
**VOLUME 4 GEOTECHNICS AND
DRAINAGE**
SECTION 2 DRAINAGE

PART 3

HA 105/04

SUMPLESS GULLIES

SUMMARY

This Advice Note gives guidance on the use of sumpleSS gullies as an alternative to conventional gullies that have a sump. Although the advice should be fully taken into account in the design of new schemes, this Advice Note contains no mandatory requirements.

INSTRUCTIONS FOR USE

This is a new Advice Note to be incorporated into the Manual

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2. Insert new Contents pages for Volume 4, dated February 2004.
3. Insert HA 105/04 into Volume 4, Section 2, Part 3.
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**THE DEPARTMENT FOR REGIONAL DEVELOPMENT
NORTHERN IRELAND**

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PART 3

HA 105/04

SUMPLESS GULLIES

Contents

Chapter

1. Introduction
2. Principles of Gully Systems
3. Description of Sumpless Gullies
4. Application
5. Design of Sumpless Gully Systems
6. Construction Aspects
7. Maintenance Issues
8. Worked Example
9. References and Bibliography
10. Enquiries

Appendix A Drawings

Appendix B Tables of Minimum Pipe-Full Flow
Velocities for Self-Cleansing Pipes in
Systems with Sumpless Gullies

1. INTRODUCTION

General

1.1 This Advice Note gives guidance on the use of sumpless gullies as an alternative to conventional gullies that have a sump. Although the advice should be fully taken into account in the design of new schemes (see 1.7), this Advice Note contains no mandatory requirements.

1.2 Sumpless gullies offer an environmental advantage in certain situations. They may not be appropriate in all locations and the environmental advantages must be weighed against maintenance aspects and the practicalities of the downstream pipework. The use of sumpless gullies supplements conventional gullies and does not supplant them.

1.3 The safety aspects of drainage features are described in HA 83, Safety Aspects of Road Edge Drainage Features (DMRB 4.2, Ref 1). Further details are given in TRL Report 422 (Ref 2).

1.4 Safety aspects of drainage details are generally a function of the location. Gullies, conventional or sumpless, are located at the carriageway edge, or in the central reserve, for the purpose of removing surface water from the road. It is therefore desirable, from the drainage aspect, that the drain should be close to, or at, the pavement edge. Refer to HA 102: Spacing of Road Gullies (Ref 1), for advice with regard to vulnerable road users.

1.5 The positioning of sumpless gullies should take account of advice given in HA 83, Safety Aspects of Road-Edge Drainage Features.

1.6 This Advice Note should be read in conjunction with HA 102: Spacing of Road Gullies.

Scope

1.7 The principles outlined in this Advice Note apply to all schemes on trunk roads including motorways. They may also be applied generally to other new highway schemes and by other highway authorities for use during the preparation, design and construction of their own comparable schemes. Sumpless gullies may be installed during major maintenance works or as a retro-fit.

Implementation

1.8 This Advice Note should be used forthwith for all schemes currently being prepared provided that, in the opinion of the Overseeing Organisation, this would not result in significant additional expense or delay progress. Design Organisations should confirm its application to particular schemes with the Overseeing Organisation.

2. PRINCIPLES OF GULLY SYSTEMS

Debris and sediment

2.1 During periods of rainfall, sediment can be washed on to the carriageway from the adjacent unpaved areas, and under moderate wind conditions is blown on to the carriageway from considerable distances. This sediment is generally in the form of fine silt particles or coarser granular sediment.

2.2 Debris accumulates on the carriageway from a number of sources. They may be actual pieces of vehicle, typically, windscreen and headlamp glass, tyre debris, pieces of bumper or exhaust or simply corroded steel. The debris is often material that is thrown from moving vehicles, for example cigarette ends and packets, drinks bottles and cans, paper etc. The third source of material is organic, from leaves and tree debris to dead animals.

2.3 A further source of debris and sediment, though not particularly applicable to the motorway and trunk road network, is the pavement itself, resulting from resurfacing works, abrasion/removal of grit and salting operations.

2.4 With a kerb and gully drainage system, the debris and sediment are carried along in the surface water runoff from the carriageway. To minimise the amount of sediment and debris that enters the pipeline or the receiving watercourse, measures are taken at the point of inlet to the system.

