Introduction

This section provides guidance on meeting the performance requirements for below ground foul and surface water drainage systems.

5.2.1 Compliance

Below ground drainage systems shall meet the performance requirements of this section.

5.2.2 Information to be provided

The Designer shall provide sufficient design details to demonstrate it meets the requirements of this section.

A full set of design drawings and specifications should be made available to the Warranty provider and all other interested parties prior to the associated works starting on site. This may include:

1. Position of soil stacks.
2. Location of foul drain connections and drainage runs.
3. Location of suitable outfall.
4. Proposed drainage layouts including invert levels, gradients, pipe diameters, location of inspection chambers and rodding points.
5. Where existing drains are retained, a CCTV survey will be required.
6. Position of any septic tank or packaged treatment plant in relation to adjacent buildings.
7. Where drainage fields are used, we would require:
    a. Details of their layout, including length and depth.
    b. Details of the trench width.
    c. Site investigation report confirming the ground is suitable for a drainage field.
    d. Results of percolation tests where treated effluent disposal is through a drainage field
8. Where soakaways are used, we require the following information:
    a. Location of the soakaway in relation to any adjacent buildings.
    b. Site investigation report confirming the ground is suitable for a soakaway.
    c. Details of an onsite percolation test confirming the permeability of the ground.
    d. Soakaway design to BRE 365.
9. Where rain gardens are specified, we require the following information:
    a. Location of the rain garden in relation to any adjacent buildings.
    b. Site investigation report confirming the ground is suitable for a rain garden.
    c. A design from a suitably qualified professional.

The Warranty surveyor, at their discretion, may also request supporting information that demonstrates suitability for use of any materials or systems contained within the above.

5.2.3 Material specification

Materials and components shall:

- Be durable.
- Be fit for purpose.
- Be installed in accordance with the manufacturer's recommendations.
- Satisfy the requirements of the relevant Building Regulations.
- Be constructed using non-hazardous materials.

Materials and components used for the below ground drainage system should be proven to be suitable for their intended purpose and comply with relevant parts of BS EN 12056 and BS EN 752. Material should be durable and suitable for use underground.

For further guidance on suitability of products, please refer to 'Appendix C'.

5.2.4 Outfalls

All below ground drainage systems shall connect to a suitable approved outfall.

Foul drainage

Foul drainage systems shall connect to a suitable approved outfall such as:

- A sewer maintained by the Local sewerage undertaker.
- A suitable private foul drainage/sewer system that leads to an adopted sewer. Connections to private foul drainage systems will require agreement of the owners of such drain/sewer.
- A septic tank or packaged treatment plant. The outfall from the septic tank should either run to a designed drainage field or a mound.

Surface water drainage

Surface water should drain into a suitable outfall, such as:

- A sewer maintained by the local sewerage undertaker.
- A suitable private sewer system that leads to an adopted sewer. Connections to private sewer systems will require agreement of the owners of such drain/sewer.
- A soakaway or other infiltration system if ground conditions and site location permit.
- A watercourse that has consent in writing from the appropriate regional agency; to allow or limit the rate of discharge. Consent from the EA, NIEA or LA means a clear confirmation in writing that they will allow discharge to the designated outfall for the period of Warranty cover.

Surface water drainage systems includes water from roofs, drives, paths and certain hard standing areas.

Drainage from impervious surfaces such as drives, paths and hard standings must drain to a suitable rain water drainage system or to a permeable area within the garden providing it is free draining.

Surface water drainage systems should generally be separated from foul drainage systems.

5.2.5 Drainage system design

All below ground drainage systems shall be designed to allow the unobstructed flow of foul and surface water.

The drainage system shall not adversely affect the structural stability of the building and shall prevent the entry of hazardous ground substances, external moisture or vermin.

Below ground drainage systems shall meet the requirements of the Building Regulations.

Laying of pipes and minimum gradients

- Pipes should be laid to an even gradient (see table 1 or 2), and significant changes in gradient should be combined with an access point.
- Pipes should be laid in straight lines, but may be laid to slight curves, providing the length of drain can be effectively cleaned by the use of rods.
- Connections should be to inspection chambers or manholes, but connections to junctions are acceptable if access is provided to clear blockages. In all cases, discharge should be in the direction of flow.
- Bends should be positioned in, or adjacent to, terminal fittings, inspection chambers or manholes, and at the foot of discharge stacks. Bends should have as large a radius as practicable.
- The system should be ventilated at or near the head of each main drain to allow free passage of air throughout; the maximum length of any branch serving a single appliance being 6m, and for a group of appliances, 12m.
- Where appliances are not fitted with integral traps at the point of discharge, a trap must be provided using either a trapped gully or low back trap.
- Where existing drains are retained, a CCTV survey will be required.

