

Sewers for Adoption

- A Design and Construction Guide for Developers – Small
Developments Version – September 2013

Taken from the Seventh edition

Published by WRc plc, Frankland Road, Blagrove, Swindon,
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Feedback Arrangements:

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FOREWORD

This document is for use by Developers when planning, designing and constructing conventional foul and surface water gravity sewers and lateral drains for small developments.

The guidance may be used for drainage systems:

- a) for housing developments of ten properties or less, or commercial developments with a combined roof area less than 1000 m²;
- b) drained only by gravity (i.e. no adoptable pumping stations);
- c) with a total impermeable area draining to the adoptable system less than 0.5 ha;
- d) where pipes are installed using conventional open trench construction;
- e) not involving the construction of any manholes (i.e. man access chambers, although inspection chambers are permitted);
- f) not involving the construction of any inspection chambers greater than 3 m in depth;
- g) in which no parts of the adoptable system are more than 150 m from an existing manhole on the public sewer system; and
- h) not involving any on-site casting of reinforced concrete structures.

Where any of the criteria listed above do not apply, then the developer should design and construct the system in accordance with Sewers for Adoption 7th edition.

Defra have published functional standards and guidance for the construction of new foul sewers and lateral drains. Relevant aspects of this guidance is incorporated here and more detailed industry recommendations have been included to help Developers comply with the Secretary of State's standards and guidance.

For adoptable surface water sewers and lateral drains, industry guidance is included pending the introduction of new arrangements for the approval and adoption of surface water drainage systems. This will include the publication of national standards for sustainable drainage systems. Part C in this document could be subject to amendment following publication of the National Standards.

It is expected that new surface water sewers and lateral drains will still be constructed and will be adoptable by the Sewerage Undertaker in the same way as foul drainage systems. Where these will connect to the public sewer system, a Section 104 agreement will still therefore be required in accordance with Section 106B of the Water Industry Act 1991. In such circumstances, adoptable sewers and laterals should be designed and constructed in accordance with the relevant provisions of the National Standards for Sustainable Drainage when they are published.

Part A – GENERAL

A1 DEFINITIONS

1. "**Access point**" means provision to access a sewer or drain for maintenance or inspection and includes any inspection chamber or rodding eye.
2. "**Drain**" means a pipeline, usually underground, designed to carry foul sewage or surface water from buildings and paved areas associated with buildings within the same curtilage.
3. "**Sewer**" means a pipeline, usually underground, designed to carry foul sewage and/or surface water from buildings and paved areas associated with buildings in more than one curtilage.
4. "**Lateral drain**" means that part of the drain which is between the point of demarcation, or the boundary of the property it serves, and the sewer.
5. "**Curtilage**" means the area of land around a building, or group of buildings, which is for the private use of the occupants of the buildings. For this purpose typically:
 - a) each detached, semi-detached and terraced house should each be considered as a separate curtilage.
 - b) where a building contains a number of flats, the whole block of flats should be considered to be a single curtilage.
 - c) separate commercial properties sited on land privately owned by a single body (e.g., a shopping centre, airport terminal, retail park, etc.) will be considered as a single curtilage if the commercial properties share the site access and facilities.

PART B – DESIGN AND CONSTRUCTION OF NEW FOUL SEWERS AND LATERAL DRAINS

B1 SEPARATE SYSTEMS

1. Separate foul and surface water systems should be provided.
2. If sewers are to discharge into an existing combined (single pipe) sewer system, the separate foul and surface water sewers should be combined at locations immediately upstream of the point where they discharge into the existing combined sewer system.
3. Watercourses or land drainage are not permitted to be directly or indirectly connected to the public sewer system. Satisfactory and separate arrangements should be agreed with the local Land Drainage Authority and confirmed with the Undertaker unless it is a part of a sustainable drainage system approved by the SuDS Approval Body (SAB) in accordance with Section 32 and Schedule 3 of the Flood and Water Management Act 2010.

B2 LAYOUT AND ACCESS

B2.1 Layout

1. Limiting flood risk can have an impact on the layout of a development and, therefore, can impact on the layout of drains and sewers.
2. Access points on sewers and lateral drains should not be laid in enclosed private land. Where this is not practicable, access points of sewers and laterals may be constructed:
 - a) in shared rear yards or parking areas, provided there is free access at all times;
 - b) in enclosed shared private areas provided that all those properties served by the sewers have right of access to the area at all times. Access control systems should include provision for access by the Sewerage Undertaker;
 - c) where the drain or sewer serves ten properties or less, in unfenced gardens; or
 - d) on sewers serving no more than two properties, provided that access is also possible from the other property by another access point.
3. As far as practicable, sewers and lateral drains should be laid in highways or public open space where they are reasonably accessible and visible. Sewers should not be laid in enclosed private land. Where this is not practicable, sewers and lateral drains with a nominal internal diameter of 150 mm or less may be laid:
 - a) in shared rear yards or parking areas or other shared areas to which all the properties served by the sewers have right of access; or where this is not reasonably practicable
 - b) where the drain or sewer serves ten properties or less, in unfenced gardens; or where this is not reasonably practicable
 - c) in fenced private areas provided that the sewer is kept as far as is practicable from any point on a building where a future extension is likely.

4. The external face of any new sewer or lateral drain should be at least 1.2 m from any building or structure, or a distance equivalent to the depth of the sewer below the foundation, whichever is greater; except that a sewer or lateral drain with a nominal internal diameter of 150 mm or less, with an invert level at least 150 mm above the base of the foundation and no more than 1100 mm deep, should be no less than 100 mm from the foundations (see Figure B.1).

5. Where it is not possible to comply with Clause B2.1.4 because another building/structure is in such close proximity that there are no permitted locations, new sewers or lateral drains may be located between buildings or structures provided that:

- a) there is at least 900 mm separating the buildings or structures where a single sewer or lateral drain is proposed and 1100 mm where dual systems are proposed;
- b) the depth of the invert of the sewer or lateral drain below the ground level is no greater than the distance between the buildings or structures;
- c) the sewers or lateral drains have a nominal internal diameter of 150 mm or less;
- d) the sewers or lateral drains have an invert level at least 150 mm above the base of the highest of the foundations of the two buildings;
- e) there is at least 350 mm cover above the pipe; and
- f) there is at least 100 mm between the pipe wall and the foundations (see Figure B.2).

6. Sewers and lateral drains should be located so that if there is a structural failure of the drain or sewer, or an excavation is carried out to repair the drain or sewer, the integrity of adjacent buildings or other infrastructure is not impaired.

7. For the purposes of B2.1.4 and B2.1.5, the foundation level of the building or structure with piled foundations should be taken from the underside of the capping beam.

Note: In B2.1.3, B2.1.4 and B2.1.5, the recommendations are intended to allow sufficient working space for hand excavation in proximity to the building or structure if repair is necessary in the future.

8. Foul sewers and lateral drains should not be constructed under any building, or any structure except that they may cross under a boundary wall not greater than 1 m high (see Section B5).

9. Sewers should be laid in straight lines in both the vertical alignment (profile) and horizontal alignment (plan) except that bends up to 45 degrees may be laid immediately outside inspection chambers (see Figure B.13).

10. The minimum depth of cover to the crown of gravity pipes without protection should be as follows:

- a) domestic gardens and pathways without any possibility of vehicular access, 0.35 m;
- b) domestic driveways, parking areas and yards with height restrictions to prevent entry by vehicles with a gross vehicle weight in excess of 7.5 tonnes, 0.5 m;
- c) domestic driveways, parking areas and narrow streets without footways (e.g., mews developments) with limited access for vehicles with a gross vehicle weight in excess of 7.5 tonnes, 0.9 m;
- d) agricultural land and public open space, 0.9 m;
- e) other highways and parking areas with unrestricted access to vehicles with a gross vehicle weight in excess of 7.5 tonnes, 1.2 m.

11. Sewers and lateral drains may be laid through arches and other external openings through buildings or structures provided that they are laid as near to the centre of the opening as possible and:

- a) for vehicular entries with a minimum width of 4.0 m and minimum height of arch above ground level of 2.1 m, the maximum nominal internal diameter of the pipe should be 225 mm with a maximum depth to invert of the pipe of 2.0 m and the invert should be at least 150 mm above the foundation level; or
- b) for pedestrian access with a minimum width of 0.9 m and minimum height of 2.0 m, the maximum nominal internal diameter of the pipe should be 100 mm and should comply with B2.1.5.

12. Sewers or lateral drains may pass through an opening in a property boundary wall provided that there is an arch or lintelled opening to give at least 50 mm space around the pipe (see Clause B2.1.8).

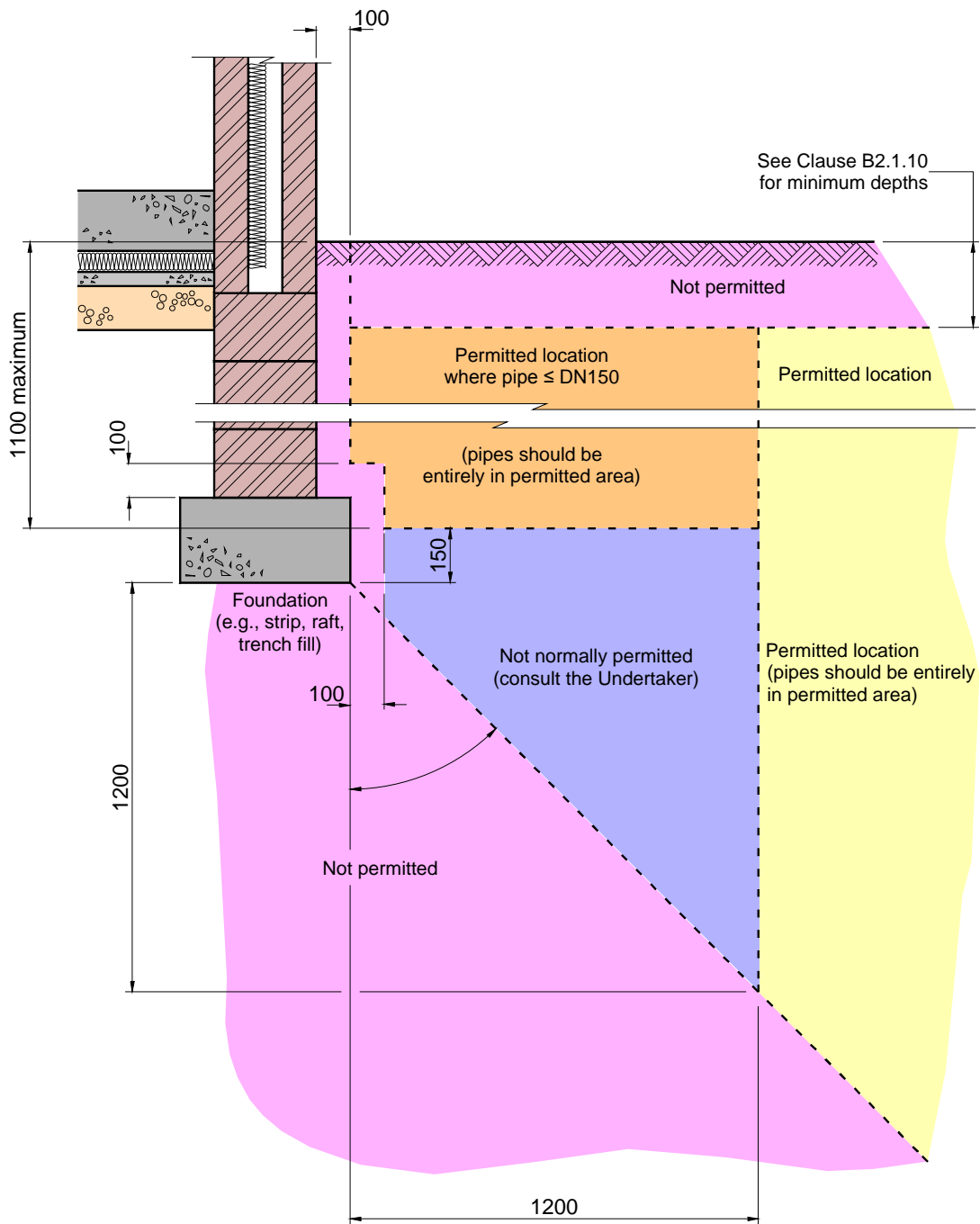
13. The design of landscaping should be undertaken at the same time as the design of the drains and sewers so that the impact of tree roots on sewers and drains can be considered. A sewer or lateral drain should not be located closer to trees/bushes/shrubs than the canopy width at mature height, except where special protection measures are provided, in accordance with Clause B5.5. A tree should not be planted directly over sewers or where excavation onto the sewer would require removal of the tree. The following shallow rooting shrubs are generally suitable for planting close to sewers and lateral drains:

- *Berberis candidula*; (Paleleaf barberry)
- *Berberis julianae*; (Wintergreen barberry)
- *Ceanothus burkwoodii*; (Californian lilac 'Burkwoodii')
- *Cotoneaster dammeri*; (Bearberry cotoneaster)
- *Cotoneaster skogholm*; (*Cotoneaster x suecicus*, 'Skogholm')
- *Cytisus varieties or Sarothamnus*; ((Common or Scotch) Broom)
- *Euonymus japonica*; (Japanese spindle)
- *Euonymus radicans*; Variety of *Euonymus* (Fortune's spindle or wintercreeper)
- *Mahonia varieties*; can be included in the genus *Berberis*, most common name is *M. aquifolium* (Oregon grape)
- *Potentilla varieties*; most varieties are types of cinquefoil. Also includes Common tormentil, silverweed and barren strawberry
- *Skimmia japonica*; (Skimmia)
- *Spiraea japonica*; (Japanese spirea or Japanese meadowsweet)
- *Veronica varieties*; (Speedwell)
- *Viburnum davidii*; (David viburnum)
- *Viburnum tinus*; (Lauristinus)

14. When in a highway, the outside of the sewer should be in the vehicle carriageway (not footway) and be at least 1 m from the kerb line. The external faces of inspection chambers should be at least 0.5 m from the kerb line.

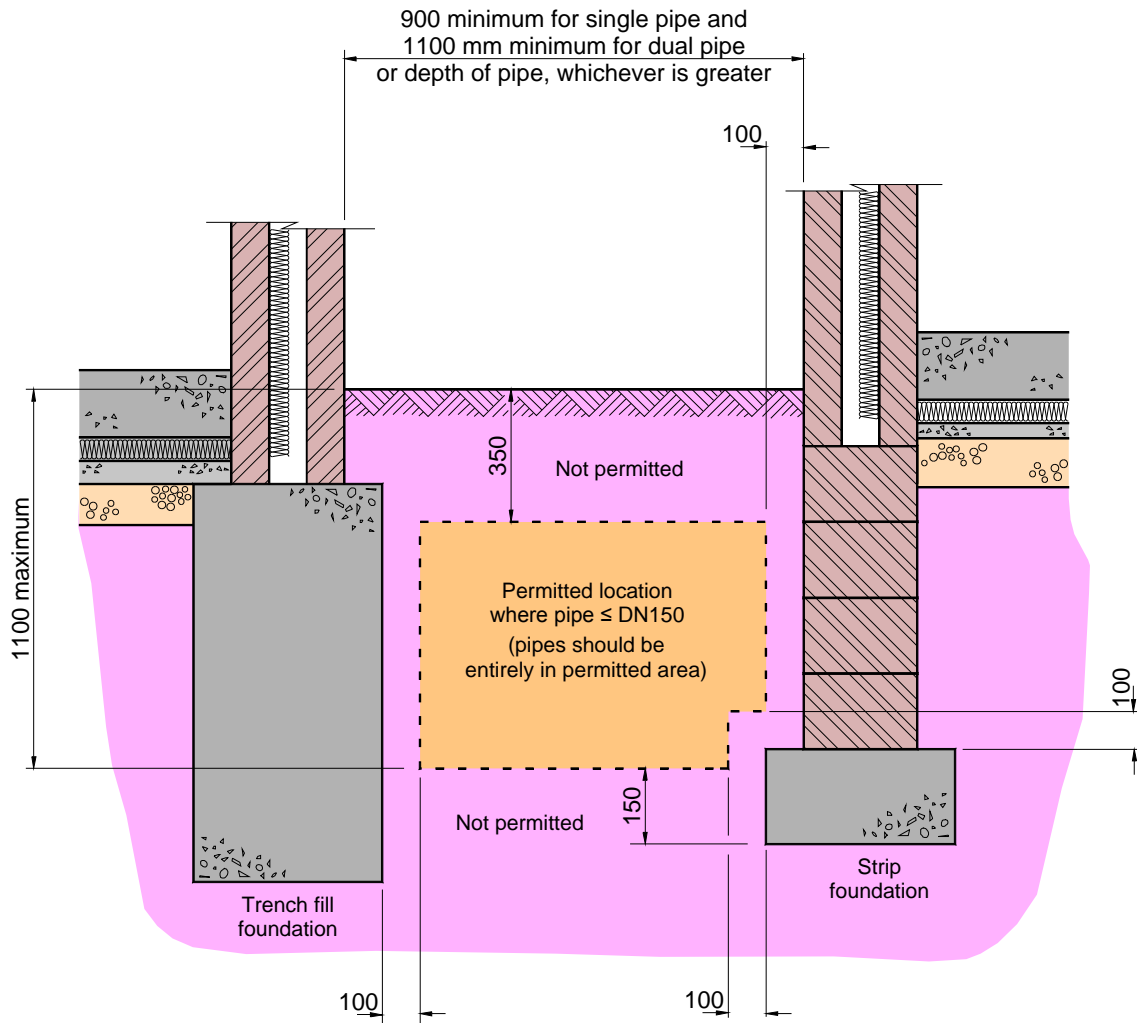
15. Typical layouts are shown in Figures B.3 to B.6.

