

Figure 1

Description of Zone		Use within the precautionary framework
Considered to be at little or no risk of fluvial or tidal/coastal flooding.	A	Used to indicate that justification test is not applicable and no need to consider flood risk further.
Areas known to have been flooded in the past evidenced by sedimentary deposits.	B	Used as part of a precautionary approach to indicate where site levels should be checked against the extreme (0.1%) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further.
Based on Environment Agency extreme flood outline, equal to or greater than 0.1% (river, tidal or coastal)	C	Used to indicate that flooding issues should be considered as an integral part of decision making by the application of the justification test including assessment of consequences.
Areas of the floodplain which are developed and served by significant infrastructure, including flood defences.	C1	Used to indicate that development can take place subject to application of justification test, including acceptability of consequences.
Areas of the floodplain without significant flood defence infrastructure.	C2	Used to indicate that only less vulnerable development should be considered subject to application of justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered.

Figure 2

Development category	Types
Emergency services	hospitals, ambulance stations, fire stations, police stations, coastguard stations, command centres, emergency depots and buildings used to provide emergency shelter in time of flood
Highly vulnerable development	all residential premises (including hotels and caravan parks), public buildings (e.g. schools, libraries, leisure centres), especially vulnerable industrial development (e.g. power stations, chemical plants, incinerators), and waste disposal sites
Less vulnerable development	General industrial, employment, commercial and retail development, transport and utilities infrastructure, car parks, mineral extraction sites and associated processing facilities, excluding waste disposal sites

Summary of Policy Requirements

DAM	Development Type (Section 5)	Planning Requirements (Section 4)	Acceptability Criteria (Section 7 & Appendix 1)	Development Advice (Section 5, 6, 7 & Appendix 1)
A	Emergency services Highly vulnerable development Less vulnerable development Other	- Justification test not applicable - Refer to surface water requirements	No increase in flooding elsewhere	No constraints relating to river or coastal flooding, other than to avoid increasing risk elsewhere.
B	Emergency services	- If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further. - Refer to surface water requirements	- Acceptable consequences for nature of use - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Generally suitable for most forms of development. Assessments, where required, are unlikely to identify consequences that cannot be overcome or managed to an acceptable level. It is unlikely, therefore, that these would result in a refusal of planning consent on the grounds of flooding.
	Highly vulnerable development		- Acceptable consequences for nature of use - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - No increase in flooding elsewhere	
	Less vulnerable development		- Occupiers aware of flood risk - No increase in flooding elsewhere	
	Other	Refer to surface water requirements	No increase in flooding elsewhere	
C1	Emergency services Highly vulnerable development Less vulnerable development	- Application of justification test (section 6), including acceptability of consequences (section 7 and appendix 1) - Refer to surface water requirements	- Acceptable consequences for nature of use - Flood defences adequate - Agreement for construction and maintenance costs secured - Occupiers aware of flood risk - Escape/evacuation routes present - Effective flood warning provided - Flood emergency plans and procedures - Flood resistant design - No increase in flooding elsewhere	Plan allocations and applications for all development can only proceed subject to justification in accordance with section 6 and acceptability of consequences in accordance with section 7 and Appendix 1.
	Other	- Application of acceptability of consequences (section 7 and appendix 1) - Refer to surface water requirements	- Acceptable consequences for nature of use - Occupiers aware of flood risk - Desirable if effective flood warning and evacuation routes/procedure provided depending on nature of proposal - No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix 1.

DAM	Development Type (Section 5)	Planning Requirements (Section 4)	Acceptability Criteria (Section 7 & Appendix 1)	Development Advice (Section 5, 6, 7 & Appendix 1)
C2	Emergency services Highly vulnerable development	The flooding consequences associated with Emergency Services and highly vulnerable development are not considered to be acceptable. Plan allocations should not be made for such development and planning applications not proposed.		
	Less vulnerable development	• Application of justification test (section 6) , including acceptability of consequences (section 7 and appendix 1) • Refer to surface water requirements	• Acceptable consequences for nature of use • Flood defences adequate • Agreement for construction and maintenance costs secured • Occupiers aware of flood risk • Escape/evacuation routes present • Effective flood warning provided • Flood emergency plans and procedures	Plan allocations or applications for less vulnerable development can only proceed subject to justification in accordance with section 6 and acceptability of consequences in accordance with section 7 and Appendix 1.
	Other	• Application of acceptability of consequences (section 7 and appendix 1) • Refer to surface water requirements	• Flood resistant design • No increase in flooding elsewhere • Acceptable consequences for nature of use • Occupiers aware of flood risk • Effective flood warning provided • No increase in flooding elsewhere	Plan allocations and applications for development should only be made if considered acceptable in accordance with section 7 and Appendix