Table 1: Recommended minimum gradient of foul drains

Peak flow	Pipe size (diameter)	Minimum gradient	Maximum capacity
<1 litre/sec	75mm 100mm	1:40 1:40	4.1 litres/sec 9.2 litres/sec
> 1 litre/sec	75mm 100mm 150mm	1:80 1:80 [1] 1:150 [2]	2.8 litres/sec 6.3 litres/sec 15 litres/sec

Notes:
[1] Minimum of 1 WC
[2] Minimum of 5 WC's

Table 2: Minimum gradient of surface water drains

Pipe size (diameter)	Minimum gradient
100mm	1:80
150mm	1:150

For surface water drainage systems:

- Silt traps should be incorporated where hard standings are being drained into the surface water drainage system to avoid build-up of material in the underground drains.
- Oil interceptors should be should be installed on car parks, or other areas where there is likely to be leakage or spillage of oil.

Bedding and Backfill

Bedding

Pipes should be firmly supported throughout their length and bedded as specified in the design to resist loads from overlying fill and traffic.

Backfill

In normal circumstances, the excavated material from the trench will be appropriate for backfilling above the chosen material. General backfill materials must be free from:

- Boulders.
- Building rubble.
- Timber.
- Vegetable matter.

Backfill needs to be positioned in layers not deeper than 300mm, and must be well compacted. When compacted backfill is at least 450mm above the crown of the pipe, only mechanical compacting should be used.

Below ground drains should not be supported on ground or fill that is susceptible to movement without adequate provision being made to:

- Maintain minimum design gradients.
- Protect against backfall.
- Protect against leakage.

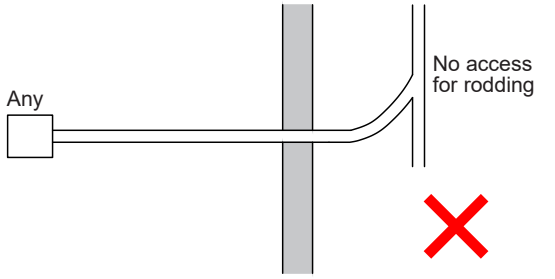
Bricks, blocks or other hard material should not be used as temporary or permanent supports for below ground drains.

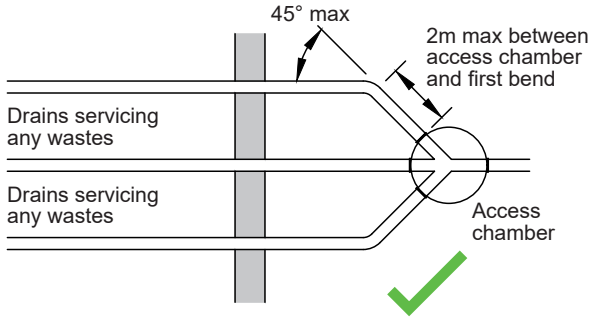
Junctions in drains under buildings

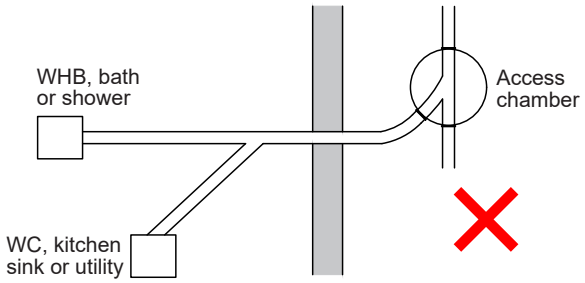
Drains under a building must be laid in straight runs – slight curves can be accepted, providing the length of the run can be effectively cleaned by the use of rods. Having junctions under a building makes it difficult to clear any blockages, however they can be accepted in some very limited circumstances.