**FIGURE B.1
PERMITTED LOCATION OF SEWERS AND
LATERAL DRAINS IN PROXIMITY TO BUILDINGS**



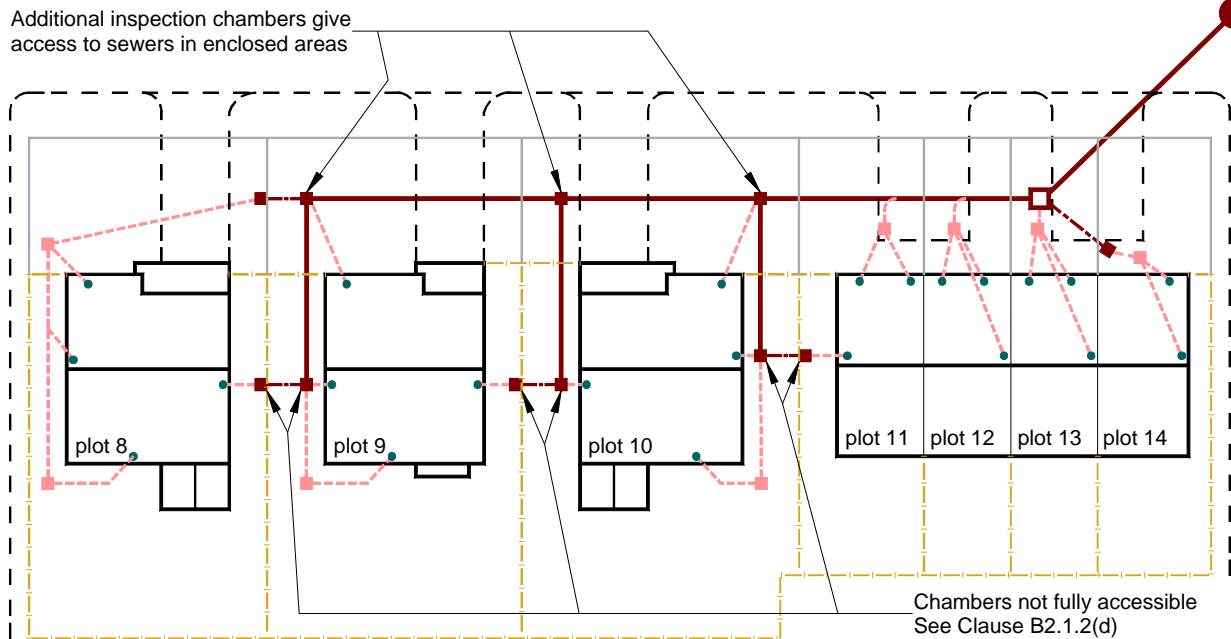
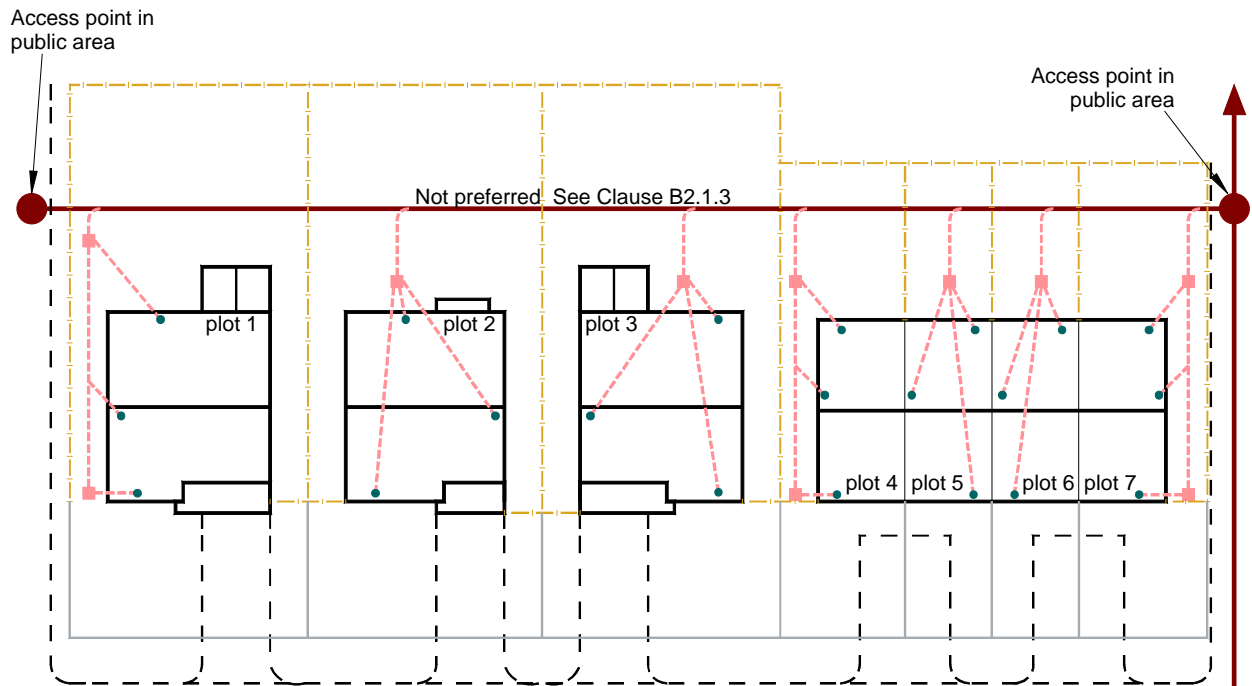
Not to scale, dimensions in millimetres

FIGURE B.2
ADDITIONAL DETAIL - PERMITTED LOCATION OF SEWERS
AND LATERAL DRAINS BETWEEN BUILDINGS
(where Figure B.1 is not applicable only)



Not to scale, dimensions in millimetres

**FIGURE B.3
TYPICAL LAYOUT 1**



Key:

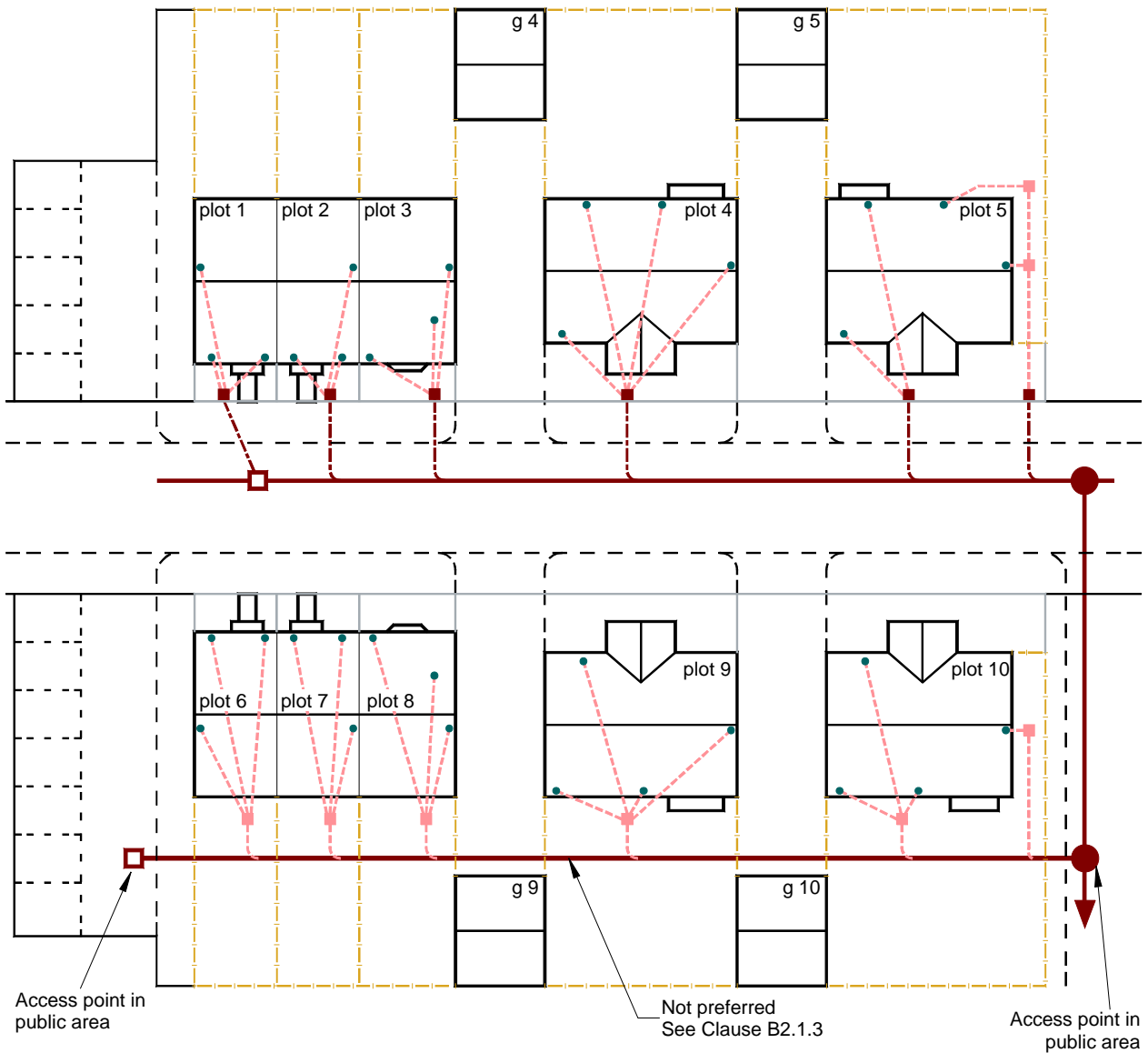
Sewers serving more than 10 dwellings to be minimum 150 mm diameter.

Other sewers or lateral drains to be minimum 100 mm diameter

- Foul sewer
- Foul lateral drain
- Foul drain (not adoptable)
- Foul manhole
- Type 3 foul inspection chamber
- Type 4 foul inspection chambers - not greater than 3 properties
- Type 4 foul inspection chambers - not greater than 1 property (not adoptable)
- Unfenced or low fence boundary
- High fence boundary

Note: Some inspection chambers act as demarcation chambers.

**FIGURE B.4
TYPICAL LAYOUT 2**



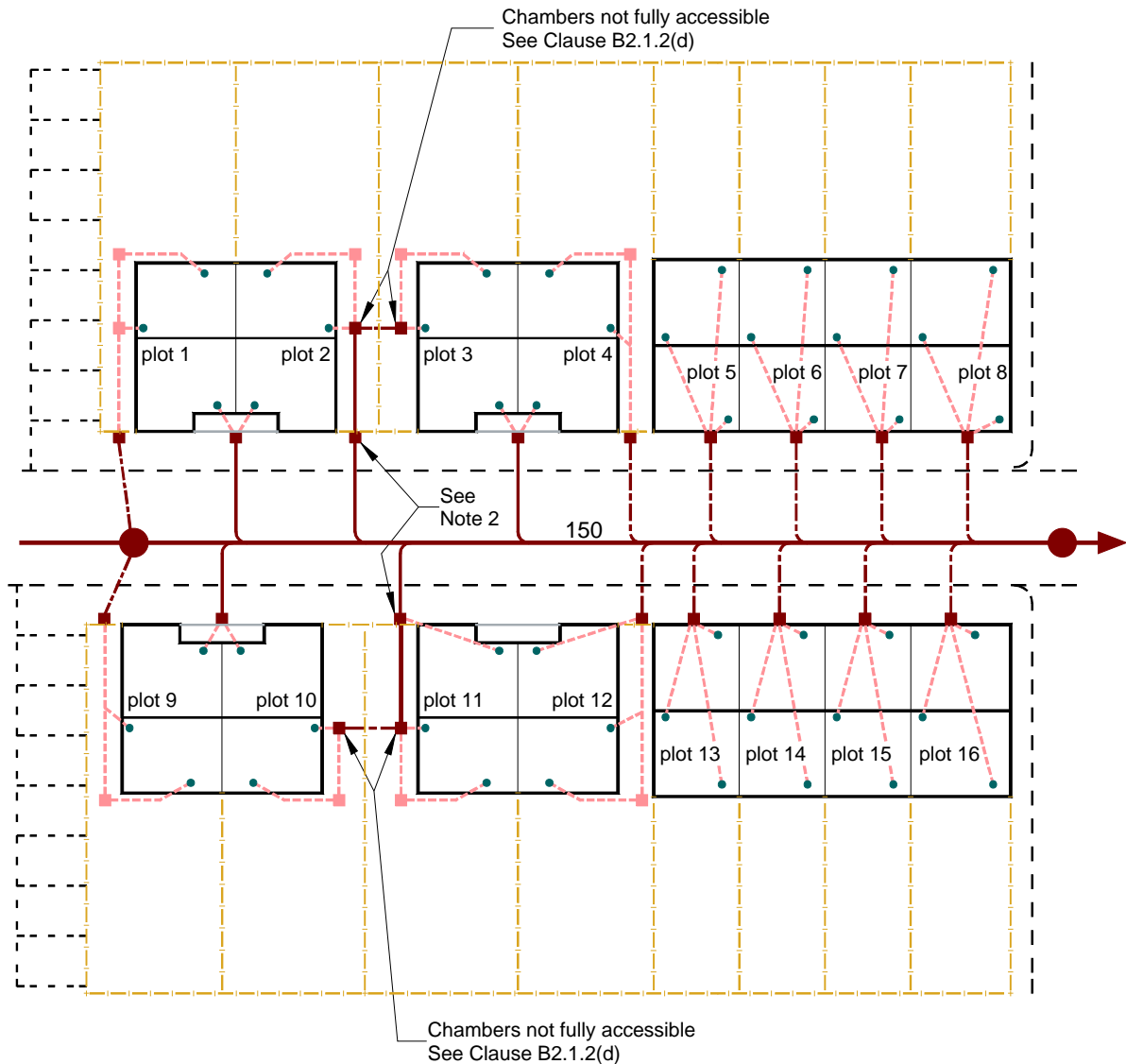
Key:

Sewers serving more than 10 dwellings to be minimum 150 mm diameter.
Other sewers or lateral drains to be minimum 100 mm diameter

- Foul sewer
- Foul lateral drain
- Foul drain (not adoptable)
- Foul manhole
- Type 3 foul inspection chamber
- Type 4 foul inspection chambers - not greater than 3 properties
- Type 4 foul inspection chambers - not greater than 1 property (not adoptable)
- Unfenced or low fence boundary
- High fence boundary

Note: Some inspection chambers act as demarcation chambers.