2.5 The conventional gully pot is effective at retaining some 90% of sediment of $d_{50} = 0.8\text{mm}$. This efficiency drops considerably to around 25% if the retained sediment level approaches the maximum level before blockage of the outlet occurs. The efficiency at retaining fine sediments is greatly reduced and is a function of flow rate and sediment particle size.

Conventional gullies

2.6 The principle behind the use of gully pots is to reduce the amount of coarse sediment that enters the drainage system. The presence of sediment in the drainage system can lead to a reduction in the flow velocity and ultimately to blockages.

2.7 The conventional gully pot comprises a sump below the level of the outlet pipe. The outlet may be trapped, meaning that there is a form of “weir” to reduce the risk of debris being washed into the connection and the carrier drain. As oil floats on water the provision of the trap will retain oils within the pot and prevent them being washed into the drain. The outlet from the pot to the trap is below the water level in the pot.

2.8 The second, less common form of conventional gully has no trap, simply having the outlet connection above the sump in the pot. This type of pot will not retain oils, but will retain most of the coarser sediments (Ref 3).

2.9 Though conventional pots trap some of the sediment they are relatively ineffective at reducing pollution and can, through poor maintenance practices, generate polluting materials.

2.10 The principal source of pollution in conventional gullies arises from the bacterial action of degrading organic materials contained within the coarse debris and the sediment. The bacterial action creates a high Biochemical Oxygen Demand, BOD, which means that the liquor will tend to remove the oxygen from any water into which it is discharged. Often referred to as the “foul flush”, highly polluted liquor is discharged during the initial stages of a storm event.

2.11 Cleansing operations also often result in the liquor being backwashed into the drainage system during periods when there is no rainfall to provide a residual flow of water within the drain to dilute the liquor. Consequently severe pollution of the receiving water courses can occur. Care must be taken during the cleansing operations to ensure that contaminated water is not used in the process.

Sumpless gullies

2.12 The sumpless gully is different from the conventional type of gully. The outlet from the pot is at the base so consequently it does not itself have the ability to retain oil or sediment. The base of the pot is shaped so that the flow of water is channelled to the outlet reducing the possibility of sediment build up around the edge of the pot base.

2.13 The pollution risk associated with the flushing of the polluting liquor from the gully sump, particularly during dry weather, indicates there are benefits to be gained from the elimination of the sump.

2.14 The use of sumpless gullies can provide benefits by:

- i) preventing contaminated silt and liquor accumulation;
- ii) helping to eliminate the “foul flush” of heavily polluted flow as the gully starts to operate;
- iii) eliminating or reducing the need to clean the pots with the risk of contaminated water from the pot being used in the cleaning process.

2.15 Sumpless gullies are not suitable for use where the carriageway drains to a combined (foul and surface water) sewer.

3. DESCRIPTION OF SUMPLESS GULLIES

General

3.1 The sumpless gully is a means of directing flows to the drainage system via discrete entry points without the construction of a sump to trap debris and sediments. The grating will trap very coarse debris and direct the surface flow into the gully. In a manner similar to the use of conventional gullies, sumpless gullies function primarily as part of the kerb and gully type of drainage system.

3.2 The gully arrangements are shown indicatively in the drawings forming Appendix A of this Advice Note. The system comprises a grating and frame supported off the gully and surrounded by one or two courses of brickwork.

3.3 Sumpless gullies can be divided into two distinct types: chutes and pots.

Sumpless chute

3.4 The sumpless chute, shown at Figure 1 in Appendix A, is a shallow construction, of a similar plan area to the grating and frame. The sloping chute is inclined towards the rear of the gully which has a vertical face incorporating the outlet from the chute to the gully connection pipe. In this Advice Note this is termed a Shallow Chute.

3.5 The chute gully can be fitted with a make-up section to increase its depth, referred to as a Deep Chute (see 3.12).

3.6 Chutes are generally made from plastic, ductile iron or cast iron, although it is possible that other materials could be equally suitable.

3.7 Chute type gullies have been used on flat roads in low-lying areas, where obtaining adequate pipeline gradients for drainage proved difficult.