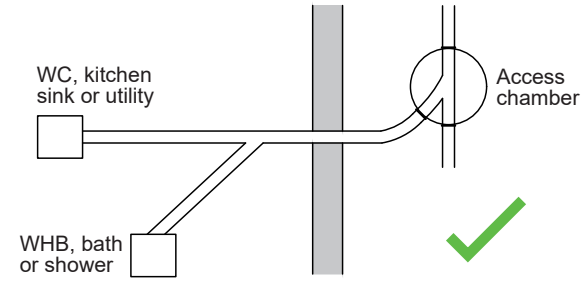
If junctions are used below a building, they should only be used in the following circumstances:

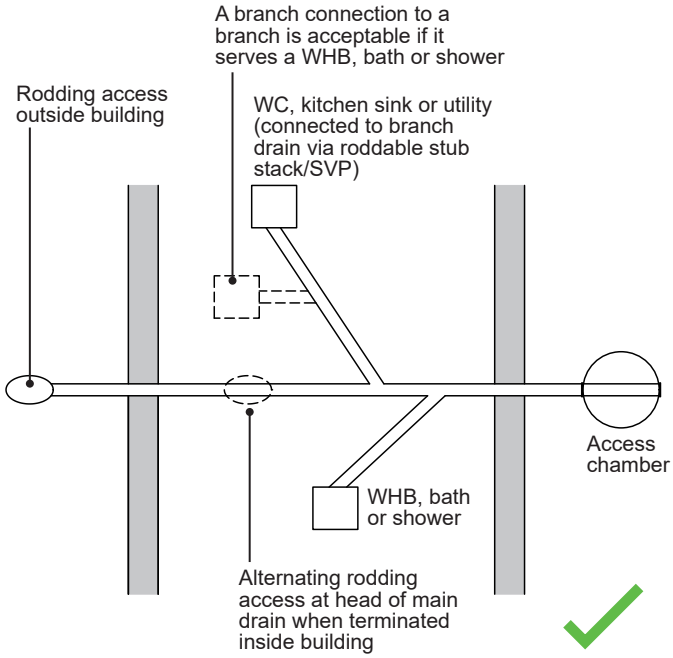
- Where the branch drain discharges lightly soiled waste such as a wash hand basin, shower or bath, a junction may be used to connect to another drain under the building.
- The main drain should extend the full length of the building and external rodding access is provided at both ends of the main drain (see diagram for further details).
- If this is not achievable, an alternative rodding access point can be provided of the head of the main drain which terminates inside the building.
- Branch drains carrying heavily soiled waste are provided with a roddable stub stack. This should not involve removing any sanitary fittings or boxing (so an access plate should be provided).











Access and connections

Suitable access must be provided to every length of drain to allow rodding access to deal with potential blockages.

Depending on the depth and position of the drain, one of the following should be provided:

- Rodding eye - capped extensions of pipes.
- Access chamber - small chambers on (or an extension of) the pipes but not with an open channel.
- Inspection chamber - chambers with working space at ground level.
- Manhole - deep chambers with working space at drain level.

The installation of access points must not impede the flow of waste and allow connections onto main runs to be in the direction of flow and not against it.

Access points must be provided:

- On or near the head of each drain run, **and**
- At a bend and change of gradient, **and**
- At junctions unless each run can be cleared from an access point (some junctions can only be rodded through from one direction).

Minimum dimensions for access fittings, inspection chambers and manholes can be referenced in the guidance supporting the relevant Building Regulations.

Inspection chambers and manholes should have removable non-ventilating covers of durable material (such as cast iron, cast or pressed steel, precast concrete or plastics) and be of a suitable strength for its location e.g. access points on driveways will require heavier duty covers than those in a garden.

Small lightweight covers should be secured to deter unauthorised access.

Access points within buildings should have mechanically fixed airtight covers.

Drainage system covers

Drainage system access point covers in hard standing areas should be level with the adjacent ground level.

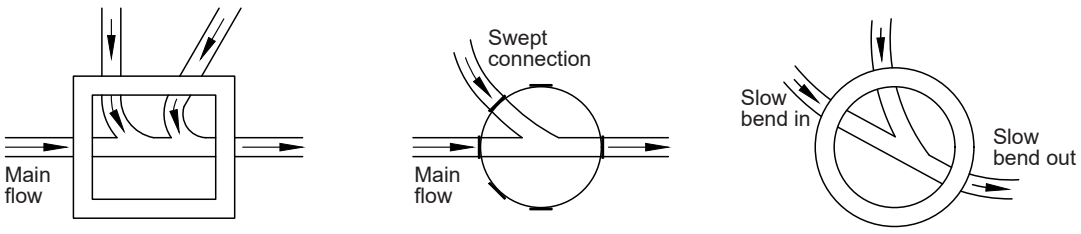
Access covers in garden areas should not be covered over by the soil/turf.

Construction of access points should be with one of the following materials and must be capable of containing the foul water under working and test conditions.

