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Safety Aspect of Road Edge Drainage Features

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For all documents that existed within the NRA DMRB or the NRA MCDRW prior to the launch of TII Publications, the NRA document reference used previously is listed above under 'historical reference'. The TII Publication Number also shown above now supersedes this historical reference. All historical references within this document are deemed to be replaced by the TII Publication Number. For the equivalent TII Publication Number for all other historical references contained within this document, please refer to the TII Publications website.

Volume 4 Section 2
Part 4
NRA HD 83/15

An tÚdarás um Bóithre Náisiúnta
National Roads Authority

Safety Aspect of Road Edge Drainage Features

March 2015

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Summary:

This Standard gives guidance on safety aspects of road edge drainage features. It relates to both all-purpose national roads and motorways, although some parts will apply to only to the first category in so far as provision for cyclists and pedestrians is not relevant to motorways.

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VOLUME 4 GEOTECHNICS AND DRAINAGE

SECTION 2 DRAINAGE

PART 4

NRA HD 83/15

SAFETY ASPECT OF ROAD EDGE DRAINAGE FEATURES

Contents

Chapter

1. INTRODUCTION

General

1.1 This Standard gives guidance on safety aspects of road edge drainage features. It relates to both all-purpose national roads and motorways, although some parts will apply only to the first category in so far as provision for cyclists and pedestrians is not relevant to motorways.

1.2 Careful consideration of safety implications at an early stage should minimise the number of problems identified during road safety audits as described in NRA HD 19 Road Safety Audits. Certain requirements of drainage systems are given in the Series 500 of NRA Specification for Road Works (NRA SRW) and NRA Notes for Guidance on the Specification for Road Works (NRA NGSRW). Appropriate details are given in the Series 100 and 500 of the NRA Road Construction Details (NRA RCD). NRA TD 19 Safety Barriers gives design requirements for roadside safety barriers.

1.3 Safety aspects of drainage details are generally a function of the location, form and size of the detail and any associated safety barrier or safety fence provision. Road edge drainage features are primarily designed to remove surface water. Since they are usually placed along the side of the carriageway, they should not normally pose any physical hazard to road users. It is only in the event of a vehicle becoming errant that the consequential effects of a road edge drainage feature upon a vehicle become important.

1.4 This Standard has been prepared combining research findings (reported in TRL Report 422 Safety Aspects of Road Edge Drainage Features and TRL Report 230 Assessment of vehicle handling safety when driving into roadside water drainage channels) and good engineering practice. In addition it draws together and augments safety advice given mainly in NRA HD 33 Drainage Systems for National Roads, NRA HD 139 Edge of Pavement Details and UK Highways Agency HA 79 Edge of Pavement Details for Porous Asphalt Surface Courses.

1.5 The 2015 revision of the NRA's drainage standards was precipitated by post-doctoral research carried out under the NRA's Research Fellowship Programme and mentored by the NRA's Environment Unit. This research looked at the impacts of national road drainage systems on both surface and ground water. The research concluded that the NRA's drainage standards needed to be expanded to promote the use of sustainable drainage systems and to maximise environmental benefits. A report entitled *Drainage Design for National Road Schemes – Sustainable Drainage Options* (NRA, 2014) documents this research and provides useful background reading to the NRA's drainage standards. This document is available at: nrastandards.nra.ie/latest/other-nra-documents

1.6 Effective drainage of rainwater from road surfaces plays a major part in road safety by quickly removing surface water. In addition a suitable drainage system will minimise damage to the structural foundations of the carriageway. This, in turn, will reduce the requirement for maintenance and roadworks which tend to increase potential hazards for the road user. However, drainage features can present a potential hazard to errant vehicles leaving the carriageway. The safety aspects of such features must be considered at the design stage.

1.7 While the National Road Authority is primarily concerned with safety of vehicles on the carriageway the designer must consider the safety implications of the drainage details to errant vehicles leaving the carriageway and should undertake all reasonable measures to mitigate such potential hazards. Refer to NRA TD 19 for design requirements.

1.8 Safety problems differ on rural and urban roads, both situations need to be considered particularly in relation to the more vulnerable road users.

1.9 There is also a distinction to be made between the safety needs of new roads and those of local improvements, the design of which may be restricted if carried out within existing road limits.

1.10 This Standard deals with most of the commonly used drainage details. For features which are not covered in this Standard, the designer should seek advice from the National Roads Authority.

Scope

1.11 The principles outlined in this Standard apply to all National Roads projects. .

Implementation

1.12 This Standard should be used forthwith for all schemes for the construction and/or improvement of national roads. It should be applied to the design of schemes already being prepared unless, in the opinion of the National Roads Authority, application would result in significant additional expense or delay progress. In such cases, Design Organisations should confirm the application of this Standard to particular schemes with the National Roads Authority.