Sumpless pot

3.8 Similar in appearance to a conventional gully pot, the sumpless pot, shown at Figure 2 in Appendix A, comprises a cylindrical body with a rounded base. The outlet from the pot is at base level and set at or close to, the horizontal. The rounded base may be shaped to direct flows towards the outlet.

3.9 The pot is suitable for manufacture by injection moulding or for manufacture using clay or concrete.

Debris collection basket

3.10 The recommended method of debris collection within the shallow chute type of gully is by means of a shallow wire basket (see Figure 1 in Appendix A). The nominal dimensions of a suitable square basket are 300mm × 300mm × 100mm deep with a square mesh size of 25mm.

Sediment collection bucket

3.11 The recommended debris and sediment collection device for the sumpless gully pot is a deep bucket that has a perforated base with a 25% opening area (see Figure 2 in Appendix A). A suitable nominal diameter for the bucket is 300mm, tapering to 250mm at the base. Since the sumpless gully pot diameter is, for example, 450mm minimum, this ensures that a 75mm wide annulus around the bucket is maintained. The overall depth of the bucket would be about 350mm. Horizontal slots of 50mm × 30mm are positioned around the bucket top to allow overflow when the bucket approaches full conditions.

3.12 This device may also be used in conjunction with the sumpless chute if a make-up section is inserted between the chute and the grating frame to produce a depth to outlet of 600mm.

3.13 At the time of the publication of this Advice Note, no debris collection baskets or buckets were commercially available for use with sumpless gully pots, although the basket and bucket described in 3.10 and 3.11 respectively have been successfully performance tested. It is anticipated that sumpless gully and basket/bucket systems will be developed and manufactured subsequent to the publication of this document and their use in scheme design and specifications.

4. APPLICATION

4.1 The following factors influence the selection of a sumpleless gully system:

- presence of catchpits;
- maintenance requirements;
- pollution effects;
- effect on downstream drainage system;
- volume of sediment storage, possible need for increased number or size of catchpits.

4.2 Sumpleless gullies may be installed in most locations that are suitable for conventional gullies except, for example, connections to foul or combined sewers.

4.3 The locations where sumpleless gullies may be applicable are tabulated in Table 4.1, and the requirements and benefits of using sumpleless gullies relative to conventional gullies are listed in Table 4.2.

4.4 A significant effect of sumpleless gullies is that an increased amount of sediment will be passed to the downstream drainage system. The downstream drainage system must be designed to transport the additional sediment and a maintenance regime set in place to ensure that blockages do not occur (see Chapter 7).

Step Longitudinal Gradients

4.5 Carriageways constructed to steep longitudinal gradients also enable the carrier pipelines to be laid at relatively steep gradients, thus producing higher flow velocities necessary to transport sediment along the pipe.

4.6 Pipes laid to gradients steeper than 1 in 90 have been shown to remain more or less free from sediment deposition. Where pipes that closely follow the carriageway longitudinal profile are of a similar gradient, sumpleless gullies should not cause siltation problems.

Low-Lying Carriageway

4.7 Carriageways constructed over low-lying terrain tend to have flat longitudinal gradients, or gradients created artificially that do not follow the ground profile.

In these situations, sumpleless gullies have been used successfully where relative levels may make connection of conventional gullies to the drainage system problematical.

4.8 The drainage systems can also have flat gradients due to the nature of the terrain. This may create sediment transport problems within a drainage pipeline; therefore in these situations sumpleless gullies could be used in conjunction with ditches.

Embankment Drainage

4.9 Used in conjunction with a kerb, the gully should outfall to a toe ditch at the base of the embankment. Care must be taken with the pipework to ensure that water is not introduced into the slope face.

Bridge Approach

4.10 Sumpleless gullies might be used on the approaches to over-bridges, particularly where the approach is on embankment. The volume of sediment entering the system will tend to be lower, due to the elevated position. The piped drainage may also have comparatively steep gradients.