**FIGURE B.5
TYPICAL LAYOUT 3**



- Notes: 1. Inspection chambers in footway are sited in zone reserved for street lighting columns
 2. Additional inspection chambers give access to sewers in enclosed areas

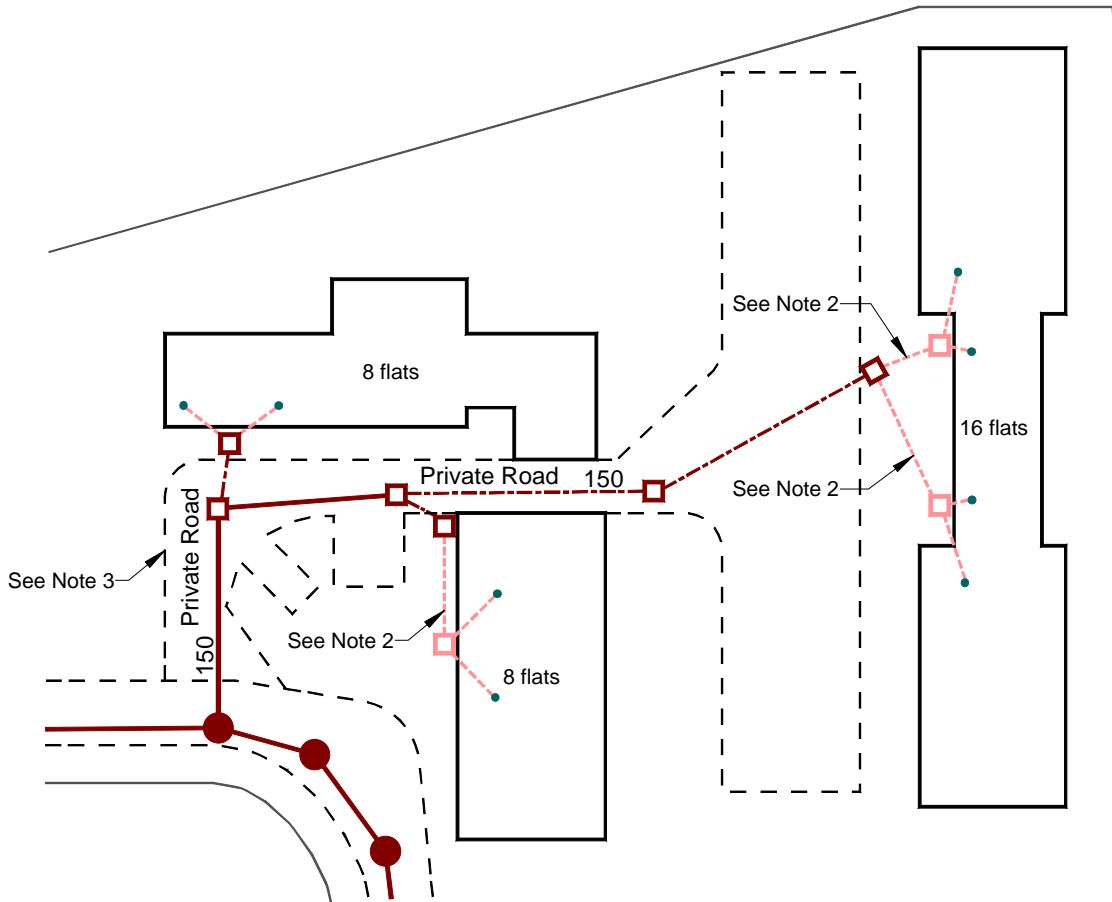
Key:

Sewers serving more than 10 dwellings to be minimum 150 mm diameter.
 Other sewers or lateral drains to be minimum 100 mm diameter

- Foul sewer
- Foul lateral drain
- Foul drain (not adoptable)
- Foul manhole
- Type 3 foul inspection chamber
- Type 4 foul inspection chambers - not greater than 3 properties
- Type 4 foul inspection chambers - not greater than 1 property (not adoptable)
- Unfenced or low fence boundary
- High fence boundary

Note: Some inspection chambers act as demarcation chambers.

**FIGURE B.6
TYPICAL LAYOUT 4**



- Notes: 1. Designation of individual pipes will depend on curtilage. See Clause A1.5
 2. Designation assumes drain is in private land
 3. Designation of pipe assumes road is private

Key:

Sewers serving more than 10 dwellings to be minimum 150 mm diameter.
 Other sewers or lateral drains to be minimum 100 mm diameter

- Foul sewer
- Foul lateral drain
- Foul drain (not adoptable)
- Foul manhole
- Type 3 foul inspection chamber
- Type 3 foul inspection chamber (not adoptable)
- Type 4 foul inspection chambers - not greater than 3 properties
- Type 4 foul inspection chambers - not greater than 1 property (not adoptable)

Note: Some inspection chambers act as demarcation chambers.

B2.2 Access

1. Access points should be located so that they are accessible and apparent to the Undertaker at all times for use. They should avoid rear gardens or enclosed locations. Additional access points may be provided in other locations, as long as access is provided to the system from other access points, in accordance with the recommendations in Clauses B2.2.2 to B2.2.15.
2. Access points, and any inlets to drains or sewers, should be located so as to minimise the risk of damage to buildings or other critical infrastructure in the event of sewer flooding.
3. Access points and sewers should be sited with due regard to public utility services. An access point should be built:
 - a) at every change of alignment, gradient or pipe material;
 - b) at the head of all sewers;
 - c) at every junction of two or more public sewers;
 - d) wherever there is a change in the size of the sewer;
 - e) at every junction of a public sewer with another sewer serving three or more properties where the access point is an inspection chamber;
 - f) at or within 1 m of the property boundary at the upstream end of each lateral drain (preferably inside the property boundary).
4. Where access to a pipe is provided through an inspection chamber, no part of the pipe should be more than 22.5 m from the adjacent inspection chamber (i.e., the distance between adjacent inspection chambers should be no more than 45 m).
5. Inspection chambers should be designed to afford reasonable access for equipment to carry out maintenance activities. Inspection chambers should be designed to deter personnel access.
6. The flow diagram in Figure B.7, used in conjunction with the access structure standard details and the recommended layouts (Figures B.3 to B.6); will ensure that the sewerage system meets the required safety, operational and sustainability standards. Each junction, change of direction or change of status, is described here as a node. No access is required at a node if it connects less than three properties and there already is, or will be, sufficient access to carry out sewer maintenance.
7. Any pipe, and associated access upstream of the point of demarcation, is a private drain and should be constructed in accordance with the Building Regulations.
8. Figures B.8 to B.16 show typical details of inspection chambers. No significant departure from these dimensions should be made without approval by the Undertaker.
9. "In-fill" type covers should not be used. Where a cover is located in an area of block paving, the bottom of the frame should be 150 mm deep.
10. Covers for inspection chambers should be in accordance with Section D2.17 of the Civil Engineering Specification.
11. Unless the chamber is designed to withstand the vertical load acting on it, a precast concrete slab or in-situ concrete slab, should be provided, to act as a collar to support the cover and frame. The collar should be separate from the chamber to ensure the loading from the cover and frame is not transferred to the chamber.

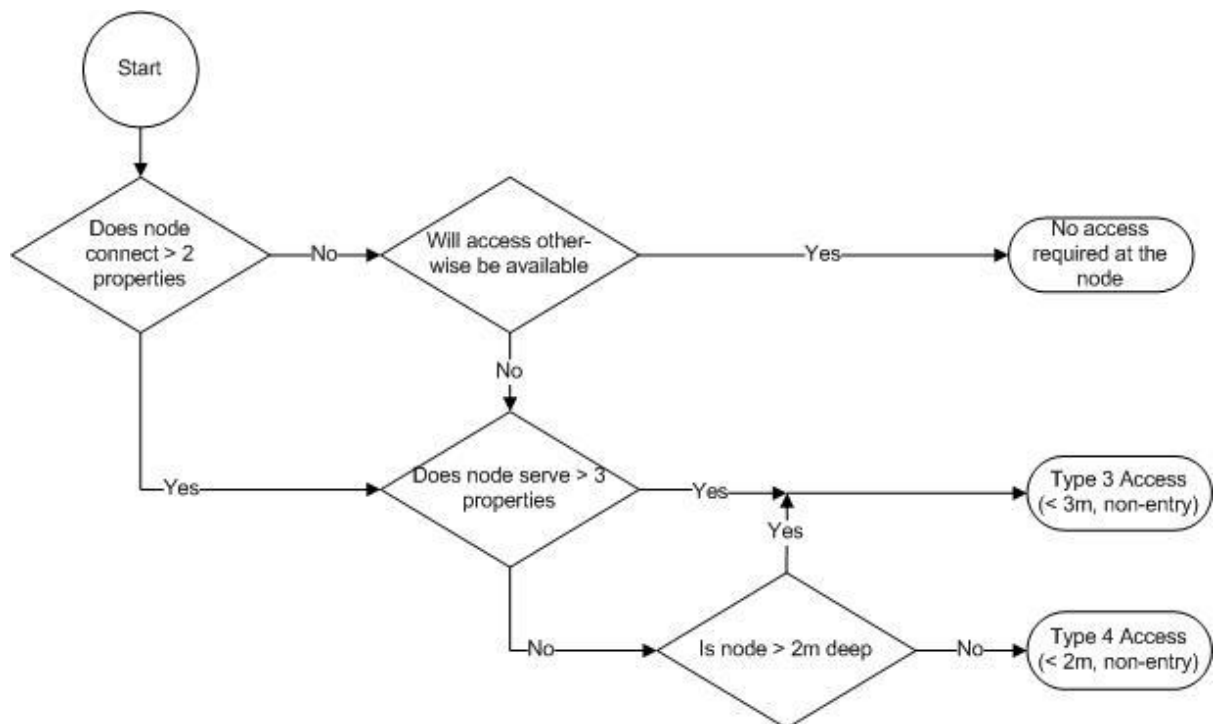
12. The first inspection chamber upstream from the connection to the (existing) public sewer should, when constructed, be fitted with a screen in order to prevent debris entering the public sewer. The screen should not be removed until immediately prior to the occupation of premises to be served by the sewer.

13. Rocker pipes should be provided at entry to, and exits from, inspection chambers when rigid pipes are used. Their length should be as shown in Table D.5 (see Section D5.3).

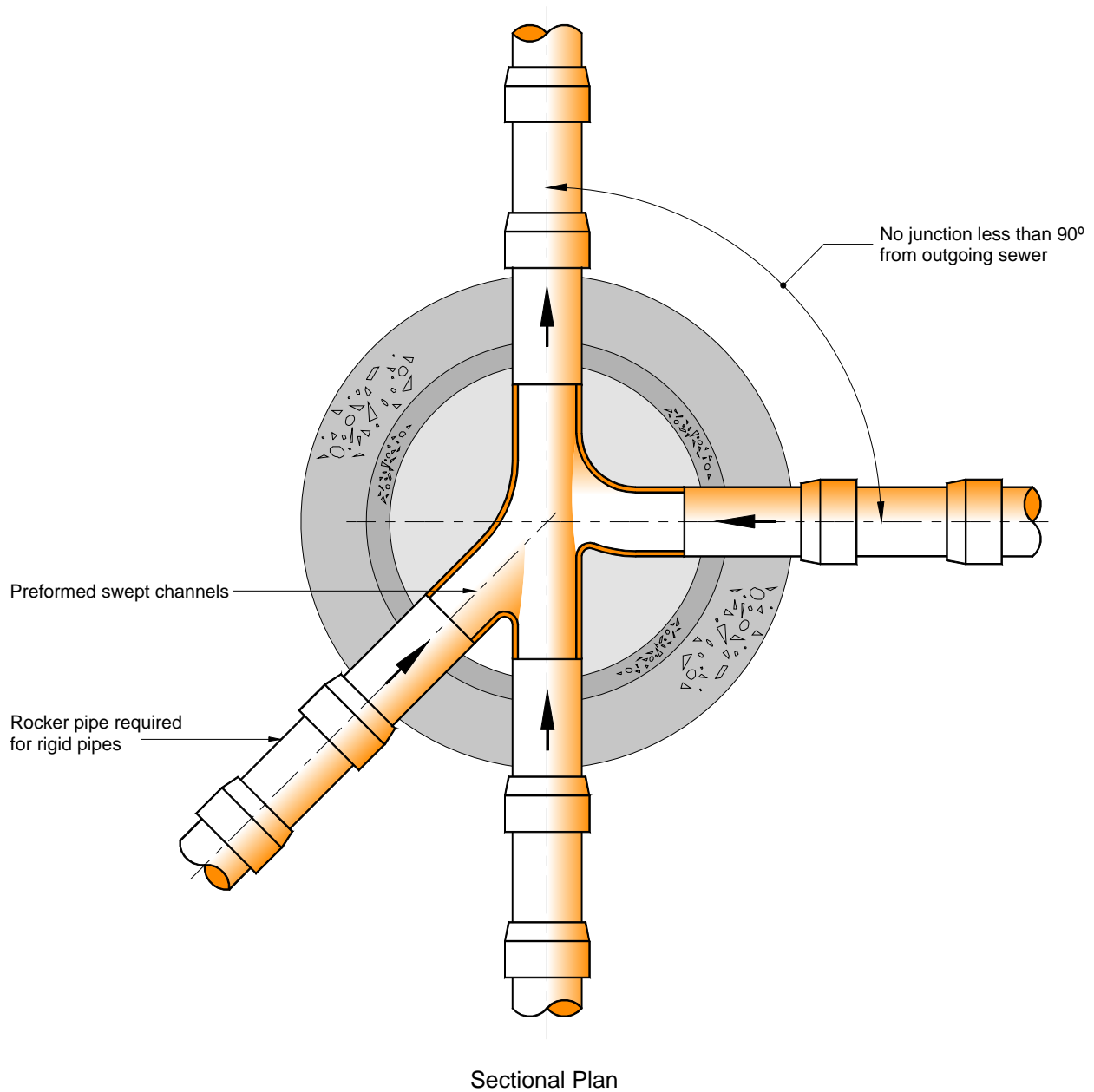
14. Where pipes serving a total of three properties or more connect to a pipe that has a nominal internal diameter less than or equal to 150 mm, the branch connections should be set so that the soffits of all the pipes are at the same level. In all other cases, branch connections should be set with the soffit levels no lower than that of the main pipe and with the invert level of the branch connection at least 50 mm above the invert of the main pipe.

15. The main channel should extend the whole length of the chamber, comprising a half-round section plus vertical benching from the top edge of the half round section to a height of not less than that of the soffit of the outlet, where it should be rounded off and sloped upwards to meet the wall of the chamber.

Figure B.7 Access Type Selection



**FIGURE B.8
TYPICAL ARRANGEMENT OF PIPE JUNCTIONS WITHIN MANHOLES**



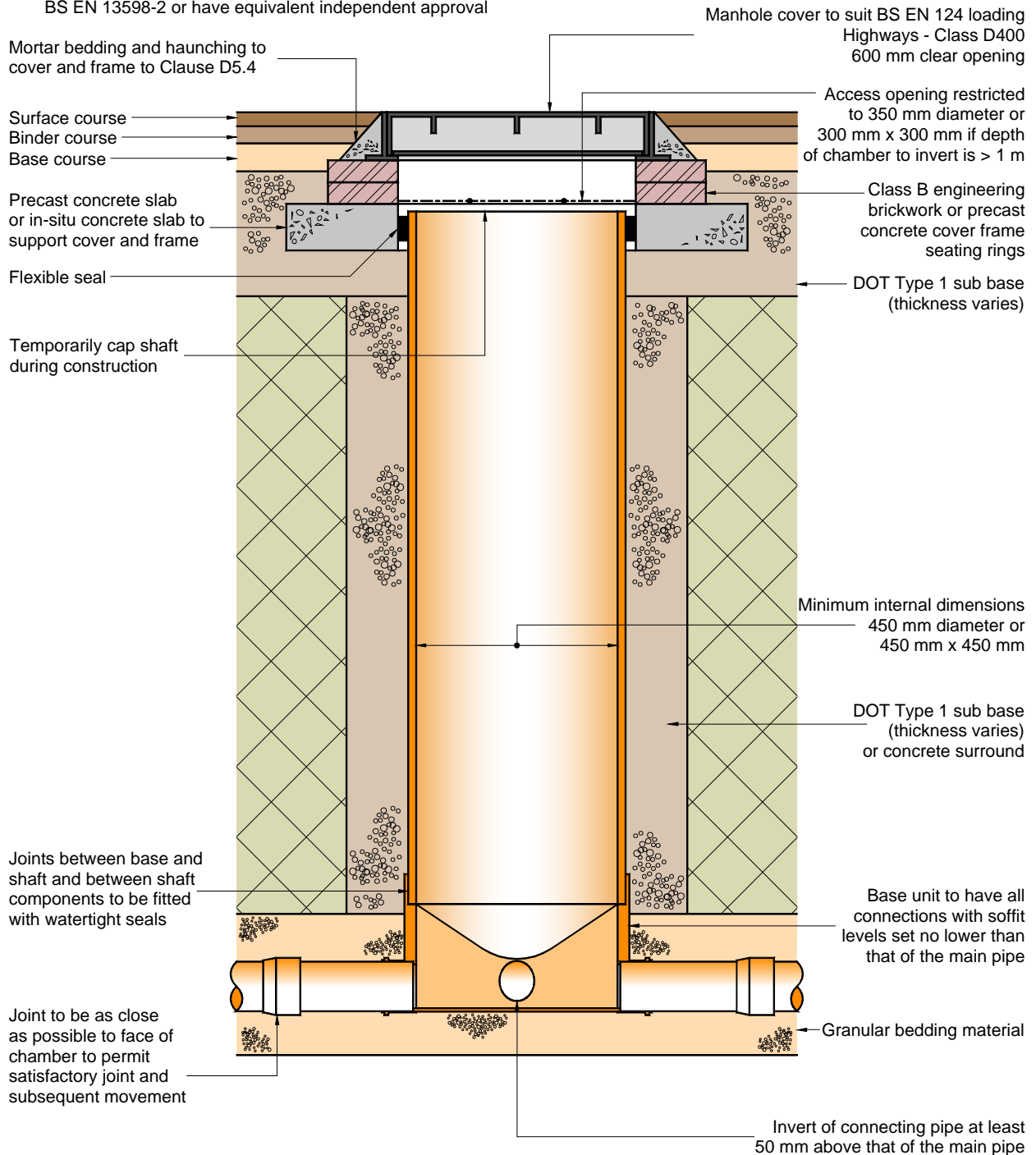
Rigid pipes built into manhole should have a flexible joint as close as feasible to the external face of the structure and the length of the next rocker pipe should be as shown.

| Nominal diameter (mm) | Maximum effective length (m) |
|-----------------------|------------------------------|
| 150 - 600 | 0.6 |
| 601 - 750 | 1.00 |
| over 750 | 1.25 |

All pipes entering the bottom of the manhole to have soffits level.