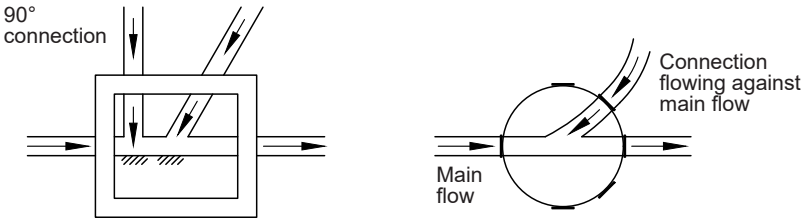
Materials for access points (inspection chambers and manholes)	British Standard
Clay bricks and blocks	BS 3921
Vitrified clay	BS EN 295, BS 65
Concrete - precast	BS 5911
Concrete - in-situ	BS 8110
Plastics	BS 7158

Rodding eyes and access fittings (excluding frames and covers) shall have an ETA or third party product conformity certificate.

Swept connections into flow of drains – Acceptable



Connections against flow of main drain - Not Acceptable



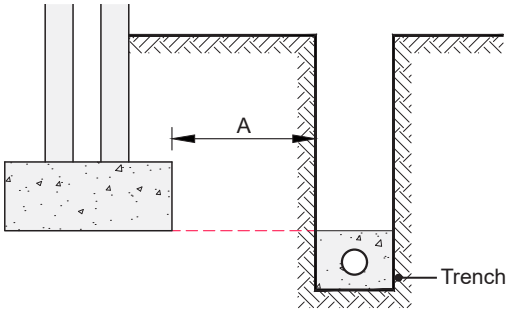
Protection of pipes and other components

Protection of pipes adjacent to foundations

Drains are to be located so that foundation loads are not transmitted to pipes. Where drainage trenches are located near to foundations, foundation depths should be increased or the drain re-routed further from the foundations.

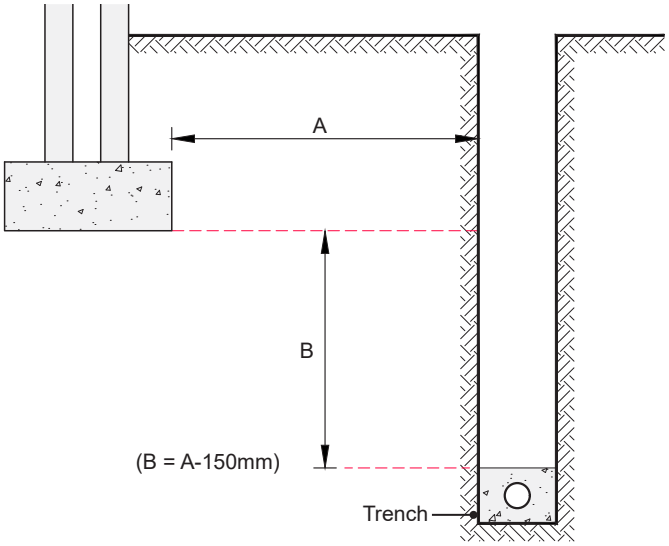
Where it is not physically practical to locate drains so they are not impacted by foundation loads, the pipes should be protected. Examples of how the pipes may be protected are given below:

Scenario 1 - where A is less than 1m



Where the trench is within 1m of the foundation, the trench is to be filled with concrete up to the lowest level of the foundation.

Scenario 2 - where A is 1m or greater



Where the trench is 1m or further from the foundation, the trench is to be filled with concrete up to measurement B as shown above.

Ground movement

Drainage trench excavations should be taken down to solid ground, but when this is not possible, the drainage system should be designed to accommodate any movement and made-up ground with a well-compacted backfill to the required formation levels.

Where ground movement is likely to occur, flexible drainage systems should be provided, e.g. filled sites, mining areas and sites with shrinkable clay.

Additional requirements for drains near trees

Drainage near trees should incorporate additional provisions where there is a volume change potential within the ground. Provisions include:

- Increased falls to cater for any ground movement.
- Deeper and wider backfill of granular material.
- A drainage system that is capable of movement should heave and shrinkage occur.
- Drainage pipes should not be encased in concrete.
- Additional clearance is required where drains pass through the structure of a building to allow for additional movement.

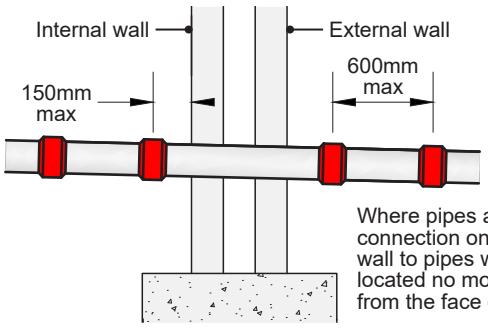
Where possible, avoid passing adjacent to tree roots. Adequate precautions should be taken where this cannot be avoided.