Carriageway Gradient	Suitable types of sumpleless gully (in order of preference)
Steeper than 1/90	<ol style="list-style-type: none"> 1) <i>Shallow chute and basket to carrier pipe</i> 2) Deep chute and bucket, or sumpleless pot and bucket, to carrier pipe 3) Shallow chute and basket – discharging directly to ditch
1/90 – 1/150	<ol style="list-style-type: none"> 1) <i>Deep chute and bucket, or sumpleless pot and bucket, to carrier pipe</i> 2) Shallow chute and basket to carrier pipe with catchpits 3) Shallow chute and basket – discharging directly to ditch
Flatter than 1/150	<ol style="list-style-type: none"> 1) <i>Shallow chute and basket – discharging directly to ditch</i> 2) Deep chute and bucket, or sumpleless pot and bucket, to carrier pipe with catchpits

Table 4.1: Selection criteria for sumpleless gullies

Note: Preferred option is shown in bold italics

Preferred sumpless gully option (see Table 4.1)	Requirements for pipe system downstream of gully	Benefits
Shallow chute and basket to carrier pipe	Pipe gradients similar to carriageway gradient	Reduced maintenance Reduced pollution
Deep chute and bucket, or sumpless pot and bucket, to carrier pipe	Pipe gradients steeper than for conventional gully pots (or approximately similar gradients if catchpits used)	Reduced pollution
Shallow chute and basket – discharging directly to ditch	Individual outlets with steep gradients to ditch	Reduced maintenance Unrestricted discharge with minimum required head at gully

Table 4.2: Preferred options for sumpless gullies – requirements and benefits relative to conventional gully pots

5. DESIGN OF SUMPLESS GULLY SYSTEMS

Choice of type

5.1 The choice between the two types of sumpless gully is governed by the location of the gully (see Table 4.1). For instance, the chute type is likely to be more appropriate for either steep carriageways, where steep downstream pipework is achievable, or for flat carriageways in low-lying areas where the individual outlets pipes can be steep.

5.2 Differences in manufacturing costs between the two types of gully are unlikely to be large. However, costs associated with the support or surrounds to the gullies may be higher, and hence should be considered when evaluating options.

Downstream pipe system

5.3 Tests have shown that when sediment is not collected within the gully it will tend to deposit in the piped system if the transport capacity of the pipeline is not adequate.

5.4 Where the gradient of the drainage system downstream of the gully makes it difficult to achieve appropriate minimum velocities for self-cleansing, consideration should be given to using a different type of drainage system.

5.5 Sediment deposition is a function of the sediment load, pipe diameter, flow velocity and hence pipe gradient. Tests carried out in support of this Advice Note (Ref 4) showed that only minor deposition would be likely to occur with sumpless gullies if the downstream pipe gradients are 1 in 100 or steeper.

5.6 The most common method of improving the sediment transport capacity of a pipeline is to increase the gradients of the pipes. Transport capacity can also be increased by slightly relaxing the self-cleansing requirements and designing the pipeline to operate satisfactorily with a small amount of sediment deposition. A more detailed explanation of the process can be found in Ref 5.

Design procedure

5.7 Where sumpless gullies are used, the designer **must** ensure that the sediment is transported through the downstream pipes without forming significant bed

deposits. With correctly-designed systems having catchpits, significant deposition should normally only occur at the catchpits. [As described in Section 7, the volume of sediment collected in catchpits will be greater than with conventional gully systems]. Since there is no retention at the gullies, larger sediment loads will need to be transported by the pipes, and hence steeper gradients will generally be necessary to achieve the required minimum flow velocities for self-cleansing.

5.8 The following design procedure takes into account whether or not catchpits are used in the pipe drainage system. Except for very short drainage systems the design procedure will normally involve the following steps:

- i) determination of run-off flows (see HA 102, Ref 1, for the spacing of road gullies, both conventional and sumpless);
- ii) determination of pipe diameters and gradients for the piped system to ensure that minimum self-cleansing velocities are achieved along the whole system. For design, it is recommended to allow for sediment effects in the pipes by using an overall roughness value (k_s) in the Colebrook-White equation equal to 3mm.

