainage hierarchy, surface water should:-

  i. Drain to a soakaway or infiltration system designed in accordance with the SUDS Manual - CIRIA C697, using a minimum of a 30-year return period storm.

  Where an FRA demonstrates that infiltration is not possible:-

  ii. A sustainable drainage system shall be provided ensuring flow attenuation, no adverse impact on water quality and where possible habitat creation.

- The total discharge from the site should aim to mimic greenfield rates. These shall be no more than the theoretical greenfield run-off rates from the corresponding 1 and 10 year storms. **For the 30 and 100 year storms, the total discharge from the site should not increase further but should also be restricted to the run-off rate for the 10 year storm.** When these values are less than 5 litres/second, a rate of 5 litres/second can be used. Attenuation may not be necessary if the discharge is directly to coastal waters. In these cases the impact on the receiving environment in terms of habitat, erosion and water quality should be assessed.

- The design must take into account the appropriate allowance for increased rainfall from climate change. This should be based on the lifetime of the development, the guidance in Annex B of PPS25 and the PPS25 Practice Guide.

- Underground attenuation and piped sections should be designed for a minimum of the 30-year storm. **However the total discharge rates from the site must still be controlled from the 100-year storm at the greenfield run-off rate from the 10 year storm**. Attenuation of events exceeding the piped system may be achieved by temporary flooding of open spaces or car parks. If surface flooding of open areas is not appropriate, the formal drainage system should be designed to accomodate the 100 year storm.

- Safe and appropriate flow routes from blockage and exceedance of the drainage system must be evaluated. This must demonstrate no property flooding or increase in flood risk, either offsite or to third parties.

E3 - Operational development equal to or greater than 1 hectare

- Meet the standards for a development less than 1 hectare as outlined in D2 above.

- Where infiltration is not used, long-term storage must be provided to store the additional volume of run-off caused by any increase in impermeable area. This is in addition to the attenuation storage required to address flow rates, see Appendix F. Alternatively rainwater harvesting can be used to offset this volume.

- The long-term storage should discharge at a rate not exceeding 2 litres/second/hectare, as per *Preliminary rainfall run-off management for developments DEFRA /Environment Agency guidance W5-074 Revision D.*

Outside Critical Drainage Areas

E4 -Developments greater than or equal to 1 hectare

Greenfield Sites

- Following the Building Regulations Drainage hierarchy, surface water should:-

  i. Drain to a soakaway or infiltration system designed in accordance with the SUDS Manual - CIRIA C697, using a minimum of a 30-year return period storm.

  Where an FRA demonstrates that infiltration is not possible:-

  ii. A sustainable drainage system shall be provided ensuring flow attenuation, no adverse impact on water quality and where possible habitat creation.

- The total discharge from the site should aim to mimic greenfield rates . These shall be no more than the theoretical greenfield run-off rates from each of the corresponding 1, 10, 30 and 100 year storms. When these values are less than 5 litres/second, a rate of 5 litres/second can be used. Attenuation may not be necessary if the discharge is directly to coastal waters. In these cases the impact on the receiving environment in terms of habitat, erosion and water quality should be assessed.

- The design must take into account the appropriate allowance for increased rainfall from climate change. This should be based on the lifetime of the development, the guidance in Annex B of PPS25 and the PPS25 Practice Guide.

- Underground attenuation and piped sections should be designed for a minimum of the 30-year storm. However total discharge rates from the site must still be controlled for the 100-year storm. Attenuation of events exceeding the piped system may be achieved by temporary flooding of open spaces or car parks. If surface flooding of open areas is not appropriate, the formal drainage system should be designed for the 100 year storm.

- Where infiltration is not used, long-term storage must be provided to store the additional volume of run-off caused by any increase in impermeable area. This is in addition to the attenuation storage required to address flow rates, see Appendix F. Alternatively rainwater harvesting can be used to offset this volume.

- The long-term storage should discharge at a rate not exceeding 2 litres/second/hectare, as per *Preliminary rainfall run-off management for developments DEFRA /Environment Agency guidance W5-074 Revision D.*

- Safe and appropriate flow routes from blockage and exceedance of the drainage system must be evaluated. This must demonstrate no property flooding or increase in flood risk, either offsite or to third parties.

Previously developed land

- Development should aim for the standards of a greenfield site outlined in E4 above. Where this is not possible the FRA should demonstrate how a sustainable drainage system is being provided which meets the policy aims of PPS25 to reduce flood risk on and off site. The FRA should demonstrate how the development will reduce run-off rates as much as is reasonably practicable.

5 - Appendices

A. The Code for Sustainable Homes
B. Best practice & Sustainable Urban Drainage Systems (SUDS)
C. Flood Risk Assessments and Conditioning SUDS
D. Climate change and greenfield run-off rates
E. Designing for exceedance
F. Long-term storage
G. Adoption, maintenance and quality control procedures
H. Green roofs
I. SUDS ponds and set-back outfalls
J. Paving gardens
K. Rainwater harvesting
L. Flood Defence Consent
M. Catchment Flood Management Plans
N. Background to the Drainage Guidance for Cornwall
O. Critical Drainage Areas - summary sheets
P. Consultation Matrix

Appendix A
Code For Sustainable Homes

The Code for Sustainable Homes provides a comprehensive measure of the sustainability of new homes, ensuring that sustainable homes deliver real improvements in key areas such as carbon dioxide emissions and water use. The Government's ambition for the Code is that it becomes the single national standard for the design and construction of sustainable homes, and that it drives improvements in home building practice.

Building sustainable homes requires us to minimise all sorts of environmental impacts in addition to carbon dioxide emissions, such as water use, waste generated, and materials for building.

The Code for Sustainable Homes is an environmental assessment method for rating and certifying the performance of new homes. It is a national standard for use in the design and construction of new homes with a view to encouraging continuous improvement in sustainable home building. Having a Code rating for new build homes is now mandatory.

The Code for Sustainable Homes covers nine categories of sustainable design, including surface water run-off (Category 4, Code SUR 1). The management of surface water run-off from development is a mandatory element that applies at all levels. The drainage standards contained within this document are considered to be in accordance with the requirements of the Code.

In addition to these mandatory elements, 2 credits are available in the Code for using SUDS to improve water quality of the rainwater discharged or for protecting the quality of the receiving waters by:

> *1. Ensuring no discharge to the watercourse for rainfall depths up to 5mm follow guidance in the Interim Code of Practice for Sustainable Drainage systems (SUDS) (CIRIA, 2004).*
> *or*
> *2. Establish agreements for the ownership, long term operation and maintenance of all sustainable drainage elements used.*

Achieving an infiltration system designed in accordance with this drainage guidance would qualify the development for the 2 additional credits.

The relevant criteria are contained in the extract over the page. The full CLG document *Code for Sustainable Homes, Technical Guide, May 2009* can be downloaded from:-

http://www.communities.gov.uk/publications/planningandbuilding/codeguide

Criteria	Credits	Mandatory Elements
1) Peak Rate of Runoff Ensure that the peak rate of runoff into watercourses (see definition) is no greater for the developed site than it was for the pre-development site. This should comply with the Interim Code of Practice for Sustainable Drainage systems (SUDS) (CIRIA, 2004) or for at least the 1 year and 100 year return period events. Calculation Criteria: • For sites of **less than 200ha**, the calculation of Greenfield runoff rates should be in accordance with Flood estimation for small catchments (Marshall and Bayliss, 1994) and any subsequent updates. • For sites of **200ha and more**, the calculation of Greenfield runoff rates should be in accordance with the Flood Estimation Handbook (Centre for Ecology and Hydrology, 1999) and any subsequent updates. • An **allowance for climate change** should be made in accordance with current best practice (PPS25, 2006).	None	All Levels
2) Volume of Runoff Ensure that the **additional** predicted volume of rainwater discharge caused by the new development, for a 1 in 100 year event of 6 hour duration including an allowance for climate change (PPS25, 2006), is entirely reduced using: • infiltration AND / OR • is made available for use in the dwelling as a replacement for potable water use in non-potable applications such as WC flushing or washing machine operation. Any residual additional rainwater volume that cannot be prevented from being discharged (reasons must be provided with supporting evidence), for all events up to the 100-year return period, the peak discharge rate from the site should be reduced to (in order of priority): **A**: the pre-development site's estimated mean annual flood flow rate (Qbar); or **B**: 2l/s/ha; or **C**: a minimum flow rate (litres per second), based on good practice guidelines to prevent easy blockage, by ensuring the outlet throttle is not too small; unless rainwater is being discharged to a public sewer or adopted surface water sewer, and there is a specific minimum requirement defined by the Sewerage Undertaker. Note; reasons for discounting any of the options above must be provided with supporting evidence.		
2 credits are available for using SUDS to improve water quality of the rainwater discharged or for protecting the quality of the receiving waters by: 1. Ensuring no discharge to the watercourse for rainfall depths up to 5mm. Follow guidance in the Interim Code of Practice for Sustainable Drainage systems (SUDS), (CIRIA, 2004). **OR** 2. Establish agreements for the ownership, long term operation and maintenance of all sustainable drainage elements used	2	
Default Cases: Credits can be awarded by default if the site discharges rainwater directly to a tidal estuary or the sea, because compliance with discharge flow rate requirements will not be required.		