FIGURE B.9
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 3 (Flexible material detail)
 Maximum depth from cover level to soffit of pipe
 in areas subject to vehicle loading 3 m, non-entry

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval



Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

FIGURE B.10 ALTERNATIVE TOP DETAILS FOR LIGHT VEHICLE LOADING AND LANDSCAPED AREAS - TYPE 3

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

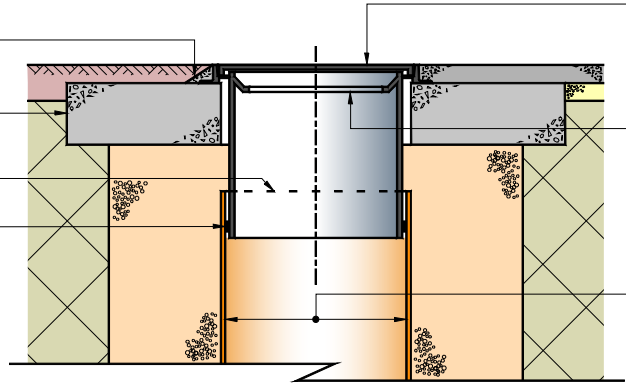
Sited in domestic driveways or footways

Mortar bedding and haunching to cover and frame to Clause D5.4

150 mm deep concrete collar

Temporarily cap shaft during construction

Flexible seal



Cover complying with BS EN 124 and BS 7903 Driveways, footways and landscaped areas - Class B125 See Clause D2.17

Access opening restricted to 350 mm diameter or 300 mm x 300 mm if depth of chamber to invert is > 1 m

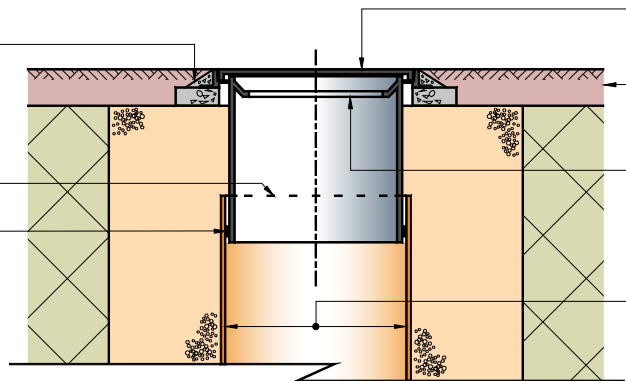
Minimum internal dimensions 450 mm diameter or 450 mm x 450 mm

Sited in domestic gardens

Mortar bedding and haunching to cover and frame to Clause D5.4

Temporarily cap shaft during construction

Flexible seal



Cover complying with BS EN 124 and BS 7903 Gardens - Class A15 See Clause D2.17

Topsoil
Access opening restricted to 350 mm diameter or 300 mm x 300 mm if depth of chamber to invert is > 1 m

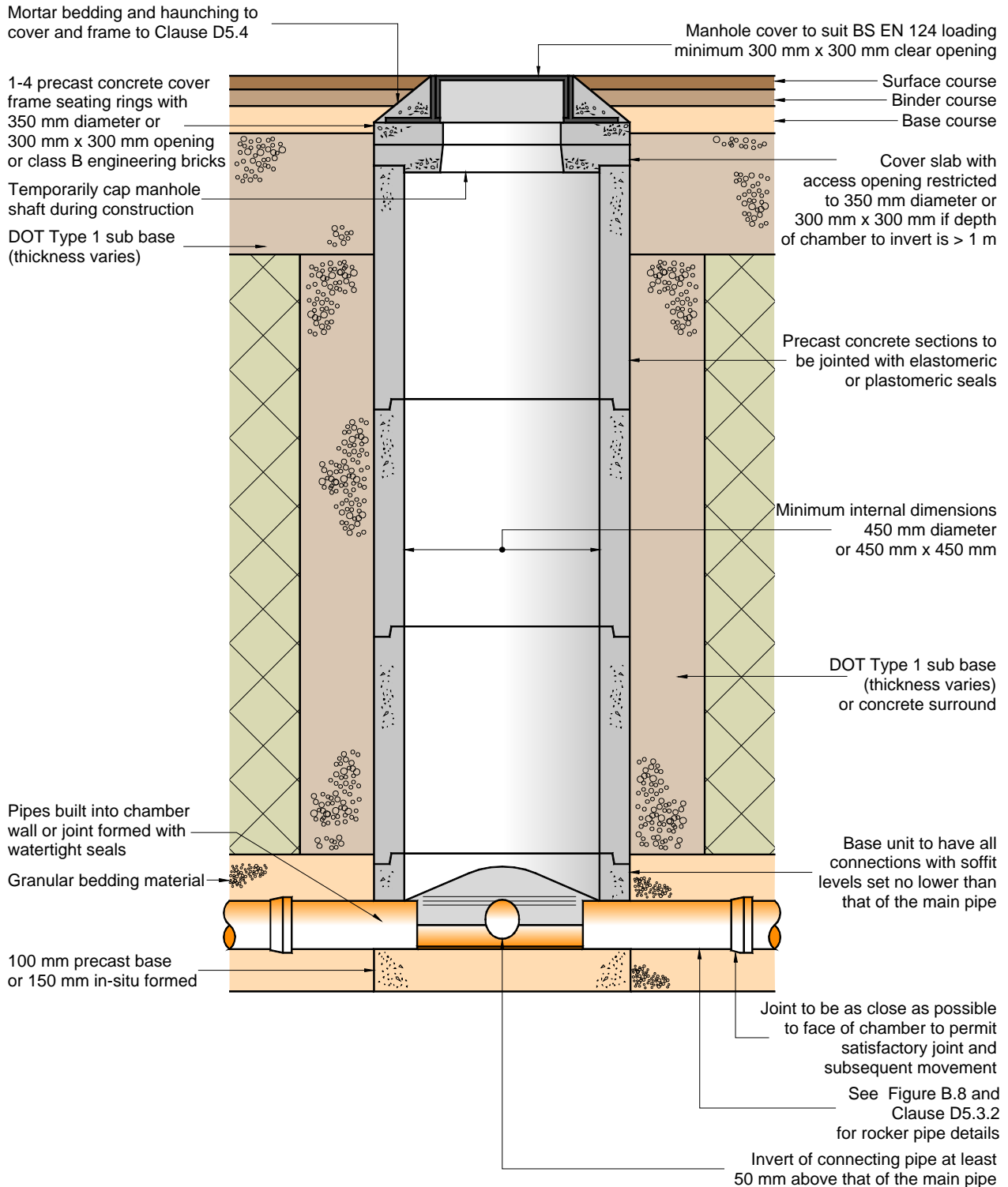
Minimum internal dimensions 450 mm diameter or 450 mm x 450 mm

Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

FIGURE B.11
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 3 (Rigid material detail)

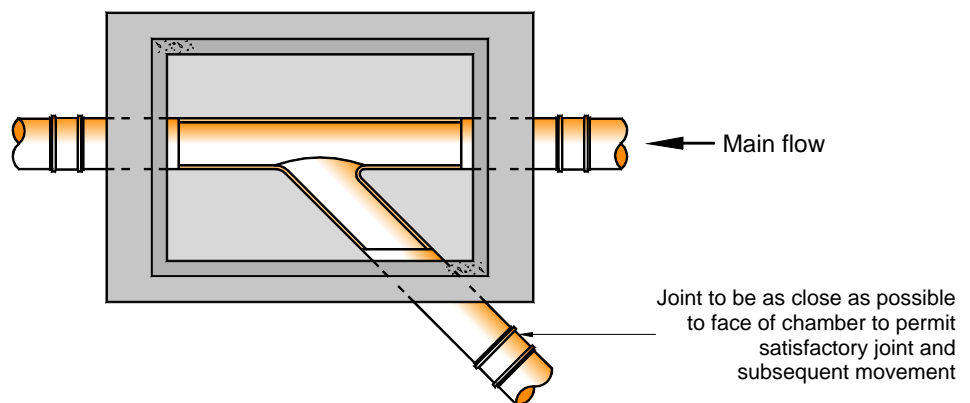
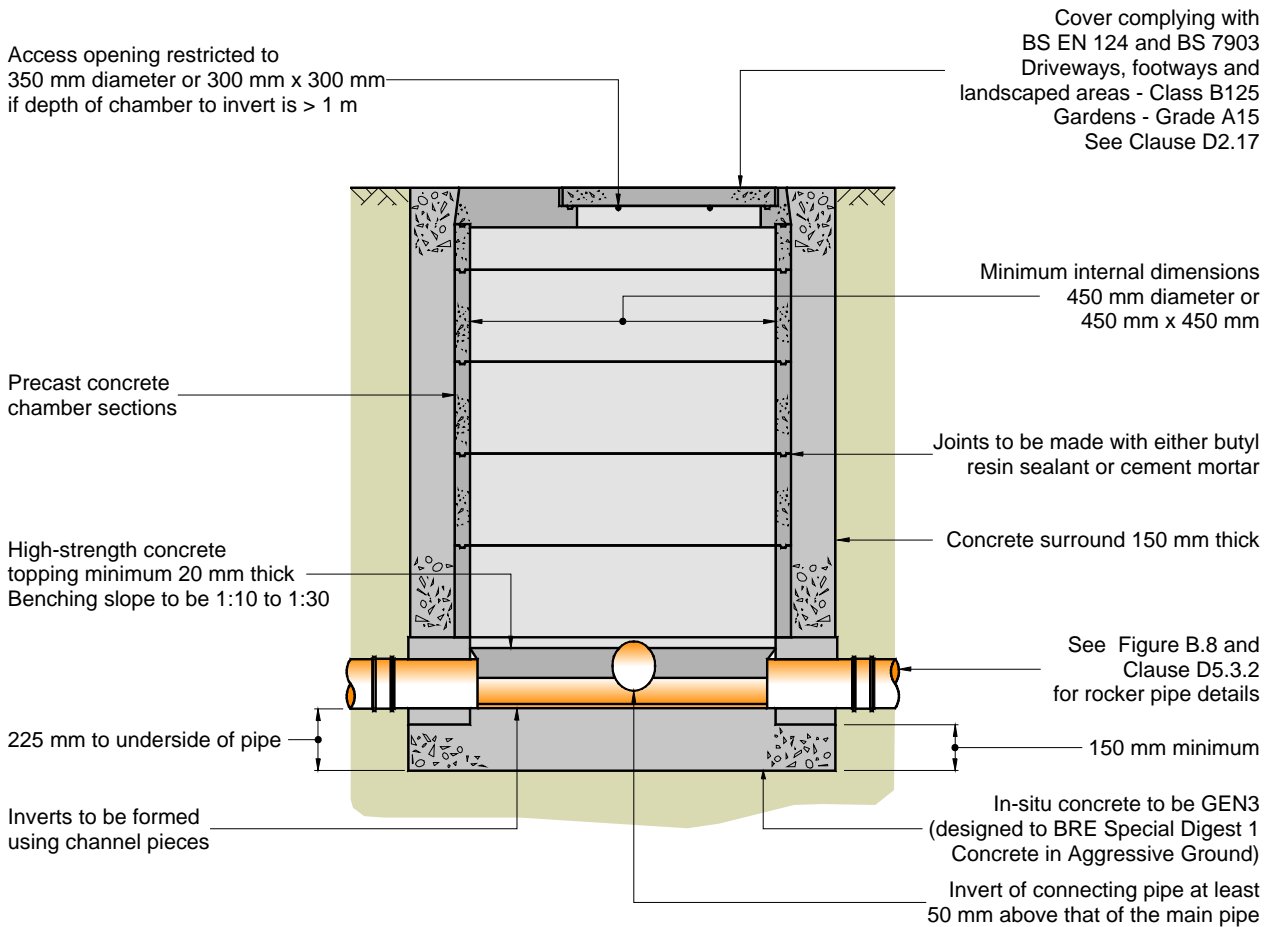
Maximum depth from cover level to soffit of pipe
in areas subject to vehicle loading 3 m, non-entry



Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

FIGURE B.12
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 3 (Rigid material detail)
 Alternative maximum depth from cover level to soffit of pipe 3 m for areas not subject to vehicle loading or areas subject to light vehicle loading, non-entry

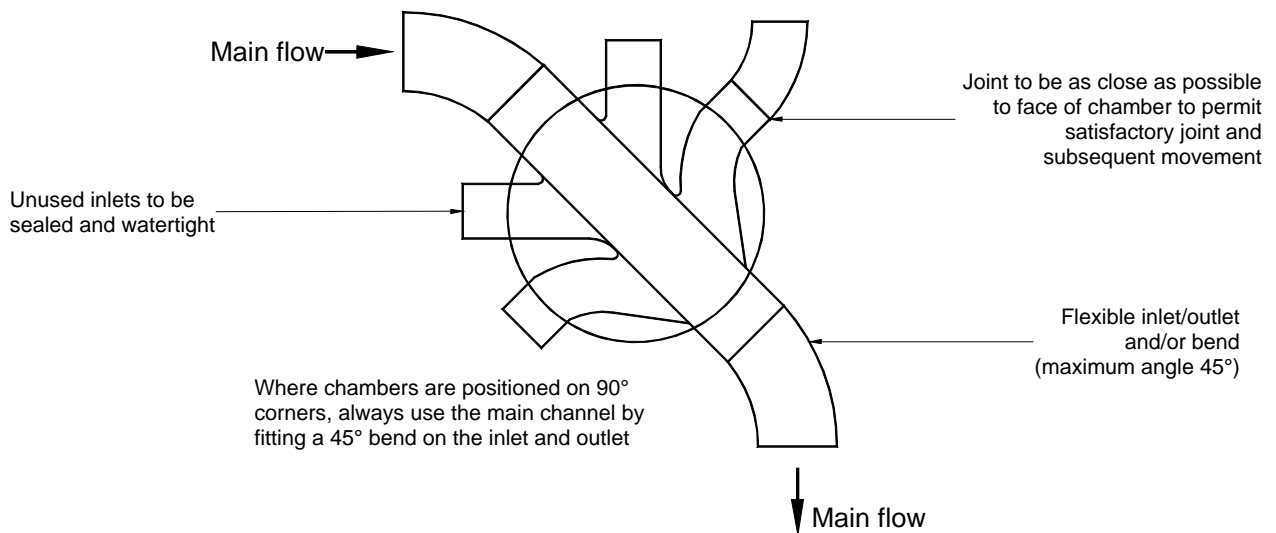
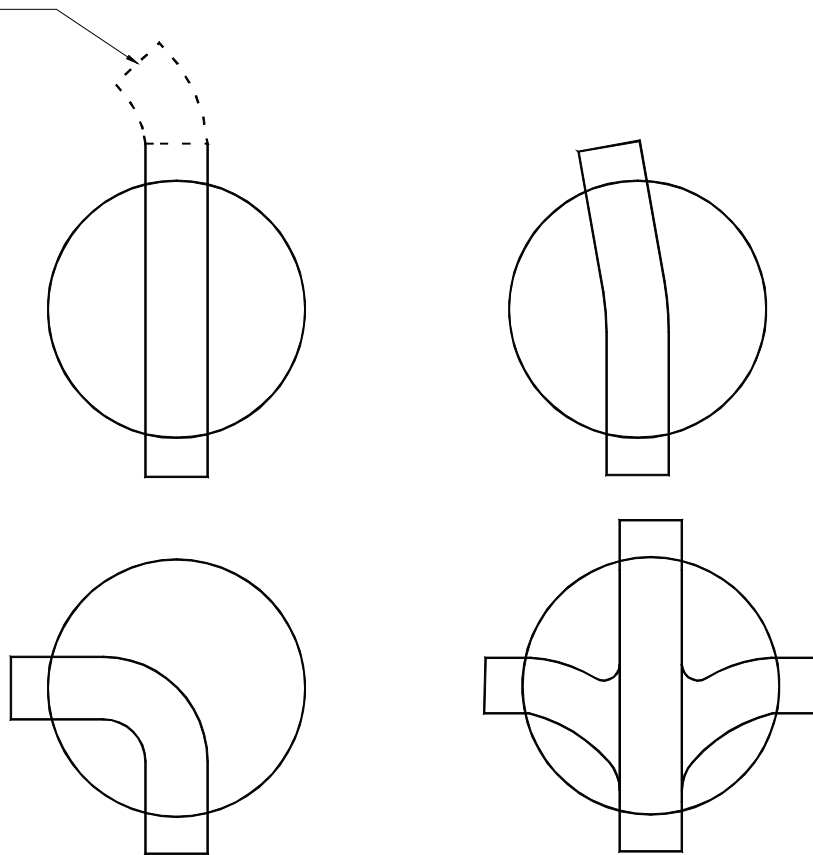


Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

**FIGURE B.13
ALTERNATIVE BASE LAYOUTS FOR TYPE 3 CHAMBERS**

Flexible inlet/outlet
and/or bend
(maximum angle 45°)
to facilitate connection



Note: Where a bend is used immediately outside the manhole, this may be used as the rocker pipe

Not to scale

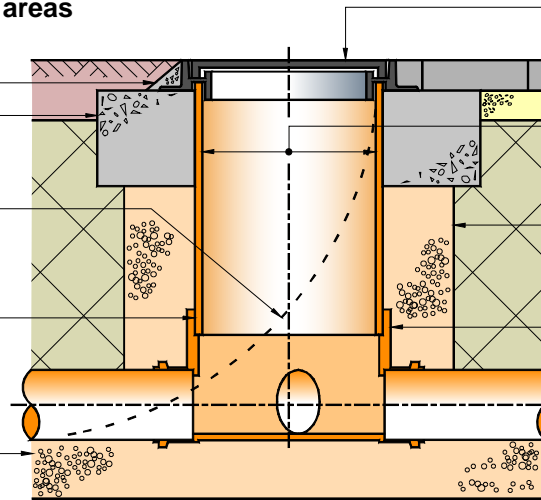
FIGURE B.14 TYPICAL INSPECTION CHAMBER DETAIL - TYPE 4 (Flexible material detail)

Maximum depth from cover level to soffit of pipe 2 m, non-entry

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

Sited in driveways/paved areas

- Mortar bedding and haunching to cover and frame to Clause D5.4
- 150 mm deep concrete collar
- Minimum radius to be 500 mm for a 100 mm diameter pipe and 600 mm for a 150 mm diameter pipe to allow entry of maintenance equipment
- Joints between base and shaft and shaft components to be fitted with watertight seals
- Granular bedding material



Cover complying with BS EN 124 and BS 7903
Driveways, footways and landscaped areas - Class B125
See Clause D2.17

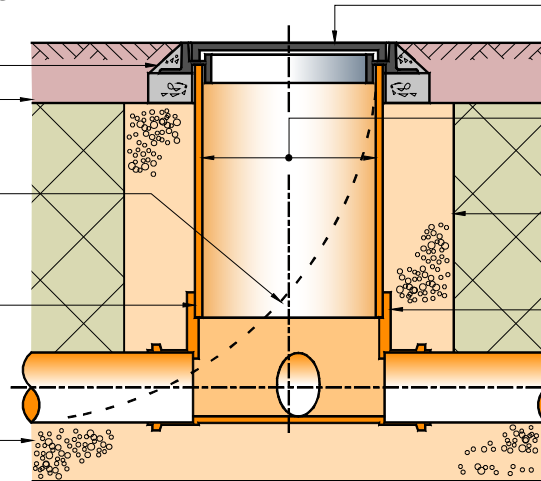
Minimum internal dimensions
180 mm diameter or
225 mm x 100 mm

DOT Type 1 sub base
(thickness varies)
or concrete surround

Base unit to have all connections
with a diameter greater than
150 mm set at soffits level

Sited in domestic gardens

- Mortar bedding and haunching to cover and frame to Clause D5.4
- Topsoil
- Minimum radius to be 500 mm for a 100 mm diameter pipe and 600 mm for a 150 mm diameter pipe to allow entry of maintenance equipment
- Joints between base and shaft and shaft components to be fitted with watertight seals
- Granular bedding material



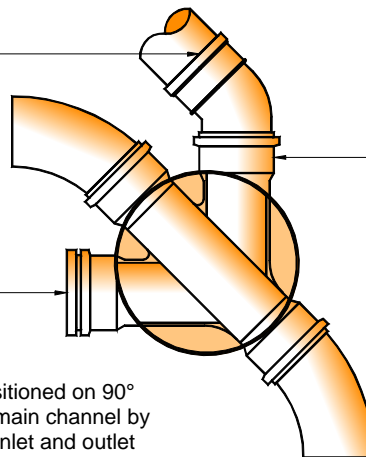
Cover complying with BS EN 124 and BS 7903
Gardens - Class A15
See Clause D2.17

Minimum internal dimensions
180 mm diameter or
225 mm x 100 mm

DOT Type 1 sub base
(thickness varies)
or concrete surround

Base unit to have all connections
with soffit levels set no lower
than that of the main pipe

Flexible inlet/outlet
and/or bend
(maximum angle 45°)



Joint to be as close as possible
to face of chamber to permit
satisfactory joint and
subsequent movement

Unused inlet to be
sealed and watertight

Where chambers are positioned on 90°
corners, always use the main channel by
fitting a 45° bend on the inlet and outlet

Note: Where the access chamber is in the highway the
Highway Authority can have specific requirements

Not to scale

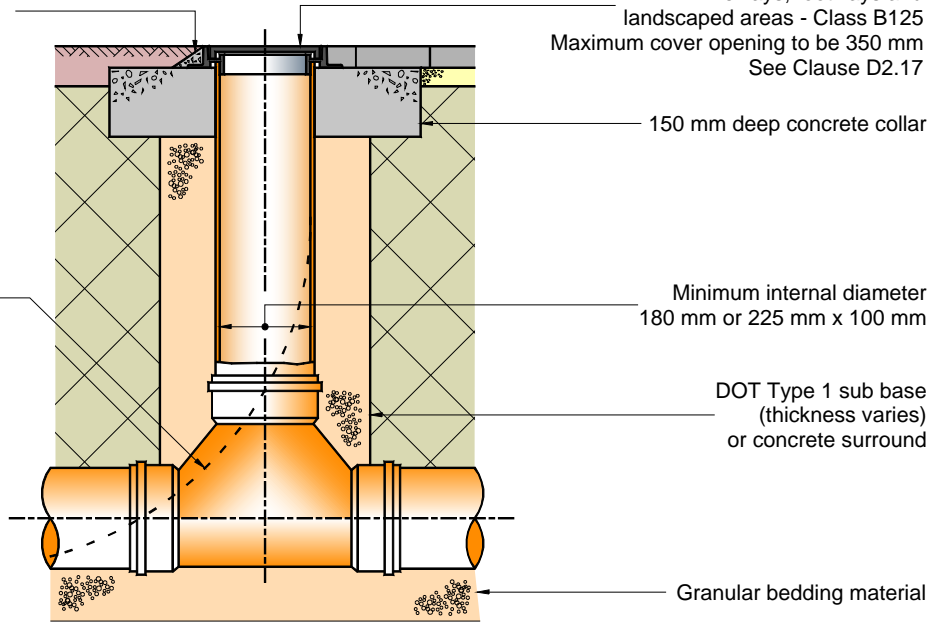
FIGURE B.15
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 4 (Alternative construction detail)
 Maximum depth from cover level to soffit of pipe 2 m, non-entry

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

Mortar bedding and haunching to cover and frame to Clause D5.4

Minimum radius to be 500 mm for a 100 mm diameter pipe and 600 mm for a 150 mm diameter pipe to allow entry of maintenance equipment

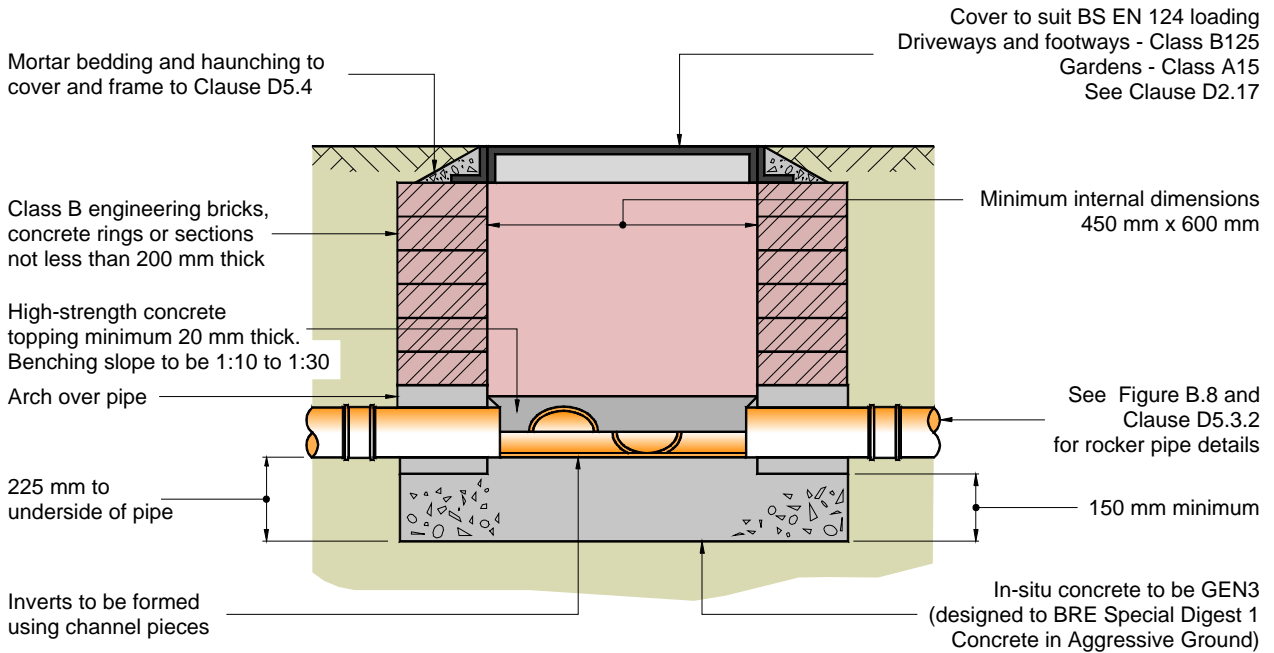
Cover complying with BS EN 124 and BS 7903 Driveways, footways and landscaped areas - Class B125
 Maximum cover opening to be 350 mm
 See Clause D2.17



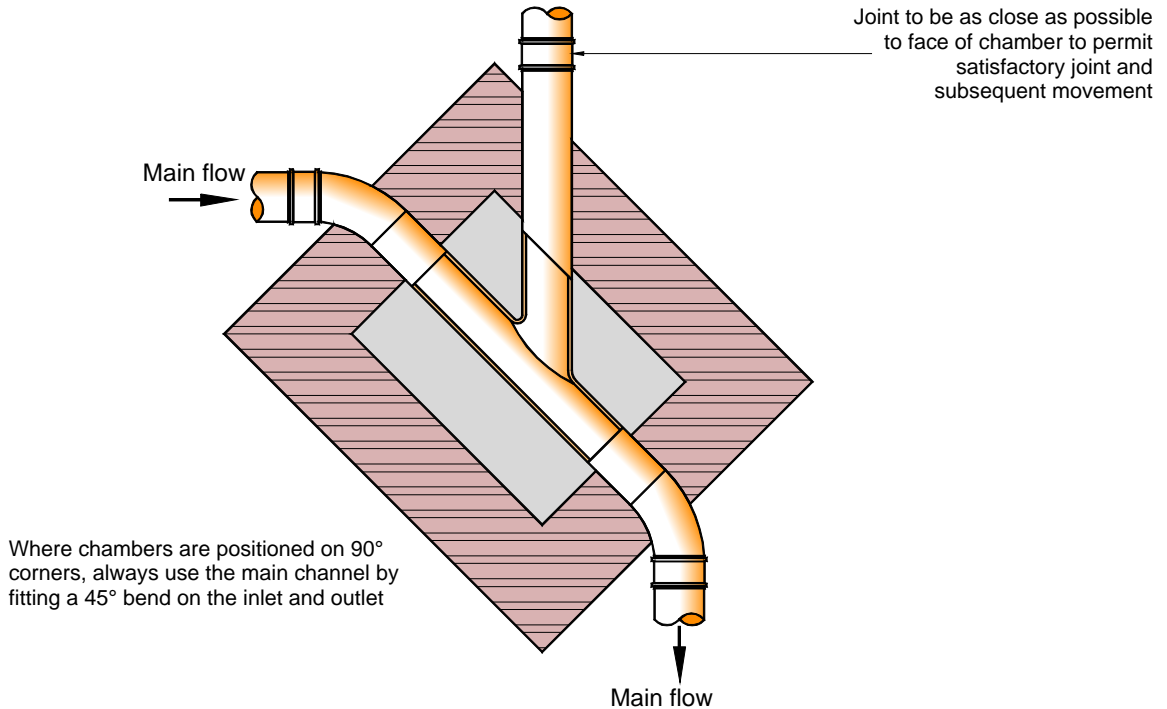
Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

Not to scale

FIGURE B.16
TYPICAL INSPECTION CHAMBER DETAIL - TYPE 4 (Rigid material detail)
 Maximum depth from cover level to soffit of pipe 1 m, non-entry



Note: The use of precast rectangular concrete manhole units with 150 mm grade GEN3 concrete surround (designed to BRE Special Digest 1 Concrete in Aggressive Ground) is permitted.



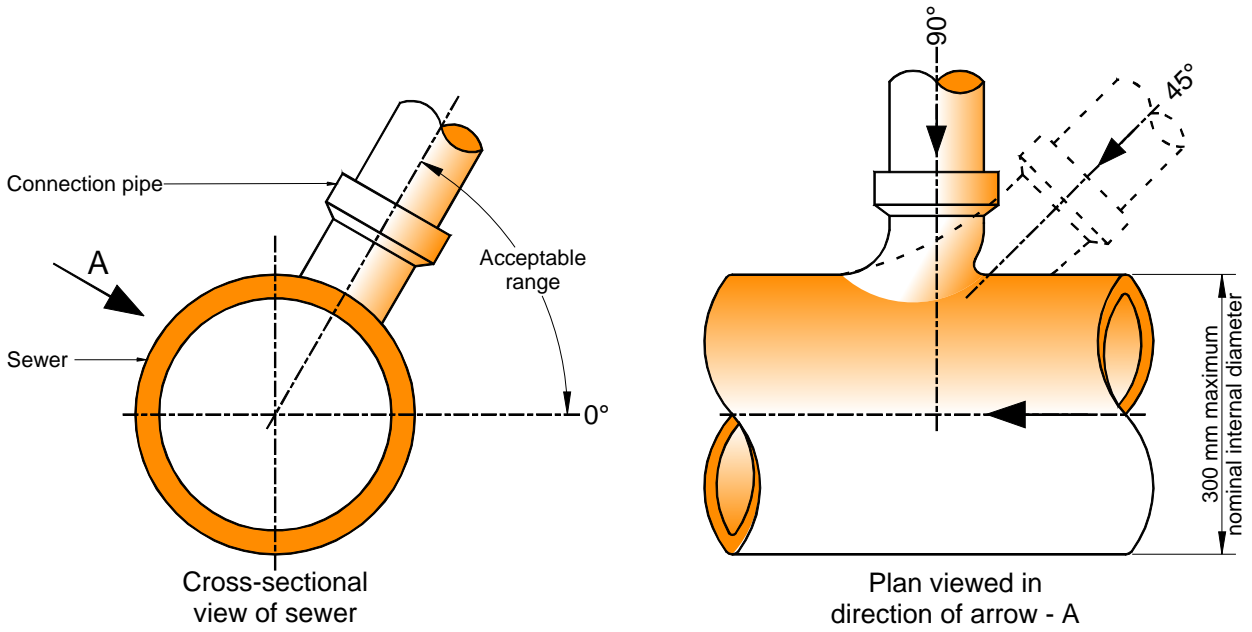
Note: Where the access chamber is in the highway the Highway Authority can have specific requirements