Drains and services passing through walls

Walls should accommodate movement where drains pass through substructure by:

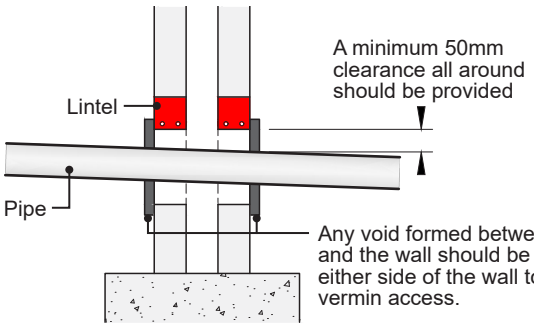
- Providing a minimum 50mm clearance all around or a sleeve with a 50mm clearance, **or**
- (If built in) A connection on both sides of the wall to pipes with flexible joints located no more than 150mm from the face of the wall.
- Any void formed between the pipe and the wall should be masked either side of the wall to prevent vermin access.

Flexible jointed pipes (rockers) either side of built in pipe



Where pipes are built-in, a connection on both sides of the wall to pipes with flexible joints located no more than 150mm from the face of the wall.

Lintel openings over pipes



Protection of pipes and other components during construction works

The drainage system, including manholes, gullies, pipe connections, etc. should be protected from damage throughout the course of the construction works.

Pumped systems

Pumped systems are acceptable where a gravity system is not possible. Pumped systems should be in accordance with BS EN 752 and BS EN 16932. Installations should include:

- A suitable warning system to indicate malfunction.
- A holding tank of sufficient volume to contain 24 hours of domestic effluent based on 120L/150L per head per day.

Pump chamber design

The pump chamber must be properly designed for the depth including any concrete backfill support to ensure loads from water pressure, parking and other external loads are fully catered for. The depth of the chamber must also be taken account in the design.

Testing

All foul and surface water drainage systems shall be adequately watertight and tested, where required by:

- The Warranty provider.
- The local authority.
- The sewerage undertaker.

Requirements for septic tanks systems

Suitable outfalls

Septic tanks require a suitable outfall for treated effluent discharge which should be agreed with the relevant authority. The outfall from the septic tank should either run to a designed drainage field or a mound.

Surface water/storm water should not discharge into the septic tank or water treatment plant and should be directed to a suitably designed soakaway or sewer.

Percolation drainage fields for treatment and outfall drainage plants should not be situated uphill of dwellings.

Percolation tests

Where the septic tank or treatment plant discharges to drainage field or mound, suitable percolation tests should be provided in conjunction with the drainage design. The test should be carried out with at least two trail holes. The average figure from the tests should be taken. The test should not be carried out during abnormal weather conditions such as heavy rain, severe frost or drought.

Location of septic tanks

Septic tanks should be sited at least 7m from any habitable parts of the building and downslope. Septic tanks should have a minimum capacity of at least 2,700 litres below the level of the inlet, for up to 4 users. The size should be increased by at least 180 litres for each additional user.

Where they are to be emptied using a tanker, the septic tank should be sited within 30m of a vehicle access provided that the invert access does not exceed 3m below the level of vehicle access. Where the depth of the invert access exceed 3m this distance may need to be reduced.

Where possible tanks should not be located beneath vehicle access points unless adequate precautions are undertaken.

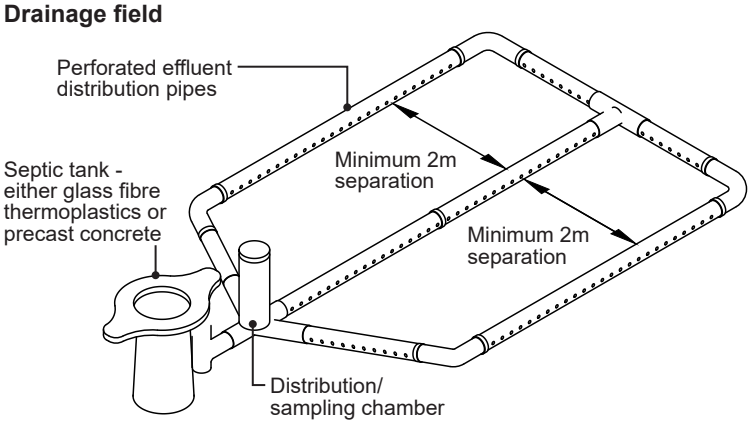
Septic tanks should be designed and constructed in accordance with the relevant Building Regulations.