Extract from : Code for Sustainable Homes, Technical Guidance, May 2009

Appendix B
Best Practice, Sustainable Drainage Systems (SUDS)

The Surface Water Drainage Consultation Matrix indicates whether the Environment Agency wish to be consulted on a planning application. This Appendix provides more detail of what we consider to be best practice. SUDS offer the opportunity for multiple benefits:- educational and amenity spaces, habitat creation, improved water quality and reduced flood risks. This can be achieved by early assessment of site conditions, careful choice, proper design and attention to detail during construction. Most importantly a successful scheme is reliant on integrating SUDS into the development, with regard to its future maintenance and management.

Surface water drainage schemes should contribute to sustainable development. There are three key objectives to minimise the impact of development on the quality and quantity of run-off and maximise amenity biodiversity opportunities. Each has equal standing and the ideal solution achieves all three benefits.

SUDS aim to replicate the natural drainage of site before development. SUDS therefore aim to minimise run-off using Source, Site and Regional controls.

SUDS schemes should therefore aim to integrate stormwater drainage throughout the site, dealing with run-off at source where possible. This approach minimises the need for large flow attenuation and control devices and means that SUDS should aim to be applied at all scales of development.

The comprehensive ***SUDS Manual (CIRIA C697)*** and the ***Site handbook for the construction of SUDS (C698)*** can be downloaded for free at:-

www.ciria.org.uk/SUDS/publications

SUDS cover a range of sustainable approaches to surface water management including:

- infiltration devices to allow water to soak into the ground;
- vegetated filter strips and swales to intercept and control overland flow routes;
- filter drains and porous pavements;
- basins and ponds to hold excess water and allow controlled discharge;
- greenroofs and walls;
- rainwater recycling.

Solutions vary from site to site because of development size type and density, availability of space, ground conditions, slope and groundwater conditions. Comprehensive guidance on the planning, design, construction, operation and maintenance is given in the ***SUDS Manual (CIRIA C697)***.

To be effective SUDS require attention to detail during construction. The geology in Cornwall mean ground conditions can vary significantly and rapidly on site. SUDS construction therefore requires competent supervision. There must also be an acceptance that the design of SUDS may need to be re-evaluated once works start if site conditions vary from those expected. Therefore the guidance in the ***Site handbook for the construction of SUDS (C698)*** should also be followed.

SUDS features must be integrated into the overall layout of the site. Determining appropriate SUDS may be an iterative process. However if appropriate areas are not identified at the master-planning stage then changes in the density and layout in the development may be required to accommodate SUDS features.

Water Quality

For a SUDS system the impact of water quality must also be considered. As well as reducing flood risk, infiltration has significant water quality benefits over a piped drainage system. The use of infiltration drainage prevents run-off passing directly to rivers for smaller events. Consequently infiltration drainage is our preferred option, where ground conditions allow.

Where infiltration is not possible we still expect a SUDS to be provided. Therefore drainage design should not be restricted to addressing run-off rates. It should also give consideration to the equally important issues of water quality and amenity/habitat value. Consequently, we would expect a drainage scheme to demonstrate how these elements are being addressed. For example a system could drain via filter strips to reduce contamination, or drain via a pond to provide habitat value.

A piped system should only be considered as a final option. In these systems consideration should be given to incorporating additional screening measures, not just petrol/oil interceptors and silt traps. Where waters discharge to our more sensitive receiving waters, filtration systems may be required.

On larger sites or in areas where the water may have a risk of high contamination a drainage system with a number of treatment components should be provided. This could prevent the need for oil interceptors. Further info is provided in our pollution prevention guidance note PPG3 which can be downloaded from our website:-

www.environment-agency.gov.uk

Permeable Paving

Permeable paving can provide infiltration at shallow depths. By over sizing the drainage blanket beneath the paving, additional impermeable areas can be drained. Permeable paving manufacturers provide guidance on the specification for providing storage and offer a design service to help achieve this. In addition to the SUDS manual guidance on the design and use of these products is produced by *The Precast Concrete Paving and Kerb Association* at:-

www.paving.org.uk/permeable

Minor developments

- **Householder developments**
- **Non-residential extension less than 250m^2**
- **Change of use**

The cumulative impact of a multitude of small development is increasing the risk of flooding in urban areas. Therefore best practice, in the form of any suitable SUDS, is recommended utilising infiltration systems wherever practical.

Individual properties can be served by small soakaways or use permeable paving. The recent changes that require the paving of front gardens to obtain planning permission highlight this issue. However the accompanying guide on providing infiltration drainage may prove a useful starting point. Further information on this can be found in Appendix J, Paving Gardens.

In addition to the ***SUDS Manual (CIRIA C697)*** there are two references for infiltration drainage design and construction:-

- ***BRE Digest 365, Soakaway Design, 1991.***
- ***CIRIA 156, Infiltration drainage – Manual of good practice, 1996***

These offer advice on the construction of soakaways and use a standard method for the assessment of soil infiltration rates. BRE 365 provides a simple design guide for traditional soakaways, appropriate for small developments or extensions.

Where infiltration systems can not be used then the inclusion of at least a water butt or equivalent should be considered as a minimum for extensions.

Developments less than 1 hectare

Best practice is recommended utilising infiltration systems wherever practical, and where this is not the case then use of alternative systems should be justified. Where the Local Planning Authority is aware of specific local issues then further constraints may be appropriate.

As well as the suggestions above for infiltration design and permeable paving, where a discharge is required we have an expectation that smaller developments will restrict run-off to a rate of 1.5 litres/second per dwelling. Products exist that allow individual properties to restrict run-off to this rate, using private underground storage tanks.

Achieving a discharge of 1.5 litres/second is typically achieved on the commercially available systems using a proprietary device with an orifice of around 30mm. This is combined with a sediment trap and a filter to prevent blockage. Storage is provided in an underground tank or crate system, operating at a maximum depth of around 0.5metres. It should be noted that due to the small orifice size it is likely that these systems would remain in private ownership as they are unlikely to be adopted.

Appendix C
Flood Risk Assessments and Conditioning SUDS

The level of detail expected of an FRA depends on whether an application is outline/full/reserved matters. It is also affected by the proposed development type and density. This section provides guidance on what we expect to see in an FRA to cover surface water drainage issues. Once an FRA contains the appropriate information conditions to ensure this is achieved on site are suggested.

Annex E of PPS25 considers the assessment of flood risk. Paragraph E.9 states that an FRA will be required where the Environment Agency have indicated that there may be drainage problems. The Critical Drainage Areas represent areas with such problems. Annex F of PPS25 indicates that assessment of surface water and drainage will be required as part of an FRA .

The FRA should focus on managing the surface water both from causes external to the development site and rain falling onto and around the site. The sustainable management of this rainfall/surface water will form an essential part of reducing and mitigating future flood risk.

Surface water drainage hierarchy

To encourage the use of SUDS the *Building Regulations 2000* establishes a hierarchy for surface water disposal. The first option is the use of infiltration. Where other drainage solutions are proposed it should be demonstrated in the FRA why infiltration is prohibited. Examples may include:-

- where a Surface Water Management Plan has determined a catchment specific solution;
- where contaminated land carries groundwater pollution risks;
- areas with a high water table; or
- where the use of attenuation ponds bring wider habitat and amenity benefits.

Outline planning application[2]

The FRA for an outline planning application will need to demonstrate how the proposed development will achieve a viable sustainable drainage scheme. It will need to as a minimum:-

- demonstrate the *surface water drainage hierarchy* - surface water will be expected to drain to infiltration unless it can be demonstrated that this is not feasible;
- demonstrate sufficient space is being allowed for sustainable drainage to meet our requirements, including water treatment features and amenity features where appropriate;

[2] FRAs should be proportional to the scale of the development and it may not be necessary to provide information on all points for small development proposals.

- demonstrate appropriate locations and that drainage will integrate into the layout and design;
- include an assessment of general ground conditions, such as soil type, groundwater levels - including permeability testing where necessary;
- outline a design that takes into account soil horizons, especially on sites requiring extensive earth works and reprofiling;
- where infiltration is not appropriate, demonstrate that an attenuation SUDS system could be achieved on site, undertake an assessment of Greenfield Runoff rates and provide the intended outfall location, or confirm capacity in the receiving sewer;
- provide an initial sizing of typical drainage components in line with the recommended standards- taking into account the climate change;
- indicate how exceedance and overland flow routes will be taken into account;
- demonstrate how the system is likely to be adopted.