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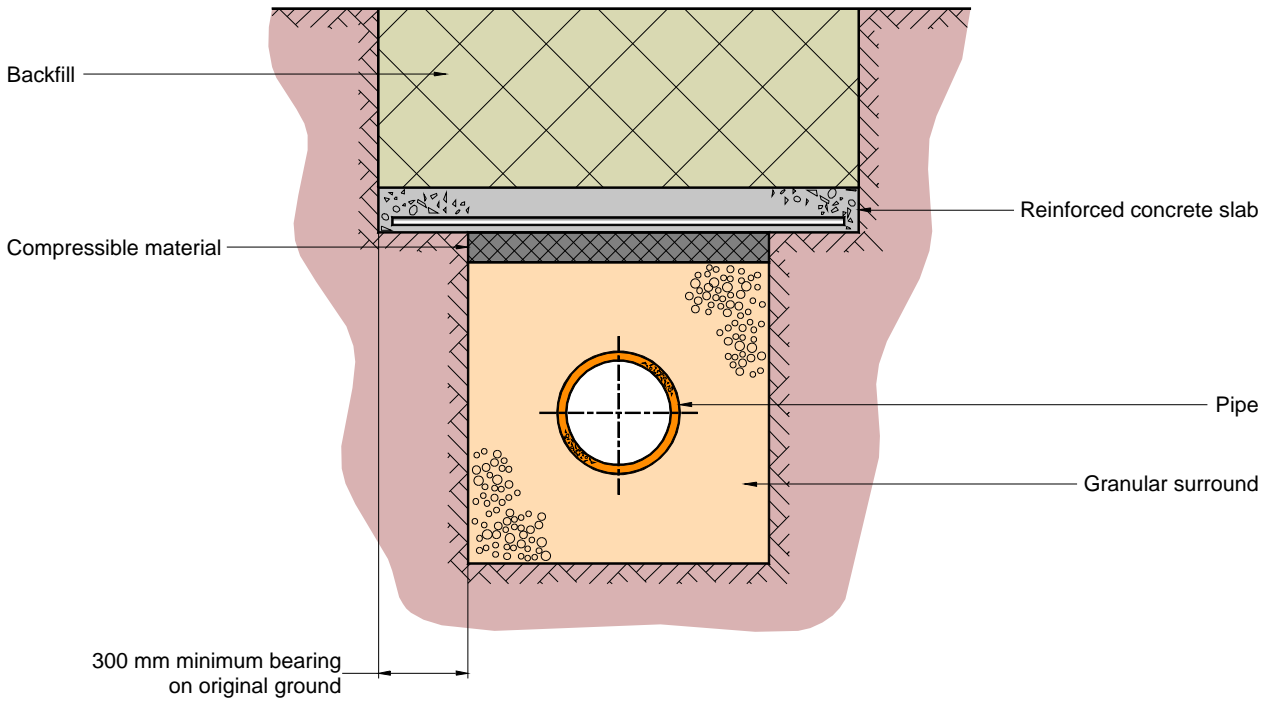
B3 RELIABILITY

1. The minimum size for a gravity foul sewer should be:
 - a) 100 mm nominal internal diameter for ten properties or less; or
 - b) 150 mm nominal internal diameter for more than ten properties.
2. The minimum size for a gravity foul lateral drain should be 100 mm.
3. As far as practicable, junctions should be built in for all planned connections when sewers are constructed to avoid damage to the sewer by installing connections at a later date. Where it is necessary to make a post-construction connection to a sewer, B3.8 and D4.6 will apply. The upstream end of any unused connection should be sealed until required.
4. The vertical angle between the connecting pipe and the horizontal should be greater than 0° and not more than 60° (see Figure B.17).
5. Where the connection is being made to a sewer with a nominal internal diameter of 300 mm or less, connections should be made using 45° angle, or 90° angle, curved square junctions (see Figure B.17).
6. Connections made with junction fittings should be made by cutting the existing pipe, inserting the junction fitting and jointing with flexible repair couplings or slip couplers.
7. Where the connection is being made to a sewer with a nominal internal diameter greater than 300 mm:
 - a) where the diameter of the connecting pipe is greater than half the diameter of the sewer, the connection of an access point should be constructed; or
 - b) where the diameter of the connecting pipe is less than or equal to half the diameter of the sewer, then the connection should be made using a preformed saddle fitting.
8. Connections made with saddle fittings should be made by cutting and safely removing a core from the pipe and jointing the saddle fitting to the pipe, in accordance with the manufacturer's instructions, to ensure a watertight joint. The connecting pipe should not protrude into the sewer.
9. To provide a self-cleansing regime within gravity foul sewers:
 - a) a 150 mm nominal internal diameter gravity sewer is laid to a gradient not flatter than 1:150 where there are at least ten dwelling units connected; or
 - b) a sewer or lateral drain with a nominal internal diameter of 100 mm, or a lateral drain serving ten or less properties is laid to a gradient not flatter than 1:80, where there is at least one WC connected and 1:40 if there is no WC connected.
10. These parameters should not to be taken as a norm when the topography permits steeper gradients. Hydraulic studies indicate that these requirements may not necessarily achieve a self-cleansing regime. When a choice has to be made between gravity sewerage and pumped sewerage, these criteria should not be regarded as inflexible and the Developer should consult the Undertaker.

**FIGURE B.17
CONNECTIONS TO SEWER**



**FIGURE B.18
PROTECTION OF PIPES LAID AT SHALLOW DEPTHS**



B4 HYDRAULIC DESIGN

B4.1 Foul Sewers and Lateral Drains

1. For developments within the scope of this guide a sewer or lateral drain with a nominal diameter of 100 mm should be adequate unless exceptional flow is expected due to the nature of the commercial property. Where exceptional flows are expected the hydraulic design should be in accordance with Sewers for Adoption 7th Edition.

B4.2 Protection Against Flooding

1. In designing the site sewerage and layout, Developers should also demonstrate flow paths and the potential effects of flooding resulting from blockages, pumping station failure or surcharging in downstream combined sewers, by checking the ground levels around the likely points that flow would flood from the system to identify the flood routes.

2. The designer should carry out checks to ensure that an adequate level of protection against the flooding of properties is achieved. The layout of the sewer system and/or the development should be adjusted to minimise the risk of flooding of properties.

B5 STRUCTURAL DESIGN AND INTEGRITY

1. Buried pipes should be designed in accordance with BS EN 1295-1.

Note: BS 9295 gives information and guidance for the use of BS EN 1295-1 Annex A, the UK established method for the structural design of buried pipelines under various conditions of loading. The procedures are explained and, where general assumptions can be made, loading tables are given. Application details for pipelines laid in various trench conditions and in poor ground are shown.

2. The design of the pipeline should take account of loading from the passage of construction plant as well as normal design loading.

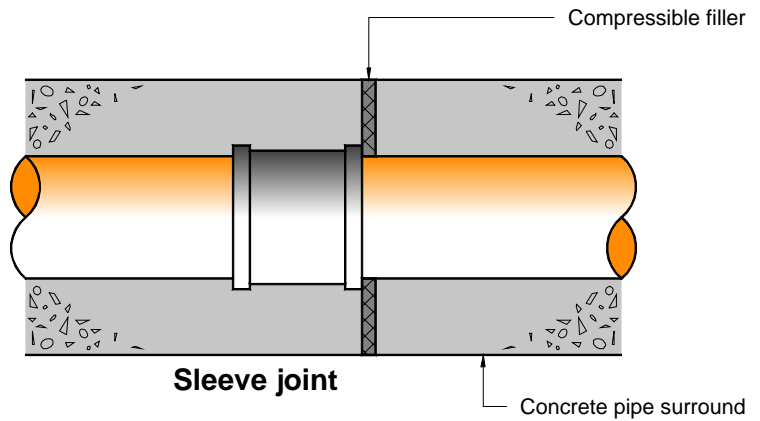
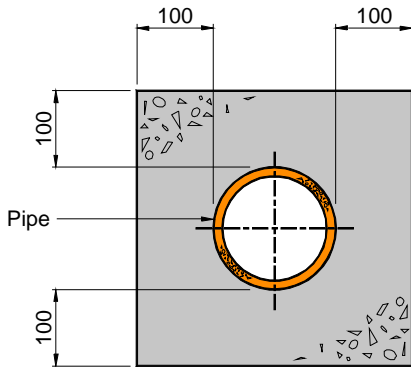
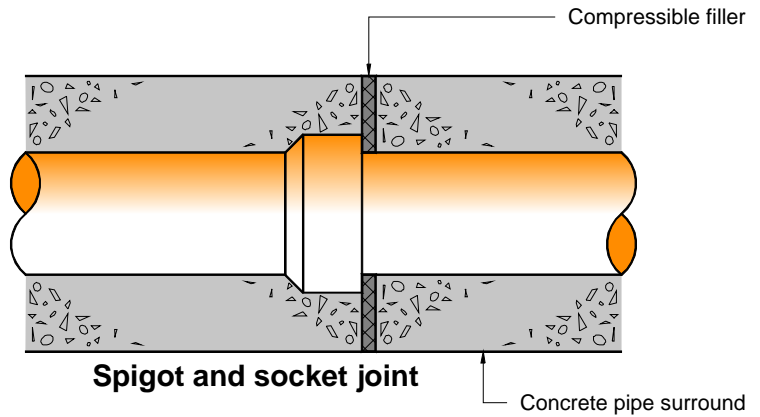
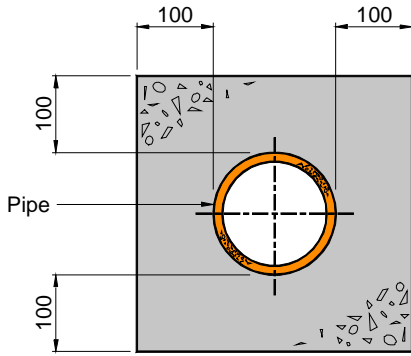
3. If the depth of cover to the crown of the pipe is less than the values recommended in Clause B2.1.10 (unless it can be demonstrated by structural calculations or other suitable means) one of the following protection measures should be provided:

- a) a concrete slab in accordance with Figure B.18; or
- b) a concrete surround with flexible joints in accordance with Figure B.19; or
- c) a ductile iron pipe of an adequate strength should be used.

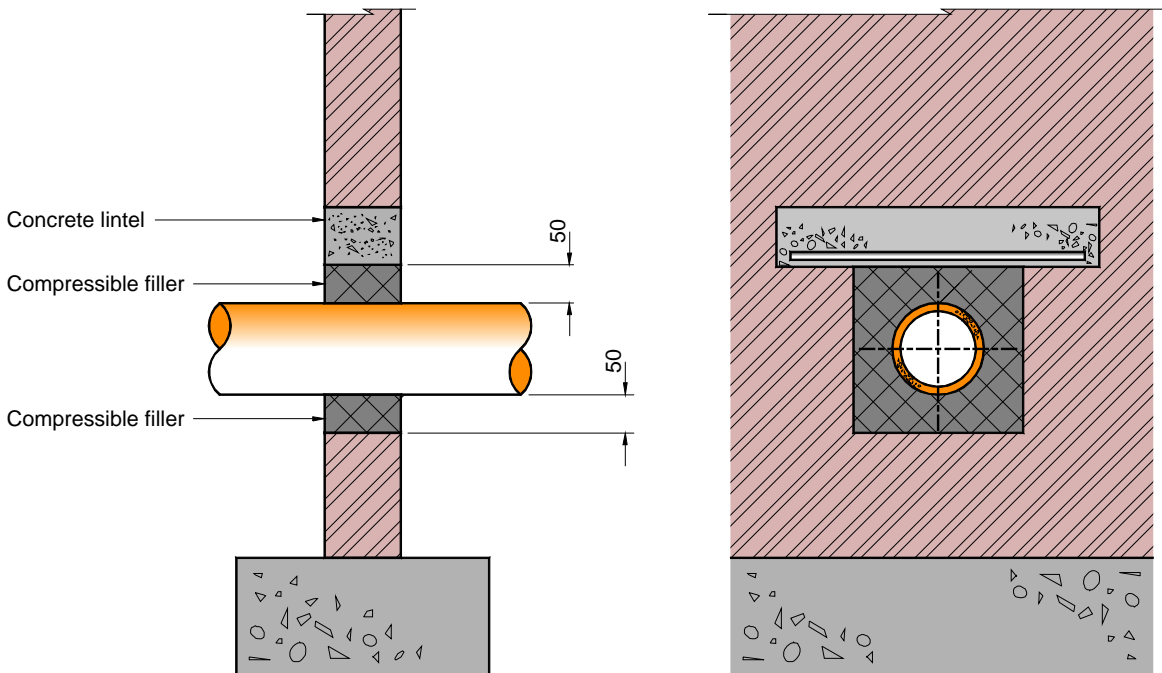
4. The structural design of all pipes should take into account the possible incidence of punching shear. The design should ensure that no vertical load is imposed by structures such as shafts onto non-load bearing components such as the pipes.

5. Where there is a risk of tree root intrusion (see Clause B2.1.13) the sewer system should be resistant to tree root ingress (e.g., by use of appropriate barriers or constructed from polyethylene with welded joints).

**FIGURE B.19
JOINTS FOR CONCRETE ENCASED PIPES**



**FIGURE B.20
PROTECTION OF PIPES PENETRATING SINGLE LEAF BOUNDARY WALLS**



Not to scale, dimensions in millimetres
(all dimensions are minimum sizes)

B6 MATERIALS

1. Materials should comply with the requirements of Part D of this guide.
2. Materials and components should comply with the following:
 - a) the manufacturing process should minimise the use of solvent-based substances that emit volatile organic compounds or ozone-depleting substances;
 - b) products should be made from recycled material, where reasonably practicable; and
 - c) the use and/or creation of substances included in the UK Red List (DoE, 1988) of toxic substances should be avoided during the manufacturing process.

B7 CONSTRUCTION

1. Construction of the drainage system should comply with the requirements of Part D of this guide.

B8 TESTING

1. Testing of the drainage system should comply with the requirements of Part D of this guide.

PART C – SURFACE WATER SEWERS AND LATERAL DRAINS

Note to Developers: New arrangements for the approval and adoption of surface water drainage by local authorities are proposed in the future.

C1 LAYOUT AND ACCESS

C1.1 Layout

1. The layout of surface water sewers and drains should be in accordance with B2.1 (except for B2.1.8) and C1.1.2.

2. Surface water sewers and lateral drains should not normally be constructed under any building, or any structure, except that they may cross under a boundary wall not greater than 1 m high (see Section C5). However, for terraced properties it is sometimes necessary to install intermediate rainwater pipes, along the length of the terrace, to take rainwater from more than one property. Where it is not reasonably practicable to route the sewer around the building, surface water sewers with a nominal internal diameter of no more than 100 mm may be laid under a building, provided that the sewer takes the drainage from no more than one rainwater pipe with a nominal internal diameter of no more than DN75, or the equivalent cross-sectional area, provided that the entry point to the rainwater pipe is in the land owned by the building concerned.

C1.2 Access

1. Access for surface water sewers and drains should be in accordance with B2.2 and C1.2.2 and C1.2.3 below.

2. For chambers containing flow control devices, see Section C4. Nodes associated with oversized pipes for storage purposes should be designed as part of the storage.

3. Where the inspection chamber is associated with a surface water attenuation arrangement, the chamber should be designed as part of that structure (see Section C4).

C2 RELIABILITY

1. Surface water sewers and drains should be in accordance with B2.3 (except for B2.3.1, B2.3.2 and B2.3.9) and C2.2, C2.3 and C2.4.

2. The minimum size for a gravity surface water sewer should be 150 mm nominal internal diameter, except where a 100 mm nominal internal diameter is permitted, in accordance with C1.1.2.

3. The minimum size for a gravity surface water lateral drain should be 100 mm nominal internal diameter.

4. To provide a self-cleansing regime within surface gravity sewers, the minimum flow velocity should be 1 m per second at pipe full flow. Where this requirement cannot be met, then this criterion would be considered to be satisfied if:

- a) a 150 mm nominal internal diameter gravity sewer is laid to a gradient not flatter than 1:150; or
- b) a 100 mm nominal internal diameter lateral drain is laid to a gradient not flatter than 1:100.

C3 HYDRAULIC DESIGN

C3.1 Surface Water on Site

1. The system should be designed under pipe full conditions to accept the following design storm (i.e., without surcharging above pipe soffit):

- sites with average ground slopes greater than 1% 1 year;
- sites with average ground slopes 1% or less 2 year; and
- sites where consequences of flooding are severe 5 year.
(e.g., existing basement properties adjacent to new development)

2. Surface water sewers should be designed for runoff from roofs and, subject to the agreement of the Undertaker, highways (including verges) and other paved areas. For these areas, an impermeability of 100% should generally be assumed. They should not be designed to take runoff from other areas or land drainage. In these cases, satisfactory and separate arrangements should be agreed with the local Land Drainage Authority and confirmed to the Undertaker.