3. Standards

Standard S1 – Surface water runoff destination

This Standard addresses the use of surface water by the development and where it should be discharged. The aim is to ensure that runoff is treated as a resource and managed in a way that minimises negative impact of the development on flood risk, the morphology and water quality of receiving waters and the associated ecology. This will ensure that early consideration is given to the use of rainwater harvesting systems to both manage runoff and deliver a source of non-potable water for the site where practical. Where it is not, prioritisation should be given to infiltration. Discharges to sewerage systems must be limited where possible.

S1 Surface water runoff destination

Priority Level 1: Surface water runoff is collected for use;

Priority Level 2: Surface water runoff is infiltrated to ground;

Priority Level 3: Surface water runoff is discharged to a surface water body;

Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or another drainage system;

Priority Level 5: Surface water runoff is discharged to a combined sewer.

Note that Priority Levels 1 is the preferred (highest priority) and that 4 and 5 should only be used in exceptional circumstances.

Guidance on Standard S1 – Surface water runoff destination

G1.1 As much of the runoff as possible (subject to technical or cost constraints) should be discharged to each destination before a lower priority destination (level) is considered.

G1.2 Depending on the site characteristics, drainage from different parts of the site could have different drainage destinations.

Sustainable Drainage Systems Standards for Wales

G1.3 Depending on the quantity of runoff and the potential for a particular destination to manage that runoff, small events may discharge to a higher level while larger events may need to make use of lower priority destinations.

Level 1 – Rainwater collected for use

G1.4 Water is a valuable resource and rainwater should be collected (harvested) for non-potable use where practicable. This not only reduces potable water demand, but it can also reduce the volume of surface water runoff requiring disposal. One or more of the following **exception criteria** needs to be demonstrated if rainwater harvesting (RWH) is not used:

- There is no foreseeable demand for non-potable water on the site throughout its design life;
- There is no foreseeable need to harvest water at the site as the relevant water undertaker's water resources and drought management plans do not identify potential stresses on mains water supplies;
- The use of rainwater harvesting is not a viable/ cost-effective part of the solution for managing surface water runoff on the site, taking account of the potential water supply benefits of such a system.

G1.5 Rainwater harvesting tanks can be sized for capturing the runoff from large rainfall events as well as water supply. The design of rainwater harvesting systems for management of large events should be in accordance with BS 8515 appendix A (2009, revision 2013)⁶. This can contribute to a significant reduction in runoff volume, helping to meet the requirements of volume control of runoff (Standard S2).

G1.6 In most cases, rainwater harvesting alone will not be adequate to deal with the site drainage and provision will be required for an overflow to a Level 2 or lower priority destination.

G1.7 RWH systems, whether designed for water supply or surface water management as well, will contribute effectively to meeting the criterion on Interception (Standard S2).

Level 2 – Discharge of surface water into the ground

G1.8 Surface runoff not collected for use in accordance with Level 1 should be discharged by infiltration (a process that allows water to percolate into the ground) to the maximum extent possible at any location across the site. A lower priority destination should only be used for any residual runoff that cannot be

⁶ <http://shop.bsigroup.com/ProductDetail/?pid=000000000030260364>

Sustainable Drainage Systems Standards for Wales

served by infiltration provided one or more of the following **exception criteria** can be demonstrated:

- **Permeability:** the use of infiltration drainage is not practicable due to the lack of permeability of the soil for disposing of runoff;
- **Ground Instability:** the use of infiltration drainage would result in a risk of instability through ground movement or subsidence;
- **Pollution of groundwater or receiving surface waters:** the use of infiltration drainage would pose an unacceptable risk of pollution of groundwater or surface water bodies:
 - as a result of existing contaminants on the site being mobilised; or
 - as a result of activities in the area draining to the infiltration device (for example an area where there is the storage or handling of chemicals or fuels); or
 - as a result of the sensitivity of the groundwater or surface waterbody;
- **Groundwater flooding:** the use of infiltration drainage would result in an unacceptable risk of flooding from groundwater;
- **Infiltration into a combined sewer:** the use of infiltration may cause ingress of flow into a combined sewer which might result in an increased risk of flooding or pollution on the site or downstream.