Full planning and reserved matters applications[1]

The FRA for a full planning application will need to address the above points, plus address in more detail as a minimum:-

- plan of detail drainage features and schematic network layout;
- Supporting calculations;
- demonstrate that water quality and amenity/habitat value have been taken into account in the design;
- demonstrate that climate change has been taken into account in the design;
- compliance with the design requirements of:-
    - Infiltration systems;
    - System discharge rates;
    - Flow volumes (long-term storage).
- retention on site of excess run-off up to 100 year event and provision of long-term storage at appropriate locations;
- establish flood routing for extreme events and demonstrate no property damage for all events;
- the measures required for exceedance routes such as raised floor levels or lowered curbs and demonstrate how these will be maintained in perpetuity;
- ensure that run-off will be intercepted and enter into the drainage system and will not flow from the site by an alternative and uncontrolled route (for example the design should consider gutter and gully capacity and the requirement for additional interception features);
- consider how permeable areas drain. Areas that are intercepted by the drainage system this should be taken into account in the drainage design. (Without such precautions run-off from garden areas etc could overload a drainage system that was designed only for the roofs and roads);
- outfall locations and designs for attenuated drainage systems;
- adoption proposals and strategy for the long-term maintenance of the system - including a maintenance plan;
- drainage during the construction phase, including details where necessary;
- future access for maintenance, taking into account CDM regulations;
- offsite impacts of the proposed drainage.

As well as the technical engineering design of the system there is clear guidance that long term ownership and maintenance of drainage needs to be taken into account at the planning stage. Paragraph F12 of PPS25 states:-

'It is essential that the ownership and responsibility for maintenance of every sustainable drainage element is clear; the scope for dispute kept to a minimum; and durable, long-term accountable arrangements made, such as management companies. These issues should be addressed as part of the FRA . Where the surface water system is provided solely to serve any particular development, the construction and ongoing maintenance costs should be fully funded by the developer'

Conditions on planning decisions

If the FRA addresses the issues outlined above and is considered suitable we will request that the LPA include an appropriate condition on the permission. This is to ensure that the drainage is constructed in accordance with the approved designs. An example condition for a large site may be as follows:-

CONDITION

No development approved by this permission shall be commenced until details of a scheme for the provision of surface water management has been submitted to and approved in writing by the Local Planning Authority. The details shall include:-

- *details of the drainage during the construction phase;*
- *details of the final drainage scheme;*
- *provision for exceedance pathways and overland flow routes;*
- *a timetable of construction;*
- *a construction quality control procedure;*
- *a plan for the future maintenance and management of the system and overland flow routes.*

Prior to occupation of the site it shall be demonstrated to the satisfaction of the Local Planning Authority that relevant parts of the scheme have been completed in accordance with the details and timetable agreed. The scheme shall thereafter be managed and maintained in accordance with the approved details unless otherwise approved in writing by the Local Planning Authority.

REASON

To prevent the increased risk of flooding and minimise the risk of pollution of surface water by ensuring the provision of a satisfactory means of surface water control and disposal during and after development.

For smaller sites where the FRA demonstrates that provision of sustainable drainage will be straightforward to achieve then a simpler condition may be appropriate, for example:-

CONDITION

Before the development hereby approved is commenced, detail of a scheme for the management of the site's surface water shall be submitted to and approved by the Local Planning Authority. The details shall include as a minimum:

- *Details of the final drainage scheme, including pathways and flow routes for excess surface water during extreme weather;*
- *A construction quality control procedure;*
- *A plan for the future maintenance of the system and of any overland flow routes.*

Prior to occupation of the site it shall be demonstrated to the satisfaction of the Local Planning Authority that the scheme is completed in accordance with the agreed details. The scheme shall thereafter be maintained in accordance with the approved details unless otherwise approved in writing by the Local Planning Authority.

REASON

To prevent the increased risk of flooding and minimise the risk of pollution of surface water by ensuring the provision of a satisfactory means of surface water control and disposal during and after development.

We expect to be re-consulted by Cornwall Council on the discharge of these conditions.

Appendix D
Climate Change and greenfield run-off rates

The expected impacts of climate change needs to be taken into account in drainage design. The post-development rate of run-off should be assessed in relation to the undeveloped or greenfield run-off rate. To do this the greenfield run-off rate must first be calculated. Acceptable methods are summarised below.

Climate Change

Drainage design should take into account the relevant increase in rainfall allowances given in Table B.2 of PPS25. The values to use depend on the lifetime of the proposed development. This can be summarised as:-

Development type	Typical lifetime	Allowance for increase in peak rainfall intensity
Commercial	75 years	20%
Residential	100 years	30%

These values should be applied to the intensity of the rainfall used in the design calculations.

Run-off rates should be calculated at current rates. Discharge rates should be controlled at these current rates. An allowance for climate change should not be applied to the future rate of run-off from a site. This will help to ensure that flood risks do not increase in the future, and is considered to be part of the measures required for adapting to climate change.

Increasing the intensity of the rainfall but restricting any discharge to existing rates will result in an increase in the volume of storage required in a system. This may favour the use of surface storage features as the cost of constructing underground storage tanks increases.

It will also require the design to give careful consideration as to how run-off will enter the system. This may require oversizing of interception devices such as gullies. Again this is more easily achieved by using surface features such as swales to intercept run-off.

Estimating greenfield run-off rates

Where infiltration drainage can not be used, a controlled discharge from a drainage system to a watercourse, the sea or a surface water sewer will be required. To ensure flood risks are not increased we compare these discharges against '*greenfield'* run-off rates.

The greenfield run-off rate refers to the quantity of rainfall that flows overland from an undeveloped site in natural conditions during and after rain. The rate of

run-off varies according to the duration and intensity of each rainfall storm. Given the uncertainties and difficulties in calculating these greenfield run-off rates, two simple and robust methodologies have been adopted to derive indicative values.

1. (IoH124) - *Flood estimation for small catchments*, Institute of Hydrology Report 124

Section 4.2 of ***The SUDS Manual (CIRIA C697)*** indicates IoH124 as an acceptable method of estimating greenfield run-off:-

www.ciria.org.uk/SUDS/publications

This estimates the mean annual peak flow for a rural catchment, using site area, annual rainfall and soil type. There is a free automated version of this procedure, as part of the tools to assess surface water storage requirements. This can be found at:-

gamma.hrwallingford.co.uk/UKStormwaterDrainage/index

This takes into account whether the site area and automatically assesses the soil type and annual rainfall from an online map. It also takes into account the minimum discharge rate of 5 litres/second, as discussed below.

2. ADAS Report 345

An alternative acceptable method to calculate greenfield run-off rates is given in ADAS 345. This technique has the advantage of taking into account site slope and can be based on site specific permeability testing. A guidance note on this method can be obtained by contacting the Environment Agency Development and Flood Risk Team at the Cornwall Area office.

Minimum discharge rate.

On small sites with permeable soils the greenfield rates can be low. In these circumstances a practicable minimum limit on the discharge rate from a flow attenuation device is a compromise between attenuating to a satisfactorily low flow rate while minimising the risk of blockage at the control device. We will therefore accept a minimum discharge rate to make it easier for smaller developments to achieve attenuation.

Propriety devices can achieve an attenuated discharge rate of 1.5 litres/second per dwelling. For sites of 1-3 dwellings this value should be achieved. For other small sites an acceptable minimum is 5 litres/second. This value is suggested in the *EA/DeFRA Technical Report W5-074/A Preliminary rainfall run-off management for developments:-*

www.defra.gov.uk/environ/fcd/research/SC030219.pdf

If alternative methods wish to be adopted these should first be agreed with the Development and Flood Risk Team.

Appendix E
Designing for exceedance

A well designed drainage system ensures little residual risk of property flooding occurring during events in excess of the return period for which the system is designed. The drainage design must ensure that all surface waters that are assumed to pass through the drainage system will be fully intercepted and will not flow from the site by an alternative and uncontrolled route. This may require the provision of overland flow routes or surface drainage features to control run-off around the site in conditions when the piped system becomes surcharged/blocked or for events that exceed the design event.

Our standards require that the drainage and run-off from the site should be controlled to greenfield rates for all events up to and including the 1 in 100 year rainfall storm event, including an appropriate allowance for climate change. However it is likely that formal drainage systems will be designed for a 30 year storm event.

For events between the 30 and 100 year event controlled flooding on site may occur and additional storage may be provided above ground. For instance an attenuation basin might be constructed within public open space or shallow flooding may be designed into a car parking area to be utilised in storms in excess of the 30 year magnitude. It must be demonstrated how overland flow routes will be directed to these areas and how they will subsequently drain.

There will be instances when the 100 year storm design criteria will be exceeded or the system blocks. The consequences of these events should be assessed and managed through good site design. Site layout and surface water drainage systems should cope with events that exceed the design capacity of the system, allowing excess water to be safely stored or conveyed from the site without adverse impacts. No flooding of property should occur as a result. Third party and offsite flood risk should not be increased.

Designs must ensure that run-off from all drained areas can be adequately conveyed into the drainage system. Many surface water systems are only designed to the 1 in 30 year standard. As such a piped system may convey run-off for up to the 30 year storm to the infiltration or storage system, but for storms in excess of this, the pipe system may become surcharged and swales, bunds or interception devices such as drains over the full width of a road may be needed to control the excess rainfall. Without interception and redirection of run-off to the drainage system, there could be an increase in overland flow and a significant increase in surface water flooding to adjacent areas.