C3.2 Protection Against Flooding

1. During extremely wet weather, the capacity of the surface water sewers may be inadequate, even though they have been designed in accordance with Clause C3.1.1. Under such conditions, sewers may surcharge and surface water can escape from those manhole covers which lie below the hydraulic gradient. In designing the site sewerage and layout, Developers should also demonstrate flow paths and the potential effects of flooding resulting from extreme rainfall blockages, pumping station failure or surcharging in downstream sewers, by checking the ground levels around the likely points that flow would flood from the system to identify the flood routes.

C3.3 Control of Surface Water Discharges

1. The Developer is encouraged to have early discussions with the Undertaker to ensure that a sustainable approach to the management of surface water from the site is applied.

2. The Local Planning Authority can specify restrictions on the route of discharge of surface water from a development. For details of these, refer to the appropriate planning guidance.

3. Flow control devices should be provided with a bypass valve so that the storage can be drained in the event of blockage of the flow control device.

C4 FLOW ATTENUATION FOR SURFACE WATER SEWER SYSTEMS

1. The design and location of flow attenuation and flow control devices and chambers are to be agreed with the Undertaker.

2. The design of flow attenuation facilities should, wherever practicable, include the following criteria:

- a) gravity tank sewers or oversized pipes should be designed as online storage;
- b) where parallel pipes are used for attenuation, one pipe should act as online storage, one as offline;
- c) the design of attenuation facilities should seek to prevent a build-up of silt and other debris, (e.g., by use of benching and low-flow channels); and
- d) attenuation facilities will be designed to allow access for regular maintenance.

3. The design of flow control devices should, wherever practicable, include the following features:

- a) flow controls may be static (such as vortex flow controls or fixed orifice plates) or variable (such as pistons or slide valves);
- b) static controls should have a minimum opening size of 100 mm chamber, or equivalent;
- c) variable controls may have a smaller opening provided they have a self-cleansing mechanism;
- d) a bypass should be included with a surface operated penstock or valve; and
- e) access should be provided to the upstream and downstream sections of a flow control device to allow maintenance.

C5 STRUCTURAL DESIGN AND INTEGRITY

1. Structural design and integrity for surface water sewers and drains should be in accordance with B5.

C6 MATERIALS

1. Materials for surface water sewers and drains should be in accordance with Part D of this guide.

C7 CONSTRUCTION

1. Construction of surface water sewers and drains should be in accordance with Part D of this guide.

C8 TESTING

1. Testing of surface water sewers and drains should be in accordance with Part D of this guide.

PART D – CIVIL ENGINEERING SPECIFICATION

Introduction

part D is drawn from Sewers for Adoption 7th Edition but is not a full reproduction of the same, and is supplemented by additional information. Any clauses in this Part which relate to work or materials not required shall be deemed not to apply.

The clause headings and marginal 'Notes for Guidance' (found in italics to the left of some clauses) are not part of the specification.

Where additional clauses are required, reference should be made to Sewers for Adoption 7th Edition.

Where Developers wish to use materials or methods not covered by this specification reference should be made to Sewers for Adoption.

D1 GENERAL

D1.1 DRAWINGS

(i) The datum level for the Works should be pre-scribed, together with any master benchmarks. Precise reference of the Works to existing features or to the Ordnance Survey National Grid should be shown.

(ii) Local differences can arise between GPS and OS coordinates.

1. One copy of the Drawings shall be kept on the site and shall be available for use by the Undertaker.

2. All levels on the Drawings shall be related to Ordnance Survey Newlyn Datum. Details shall be provided of the level and location of the temporary benchmarks and reference points which are proposed to be used.

D1.2 SETTING OUT

1. The Developer shall be responsible for setting out the Works and for the correctness of the position and dimensions of all parts of the Works.

D1.3 QUALITY OF MATERIALS, WORKMANSHIP AND TESTS

1. All materials and workmanship shall be subjected, from time to time, to such tests as the Undertaker may direct.

2. If required by the Undertaker, a list of the Developer's proposed suppliers and sources of materials required for the execution of the Works shall be submitted to the Undertaker. Samples shall be taken in accordance with the appropriate British

Standard, where applicable.

D1.4 EXAMINATION OF WORK

1. The Undertaker shall be afforded the opportunity to examine any work which is about to be covered up or put out of view, and to examine foundations before permanent work is to be placed thereon.

2. At least one clear working day's notice shall be given to the Undertaker before any formation is covered with permanent work and before testing any pipeline.

D1.5 EXISTING PUBLIC SEWERS

All necessary precautions shall be taken to avoid causing any damage to, or interference with flow in, existing public sewers and shall ensure that debris, silt and mud, etc., do not enter the sewer. All necessary precautions shall be taken to avoid misconnection to existing public sewers.

D1.6 SAFETY IN SEWERS

1. Where work is required to be carried out within or adjacent to any sewer, there shall be regard of the relevant provisions of 'The Classification and Management of Confined Space Entries' published by Water UK.

(i) The Undertaker may also have its own health and safety provisions in respect of work carried out within or adjacent to any public sewer

D1.7 BRITISH AND EUROPEAN STANDARDS AND OTHER DOCUMENTS

Any reference to a Standard published by BSI, or to the specification of another body, shall be construed equally as reference to an equivalent one. Submissions shall be in accordance with the latest published Standard which is current on the date the submission is made.

D2 MATERIALS

D2.1 STORAGE OF MATERIALS

1. Materials and components shall be stored in such a manner as to preserve their quality and condition to the standards required by the Specification.

D2.2 HANDLING AND USE OF MATERIALS

1. Materials and components shall be handled in such a manner as to avoid any damage or contamination, and in accordance with all applicable recommendations of the manufacturers.

2. Unless otherwise described in the Specification, the use, installation, application or fixing of materials and components shall be in accordance with all applicable recommendations of

(i) An understanding of manufacturer's recommendations is necessary before their applicability can be assessed.

the manufacturers. Where appropriate, any technical advisory services offered by manufacturers shall be used.

D2.3 WATER

1. Water for use with cement shall be of wholesome quality.

D2.4 SANDS FOR MORTAR AND GROUT

i) The requirement for sands to be washed is additional to the requirements of the Standards, but is in line with the main conclusion of CIRIA Report R59 'Building Sands: Availability, Usage and Compliance with Specification Requirements'.

1. Sands for mortar and grout shall comply with BS EN 13139 and PD 6682-3.

2. Sands for external rendering shall comply with the relevant provisions of BS EN 13139 and PD 6682-3.

3. All sands required to comply with BS EN 12620 and PD 6682-1, BS EN 13139 and PD 6682-3 shall be washed sands.

D2.5 CEMENT

(i) The lower strength limit of 20 N per mm² for the use of sulphate-resisting Portland cement is consistent with BS 4027 for standard mixes.

1. Cement shall either:

a) be factory-produced by the cement manufacturer and comply with the provisions of the appropriate Standard, as Table D.1; or

Table D.1

| Type | Standard |
|-----------------------------|-------------|
| Portland (CEM1) | BS EN 197-1 |
| Sulphate-resisting Portland | BS 4027 |

(ii) BRE Special Digest No. 1 'Concrete in Aggressive Ground' deals with sulphate-resistance classification.

(iii) For a comprehensive specification for cement see CESWI 7th edition.

b) be combinations, complying with BS 8500-1 Annex A, of CEM 1 cement conforming to BS EN 197-1 and fly ash conforming to BS EN 450-1 or blastfurnace slag conforming to BS EN 15167-1.

2. For precast concrete pipes or inspection chambers complying with BS EN 1916, BS EN 1917 and BS 5911, a minimum class 3, sulphate-resistant cement shall be used unless the Undertaker can be satisfied that a lower class will resist attack from soils and groundwater.

D2.6 MORTAR

(i) The alternative mixes are broadly equivalent (see Table 3 of PD 6472) but the use of lime putty or plasticiser gives additional plasticity (see BS EN 998-1 and BS EN 998-2).

(ii) The cement:lime:sand mortar is consistent with Category 1.12 of BS EN 998-1 and BS EN 998-2 and, together with the cement:sand:mortar, is consistent with Designation (i) ready-to-use mortar in BS EN 998-2.

(i) Where necessary, the surface finish should be shown on the Drawings.

(i) IGN 4-11-01 deals with vitrified clay pipes and fittings.

(ii) The type of joint and jointing materials for extra chemically-resistant pipes should be shown on the

1. Mortar shall be mixed only as and when required, in the relevant proportions indicated in Table D.2, until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand.

Table D.2

| Alternative nominal mixes by volume | | |
|-------------------------------------|-------------|------------------------------|
| Cement:lime:sand | Cement:sand | Cement:sand with plasticiser |
| 1 : ¼ : 3 | 1 : 3 | 1 : 2½ to 3 |

2. Ready-mixed lime, sand for mortar and ready-to-use retarded mortar shall comply with the relevant provisions of BS EN 998-1 and BS EN 998-2 and be of Category 1.12 and Designation (i), respectively.

3. All mortar shall be conveyed fresh to the Works as required for use. Mortar which has begun to set or which has been site-mixed for a period of more than one hour shall not be used. Plasticising and set-retarding mortar admixtures shall comply with BS EN 934-3 and shall be supplied with instructions for use.

D2.7 PRECAST CONCRETE PRODUCTS

1. Constituent materials of precast concrete products shall comply with the relevant requirements of this Specification, except where an appropriate European or British Standard includes specified requirements to the contrary.

2. Except where otherwise agreed or specified in a relevant European or British Standard, the surface finish of precast concrete products shall be Rough Finish for surfaces next to earth and Fair Finish elsewhere.

3. Precast concrete slabs and cover frame seating rings shall comply with the relevant provisions of BS EN 1917 and BS 5911-3.

D2.8 VITRIFIED CLAY PIPES AND FITTINGS

1. Vitrified clay pipes and fittings for sewers shall have flexible mechanical joints. Pipes for foul sewers and surface water sewers shall comply with the relevant requirements of BS EN 295-1 and BS 65 (surface water pipes only).

2. Extra chemically-resistant pipes and fittings shall comply with the additional requirements of BS 65.

Drawings.

(i) Particular requirements from the options listed in BS EN 1916 and BS 5911 should be described.

(ii) Additional protective measures required by BRE Special Digest No.1 to provide resistance to the actual ACEC (Aggressive Chemical Environment for Concrete class) should be described.

(i) BS EN 1295-1 gives guidance on the structural design of underground non-pressure PVC-U pipes.

3. Vitrified clay jacking pipes shall conform to BS EN 295-7.

D2.9 CONCRETE PIPES AND FITTINGS

1. Unreinforced and reinforced concrete pipes and fittings shall comply with the relevant provisions of BS EN 1916 and BS 5911-1.

2. All pipes and fittings shall have gasket-type joints of spigot and socket or rebated form.

3. Unreinforced and reinforced concrete jacking pipes shall comply with the relevant provisions of BS EN 1916 and BS 5911-1. Pipes shall withstand the jacking loads to which they will be subjected during installation, without cracking or spalling. A certificate shall be supplied, confirming that the pipes are suitable for jacking and stating the distributed jacking loads for which they were designed.

D2.10 THERMOPLASTICS PIPES AND FITTINGS

1. Thermoplastics pipes, joints and fittings for gravity sewers shall comply with the relevant provisions of BS EN 1401-1, BS EN 1852 and BS EN 12666-1.

D2.11 JOINT SEALS AND LUBRICANTS

1. Elastomeric joint seals shall be Type WC or WG, complying with the relevant provisions of BS EN 681-1, and shall be obtained from the pipe manufacturer.

2. Joint lubricants for sliding joints shall have no deleterious effect on either the joint rings or pipes, and shall be unaffected by sewage.

3. Seals shall be tested in accordance with BS 7874 and shall comply with the following:

- a) the average loss in mass (Z) of the test pieces shall not exceed 3.5%; and
- b) there shall be no greater release of carbon black or other fillers from the test set than from the control set when the surface of the specimens is lightly rubbed.

4. In the case of composite seals, the requirements apply only to those components exposed to the contents of the pipeline or pipework.

D2.12 PIPE SURROUND MATERIALS

(i) IGN 4-08-01 gives guidance on pipe surround materials.

(ii) Any limitations on the size and type of materials should be described.

1. Processed granular and "as-dug" bedding, sidefill and surround materials for buried pipelines shall comply with WIS 4-08-02.

2. Recycled materials shall comply with BS 8500-2.

D2.13 COMPRESSIBLE FILLER AND PACKING FOR PIPELINES

1. Compressible filler for interrupting concrete protection to pipes shall consist of bitumen-impregnated insulating board to BS EN 622-1 and BS EN 622-4. The thickness of compressible filler shall be as Table D.3.

Table D.3

| Nominal diameter of pipe (mm) | Thickness of compressible filler (mm) |
|-------------------------------|---------------------------------------|
| Less than 450 | 18 |
| 450 – 1200 | 36 |
| Exceeding 1200 | 54 |

2. Compressible packing for use between pipes and precast concrete setting blocks shall consist of bitumen damp proof sheeting complying with BS 6398.

3. Bituminous materials shall not be put into contact with plastics pipes.

D2.14 PRECAST CONCRETE INSPECTION CHAMBERS

(i) Particular requirements from the options listed in BS EN 1917 and BS 5911-3 should be shown on the Drawings.

1. Precast concrete inspection chambers units shall comply with the relevant provisions of BS EN 1917 and BS 5911-3. Units which bed into bases shall be manufactured so that imposed vertical loads are transmitted directly via the full wall thickness of the unit. The profiles of joints between units and the underside of slabs, shall be capable of withstanding applied loadings from such slabs and spigot-ended sections shall only be used where the soffit of the slab is recessed to receive them.

D2.15 PRECAST CONCRETE INSPECTION CHAMBERS COMPONENTS

1. Precast concrete shall comply with the relevant provisions of BS EN 1917 and BS 5911-3.

D2.16 PLASTIC CHAMBERS AND RINGS

1. Plastic chambers and rings, including demarcation chambers, shall comply with BS EN 13598-1 or BS EN 13598-2 as appropriate.

D2.17 INSPECTION CHAMBER COVERS AND FRAMES

(i) BS EN 124 is a minimum performance standard only.

1. Inspection chamber covers and frames shall comply with the relevant provisions of BS EN 124, BS 7903 and Highways Agency Guidance Document HA 104/09. They shall be of a non-rocking design which does not rely on the use of cushion inserts.

2. Inspection chamber covers on foul-only sewers shall be of low leakage types in order to prevent excessive surface water ingress.

3. As a minimum, Class D 400 covers shall be used in carriageways of roads (including pedestrian streets), hard shoulders and parking areas used by all types of road vehicles.

4. Minimum frame depths for New Roads and Street Works Act road categories I to IV shall be as Table D.4.

Table D.4

| NRSWA road category | Description | Minimum frame depth (mm) |
|----------------------------|--|---------------------------------|
| I | Trunk roads and dual carriageways | 150 |
| II | All other A roads | 150 |
| III | Bus services | 150 |
| IV | All other roads except residential cul-de-sacs | 150 |
| | Residential cul-de-sacs | 100 |

5. Class B 125 shall be used in footways, pedestrian areas and comparable locations.

6. In situations where traffic loading is anticipated to be heavier than would occur on a typical residential estate distributor road

(i.e., braking or turning near a junction), a higher specification (E600) shall be used.

7. All inspection chamber covers shall be the non-ventilating type and shall have closed keyways.

D2.18 BRICKS AND BLOCKS

(i) The term "blocks" has been used for precast concrete masonry units.

1. Concrete bricks or blocks to be used in inspection chambers shall be precast concrete masonry units, manufactured in accordance with BS 6073-2 (partially replaced by BS EN 772-2, containing a minimum of 350 kg per m³ of sulphate-resisting cement and having a maximum water:cement ratio of 0.45, a minimum compressive strength of 40 N per mm², and a maximum water absorption of 7%.

2. Clay bricks to be used in inspection chambers shall be solid, Class B engineering bricks complying with the relevant provisions of BS EN 771-1.

3. The shapes and dimensions of special bricks shall comply with the relevant provisions of BS 4729.

4. All bricks shall have freeze/thaw designation F2.

5. All bricks shall have active soluble salts content designation S2.

D2.19 FLEXIBLE COUPLINGS

1. Flexible couplings for gravity sewerage and drainage pipes shall comply with the provisions of WIS 4-41-01 and BS EN 295-4.

D3 EXCAVATION AND BACKFILLING

D3.1 EXCAVATION

1. Operations shall be carried out in such a manner as to prevent damage to, or deterioration of, the formation of excavations.