5.9 Tables A, B, C and D (see Appendix B) give values of minimum self-cleansing velocity that need to be achievable in different sizes of pipe under pipe-full conditions depending on the type of gully used and the location of the pipe within the system. These tables were produced using methods recommended in Ref 5 and described in Ref 4, with the following assumptions: pipe wall roughness of 0.6mm; and maximum depth of sediment deposit equal to 1% of the pipe diameter (giving an effective overall roughness of about 3mm). The tables are based on internal pipe diameters; if values of flow velocity are needed for other pipe sizes, these can be obtained by interpolation between adjacent values in the tables.

5.10 Table 5.1 shows design options and identifies the appropriate tables in Appendix B for determining minimum pipe-full flow velocities for drainage systems with different types of sumpless and conventional gully. When catchpits are used, the sediment concentration decreases towards the downstream end of the system. This reduces the required values of minimum velocity

and enables the pipes to be laid at flatter gradients than would be the case with benched manholes that do not trap any sediment. In Table 5.1, the catchpits are numbered starting at the most upstream end of the system. Downstream of junctions in branched systems, the catchpit number should be counted from the upstream end of the branch having the largest number of catchpits.

5.11 A worked example is given in Chapter 8 to illustrate the use of the tables in Appendix B.

Type of gully	Downstream pipe system			
	With Catchpits		No Catchpits	
Sumpless gullies (pot or chute) with basket	Upstream of Catchpit 1	Table A	Whole system	Table A
	Between Catchpits 1 and 4	Table B		
	Between Catchpits 4 and 10	Table C		
	Downstream of Catchpit 10	Table D		
Sumpless gullies (pot or chute) with bucket	Upstream of Catchpit 2	Table C	Whole system	Table C
	Downstream of Catchpit 2	Table D		
Conventional gully pot	Whole system	Table D	Whole system	Table D

Table 5.1 Design options and choice of appropriate tables in Appendix B for minimum flow velocities

Note: This table should be read in conjunction with Paragraph 5.10

6. CONSTRUCTION ASPECTS

6.1 The predominant use of gullies, conventional or sumpless, is in conjunction with kerbs as part of the typical kerb and gully system.

6.2 The depth of the gully **must** be sufficient to ensure that the piped outlet from the gully remains below the level of the kerb race. Where the gully discharges to the rear of the carriageway, this minimum depth will be approximately 600mm.

6.3 Where gullies are used in conjunction with extruded asphalt kerbs or located on embankment and discharging to toe ditches at the embankment base, there is no minimum depth requirement. The system **must** be designed to ensure that there is no detrimental effect on the embankment slope stability.

6.4 Plastic gully pots and chutes **must** be bedded and surrounded in ST4 concrete. The concrete mix used should be sufficiently stiff to avoid flotation. It is not advised to insert a stopper into plastic sumpless gullies prior to placing the concrete. This is because the pot could distort under the pressure of the concrete and trap the stopper in the outlet pipe. Typical details are shown as Figures 1 and 2 in Appendix A.

6.5 The grate and frame size chosen should be large enough to enable the basket or bucket to be extracted from the gully pot.

6.6 There is a greater potential risk of construction materials entering the drainage pipelines since material, in particular sub-base material, will not be trapped by a sump. The use of CCTV surveys of completed drainage systems is recommended.

7. MAINTENANCE ISSUES

7.1 The principal maintenance issues are the entrapment of debris and sediment and their removal. The type of sumpless gully selected determines whether the debris is collected by a basket (see 3.10), or bucket (see 3.11).

7.2 The frequency of debris removal should not need to be greater than specified in the Trunk Road Maintenance Manual (TRMM, Ref 6) for conventional gully cleaning.

7.3 The bucket or basket containing debris/sediment can be lifted from the gully and emptied into a suitable receptacle. There is no requirement to wash out the gully pot as with a conventional system. It may be necessary to utilise a hook to extract the basket or bucket from the gully. Health and Safety advice on lifting shall be complied with.

7.4 The baskets and buckets may become damaged during cleaning operations, therefore it is recommended that spare baskets and buckets are carried in the maintenance vehicles.

7.5 In sumpless gullies, some of the silt will be trapped by the sediment and debris contained in the bucket or basket, but most will flush through into the downstream drainage system.