The assessment should address how all areas would drain in more extreme events - including gardens and landscaped area - ensuring that this is taken into account in the drainage design. Overland flow routes should be considered in the layout to ensure property is not at risk from surface water flooding.

It is more effective to manage surface water flooding in the design process rather than to resolve problems during or after development. Site layout should

be influenced by the topography. Locating buildings where surface water may flow naturally or as a result of development should be avoided.

Plans demonstrating how the above will be achieved will need to form part of the planning application. At an outline stage the plans will need to demonstrate that drainage exceedance is being addressed in the conceptual design. This is likely to require identification of flow routes both onto and off of the site, as well as identifying areas for controlling water within the site. It must also take into account any site profiling that would be required for the development to be feasible.

For a full planning application detailed plans and assessment demonstrating how these flow routes are to be achieved will be required. This may require details such as raised floor levels, dropped kerbs and specific openings to be identified.

Safe above ground flow paths will need continued protection from obstruction. This is a requirement of “Sewers for Adoption”. These flow routes can be considered Functional Floodplain. This may need to be covered in maintenance plans and legal agreements.

Third party flood risks offsite must be assessed and demonstrated not to be increased by the development.

Further guidance is provided in *Designing for Exceedance in Urban Drainage – Good Practice (*CIRIA publication C635).

Appendix F
Long-term Storage

Development can affect the volume of water discharging from a site as well as the rate at which it discharges. Infiltration drainage reduces this impact by directing surface water to the ground. On larger sites where infiltration can not be achieved, long-term storage should be provided for this additional volume.

From the outset it is worth noting that we will not be seeking long-term storage where a site:-

- drains via a soakaway or infiltration system, or
- utilises the additional run-off in a rainwater harvesting system.

The need for long-term storage where the above does not apply is in line with the requirements of the Code for Sustainable Homes, see Appendix A. It may be possible to address this requirement through a grass roof, see Appendix H.

Where a site is not draining to infiltration, in extreme events the total volume of run-off from a developed site can be 5 times that from the site in a greenfield state. It is important to control this additional volume from the developed site for three reasons:-

- Without long-term storage run-off from smaller events tends to be released quicker than from a greenfield site. This can have an adverse impact on the receiving watercourse in terms of flow regime and loss of base flows.
- Because of the limited storage volume available on floodplains, there may be greater flooding if the volume of water discharged is increased.
- Where drainage systems are tidally affected, any additional volume of water can increase flood risk behind defences.

In order to understand the provision of *Long-term Storage* it is necessary to differentiate it from *Attenuation Storage:-*

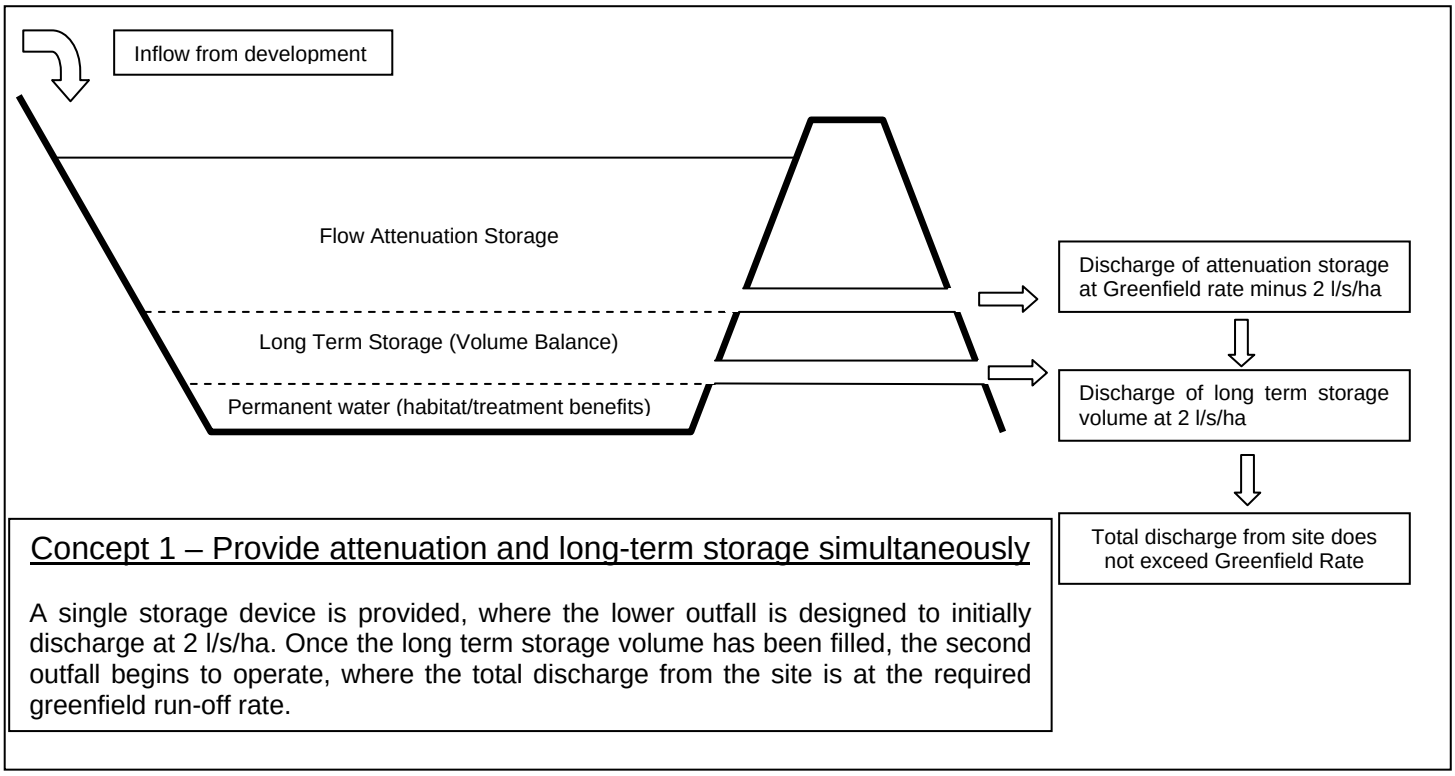
Attenuation storage aims to limit the rate of discharge to that which took place prior to development, i.e. mimic the greenfield run-off rates.

Long-term storage aims to address the additional volume of run-off caused by development increasing impermeable areas. This is integral to an infiltration system. However piped systems discharging to a watercourse or sewer reduce the amount of water infiltrated into the ground. To compensate for this the additional volume of run-off is stored on site and discharged at low rates of flow to the receiving watercourse.

The volume of the long-term storage is approximated by calculating the additional volume of run-off generated by a 6 hour 100 year rainfall event as a result of developing the site. The long-term storage discharges at a rate of 2 litres/second per hectare or less. The method of calculating the Long-term Storage volume is given in the *SUDS Manual CIRIA C697* and *EA/DeFRA*

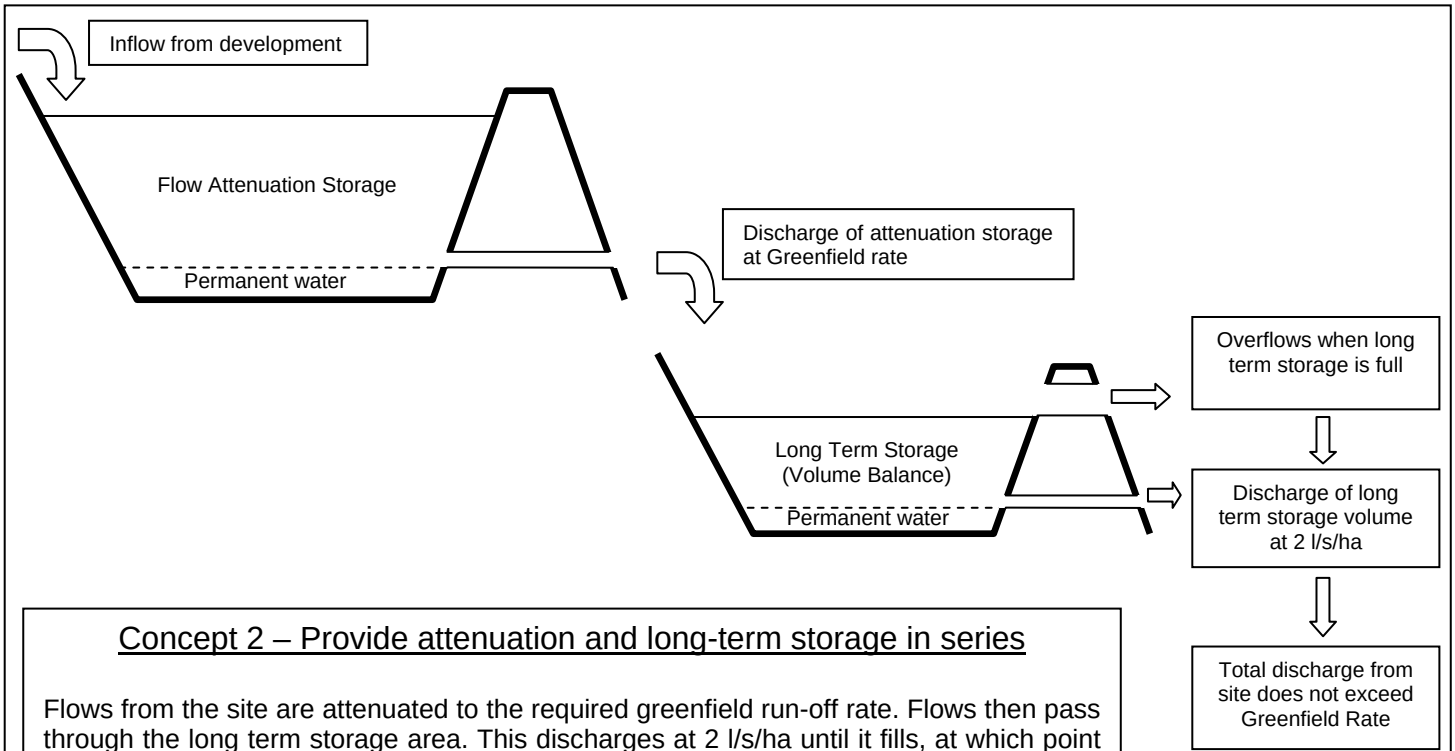
Technical Report W5-074/A Preliminary rainfall run-off management for developments:-
www.defra.gov.uk/environ/fcd/research/SC030219.pdf