G1.9 Guidance on meeting the exception criteria is provided in the clauses below.

G1.10 Infiltration systems can be designed for any scale of event and any size of runoff area. The larger the event or contributing area, the larger the required storage volume and/or infiltration area will be. The optimum size will depend on the rate of infiltration, the space available and cost of storage, and the feasibility and costs associated with managing events larger than that for which the system is designed.

G1.11 The infiltration component should discharge from full to half-full within a reasonable time so that the risk of it not being able to manage a subsequent rainfall event is minimised. Where components are designed to manage the 1 in 10 year or 1 in 30 year event, it is usual to specify that half emptying occurs within 24 hours. If components are designed to infiltrate events greater than the 1 in 30 year event, designing to half empty in 24 hours can result in very large storage requirements and, with agreement from the drainage approving body, it may be appropriate to allow longer half emptying times. This decision should be

Sustainable Drainage Systems Standards for Wales

based on an assessment of the performance of the system and the risk and consequences of consecutive rainfall events occurring.

G1.12 Drainage design should always aim to infiltrate as much runoff as is safe and practicable.

G1.13 A large site may have a range of soil characteristics. Infiltration should be utilised to the greatest extent possible in each area.

G1.14 Guidance on designing an infiltration system is provided in the SuDS Manual CIRIA C697⁷.

Infiltration Rates

G1.15 Disposal of significant events using solutions such as soakaway units or infiltration basins usually requires infiltration rates of the order of 1×10^{-5} m/s or higher. However, effective infiltration can be achieved with lower rates under units such as permeable pavements due to the large storage and infiltrating surface area available and the removal of sediment which would otherwise blind the infiltration surface.

G1.16 Geological and hydrological mapping and data at the British Geological Survey⁸ can provide an indication of infiltration potential, based on the characteristics of the soil layers. However site inspection, testing, trial pits and boreholes should be used to determine the site characteristics used in the drainage design.

G1.17 In order to account for both uncertainties over soil infiltration rates and their possible reduction in performance over time, and the consequence of inadequate performance, a factor of safety should be used in sizing the infiltration unit or assessing its performance. This is set out in Table G1.1.

⁷ https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

⁸ <http://www.bgs.ac.uk/products/hydrogeology/infiltrationSuds.html>

Sustainable Drainage Systems Standards for Wales

Table G1.1 Suggested factors of safety for use for hydraulic design of infiltration systems

Size of area to be drained	Consequences of failure		
	No damage or inconvenience	Minor inconvenience (e.g. surface water on car parking)	Damage to buildings or structures, or major inconvenience (e.g. flooding of roads)
< 100m ²	1.5	2	10
100-1000m ²	1.5	3	10
>1000m ²	1.5	5	10

Ground Instability

G1.18 Geotechnical investigations may be required to ensure that the ground conditions are suitable for infiltrating surface water runoff. The frequent discharge of water into the soil can change the soil characteristics, either chemically or structurally, and the suitability of infiltration may be limited or not appropriate even when stabilisation techniques are used.

G1.19 Where infiltration systems lie beneath trafficked surfaces, consideration should be given to structural loading and any likely weakening of the soil due to saturation. Where the soil structural strength may be compromised, the pavement layers should be designed to carry the traffic loads, or infiltration avoided by using an appropriate lining.

G1.20 Where runoff is discharged into the infiltration system or natural infiltration processes are being significantly enhanced within 5m of an existing or proposed building or buildings, the risk of building instability should be assessed by a geotechnical engineer and appropriate mitigation provided. If the risk cannot be effectively mitigated then infiltration should be avoided or be located a minimum of 5m from a building or buildings or such a distance agreed by the geotechnical engineer.