7.6 The volume of silt accumulating in catchpits will increase where sumpless gullies are installed. It is important that the sediment deposition in systems utilising sumpless gullies is monitored to determine a suitable inspection frequency. The inspection frequency for catchpits must not be less than the minimum specified in the TRMM. Catchpits may also need to be installed more frequently and with a greater volume for sediment storage. It is important that catchpits are cleaned effectively.

7.7 If the installation of a proprietary silt or sediment detention apparatus is being considered, it is essential to ensure that the pipeline gradient is sufficiently steep to be able to accommodate the difference in levels across the device, necessary for it to function correctly. Off-carriageway access for emptying must be available wherever the use of these devices is being considered.

8. WORKED EXAMPLE

8.1 This example illustrates how a carrier pipe system should be designed for a road drained by sumpless gullies with baskets (for collection of debris). The drainage pipe system includes five catchpits, where sediment is collected, and pipework receiving nine gully connections between adjacent pairs of catchpits (see Figure 3 in Appendix A). It is assumed that the flow rate from each of the gullies is the same, equal to 2.8 l/s. The catchpits are numbered from upstream: C1, C2, etc.

8.2 In this example, the objective is to determine the pipe diameters and gradients necessary to achieve minimum self-cleansing velocities in the whole system.

8.3 In this example the “Tables for the hydraulic design of pipes, sewers and channels” (Ref 7), were used for the determination of the pipe sizes and diameters that would ensure flow velocities equal to, or greater than, those given in Appendix B of this Advice Note. The Tables are based on the Colebrook-White equation and the roughness value used was $k_s = 3\text{mm}$. When more than one pipe diameter satisfied the requirement for minimum flow velocity, the criterion used was to select the pipe diameter associated with the flattest gradient.

8.4 From Table 5.1, for a system consisting of sumpless gullies with basket and five catchpits, the values of minimum flow velocity are obtained from Tables A to C of Appendix B.

8.5 In each pipe reach between catchpits, the pipe section immediately upstream of the catchpit has the highest sediment concentration, whereas the pipe section immediately downstream of the catchpit will have the lowest concentration, since the sediment will tend to deposit in the catchpit. In this example pipe sizes and gradients were determined for each of these upstream and downstream sections.

Upstream of Catchpit 1, C1:

First pipe section; $Q = 2.8\text{l/s}$

Choose minimum pipe size, 150mm diameter. From Table A of Appendix B, the minimum self-cleansing flow velocity is 0.69m/s. From the hydraulic design tables, a 150mm diameter pipe at 1/125 gradient will convey 12.2 l/s with $V = 0.693\text{m/s}$. This pipe will flow part full.

Section u/s of C1; $Q = 25.2\text{l/s}$

Assume pipe diameter of 200mm; from Table A of Appendix B, the minimum self-cleansing flow velocity is 0.78m/s. From the hydraulic design tables, a 200mm diameter pipe at 1/133 gradient will convey 25.7 l/s with $V = 0.818\text{m/s}$ ($> 0.78\text{m/s}$). [A 225mm pipe would not satisfy the requirement of minimum flow velocity].

From C1 to C2:

Section d/s of C1; $Q = 25.2\text{l/s}$

200mm diameter; 1/133 gradient.

Section u/s of C2; $Q = 50.4\text{l/s}$

Assume pipe diameter of 225mm; since this section is downstream of Catchpit 1, from Table B of Appendix B the minimum self-cleansing flow velocity is 0.72m/s. A 225mm diameter pipe at 1/63 gradient will convey the required flow but the gradient is considered too steep. Consider a 275mm diameter pipe; from Table B, the self-cleansing velocity is 0.76m/s. This pipe will convey the flow at 1/182 gradient with velocity = $0.869\text{m/s} > 0.76\text{m/s}$. [A 300mm pipe would not satisfy the requirement of minimum flow velocity].

From C2 to C3:

Section d/s of C2; $Q = 50.4\text{l/s}$

275mm diameter; 1/182 gradient.

Section u/s of C3; $Q = 75.6\text{l/s}$

Assume pipe diameter of 300mm; from Table B of Appendix B, the minimum self-cleansing flow velocity is 0.79m/s. A 300mm diameter pipe at 1/133 gradient will convey the required flow at a velocity above the self-cleansing velocity. [A 350mm pipe would not satisfy the requirement of minimum flow velocity, i.e. 0.84m/s from Table B].