These drawings demonstrate two ways that long-term storage could be incorporated into a drainage system. Note that the discharge from the long-term storage should be incorporated into the calculation of the attenuated discharge rates from the site, rather than as an additional flow. While these help to demonstrate the concept there are other ways in which this can be achieved.



Concept 1 – Provide attenuation and long-term storage simultaneously

A single storage device is provided, where the lower outfall is designed to initially discharge at 2 l/s/ha. Once the long term storage volume has been filled, the second outfall begins to operate, where the total discharge from the site is at the required greenfield run-off rate.



Concept 2 – Provide attenuation and long-term storage in series

Flows from the site are attenuated to the required greenfield run-off rate. Flows then pass through the long term storage area. This discharges at 2 l/s/ha until it fills, at which point an overflow operates.

Because the inflow into the long term storage is already controlled, the final flow from the site is controlled to the required greenfield run-off rate.

Appendix G
Adoption, maintenance and quality control procedure

The long-term effective drainage is dependant on proper construction and maintenance. This will depend on the organisation who will adopt it. Therefore the constraints of adoption should be considered at the outset of design as well as the safe future maintenance.

In the past there have been difficulties because the requirements for a drainage system have not been consistent through the planning, implementation and adoption stages. We have therefore modified our guidance to try to ensure that the requirements are more consistent throughout.

Adoption of SUDS

The adoption of any proposed drainage system should be addressed at the outset. Adoption and future maintenance of SUDS is an issue that has been highlighted by the Pitt review. The Governments response to recommendation of the Pitt review indicates that Local Authorities should be responsible for adopting and maintaining new build (and re-developed) SUDS on highways and in the public realm. How this is to be achieved is likely to be covered in the forthcoming Floods and Water Bill. The Governments response can be found at:-

www.defra.gov.uk/environ/fcd/floods07/Govtresptopitt.pdf

Currently in most circumstances South West Water (SWW) do not adopt SUDS. Nor do they typically adopt piped system which receive flows from vegetated systems such as swales, or infiltration devices into which groundwater may discharge. This can present problems where a development proposes a mixture of systems to overcome site conditions. Such drainage systems may require maintenance by a private management company.

However there are solutions to overcome this. For example:-

- At Pilmere in Saltash the attenuation basin has been incorporated on to the public open space play area. As such it is maintained by the local authority as part of its open space.
- Cornwall Council will adopt SUDS designed in accordance with their design standards to drain areas of highways.

SWW current practice is to only adopt systems designed to a 30 year design standard, with climate change. Therefore where a system proposes a tanked or sewered system it has been necessary to have a separate private system to accommodate flows greater than the 30 year design event.

All sewers for adoption by the sewerage undertaker must be designed and built in accordance with the requirements of the latest version of "*Sewers for Adoption",* currently Edition 6. This document provides guidance on suitable

return periods for use in the design of sewerage systems for various development types. The minimum size of pipe discharging from a flow attenuation device should be 150mm laid at a gradient not flatter than 1 in 150.

Sewers should be designed to ensure no flooding above ground level for events with a return-period in the range of 30 to 50 years, depending on the development type.

The hydraulic design of the surface water system will be required to offer protection against flooding. This will be achieved by designing the system not to flood any part of the site in a 1:30 year return period design storm, with the level of off-line storage provided for a 1:100 (1%) storm return period. For events with a return period in excess of the sewer design capacity up to the 100 year event, provision should be made to deal with the water within the site. Controlled surface flooding of open spaces such as landscaped areas or car parks may be acceptable for short periods. If surface flooding is not appropriate, then additional storage areas or tanks may be required.

Drainage of rainwater from buildings and paved areas around buildings will need to comply with the 2002 Building Regulation Approved Document H – *Drainage and Waste Disposal*.

Construction phase

A quality control procedure for the installation of the drainage system is expected. Without such a procedure, it is difficult to ensure that the drainage system has been installed in accordance with the agreed designs. This is especially important for below ground elements in the design. This may require:-

- infiltration device location specific permeability testing;
- construction quality assurance supervision;
- submission of a construction quality assurance report to discharge the planning condition. This may include as-builts of the drainage, demonstrating that it has been built in accordance with the approved design.

It must also be ensured that the construction phase does not compromise the long term effectiveness of the drainage feature. Examples include:-

- using attenuation ponds for as settling ponds during construction can reduce their capacity if not re-excavated at the end of the construction phase;
- siltation of infiltration devices reduces the permeability of soils;
- compaction of soils by machinery reducing permeability;
- re-profiling of site removing permeable soils.

Consequently there is now a requirement for the drainage during the construction phase to be considered as a separate system to the final system. Details of this can be requested through condition, and can be tied into the Construction Environmental Management Plan (CEMP). Comprehensive guidance can be found in the ***Site handbook for the construction of SUDS (C698)*** can be downloaded for free at:-

www.ciria.org.uk/SUDS/publications.htm

Section 106 agreements to secure maintenance

It is recommended that the local planning authority obtain the agreement of the adopting body before the SUDS are approved through the development control process. This may require a restrictive condition to prevent the development beginning before the drainage arrangements are in place.

Before granting planning permission, the local planning authority may need to secure a Section 106 agreement to clarify and establish appropriate mechanisms for adoption and maintenance of the SUDS.

In some instances it will be necessary to ensure that a properly guaranteed or bonded maintenance arrangement is put in place or to secure a commuted sum to fund maintenance. The model agreements developed for the *Interim Code of Practice for SUDS* can help this process.

The design of SUDS should facilitate safe and convenient access by personnel and construction plant to undertake maintenance tasks. To avoid compromising the effectiveness of the SUDS, it is important to give priority to the proposed maintenance regime over other considerations. The creation or enhancement of any wildlife habitat as a result of the SUDS must recognise potential impacts on the maintenance requirements. In most cases, the most effective and economic maintenance of SUDS is compatible with the presence of wildlife.

CIRIA publication C609 *Sustainable drainage systems – hydraulic, structural and water quality advice* and Chapter 22 of the *SUDS Manual C697* provides information on designing SUDS systems to facilitate effective maintenance and on managing the interaction between function, amenity and maintenance.

Appendix H
Green roofs and walls

Green roofs can help replace habitats lost through development, insulate buildings, reduce urban heating effects and improve the quality of the local environment – all while reducing flood risks by attenuating run-off.

We will take into account the attenuation provided in a green roof when reviewing drainage schemes. This will be reviewed on a site by site basis, as the attenuation provided in a green roof depends on its design and how the subsurface drainage is configured.

The Environment Agency has produced the *Green Roof Toolkit* to aid design and implementation of green roofs. This can be found on our website at:-

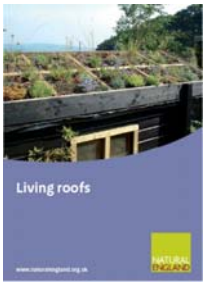
http://www.environment-agency.gov.uk/business/sectors/91967.aspx

CIRIA have produced *Building greener. Guidance on the use of green roofs, green walls and complementary features on buildings (C644)*. This can be downloaded for free from:-

http://www.ciria.org/acatalog/C644.html

More general advice is provided by Living Roofs who are dedicated to increasing the uptake and of green roofs and walls:-

http://www.livingroofs.org.uk/



On a domestic scale Natural England provide practical guidance on implementing green roofs in *Living Roofs*

Appendix I
SUDS Ponds & Set-Back Outfalls

Ponds in a drainage system have the potential to provide the most diverse range of benefits of any SUDS feature – attenuation, habitat, water quality and educational benefits. Yet their use is limited by perception of land take, maintenance and not least health and safety issues. These issues can be avoided through early consideration and good design.