G1.21 Diffuse infiltration at or near the surface using permeable surfaces (or other similar approaches taking direct rainfall or very small catchments with a similar area to the infiltration surface) close to the building should not normally pose a risk to the structure. Any such proposals within 3 metres of a building should be assessed by a geotechnical engineer.

G1.22 Under some circumstances, the infiltration of water into soils (including superficial deposits and bedrock geology) can have serious implications for the stability of slopes. An assessment of potential risks should be made in accordance with *Planning Policy Wales*⁹ guidance on dealing with unstable and

⁹ <http://wales.gov.uk/topics/planning/policy/ppw/?lang=en>

Sustainable Drainage Systems Standards for Wales

contaminated land and infiltration ruled out where the risks are considered significant. A checklist for considering site suitability for infiltration is available¹⁰.

G1.23 The assessment of collapsible deposits should consider potential geo-hazards such as shrinkage, swelling and dissolution of rocks. Sources of information include the British Geological Survey's GeoSure maps, which provide an indication of the relative susceptibility of an area to the six types of geohazards. Their GeoSure¹¹ national data sets and reports provide general geological information as well as information on geohazards and hydrogeological risks that can help planning decisions. GeoSure data gives information on:

- Compressible ground,
- Landslides (slope instability),
- Running sand,
- Shrinkage or swelling,
- Soluble rocks (dissolution).

G1.24 A report should be provided giving details of geo-hazards where ground stability is an issue.

G1.25 The local authority may request an accompanying ground investigation to determine if the geological deposits are susceptible to these hazards and possible causes. Testing should follow the procedures set out in Eurocode 7 Part 2 and BS5930¹².

Pollution of groundwater or receiving surface waters

G1.26 The use of infiltration systems should not be discounted simply because the site is or was contaminated. Where possible, remediation strategies should be developed in conjunction with drainage system design to allow the safe use of infiltration where this is practicable. Regard needs to be given to the cost effectiveness of using infiltration drainage in this situation in comparison to alternative SuDS options.

G1.27 Infiltration systems are suitable in contaminated sites where:

¹⁰ CLG Development on unstable Land Annex2: Subsidence and planning
<http://webarchive.nationalarchives.gov.uk/20120919132719/http://www.communities.gov.uk/documents/planningandbuilding/pdf/147474.pdf>

¹¹ <http://www.bgs.ac.uk/products/geosure/>

¹² <http://shop.bsigroup.com/ProductDetail/?pid=00000000030238211>

Sustainable Drainage Systems Standards for Wales

- The infiltration surfaces are located in areas that are either not contaminated and consequently require no remediation based on risk assessment or have been appropriately remediated.¹³
- The infiltration can take place in isolation from the contaminated layer.

G1.28 Infiltration to ground should only occur if the surface water has been suitably treated considering the degree of contamination of the surface water runoff and the groundwater category (see Standard S3).

Groundwater flooding

G1.29 An assessment should be undertaken of the potential effect of infiltration on groundwater levels local to any infiltration component and the potential wider impact of multiple infiltration components within the site, with respect to groundwater flood risk. The use of infiltration for steep sites can increase the risk of springs developing lower down the slope in layered geology/steep topography.

Infiltration into combined sewers increasing the flood or pollution risk

G1.30 Where a proposed infiltration system is located in the vicinity of a foul or combined sewer which is susceptible to infiltration (as a result of its level, location and structural condition), and there is considered to be an enhanced risk of pollution or flood risk as a result, then consideration should be given as to the most appropriate mitigation action to take. This may be to reduce or avoid the use of infiltration at that location, or for the sewerage undertaker to address the structural state of the sewer.

Level 3 – Discharge to a surface water body

G1.31 Surface runoff not collected for use in accordance with Level 1 or discharged to ground in accordance with Level 2 should be discharged to a receiving surface water body. A lower priority destination should only be used provided one or more of the following **exception criteria** can be shown to apply:

- **Access:** It is not reasonably practicable to convey the surface runoff to the water body – See Box 1 for further guidance;
- **Drainage by use of pumps:** Discharge to a surface water body would require the use of pumping, and discharge to a lower level destination would not require pumping and could be delivered more cost-effectively.– see Box 2 for further guidance;

¹³ The risk assessment should be supplied to the local authority and follow recognised groundwater risk assessment procedures

Sustainable Drainage Systems Standards for Wales

- **Increase in flood risk:** The discharge would result in an unacceptable increase in the risk of flooding – see Box 3 for further guidance.