2. Excavation in roads and streets shall be carried out in accordance with the relevant Highway Reinstatement Specification.

3. Excavations in locations where services may be encountered shall be carried out in accordance with 'HSG 47 Avoiding Danger from Underground Services'.

4. Trenches shall be excavated so that the effective width is maintained within any limit imposed by the design of the pipeline. The sides of excavations shall be adequately supported at all times and, except where permitted, shall not be battered.

5. If ground in the formations is encountered which is considered unsuitable, or if the formation is damaged or allowed to

deteriorate, the Undertaker shall be promptly informed.

6. Soft spots shall be removed from the bottom of trenches and other excavations, which shall then be refilled to formation level with the same material as the permanent work which is to rest on that formation. Any void which results from over-excavation below formation level shall be refilled in the same manner.

7. Excavated granular material which can be reused shall be kept separate from excavated cohesive materials.

D3.2 DEALING WITH WATER

(i) A Discharge Consent may be required from the Environment Agency.

(ii) Pollution Prevention Guidance PPG 5 and 6 published by the Environment Agency should be applied.

1. Water shall not be allowed to accumulate in any part of the Works. Water arising from, or draining into, the Works shall be drained or pumped to a consented disposal point. Any drainage sumps required shall, where practicable, be sited outside the area excavated for the permanent Works, and shall be refilled with either DoT Type 1 granular sub-base material or lean concrete Grade GEN1 (C10) to the level of the underside of the adjacent permanent Works.

2. All necessary precautions shall be taken to prevent any adjacent ground from being adversely affected by loss of fines through any dewatering process.

3. Discharges to sewers shall not take place without the consent of the Undertaker.

D3.3 BACKFILLING

(i) The Highway Authority may impose requirements for backfilling under existing highways.

1. Backfilling shall, wherever practicable, be undertaken immediately when the specified operations preceding it have been completed. Backfilling shall not, however, be commenced until the works to be covered have achieved a strength sufficient to withstand all loading imposed thereon.

2. Backfilling shall be undertaken in such a manner as to avoid uneven loading or damage.

3. Filling material shall be deposited in layers not exceeding 225 mm unconsolidated thickness, and then fully compacted to form a stable backfill. Where the excavation is within 1 m of the outside of the edge of the carriageway (or proposed carriageway), the fill material shall be such as to permit adequate drainage. Where the excavations have been supported and the supports are to be removed, these, where practicable, shall be withdrawn progressively as backfilling proceeds, in such a manner as to minimise the danger of collapse, and all voids formed behind the supports shall be carefully filled and compacted.

4. Backfilling and reinstatement in roads and streets shall be above the level of any pipe surround required, in accordance with

the relevant Highway Reinstatement Specification.

5. Filling material to excavations not situated in highways or prospective highways shall be placed and compacted to form a stable backfill.

6. Hardcore shall consist of clean, hard, durable material uniformly graded from 200 mm to 20 mm, and be free from extraneous matter.

7. Selected fill, whether selected from locally-excavated material or imported, shall consist of uniform, readily-compactible material. Fill shall be free from vegetable matter, building rubbish and frozen material or materials susceptible to spontaneous combustion, and shall exclude clay of liquid limit greater than 80 and/or plastic limit greater than 55 and materials of excessively high moisture content. Clay lumps and stones retained on 75 mm and 37.5 mm sieves, respectively, shall be excluded from the fill material.

D3.4 REINSTATEMENT USING FOAMED CONCRETE

1. Reinstatement of openings in highways and roads using foamed concrete shall comply with the British Cement Association publication 'Foamed Concrete – A Specification for Use in Reinstatement of Openings in Highways'.

2. The pipe surround material shall be protected from the foamed concrete by an impermeable layer.

D4 CONSTRUCTION OF GRAVITY SEWERS

D4.1 GENERAL CONSTRUCTION

(i) The following publications give recommendations on standards of good practice for the installation of pipelines on land:

BS 5955-6 'Code of Practice for the Installation of Unplasticized PVC Pipework for Gravity Drains and Sewers';

'Principles of Laying Sewers', is a guide to good site practice available from Water UK;

BS EN 752 'Drain and Sewer Systems Outside Buildings';

BS EN 1610 'Construction

1. Where socketed pipes are required to be laid on a granular or sand bed or directly on a trench bottom, joint holes shall be formed in the bedding material or excavated formation to ensure that each pipe is uniformly supported throughout the length of its barrel and to enable the joint to be made.

2. Pipes shall be laid on setting blocks only where a concrete bed or cradle is used.

3. Where pipes are required to be bedded directly on the trench bottom, the formation shall be trimmed and levelled to provide even bedding of the pipeline and shall be free from all extraneous matter that may damage the pipe, pipe coating or sleeving.

4. Pipes and fittings shall be examined for damage and the joint surfaces and components shall be cleaned immediately before laying.

5. Suitable measures shall be taken to prevent soil or other material from entering pipes, and each pipe shall be anchored to prevent flotation or other movement before the Works are

and Testing of Drains and Sewers'; and

BS 8000-14 'Workmanship on Building Sites. Code of Practice for Below Ground Drainage'.

(i) IGN 4-08-01 gives guidance on pipe surround materials.

(ii) Geotextile membranes may be an acceptable alternative to the use of clay stanks.

(iii) Full bed and surround may not be required for rigid, large diameter pipes. Reference should be made to manufacturer's instructions.

(i) Full bed and surround may not be required for rigid, large diameter pipes.

complete.

6. Where pipeline marker tapes are specified, they shall be laid between 100 mm and 300 mm above the pipe. Where a tracer system is specified, it shall be continuous and adequately secured to valves and fittings.

D4.2 PIPE BEDDING

1. Bedding for pipes shall be constructed by spreading and compacting granular bedding material over the full width of the pipe trench. After the pipes have been laid, additional granular material shall, if required, be placed and compacted equally on each side of the pipes and, where practicable, this shall be done in sequence with the removal of the trench supports.

2. Where in the opinion of the Undertaker the flow of groundwater is likely to transport fine soil particles, water stops of puddle clay extending up through the bedding and sidefill shall be placed across the trench and immediately downstream of any temporary works.

3. In bad ground conditions, where the migration of the pipe granular surround into the ground may occur or fines may be moved from the surround material into the bedding material causing a lack of support of the bedding, the surround shall be wrapped in geotextile membrane (see BS 9295:2010 Clause A.13, Figures A.5 and A.6).

D4.3 PIPE SURROUND

1. Pipe surround material shall, where required, be placed and compacted over the full width of the trench in layers not exceeding 150 mm before compaction, to a finished thickness of 300 mm above the crown of the pipes.

2. Subsequent backfilling shall then be carried out as specified in Section 3.3.

D4.4 PIPE JOINTING GENERALLY

i) Proprietary joints are required to be made in accordance with the manufacturer's instructions.

(ii) The remaining flexibility is required for any subsequent settlement or ground movement.

1. Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled. Care shall be taken to ensure that there is no ingress of grout or other extraneous material into the joint annulus after the joint has been made.

2. Site fusion jointing in polyethylene pressure pipelines shall be undertaken in accordance with the relevant provisions of WIS 4-32-08.

3. Where PE pipes are used, a fully-welded system shall be used and the number of joints minimised. Mechanical or electrofusion joints shall not be used.

4. Proprietary joints shall be made in accordance with the manufacturer's instructions.

D4.5 CUTTING PIPES

1. Pipes shall be cut in accordance with the manufacturer's recommendations to provide a clean square profile without splitting or fracturing the pipe wall and causing minimal damage to any protective coating. Where necessary, the cut ends of pipes shall be formed to the tapers and chamfers suitable for the type of joint to be used.

2. Where ductile iron pipes are to be cut to form non-standard lengths, the manufacturer's recommendations in respect of ovality correction and tolerances to the cut spigot end shall be complied with.

3. Where concrete pipes are cut, any exposed reinforcement shall be sealed with an epoxy-resin mortar.

4. Pre-stressed concrete pipes shall not be cut on site.

5. Particular safety precautions shall be taken to avoid inhalation of dust when cutting asbestos-cement pipes.

D4.6 CONNECTIONS TO GRAVITY SEWERS

1. Where junction pipes for future connections are required, they shall be inserted, as necessary, during construction of the sewers, and the ends of connections and pipes not needed for immediate use shall be effectively sealed with a plug. The position of all junctions shall be recorded by measurement from the centre of the manhole cover immediately downstream, and notified to the Undertaker before backfilling is carried out.

2. Connections shall be made using standard pre-formed junctions, where possible. Saddle connections to existing sewers shall only be allowed when the internal diameter of the major pipe is at least 150 mm greater than the internal diameter of the

branch pipe.

3. Pipe saddles for concrete or clay sewers shall be bedded in Class M1 mortar and a mortar fillet formed to give a cover of at least 50 mm to the base of the saddle.

D4.7 TOLERANCES IN GRAVITY SEWERS AND LATERAL DRAINS

(i) Lines and levels for sewers and lateral drains should be as shown on the Drawings.

1. The position of the internal face of any sewer or lateral drain shall not deviate from the line and level described in the Agreement, or agreed variation, by more than ± 20 mm.

2. No pipe in a sewer or lateral drain shall have a reverse gradient.

3. The joint displacement, being the difference in level or alignment between the adjacent ends of two adjoining pipes at a joint, shall not exceed the least of 5% of the nominal diameter of the pipe or 20 mm.

4. The angular displacement at a joint, being the difference in the alignment of two adjacent pipes, shall not exceed 2° except where the joint has been specifically designed and manufactured to accommodate a larger displacement.

5. Flexible pipes shall have a limit of 6% deformation.

D5 CONSTRUCTION OF INSPECTION CHAMBERS

D5.1 PRECAST CONCRETE INSPECTION CHAMBERS

1. Precast concrete inspection chamber sections for inspection chambers shall be constructed with steps, ladders and slabs aligned correctly.

2. The jointing material for precast units shall be mortar, proprietary plastomeric or elastomeric seal with load bearing distribution, with the concrete surfaces prepared in accordance with the manufacturer's recommendations.

3. Joints shall be made so that the required jointing material fills the joint cavity. Concrete to concrete contact across the joint shall not be permitted. Any surplus jointing material which is extruded inside the manhole, chamber or wet well shall be trimmed off and joints shall be pointed on completion.

4. Concrete surrounds to manholes, chambers and the wet well shall be Grade GEN3 and the height of each concrete pour shall not exceed 2 m. Each construction joint shall break joint with the precast sections by at least 150 mm.

5. Cements are to achieve BRE Digest Class 4 sulphate resistance.

D5.2 IN-SITU INVERTS AND BENCHINGS

1. Inverts and benchings in inspection chambers shall have a screeded, ridged finish and shall have a smooth, high-strength concrete topping applied with a steel trowel before the concrete has set.

D5.3 PIPES AND JOINTS ADJACENT TO STRUCTURES

1. Where rigid pipes are used, a flexible joint shall be provided as close as is feasible to the outside face of any structure into which a pipe is built, within 150 mm for pipe diameters less than 300 mm. The design of the joints shall be compatible with any subsequent movement.

2. The recommended length of the next pipe (rocker pipe) away from the structure shall be as shown in Table D.5.

Table D.5

| Nominal diameter (mm) | Maximum effective length (m) |
|----------------------------------|---|
| 150 to 600 | 0.6 |
| 600 to 750 | 1.0 |
| over 750 | 1.25 |

3. Stub pipes into structures shall be of rigid material.

D5.4 SETTING INSPECTION CHAMBERS COVERS AND FRAMES

1. Inspection chamber frames shall be set to level, bedded and haunched externally over the base and sides of the frame in mortar, in accordance with the manufacturer's instructions. The frame shall be seated on at least two courses of Class B engineering bricks, on precast concrete masonry units or on precast concrete cover frame seating rings to regulate the distance between the top of the cover and the top rung to no greater than 675 mm. A mortar fillet shall be provided where the corners to an opening in a slab are chamfered and the brickwork is not flush with the edges of the opening.

2. Frames for inspection chamber covers shall be bedded in a polyester resin bedding mortar in all situations where covers are sited in NRSWA Road Categories I, II or III (i.e., all except residential cul-de-sacs).

D5.5 NON-MAN INSPECTION CHAMBERS

1. Non-man inspection chambers shall comply with the relevant provisions of BS EN 752.

D6 CLEANSING AND TESTING

D6.1 CLEANSING OF GRAVITY SEWERS AND MANHOLES

(i) The action to be taken in the event of failure to satisfy the tests specified has only been referred to in general terms where the text so requires (see also Section D1.3).

1. On completion of construction, internal surfaces of sewers, inspection chambers and other access points shall be thoroughly cleansed to remove all deleterious matter, without such matter being passed forward into existing public sewers or watercourses. The sewers and manholes shall be maintained in a clean and serviceable condition until they are vested as public sewers.

D6.2 TESTING OF GRAVITY SEWERS

(i) Visual examination may include the use of CCTV and/or light-line inspections

1. Sewers shall be tested after they are jointed and before any concreting or backfilling is commenced, other than such as may be necessary for structural stability whilst under test.

2. Sewers up to and including 750 mm nominal diameter shall be tested by means of an air or water test.

3. An air test shall be carried out after the backfilling is complete.

4. The pipelines shall be tested by means of a visual or closed-circuit television (CCTV) examination, in lengths determined by the course of construction, in accordance with the programme. For flexible pipes, the CCTV examination shall use light rings to measure deformations.

D6.3 AIR TEST FOR GRAVITY SEWERS

(i) BS EN 1610 'Construction and Testing of Drains and Sewers' gives advice on testing requirements.

1. Sewers to be air tested, including adopted laterals up to demarcation chambers, shall have air pumped in by a suitable means until a pressure of 100 mm head of water is indicated in a U-tube connected to the system. The sewer shall be accepted if the air pressure remains above 75 mm head of water after a period of five minutes without further pumping, following a period for stabilisation. Failure to pass the test shall not preclude acceptance of the pipeline if a successful water test can subsequently be carried out in accordance with Section D6.4.

D6.4 WATER TEST FOR GRAVITY SEWERS

1. The test pressure for sewers shall not be less than 1.2 m head of water above the pipe soffit or groundwater level, whichever is the higher, at the highest point, and not greater than 6 m head at the lowest point of the section. Steeply-graded sewers shall be tested in stages in cases where the maximum head, as stated above, would be exceeded if the whole section were tested in one length.

2. The sewer shall be filled with water and a minimum period of two hours shall be allowed for absorption, after which water shall be added from a measuring vessel at intervals of five minutes and the quantity required to maintain the original water level

noted, following which the original water level shall be restored. Unless otherwise specified, the length of sewer shall be accepted if the quantity of water added over a 30-minute period is less than 0.5 litres per linear metre of sewer per metre of nominal diameter.

3. Notwithstanding the satisfactory completion of the above test, if there is any discernible leakage of water from any pipe or joint, the pipe shall be replaced and/or the joint remade, as appropriate, and the test repeated until leakage is stopped.

D6.5 VISUAL INSPECTION OF GRAVITY SEWERS

(i) A visual survey may include the use of CCTV and/or internal survey, or walk-through inspection.

(ii) The ratio described in D6.5.2 may be approximated to

$$\frac{\phi_{\text{max}} - \phi_{\text{mean}}}{\phi_{\text{mean}}}$$

(i) The permissible infiltration is the same as the permissible loss in the water test in section D6.4.

(ii) Infiltration rate is based on the 0.15π calculation included in BS EN 1610.

1. A visual survey shall be carried out by a qualified and approved contractor, and in accordance with the 'Model Contract Document for Sewer Condition Inspection' 2nd edition.

2. Light ring survey equipment shall be calibrated to measure the cross-sectional dimensions and the pipe ovality to within $\pm 1\%$, where ovality is defined as the ratio between the difference between the maximum internal diameter and the mean internal diameter, and the mean internal diameter.

D6.6 INFILTRATION

1. Non-pressure pipelines and manholes shall be inspected and tested for infiltration after backfilling. All inlets to the system shall be effectively closed and any residual flow shall be deemed to be infiltration.

2. The pipeline and manholes shall be accepted as satisfactory if the infiltration; including infiltration into manholes, in 30 minutes does not exceed 0.5 litres per linear metre of pipeline per metre of nominal bore.

3. Notwithstanding the satisfactory completion of the above inspection or test, if there is any discernible flow of water entering the sewers or manholes which can be seen either by visual or CCTV inspection, such measures as are necessary to stop such infiltration shall be taken.

D6.7 WATERTIGHTNESS OF INSPECTION CHAMBERS AND CHAMBERS

1. These shall be inspected to ensure that they are watertight with no identifiable flow of water penetrating the chamber.