From C3 to C4:

Section d/s of C3; $Q = 75.6\text{l/s}$

300mm diameter; 1/133 gradient.

Section u/s of C4; $Q = 100.8\text{l/s}$

Assume pipe diameter of 375mm; from Table B of Appendix B, the minimum self-cleansing flow velocity is 0.87m/s. A 375mm diameter pipe at 1/238 gradient will convey the required flow at a velocity above the self-cleansing velocity.

From C4 to C5:

Section d/s of C4; $Q = 100.8 \text{ l/s}$

375mm diameter; 1/238 gradient ($V=0.934\text{m/s}$ larger than minimum self-cleansing velocity of 0.77m/s , in Table C – this table is applicable because the section is downstream of Catchpit 4).

Section u/s of C5; $Q = 126 \text{ l/s}$

Assume pipe diameter of 450mm; from Table C of Appendix B, the minimum self-cleansing flow velocity is 0.79m/s . A 450mm diameter pipe at 1/417 gradient will convey the required flow at a velocity above the self-cleansing velocity. A 400mm pipe at a 1/217 gradient would equally satisfy the requirements.

9. REFERENCES AND BIBLIOGRAPHY

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HD 33 Surface and Sub-surface Drainage Systems for Highways (DMRB 4.2)
HA37 Hydraulic Design of Road Edge Surface Water Channels (DMRB 4.2)
HA 39 Edge of Pavement Details (DMRB 4.2)
HA 42 Road Safety Audits (DMRB 5.2)
HA 79 Edge of Pavement Details for Porous Asphalt Surface Courses (DMRB 4.2)
HA 83 Safety Aspects of Road-edge Drainage Features (DMRB 4.2)
HA 102 Spacing of Road Gullies (DMRB 4.2)
TA 57 Roadside Features (DMRB 6.3)
TA 67 Providing for Cyclists (DMRB 5.2)
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10. ENQUIRIES

All technical enquiries or comments on this Advice Note should be sent in writing as appropriate to:

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APPENDIX A DRAWINGS

FIGURE 1: CHUTE TYPE SUMPLESS GULLY.

FIGURE 2: POT TYPE SUMPLESS GULLY.

FIGURE 3: SCHEMATIC PLAN LAYOUT OF
THE DRAINAGE SYSTEM FOR
WORKED EXAMPLE IN
CHAPTER 8.