The ***Pond Creation Toolkit*** is an extremely useful guide to the creation and management of ponds.

www.pondconservation.org.uk/millionponds/pondcreationtoolkit

Factsheet 4 provides comprehensive guidance on how to design a pond to maximise its habitat value.

A suitable location, sensible construction and appropriate management should ensure that the pond adds to the amenity value of an area, rather than detracting from it. The following are features of good pond design:

- A series of small scrapes, beneficial for wetland plants and animals.
- Dry weather depth does not need to exceed 300mm. Utilising shallow sections creates a similar effect. (Many of the rarest inhabitants of ponds are associated with temporary pools that dry up).
- Side slopes should be as shallow as conditions allow. For habitat creation a minimum of 1:4 slope is beneficial.
- In restricted sites, steepening some banks to make others shallower is preferable to even slopes on all sides. The slope should vary around the pond to produce an irregular shoreline enabling a range of vegetation to establish.
- Native vegetation should be allowed to colonise naturally, in its own time.
- Once established pond vegetation will need to be managed, and silt periodically removed. The designer should take into account safe access and procedures for maintenance as required under the CDM regulations. Where necessary the banks should be constructed to be able to withstand machinery.
- Attenuation pond design needs to take into account ground water levels during wet periods. The permanently wet area can be influenced by groundwater levels. However a water table above the outlet of the pond

will reduce the ponds design capacity and restrict its ability to attenuate, increasing flood risk downstream.

- Where there is the risk of pollution, discharges should be via a two stage pond, or pass through a wetland before they enter the pond.
- Spoil should not be tipped in the floodplain or within 7 metres of any watercourse. This may block flood flow routes and result in a loss of floodwater storage. Flood Defence Consent may be refused for this where it is a Main River.
- Waste management and pollution control during construction need to be considered. We have produced Pollution Prevention Guidance on this (PPG5) which can be downloaded from our website:

www.environment-agency.gov.uk

Health and safety

There can be a perception that SUDS ponds pose a unacceptable risk to the public. With careful design these perceived risks to public safety can be reduced. If ponds are properly designed with shallow side slopes (the SUDS Manual indicates a max slope of 1 in 3 but that 1 in 4 are preferred), shelving edges and strategically placed barrier vegetation they are at least as safe as many other watercourses, ponds and lakes that are unfenced in parks, country parks and similar locations.

The design and construction of all drainage systems including SUDS must comply with the Construction Design and Management (CDM) Regulations 2007. The construction, operation and maintenance of SUDS must comply with a whole range of health and safety legislation including, but not restricted to, the following:

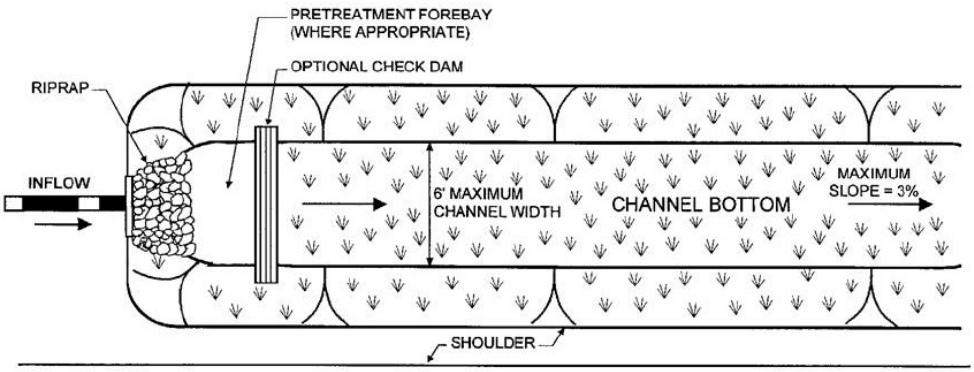
- Construction (Health, Safety and Welfare) Regulations 1996
- Management of Health and Safety at Work Regulations 1999
- Control of Substances Hazardous to Health Regulations 2002 (COSHH).

It is good practice to undertake a safety audit or risk assessment of a SUDS scheme before the design is finalised to ensure that risks to maintenance workers and the public (especially children) have been designed out as far as reasonably practicable. This may be incorporated into the risk assessments carried out to meet the requirements of the CDM Regulations.

Further information can be obtained from the Royal Society for the Prevention of Accidents (ROSPA) and in CIRIA C697.

Set-back Headwall

For a piped system discharging to a watercourse, the only opportunity for any water quality or habitat benefits may be through provision of a set-back headwall. These should be designed to fit with the surrounding habitat. The basic principal of a set back head wall is illustrated below. Flood Defence Consent may be required for the outfall structure, see Appendix L.



PLAN VIEW

Further Guidance

www.pondconservation.org.uk

The pond book is a comprehensive guide on pond creation and is a valuable source of information.

www.pondconservation.org.uk/advice/Buythepondbook/buy_the_Pond_Book

We would also recommend referring to the design guidance in the Design Manual for Roads and Bridges - ***HA 103/06 Vegetated Drainage Systems For Highway Runoff.***

Appendix J
Paving gardens

Paving more than 5 square metres of a front garden with impermeable surface needs planning permission. Guidance on how to avoid this and reduce the impacts is given below.

The drains in most urban areas were built many years ago and were not designed to cope with increased rainfall expected as a result of climate change.

Paving front gardens adds water into the drainage system causing them to be exceeded and flooding to occur. Although paving over a garden may not seem to make a difference, the combined effect of lots of people in a street or area doing this can increase the risk and severity of flooding.

To help counter this problem on the 1st October 2008, the Government introduced changes to the General Permitted Development Order making the hard surfacing of more than 5 square metres of domestic front gardens permitted development only where the surface in question is rendered permeable. Use of impermeable materials such as concrete where there is no facility in place to ensure permeability now requires planning permission.

The Department for Communities and Local Government and the Environment Agency have produced ***Guidance on the permeable surfacing of front gardens.***

The guidance advises householders of the options for achieving permeability and meeting the condition for permitted development status, avoiding the need for planning permission. This is available to download free at:-

www.communities.gov.uk/publications/planningandbuilding/pavingfrontgardens

Further information on the wider implications of paving front gardens can be found in the RHS guidance ***Gardening Matters – Front Gardens*** which includes useful suggestions from a wider perspective. This can be downloaded from the RHS website (www.rhs.org.uk) at:-

www.rhs.org.uk/Gardening/Sustainable-gardening

Appendix K
Rainwater Harvesting

Rainwater harvesting is the simple collection of rainwater for use. It is important to reduce the water supply demands from new development and should be incorporated wherever possible. Rainwater harvesting systems can be installed in both new and existing buildings. Generally the water can be used to flush the toilet, water gardens and even fill the washing machine.

Due to the variability in the timing of rainfall, rainwater harvesting can not generally be used to offset the requirement to attenuate/infiltrate run-off from development. However we are open to discussion on ways in which rainwater harvesting can be integrated with SUDS to control rainwater on and offsite. For example rain water harvesting system reduces the volume of run-off from a site. Therefore an appropriately designed rainwater harvesting system may be an appropriate alternative to providing long-term storage.

Reduced water usage has environmental benefits and while rainwater harvesting has the potential of significant financial savings, this depends heavily on a number of factors:

- the anticipated water demand;
- the water supply being metered;
- the size of the surface area that the water is being collected from;
- rainfall amounts vary from site to site – with 1600mm of rain per annum, Bodmin Moor has double the 800mm of rainfall that Padstow receives in an average year);
- the cost of installing and maintenance.

Rainwater harvesting depends on impermeable surfaces for supply. It is worth evaluating the volume of rainfall that can be collected from roof areas or driveways at the initial stage to see whether rainwater harvesting would be viable. On a typical dwelling roofs and driveways are ideal for rainwater harvesting and can provide around 100m^3 of water per annum.

There are a number of rainwater harvesting systems available, but a typical example collects rain from the roof in a storage tank (usually underground) once the leaves and debris have been filtered out. As the water is not suitable for drinking without treatment, it is then used to supply toilets, outside taps, etc. through a separate pipe network. A control unit monitors the water level in the storage. If levels drop too low, the system switches to the mains water supply. If it gets too high, an overflow sends water to a SUDS scheme.

Many businesses, housing developments and schools would see financial benefits. ***Harvesting rainwater for domestic uses: an information guide*** can be downloaded from our website:- http://www.environment-agency.gov.uk/

Rain Harvesting Systems:- http://www.rainharvesting.co.uk/
UK Rainwater Harvesting Association:- http://www.ukrha.org/

Appendix L
Flood Defence Consent

A brief summary of when Flood Defence Consent would be required.

The Water Resources Act 1991 and associated byelaws require you to apply for formal consent for works in, over, under or adjacent to main rivers. This is to ensure that such activities do not cause or make worse an existing flooding problem, interfere with our work, and do not adversely affect the local environment, fisheries, wildlife, and flood defences. These consents are referred to as 'flood defence consents', in the past they were sometimes called 'land drainage consents'.