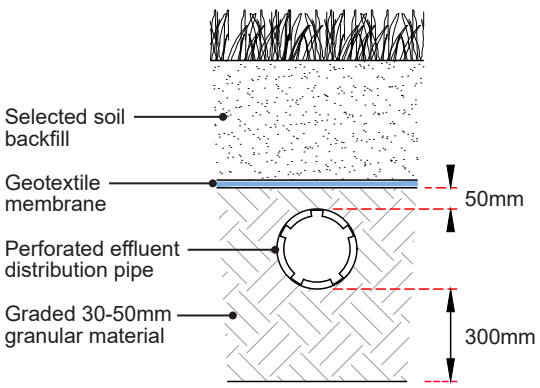
Drainage fields and drainage mounds

Drainage fields should meet the requirements of BS 6297. A drainage field or mound serving a wastewater treatment plant or septic tank should be located:

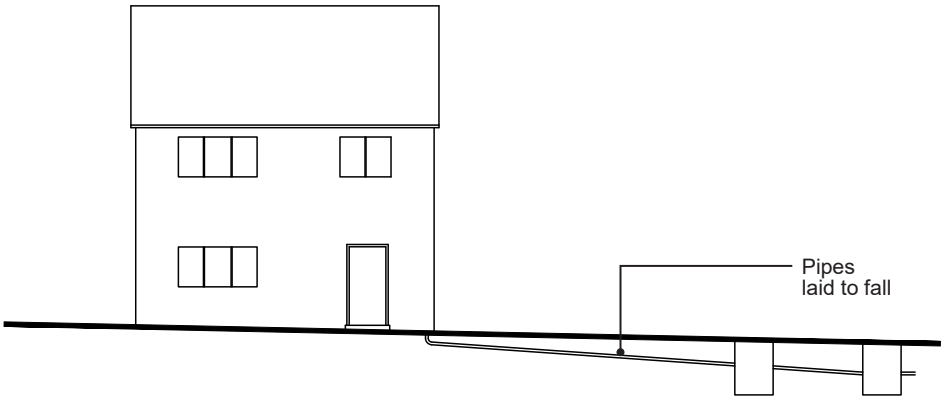
- At least 10m from any watercourse or permeable drain.
- At least 50m from the point of abstraction of any ground water supply and not in any zone 1 groundwater protection zone.
- At least 15m from any building.
- Sufficiently far from any other drainage fields, drainage mounds, soakaways or other ground infiltration system so that the overall soakage capacity of the ground is not exceeded.