Box 1 Access

B1.1 Where drainage is to pass to any downstream system, the applicant should agree acceptable flow conditions with those responsible for the downstream systems.

B1.2 Considerations that could make a conveyance route to the receiving water body not reasonably practicable include:

- **Distance:** Taking into account the size of the development, where the distance from the nearest point in the site to the surface water body, or an existing non-piped drainage system is significantly greater than the distance to a sewer and the connection would be significantly more expensive;
- **Inappropriate or inadequate access:** for construction, operation or maintenance purposes, including right of access, which cannot be overcome or mitigated;
- **Health and safety risks** associated with construction, operation or maintenance activities (which can be avoided by the use of a lower priority Standard) are unacceptable;
- **Inadequate** protection for the conveyance system due to land use along the drainage route (avoidable by using a lower priority Standard).

B1.3 Where the site is not adjacent to the receiving surface water body, access to the intervening land will be required. The proposals must therefore be acceptable to neighbours and landowners affected by the construction and operation of the scheme. The right to discharge to the proposed receiving surface water body should be agreed with the riparian owners at the point of discharge. Where land ownership is an issue, the local authority will need evidence that any necessary easements are in place before agreeing the drainage proposal. Where a developer cannot obtain the right to discharge, the local authority may be able to obtain such a right through its powers under paragraph 29(1) of Schedule 1 of the Flood and Water Management Act 2010. These allow it to construct and maintain new works for the purpose of flood risk management.

Sustainable Drainage Systems Standards for Wales

Box 2 - Pumping requirements

B2.1 Because of the ongoing energy and maintenance requirements of pumping water and the risks associated with failure, pumping should be avoided where possible.

B2.2 The need for pumping may mean that discharge to a surface water body is not the right solution for the site, and a lower priority destination should be used instead. However, an assessment should be undertaken to establish which solution could be delivered more cost-effectively, taking account of all enhanced flooding and pollution risks, and risks associated with pump failure or poor performance.

B2.3 Pumping should only be used for parts of the site that cannot be drained by gravity. Pumping to a surface water body or lower priority destinations can only take place where it can be demonstrated that there is the capacity to accept the flow rates proposed.

B2.4 Where pumping of surface water has to take place, and the drainage system is to be adopted (and not privately owned), the developer should ensure that the adopting organisation has agreed in principle to adopt a pumping station, before putting in the planning application. Pumping stations should be designed and built to the standards set out in Sewers for Adoption 7 unless an alternative requirement is agreed with by the proposed adoption organisation.

B2.5 Where the downstream drainage system has a pumping station, the developer will need to demonstrate that adequate capacity is available.

Sustainable Drainage Systems Standards for Wales

Box 3 - Increased risk of flooding

B3.1 The design of any off-site drainage system should demonstrate that the scheme does not adversely affect off-site flood risk. This includes the receiving surface water body and any location between the site and the outfall.

B3.2 A discharge to a surface water sewer, highways drain or combined sewer may be considered if the risk of flooding associated with the receiving surface water body is so high that surface water discharges from the development site at any reasonable rate of flow are disallowed and the following conditions are met:

- there is no alternative water body to which part or all of the discharge can be made; and
- full account has been taken of on-site attenuation or multiple component systems to restrict storm discharges; and
- there is no equivalent increase in flood risk from the drainage system or the receiving water into which it discharges; and
- the owners of the receiving drainage systems agree.

B3.3 Relevant local guidance, including the Local Flood Risk Management Strategy should be examined for the acceptability of discharging to the proposed water body.