Under the Land Drainage Act 1991, you also need our consent if you want to fill, divert, obstruct, construct a culvert or flow control structure (such as a weir) on any ordinary watercourse.

We will need to see full details of the work you propose and recommend you contact us as soon as possible to discuss your plans, we welcome pre-consenting meetings / negotiations. Talking to us early helps everyone and avoids unnecessary delays and wasted effort. Once preliminary details have been agreed, will consult internally. We will ask you to fill in an application form which must be returned with the appropriate fee, currently £50 per structure. On the receipt of a completed application we have 2 months to determine an application.

We will not approve works that would increase flood risk or harm the environment – even if the works appear to be sound from an engineering or structural point of view.

We would not normally consent culverting of watercourses and have a policy regarding culverts. We actively promote 'soft engineering' methods to control erosion combined with environmental enhancement. For example, using natural materials such as woven willow spiling or natural planting to limit erosion where practical. However we accept that in certain circumstances and where local conditions prevail, 'harder engineering' may be the only practical solution.

You must not carry out work without our formal consent. If you do, the consequences can be expensive. We can reclaim from you the cost of whatever action we decide is necessary to remove or alter your work. Or, we can require you to put things right. Carrying out works without prior consent or failing to rectify problems may be a criminal offence. We are unable to issue retrospective consent and the works will remain unconsented.

Further details on Flood Defence Consents, advise and application forms can be obtained from the area Development and Flood Risk team, on **08708 506 506** or via e-mail at dfrcornwall@environment-agency.gov.uk

Appendix M
Catchment Flood Management Plan

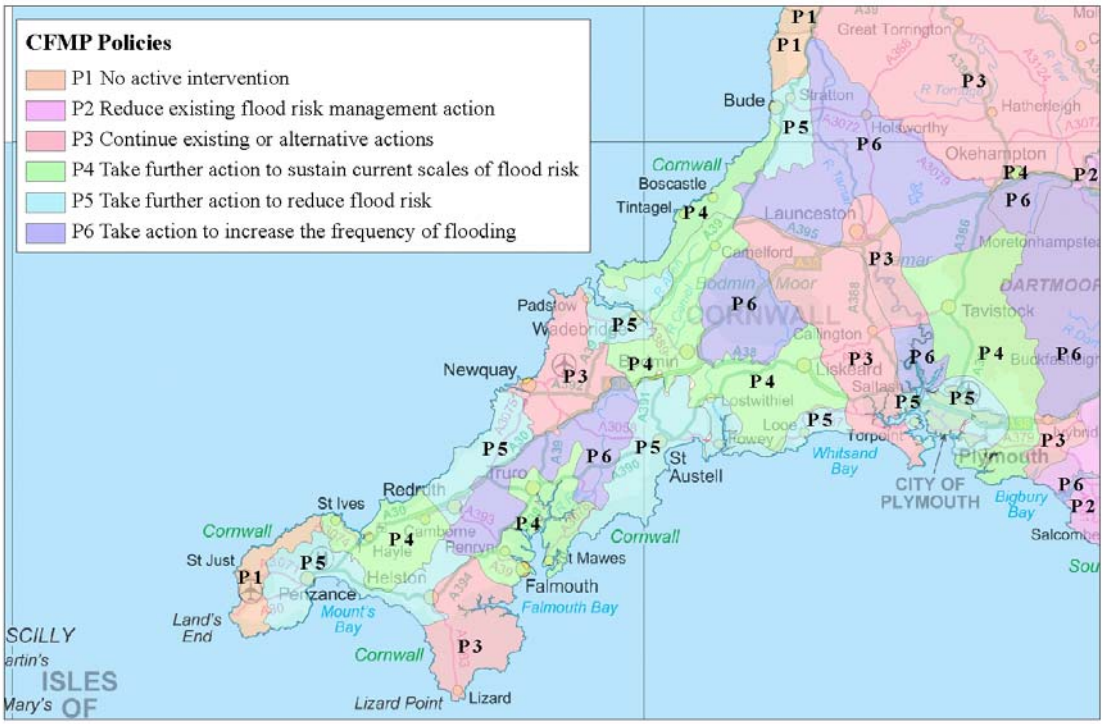
A brief summary of CFMP, their aims and how these relate to the Drainage Guidance for Cornwall and Critical Drainage Areas.

There are three Catchment Flood Management Plans (CFMP) covering Cornwall. These were formally published in 2009. These can be viewed via the Environment Agency website at:-

www.environment-agency.gov.uk/research/planning/114342.aspx

Policy Units

CFMP's are broken down into Policy unit areas where flood risks and flooding mechanics are broadly similar. For each Policy Unit one of the six Policies are selected. These range from no active intervention, through reduce existing actions to taking further action to reduce flood risk, as well as taking action to increase the frequency of flooding to deliver benefits locally or elsewhere. The expected coverage of policies across Cornwall is shown in the figure below.



The policies are intended to give direction on the level of flood risk management activity that will be carried out, and an indication of the distribution of likely flood risk management funding and spending (at least for the Key Settlements listed in the CFMP). However, even in no active intervention areas, we will still look to monitor and advise on the flood risks. There are some broad planning messages that the CFMP policies support. These are given in the table below.

Policy	Policy Description	Spatial Planning message
P1 No Active Intervention (including flood warning and maintenance).	We could select this for natural catchments where the river is connected to the floodplains and flooding has beneficial effects for habitats.	• LDFs should identify the floodplain (FZ2&3) as functional floodplain • The Agency will not expect to contribute to or adopt any private defences as part of development
P2 Reduce existing flood risk management actions (accepting that flood risk will increase over time)	The current and future risks in all or part of these areas do not warrant as much intervention (for example on maintenance) and we can allow the risk of flooding to increase naturally over time.	• The Agency will not expect to contribute to or adopt any private defences as part of development. • Development Plans should seek to reduce the vulnerability classes of land use in at risk areas.
P3 Continue with existing or alternative actions	The risks are currently managed appropriately and where the risk of flooding is not expected to increase significantly in the future. Where we are confident that the risks do need managing we may need to review if what we are doing currently is the best way of managing the risk in the longer term. The policy may lead to reviewing the flood warning services, or how we manage assets that may be in place	• Development Plans should seek to reduce the vulnerability classes of highly vulnerable and vulnerable land uses in at risk settlements. • The Agency will not expect to contribute to or adopt any private defences as part of development.
P4 Take further action to sustain the current scale of flood risk	The risks are deemed to be currently managed in an appropriate manner, but the risk of flooding is expected to significantly rise in the future. In this case we would need to do more in the future to reduce the increases in risk.	• The Agency will commit to sustaining appropriate defences to key settlements • Development at key settlements may be appropriate where there are no other lower risk sites available but adaptation to changing risk needs to be considered by Development Plans
P5 Take further action to reduce flood risk	The policy is to reduce the flood risk in areas where the existing flood risk is too high. We need to take action in the short term to reduce this level of risk. Alternatively it may be about reducing flood risk in locations where the future flood risk is high. We will need to take longer term action to reduce flood risk in these locations.	• The Agency will commit to providing appropriate defences to key settlements • Development at key settlements may be appropriate where there are no other lower risk sites available
P6 Take action to increase the frequency of flooding to deliver benefits locally or elsewhere	This can be used to transfer flooding to places remote from the area that is at flood risk (now or in the future). This may mean that we can restore floodplains and improve habitats in order to reduce the risk elsewhere. This may also include changing the way we use the land to hold water in that part of the catchment for longer, in order to reduce flood risk elsewhere.	• LDFs should identify floodplains (FZ 2&3), and ideally wetlands, as functional floodplain • Development plans should support the relocation of development from existing floodplain areas

Key settlements

The CFMPs have identified key settlements in terms of flood risk and consequence. It gives an indication of the number of people and property at risk of flooding in the Flood Zone 3, and the scale of the likely future economic damages from flooding.

CFMP Actions

There are a range of specific actions that the spatial planning system can help to deliver. This includes addressing surface water drainage issues. This drainage guidance aims to progress this aim.

SFRA and LDF work is highlighted as being important at a number of locations - particularly Wadebridge, Bodmin, Newquay, Fowey, Looe, Lerryn, Lostwithiel, Truro, Falmouth, Penryn, Helston, Penzance, St Austell, St Blazey and Launceston.

Surface water management plans and other integrated urban drainage studies are highlighted as required for: Wadebridge, Padstow, Bodmin, Camborne Pool and Redruth, St Ives, Halye, Truro, Falmouth, Penryn, Penzance, Porthleven, Newlyn, Mousehole, Cowlas, Helston, St Austell, Mevagissey, Par and St Blazey.

Work has already been carried out for Camborne Pool and Redruth, with a SWMP and Implementation Strategy produced. This work is directly related to the implementation of the CPIR Area Action Plan, and further work to update the previous studies is being carried out in partnership by the Environment Agency and Cornwall Council. It is essential that the Core Strategy supports this work and approach.