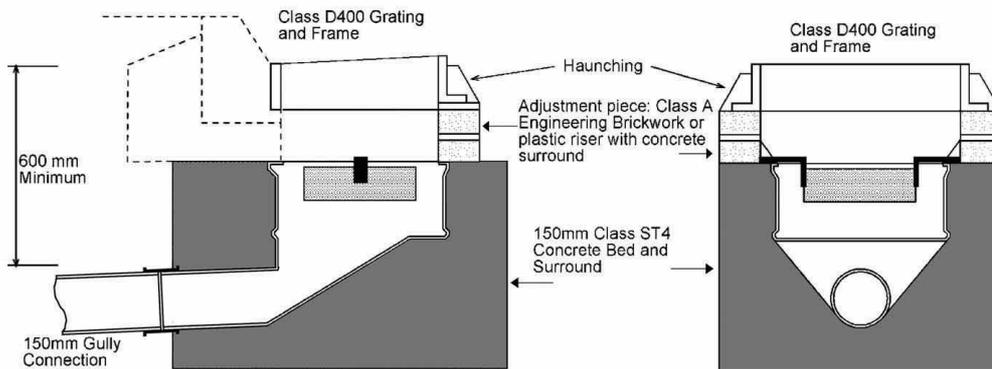


Figure 1 - Chute type sumpless gully

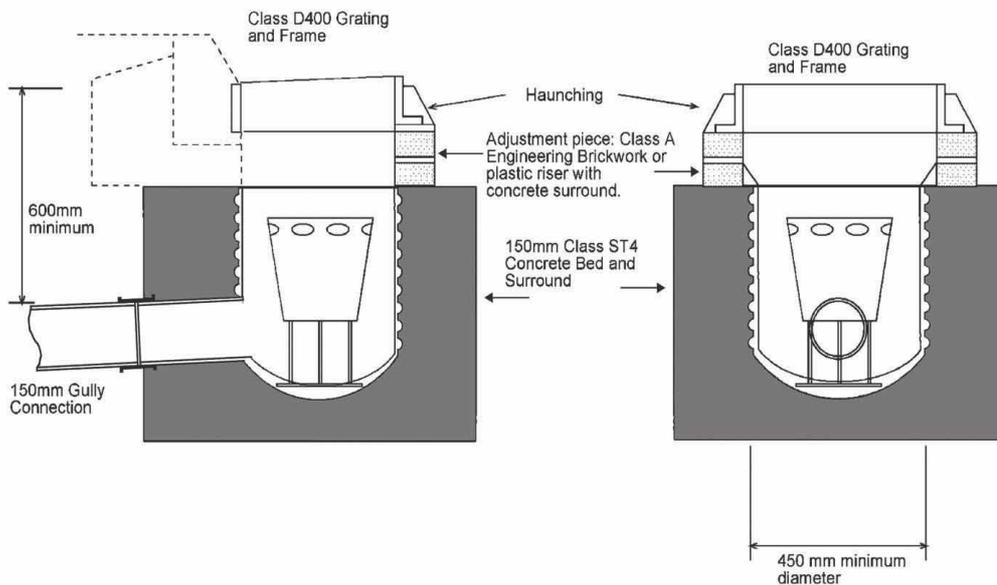


Figure 2 - Pot type sumpless gully

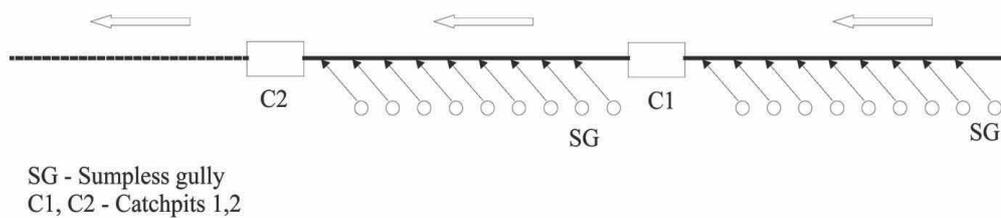


Figure 3 - Schematic plan layout of the drainage system for worked example in Chapter 8

APPENDIX B TABLES OF MINIMUM PIPE-FULL FLOW VELOCITIES FOR SELF-CLEANSING PIPES IN SYSTEMS WITH SUMPLESS GULLIES

Table A

Pipe Diameter (internal)	Minimum Velocity (m/s)
150mm	0.69
200mm	0.78
225mm	0.82
250mm	0.89
275mm	0.96
300mm	1.03
350mm	1.17
375mm	1.24
400mm	1.32
450mm	1.48
500mm	1.63
600mm	1.84

Table C

Pipe Diameter (internal)	Minimum Velocity (m/s)
150mm	0.67
200mm	0.71
225mm	0.72
250mm	0.73
275mm	0.74
300mm	0.75
350mm	0.76
375mm	0.77
400mm	0.78
450mm	0.79
500mm	0.81
600mm	0.85
700mm	0.91
750mm	0.93
800mm	0.96
900mm	1.00

Table B

Pipe Diameter (internal)	Minimum Velocity (m/s)
150mm	0.67
200mm	0.71
225mm	0.72
250mm	0.73
275mm	0.76
300mm	0.79
350mm	0.84
375mm	0.87
400mm	0.89
450mm	0.97
500mm	1.05
600mm	1.21
700mm	1.38
750mm	1.47
800mm	1.56
900mm	1.76

Table D

Pipe Diameter (internal)	Minimum Velocity (m/s)
150mm	0.67
200mm	0.71
225mm	0.72
250mm	0.73
275mm	0.74
300mm	0.75
350mm	0.76
375mm	0.77
400mm	0.78
450mm	0.79
500mm	0.81
600mm	0.82
700mm	0.85
750mm	0.86
800mm	0.86
900mm	0.87