Sustainable Drainage Systems Standards for Wales

Level 4 – Discharge to a surface water sewer or highway drain

G1.32 Surface runoff not collected for use in accordance with Level 1 or discharged to ground in accordance with Level 2 should be discharged to a receiving surface water body. If this is not possible and the exception criteria under level 3 are met, the runoff may be discharged to a surface water sewer or a highway drain. A lower priority Standard should only be used if one or more of the following **exception criteria** can be shown to apply:

- **Access:** It is not reasonably practicable to convey the surface runoff to a surface water sewer or highway drainage system – See G1.33 for further guidance;
- **Drainage by use of pumps:** If it is not possible to discharge the surface water to a surface water sewer or highway drainage system without the use of pumping – see Box 2 for guidance ;

Increase in flood risk: The discharge would result in an unacceptable increase in the risk of flooding – see Box 3 for guidance

G1.33 Any connection to a sewer may require both a Water Industry Act 1991 Section 104 (adoption) and Section 106 (Connection) agreements from the sewerage undertaker.

Level 5 – Discharge to a combined sewer

G1.34 There is a strong presumption against a discharge to combined sewer. It is the least preferred option, because of the water quality problems that may be caused by sewerage flooding and/or increased discharges from Combined Sewer Overflows to surface water bodies.

G1.35 Surface runoff not discharged in accordance with Levels 1 to 4 may be discharged to a public combined sewer with the agreement of the sewerage undertaker; providing it has capacity to accommodate the additional flows and that the requirements set out in the clauses below are met.

G1.36 For the purposes of this Standard, a combined sewer is a sewer intended to receive both foul sewage and surface runoff and does not include a sewer intended to receive only foul sewage, even if it has the capacity to accommodate additional flows, or has an element of surface water in it already. It is not permissible to connect surface water runoff to a foul sewer.

G1.37 The risks associated with surface water runoff entering the combined sewer and resultant possible pollution from backflow or surcharge should be guarded against, including consideration of the use of non-return valves at appropriate locations.

Sustainable Drainage Systems Standards for Wales

G1.38 Provision should be made for separation and removal of sediments and oils before connection to a combined sewer.

G1.39 The possibility of the developer funding disconnection of surface water entering the combined sewer at locations either upstream or downstream of the site connection should be investigated with the sewerage undertaker and the local authority to mitigate the impact of the runoff into the sewer from the development.

Standard S2 – Surface water runoff hydraulic control

The aim of Standard S2 is to manage the surface water runoff from and on a site to protect people on the site from flooding from the drainage system for events up to a suitable return period, to mitigate any increased flood risk to people and property downstream of the site as a result of the development, and to protect the receiving water body from morphological damage.

S2 Surface water runoff hydraulic control

- 1) Surface water should be managed to prevent, so far as possible, any discharge from the site for the majority of rainfall events of less than 5mm.
- 2) The surface water runoff rate for the 1 in 1 year return period event (or agreed equivalent) should be controlled to help mitigate the negative impacts of the development runoff on the morphology and associated ecology of the receiving surface water bodies.
- 3) The surface water runoff (rate and volume) for the 1% (1 in 100 year) return period event (or agreed equivalent) should be controlled to help mitigate negative impacts of the development on flood risk in the receiving water body.
- 4) The surface water runoff for events up to the 1% (1 in 100 year) return period (or agreed equivalent) should be managed to protect people and property on and adjacent to the site from flooding from the drainage system.
- 5) The risks (both on site and off site) associated with the surface water runoff for events greater than the 1% (1 in 100 year) return period should be considered. Where the consequences are excessive in terms of social disruption, damage or risk to life, mitigating proposals should be developed to reduce these impacts.
- 6) Drainage design proposals should be examined for the likelihood and consequences of any potential failure scenarios (e.g. structural failure or

Sustainable Drainage Systems Standards for Wales

blockage), and the associated flood risks managed where possible.

Guidance on Standard S2 - Surface water runoff hydraulic control

G2.1 This Standard applies to discharges to surface water bodies, surface water sewers or combined sewerage systems. However where the surface water body is unaffected by either the discharge rate or volume of runoff (e.g. an estuary, the sea or a water body identified in the Local Flood Risk Management Strategy (LFRMS) as not needing hydraulic control of runoff to it), the hydraulic management control requirements are limited to the drainage service provisions for the site and adjacent areas that could be affected by the performance of the drainage system.