Master planning of SUDS for the urban extension of Truro was started by Carrick District Council and needs to be completed by Cornwall Council to support the Truro and Threemilestown Area Action Plan. This will need to from part of the SWMP.

An initial review of surface water and flooding is being undertaken for Bodmin. Any SWMP that is produced for this is likely to need support from the Core Strategy.

St Austell and St Blazey form a growth point. There is a specific need for the sustainable regeneration policies for St Blazey to incorporate and take full account of flood risk management opportunities. Funding has been sought through the growth point bid to undertake work relating to a SWMP.

Appendix N
Background to the Drainage Guidance for Cornwall

A brief summary of why the guidance has been updated.

Our original Drainage Guidance for Cornwall was issued in 2004, to aid the Local Planning Authorities and developers in understanding our requirements for Sustainable Drainage Systems (SUDS). Since then:

- *PPS25* was issued, updating the national planning guidance on Development and Flood Risk and introducing the concept of catchments with '*Critical Drainage Problems*'.
- B*uilding Regulations 2000 Approved Document H - Drainage and Waste Disposal, May 2006* sets out and clarifies the expected drainage hierarchy.
- Further work has been published on SUDS. This includes *EA/DeFRA Technical Report W5-074/A Preliminary rainfall run-off management for developments, Revision D (HR Wallingford 2005).*
- CIRIA have consolidated guidance on Sustainable Drainage System into the *SUDS Manual (CIRIA C697).*
- The Pitt Review has emphasized the need to include and adopt SUDS in new development proposals.
- The *Code for Sustainable Homes, Technical Guide, October 2008* provides requirements for Sustainable Drainage to be incorporated into the design.
- Work on Surface Water Management Plans have progressed.
- The draft Flood and Water Management Bill aims to develop the role of the Local Authority in assessing and adopting SUDS.
- The *Catchment Flood Management Plans* have been produced (expected to be published July 2009).

As a result we have updated the Guidance. This has been timed to coincide with the formation of the Cornwall Council and the work on its Strategic Flood Risk Assessment – Level 1 (SFRA 1). The key updates are:-

- a review of the identified catchments and drainage issues;
- updated drainage standards to reflect current expectations;
- revised development sizes to match our national Flood Risk Standing Advice;
- reflect the expectations of PPS25;
- referencing the most recent SUDS literature;
- inclusion of designing for exceedance.

Appendix O
Critical Drainage Areas – summary sheets

These summary sheets include a map of the Critical Drainage Area, the flooding issues and problems and the appropriate drainage requirements for the catchment. The sheets can be found in the separate Annexed documents.

Critical Drainage Areas – *with developing Surface Water Management Plans (August 2009):-*

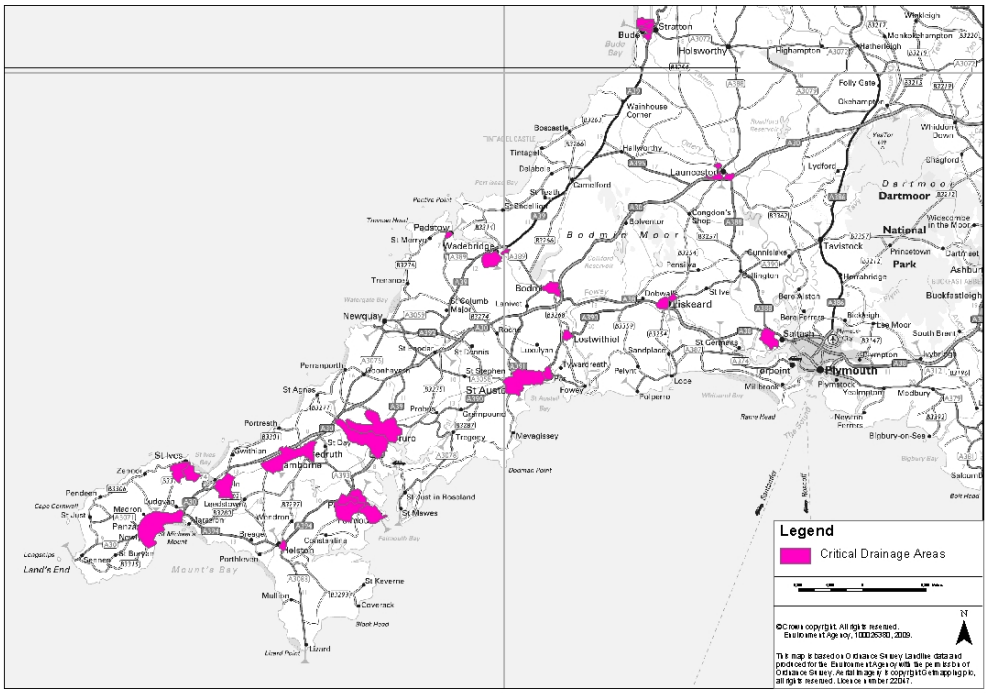
- CPIR - Camborne, Pool, Illogan, Redruth
- Truro - River Tinney

Critical Drainage Areas – *without SWMP (August 2009*)

East
- Bodmin
- Bude
- Flexbury
- Launceston
- Liskeard - Moorswater
- Liskeard - North
- Padstow
- Saltash - Latchbrook Stream
- Wadebridge

Central
- Falmouth and Penryn
- Lostwithiel
- St Austell
- St Blazey
- Truro - Kenwyn, Allen, Tregolls Rd

West
- Hayle
- Helston
- Penzance
- St Ives and Carbis Bay



Appendix P
Consultation Matrix

The consultation matrix indicates the drainage standards we expect to see achieved and those applications that the Environment Agency wishes to be consulted on.

The consultation Matrix indicates the Environment Agency's requirements for taking surface water drainage into account developments in developments in Critical Drainage Areas. It should be noted that this is being piloted in Cornwall and this Matrix maybe subject to change, in which case revised Guidance will be issued.

Notes to the Surface Water Drainage Consultation Matrix

1. Climate Change - All drainage designs must take into account the relevant increase in rainfall allowances given in Table B.2 of PPS25, see Appendix D. In addition to the summarised standards, all applications should evaluate exceedance events and flow routes.

2. Development in Critical Drainage Areas should contribute to sustainable communities by reducing existing drainage problems. Therefore in Critical Drainage Areas the standards go beyond the general expectation in PPS25 to match *pre-development* run-off rates.

3. Non-infiltration drainage options should generally only be considered where the FRA demonstrates infiltration is not achievable as per the drainage hierarchy of the 2002 amendment of the Building Regulations, Approved Document H – *Drainage and waste disposal*. An exception to this may be where alternative SUDS are shown to be more sustainable option or where discharge is directly to coastal waters. In these instances an assessment should be undertaken of the impact/benefit of the proposed system.

4. Rectifying historic bad practice through redevelopment has the potential to reduce flood risk. However there are constraints on, but an expectation to deliver development on previously developed sites. Therefore the standards for previously developed sites in Critical Drainage Areas seek betterment to the existing drainage system by utilising infiltration or restricting run-off to theoretical greenfield rates.

5. There are currently Surface Water Management Plans for the Truro and Camborne, Pool, Illogan and Redruth (CPIR) areas.

Surface Water Drainage Consultation Matrix [1]

Version 2 August 2009

Development Type	Surface Water Management Plan (SWMP) [5]	Site is within Critical Drainage Area [2]			Site is outside of Critical Drainage Area
		1. No FRA or inappropriate FRA submitted	2. FRA shows Piped or Positive Drainage [3]	3. FRA shows Infiltration Drainage	
A a. Householder development or alteration b. Non-residential extension less than 250m^2 c. Change of use	Refer to SWMP for guidance and requirements.	Refer to 'Best Practice' recommendations in Appendix B and Flood Risk Standing Advice (FRSA) rows 2-4 at: www.environment-agency.gov.uk			Refer to 'Best Practice' recommendations in Appendix B and Flood Risk Standing Advice (FRSA) at: www.environment-agency.gov.uk
B Development of 1 to 3 dwellings	Refer to SWMP for guidance and requirements. Consult the EA as required.	PPS25 states that an FRA is required where proposed development is in area where the EA have indicated there may be drainage problems. Where an application has no FRA or the FRA does not adequately address the drainage of the site the application should not be considered as complete.	B2 Run-off is restricted to 1.5 litres/second per dwelling	B3 Infiltration is designed for minimum 30 year rainfall events. See FRSA (row 5) at: www.environment-agency.gov.uk	
Operational development less than 1 hectare C Previously developed site [4]			C2 Consult EA with FRA	C3 Infiltration is designed for minimum 30 year rainfall event, with control upto 100 year.	
Operational development less than 1 hectare D Greenfield site			D2 Consult EA with FRA	D3 Infiltration is designed for minimum 30 year rainfall event, with control upto 100 year.	
E Operational development of 1 hectare or greater		Object - no FRA see FRSA at: www.environment-agency.gov.uk	E2 Previously developed site [4] Consult EA with FRA		E4 Consult EA with FRA
			E3 Greenfield site Consult EA with FRA		