Drainage field

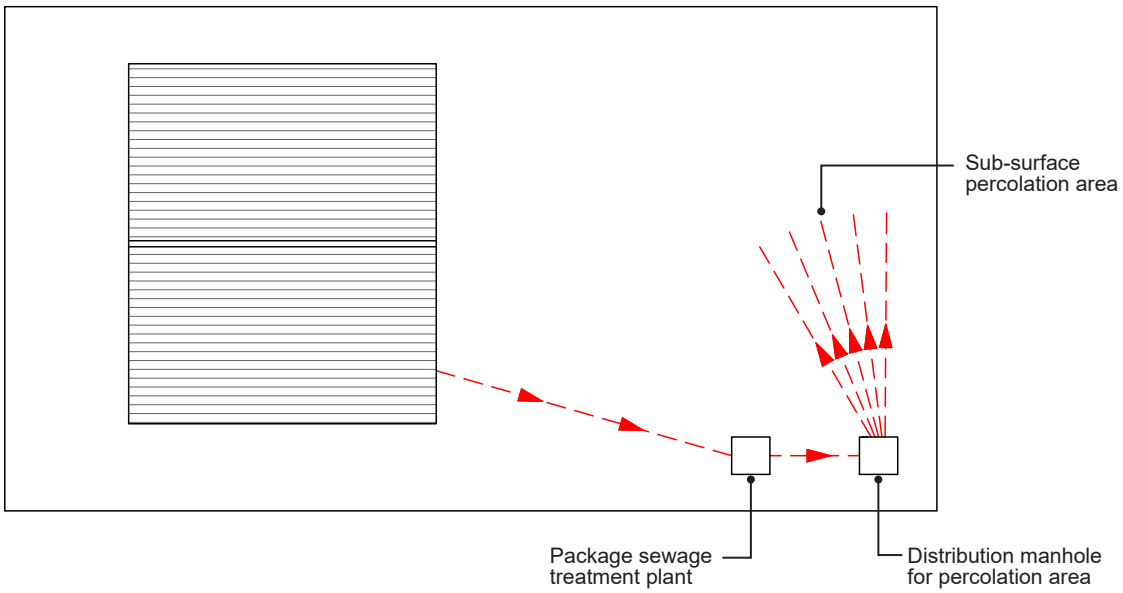




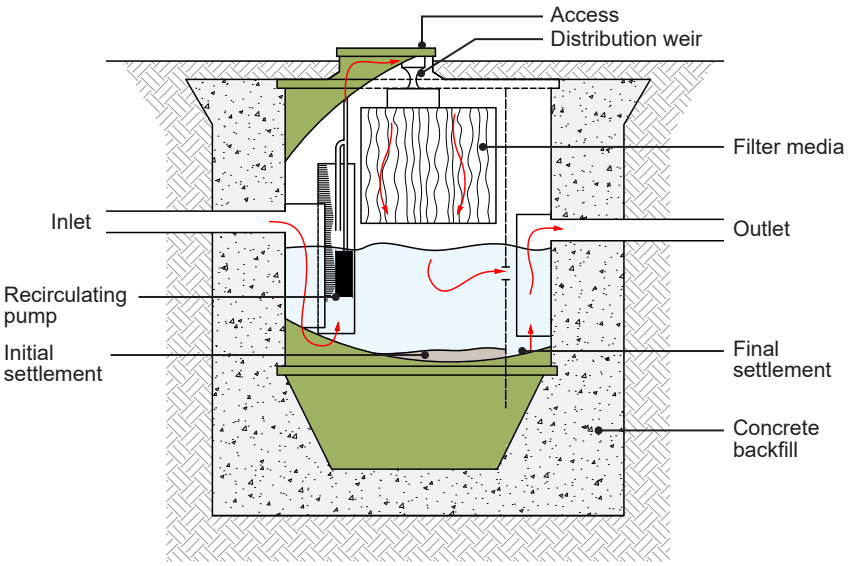
Typical sewage treatment plant (section)



Typical sewage treatment plant (plan)



Typical sewage treatment plant



Requirements for packaged treatment plants

- Packaged treatment plants should meet the requirements of BS EN 12566 and have a suitable third party product conformity certificate.
- Packaged treatment plants require a suitable outfall to discharge to which should be agreed with the relevant authority.
- The discharge from the waste water treatment plant should be sited at least 10m away from watercourses and any other buildings.
- Where packaged treatment plants require power to operate it should be able to adequately function without power for up to 6 hours or have uninterruptible power supply.

Requirements for soakaways

Soakaways are a simple way of percolating surface and storm water into the surrounding ground. Soakaways are part of the Sustainable Urban Drainage Systems (SuDS) technologies that handle storm water at the source rather than leading it into the public sewer systems.

Where soakaways are proposed, the Warranty surveyor must be provided with:

- A site investigation confirming the ground is suitable for a soakaway.
- Details of soakaway design in accordance with BRE Digest 365.
- An on-site percolation test confirming the permeability of the ground.

Site conditions

Soakaways can only be considered in permeable conditions. A suitable site must be:

- In a location lower than or sloping away from the area being drained.
- At least 5m away from any building (BS 8301).
- Situated so that it will not saturate the foundations of any structure.
- Situated so that the base of any soakaway/infiltration system is permanently above the water table.
- Situated far enough away from other soakaways, infiltration systems or SuDS to ensure that the capacity of those other systems and the ground itself is not impaired.
- Situated so that there is no risk of contamination from pollutants.

Soakaways where chalk is prevalent

For sites where chalk is prevalent, the CIRIA C574 Engineering in Chalk 2002 publication gives the following recommendations:

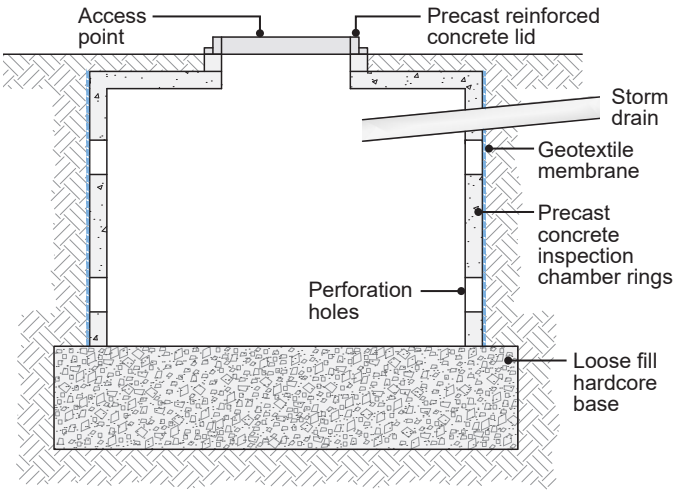
Concentrated ingress of water into the chalk can initiate new dissolution features, particularly in low-density chalk, and destabilise the loose backfill of existing ones. For this reason, any soakaways should be sited well away from foundations for structures or roads, as indicated below:

- In areas where dissolution features are known to be prevalent, soakaways should be avoided if at all possible but, if unavoidable, should be sited at least 20m away from any foundations.
- Where the chalk is of low density, or its density is not known, soakaways should be sited at least 10m away from any foundations.
- For drainage systems, flexible jointed pipes should be used wherever possible; particular care should be taken for the avoidance of leaks in both water supply and drainage pipe work.
- As the chalk is a vitally important aquifer, the Environment Agency and Local Authority must be consulted when planning soakaway installations where chalk lies below the site, even where it is mantled with superficial deposits.

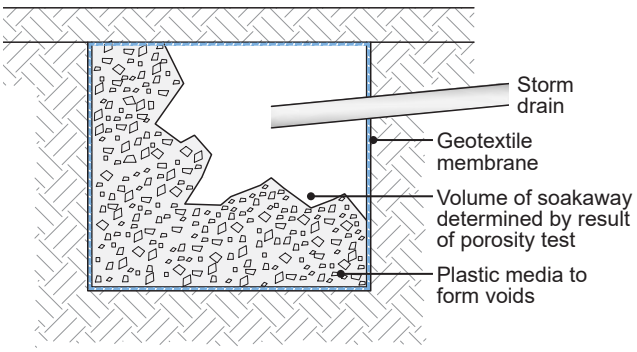
Layout of land drains

Drain runs on sloping sites need to be positioned perpendicular to the fall of the site. Land drains should be positioned adjacent to paths, drives and outbuildings. The pipe soffit should be positioned at least 400mm below the finished ground level, and the backfill consolidated to the same degree of compaction as the adjacent soil.

Chamber-type soakaway



Typical soakaway design



Requirements for rain gardens

For the purposes of Warranty, a rain garden is a small bio-retention systems that serves part of a single property surface water and storm water disposal system. They can be shallow landscaped depressions or raised component features designed to manage rainwater runoff, and treat rainwater through engineered soils and vegetation.

Rain gardens will require a positive drainage system and positioning to avoid impacting on the building foundations.

Detailed rain garden design proposals must be provided to demonstrate:

- The ability to deal with everyday rainwater discharge from the building.
- Adequacy to manage with extreme rainfall and runoff to receiving watercourses or outfalls.
- Rain gardens must have an overflow which discharges into the surface water system.
- Be correctly positioned in relation to the local topography, ground conditions and avoid potential damage to adjacent buildings.
- That a suitable maintenance plan is in place which is detailed in the handover pack to the homeowner clearly outlining the homeowners responsibilities.

As with all surface water ground filtration systems, the location of the water garden in relation to a building must avoid the potential for foundation movement to any building foundations.

Therefore for Warranty provision:

- If constructed on a sloping site, they must be positioned ‘downhill’ of the adjacent building.
- Any designs received where a rain garden is located nearer than 5.0m will require a detailed hydraulic design proposal by a SuDs qualified drainage engineer to demonstrate the rain garden will not pose a risk to the building foundations.

Guidance given in The SuDs Manual (CIRIA 753) Parts B; Design Philosophy and Part E: Supporting Guidance may be followed and a detailed proposal by the drainage engineer must be submitted at least 8 weeks before drainage works commences on site.

In situations where a rain garden is positioned on a building structure, additional guidance for waterproofing the structure is provided in the ‘Roof - Green roofs’ and ‘Roofs - Podium Decks’ section. Further guidance for effective waterproofing of structures can also be found in BS8102.

Requirements for other Sustainable Drainage Systems (SuDS)

Developments proposing to use other types of SuDS which are not covered within this section should follow the guidance found in ‘SuDS Manual’ (a design manual published by CIRIA). The developer should also confirm if the Planning consent for the project imposes any additional requirements which may impact on the design of the sustainable drainage systems (SuDS). Any surface water drain, soakaway or other infiltration system (including a SuDS system) which is intended to discharge to a water course should have consent to discharge in writing from the appropriate regional agency.

5.2.6 Prevention of ground gases/contaminants entering the home

Where ground gases/contaminants are present in the ground, the designer shall take precautions to prevent the gases/contaminants entering the home.

For further information on managing ground gases contaminants, please refer to the ‘Ground Conditions – Managing Ground Contaminants’ section.