G2.2 Where a LFRMS sets out an approach to managing surface water runoff from developments (defining specific discharge controls for the location of development) which stipulates more stringent requirements than this Standard, the requirements of the LFRMS take precedence.

G2.3 The status of the receiving water may influence the regulatory requirements of the site discharge rate or volume requirements. Agreement on the discharge limits and the right to discharge should be obtained from the responsible body and/or the landowner.

G2.4 Where discharges are made to a sewer or highway drain, agreement of the discharge limits will need to be made with the owner (Local authority, Water company etc.) as they may require more onerous constraints to be applied.

G2.5 Consideration should be given to likely future pressures on the site drainage system in accordance with current guidance, such as increasing intensity of rainfall due to climate change, and increasing impervious surface area due to urban creep.

G2.6 Drainage solutions should take into account historical information on all forms of flooding and ground water levels during extended wet periods.

G2.7 A suitable model should be used to design the drainage system to a level of detail which effectively represents the conveyance and storage of the drainage system and is able to demonstrate its performance for all relevant hydrological conditions. An appropriate runoff model should be used which predicts the impervious and pervious area response appropriate for the rainfall event being used.

Sustainable Drainage Systems Standards for Wales

G2.8 Attenuation storage is likely to be required to limit discharge of runoff from the site. There should be a presumption for the use of surface storage features in preference to underground systems as they tend to be more adaptable and can also provide partial treatment and other benefits. Permeable pavements can be regarded as surface storage in this context.

G2.9 In determining the maximum water levels, flows and attenuation storage volumes, the critical duration rainfall event should be determined. Note that different critical durations may apply to different storage elements used on a site.

G2.10 Where the risk of blockage of flow control structures in meeting the limiting discharge requirements is considered to be significant, appropriate protective measures should be implemented or the proposals modified.

Interception of runoff

G2.11 When rainfall takes place on greenfield sites there is, for the majority of rainfall events during the year, no discernible surface water runoff to receiving water bodies. The rainwater normally evapotranspires, or in winter it can result in river base flow replenishment and/or groundwater recharge. However, impermeable surfaces generate runoff from virtually all rainfall events, and this change in runoff characteristics can have a negative impact on the morphology and ecology of receiving water bodies. Interception aims to mimic greenfield runoff conditions.

G2.12 The overall pollution load from site runoff is closely linked to the total volume of runoff. Therefore prevention of runoff from the majority of all small rainfall events and reducing runoff volume from larger events can contribute effectively to reducing the pollution load to receiving surface water bodies. This is particularly important in the summer, when diluting flows in receiving watercourses are often low.

G2.13 Meeting the Interception criterion is not expected during particularly wet periods when permeable surfaces and subsoils are saturated, so it is more appropriate to set compliance requirements on a probabilistic basis (i.e. Interception should be delivered for a proportion of all events, either per season or on an annual basis). A suggested target is that 80% compliance should be achieved during the summer and 50% in winter.

G2.14 Interception mechanisms are based on runoff volume reduction using rainwater harvesting, evapotranspiration and infiltration processes. Infiltration rates of soils can be marginal (in terms of their use for infiltration system design for large events), but they can be extremely effective at providing Interception. This reinforces the importance of vegetative and soil based SuDS components being used.

Sustainable Drainage Systems Standards for Wales

G2.15 For smaller sites, a simplified approach to delivering Interception can be used based on assumed compliance of various drainage components. See Table G2.1 for details of these assumptions.

G2.16 The use of continuous rainfall series with detailed simulation models which model infiltration and evapotranspiration can also be used to demonstrate the effectiveness of any design for meeting Interception requirements.

Table G2.1 Interception mechanisms with assumed compliance

Systems	Interception methods that can be assumed to be compliant for zero runoff for the first 5mm rainfall for 80% of events during the summer and 50% in winter *.
Green roofs	All surfaces that have green roofs.
Rainwater harvesting systems	All surfaces drained to rainwater harvesting systems designed to BS 8515, whether for surface water management or just water supply, provided the RWH system design is based on regular daily demand for non-potable water from surface water runoff.
Soakaway/ infiltration systems	Areas of the site drained to systems that are designed to infiltrate runoff for events greater than a 1 month return period. Note: design of the infiltration system should be in accordance with the SuDS manual, RP 156 or BRE 365 or any other appropriate recognised approach.
Permeable surfaces	All permeable surfaces, whether lined or not, can be assumed to comply provided there is no additional area drained to the permeable pavement. Where the surface also drains an adjacent impermeable area, compliance can be assumed for all soil types where the system is unlined as long as the additional paved area is no greater than the permeable area. Where the infiltration capacity of the ground below the permeable surface is greater than $1 \times 10^{-6} \text{m/s}$, up to 5 times the permeable surface area can be added as additional contributing area. Where the permeable surface also drains an adjacent impermeable area and is lined, compliance cannot be deemed to have been achieved and additional downstream Interception components will be required (*).

Sustainable Drainage Systems Standards for Wales

Systems	Interception methods that can be assumed to be compliant for zero runoff for the first 5mm rainfall for 80% of events during the summer and 50% in winter *.
Swales	Roads drained by swales (even those which are lined - providing the linings are at least 500mm below the base of the swale), where the longitudinal gradient of the swale is less than 1:100, are suitable for Interception delivery for impermeable surface areas up to 5 times the base of the vegetated surface area receiving the runoff. Swales steeper than 1:100 cannot be deemed to provide Interception unless additional effective Interception design can be demonstrated. For areas other than roads, any swale which is unlined and has a gradient which is less than 1:100 and has an infiltration capability greater than 1×10^{-6} m/s can be assumed to comply with Interception for a contributing area up to 25 times the base of the swale. Interception cannot be deemed to have been provided for impermeable areas draining to a swale within 5m from the swale outlet, unless the swale is flat and has a slightly raised outlet to create a temporary storage zone to encourage infiltration before runoff takes place. Greater loading ratios can be achieved by providing flat swales with greater temporary storage and infiltration, but these require detailed design based on the use of appropriate continuous rainfall series.
Infiltration trenches	Roads drained by infiltration trenches can be considered to provide Interception.
Detention basins	Areas of the site drained to detention basins with a flat unlined base (without specific provision for routing low flows directly to the outlet) can be assumed to comply where the drained impermeable surface area is less than 5 times the vegetated surface area receiving the runoff for any soil type. The area of the basin that is assumed to contribute to interception of runoff should be below the outlet level of the basin.

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Detention basins (Continued)	Areas up to 25 times the base area of the basin can be assumed to meet interception requirements where infiltration rates are greater than 1×10^{-6} m/s. Higher loading ratios can be achieved where specific provision is made for water being stored below the outlet pipe and higher infiltration rates exist. Where a basin is designed to infiltrate runoff, specific provision should be made for the upstream control of sediments to minimise risks of waterlogging, high maintenance costs and reduced component amenity value.
Bioretention areas and rain gardens	Areas of the site drained to unlined bioretention components can be assumed to comply (*) where the impermeable surface area is less than 5 times the vegetated surface area receiving the runoff.
Ponds	Areas drained by ponds (with a permanent water pool is effectively maintained by the outlet structure) are assumed not to deliver Interception

** Where individual components do not provide sufficient Interception for the area draining to them, Interception capacity can also be provided by downstream components. Detailed calculations will be needed to demonstrate compliance in this case.*

Morphological protection of receiving surface water bodies

G2.17 A bank-full event for a stream or river tends to equate to about a 1:1 or 1:2 year event. By aiming to replicate greenfield runoff rates for this size of event, the receiving watercourse can be protected from erosion and the resulting morphological and ecological damage. For previously developed sites, site runoff rates should be reduced to the greenfield rates wherever possible.

G2.18 By limiting discharges to sewers (and surface waters), replicating the greenfield runoff rate will reduce the impact on downstream capacity. If discharging to a combined sewer, this also reduces the impact on CSO spills and downstream wastewater treatment works.

G2.19 The assessment of peak runoff rates from greenfield, previously developed and proposed development sites, and the design of attenuation storage systems is set out in the SuDS Manual¹⁴.

¹⁴ https://www.ciria.org/Resources/Free_publications/SuDS_manual_C753.aspx

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