2. PRINCIPLES

2.1 It is essential that drainage features should be efficient in removing water from the carriageway. They must also be safe and structurally adequate for normal usage and that which may occur during motorway lane closures and consequent trafficking of hard shoulders. For National Roads a minimum strength class will normally be D400. In exceptional circumstances where gullies are to be located in areas subjected to large numbers of high speed heavy goods vehicles, Class E600 shall be considered.

2.2 Maintenance on motorways and other high speed roads involves a higher than normal degree of risk, both to road users and maintenance operatives. Longevity of the system, amount of future maintenance and safety aspects of the maintenance of road edge drainage features shall therefore be considered at the design stage, together with the impact that such edge features may have on safety when general maintenance work is carried out. The emphasis on central reserve drainage must be on the need for minimum maintenance owing to difficulty of access.

2.3 It is important that the safety of all categories of road users permitted on a particular road shall be considered. For all purpose national roads this may include drivers of motor vehicles, pedestrians, cyclists, equestrians and the disabled. Development, both existing and proposed, should be taken into account, such as the presence of schools, nursing homes and access for emergency vehicles.

2.4 The potential for safety hazards is often greatest at junctions and tie-ins. Where an improvement joins an existing road or junction, differences in the alignment can create hazards so special attention should be paid to those areas to ensure a safe transition is achieved for all features, including drainage. This applies particularly to on-line improvements, where variations in quality of alignment between new and existing sections may not be obvious to the road user.

2.5 The designer must consider carefully the safety implications of the design and should undertake all reasonable measures in order to mitigate potential hazards.

3. KERBS AND GULLIES

3.1 Kerbs and gullies have been for many years one of the most commonly used forms of road drainage. Kerbs may cause a hazard to errant road users, especially cyclists and motorcyclists. The degree of hazard they present appears to be acceptable in practice, primarily because they are a well-established feature. Where other special kerb features are included, advice should be sought from the National Roads Authority.

3.2 Although the main functions of kerbs are to protect pedestrians and provide support for the carriageway, they are often also an essential part of a drainage system. They form a channel at the carriageway edge directing surface water to gullies from where it is removed through a system of pipes.

3.3 As the safety of vehicles is the main priority on high speed roads, kerbs are not recommended for general use on national roads in rural locations unless adjacent footways are present as per Figure 3.1 of NRA HD 33. They shall therefore only be chosen for drainage reasons when other systems are unsuitable.

3.4 It is considered that a kerb upstand of 75mm or less (especially if battered at 45 degrees) allows an errant vehicle to mount the kerb, whereas upstands greater than this (especially if near vertical) tend to deflect an errant vehicle back into its original path. In rural locations it is generally safer for a high speed errant vehicle to be able to mount the kerb without overturning or causing a hazard to following vehicles. In urban situations, where the protection of pedestrians is the highest priority, it is necessary to provide kerbs of a more prominent upstand in order to prevent vehicles from mounting the footway. In such situations there is generally a speed restriction.

3.5 If kerbs have to be provided on national roads in rural areas they should normally be 75mm in height and fully battered i.e. splayed at 45 degrees. A vertical or near-vertical upstand should not be used in these circumstances within 300mm of a running lane.

3.6 As the safety of pedestrians is the priority in urban areas, vertical or half battered kerbs should always be provided in these locations. These normally have a 100mm to 125mm upstand.

3.7 Roundabout design to NRA TD 16 Geometric Design of Roundabouts deliberately sets a high deflection to deter high entry and gyratory speeds. This trades off an increase in slight accidents against a reduction in fatal/serious accidents. The use of substantial kerb upstands is one of the measures adopted to inform the driver of the deflection.

3.8 Details of precast kerbs are shown in Series 1100 of the NRA RCD. However it is not intended to exclude the range of kerbing/bedding combinations permitted in the NRA Specification for Road Works.

3.9 For the use of kerbs in relation to safety barriers see NRA TD 19. In particular, wire rope safety barriers should not be used where the height of any kerb at the edge of the adjacent paved surface exceeds 110mm.

3.10 The designer should base the gully spacing on an appropriate flooded width for that particular location. For example a relatively small flooded width (typically 0.5m) in the channel would normally be chosen in an urban situation to minimise nuisance and danger to cyclists and pedestrians. Refer to NRA HD 33 for maximum permissible flow widths adjacent to the kerb.

3.11 Where necessary, allowance for maintenance and blockage of gullies shall be made in accordance with NRA HD 102 Spacing of Road Gullies. It is also important to ensure that gullies are located at low points. Potential problems may arise from consequent flooding and freezing if gully positions are not correctly and accurately determined.

3.12 Where lay-bys are constructed on kerbed carriageways any islands separating the lay-by from the carriageway should not encroach within the one metre hard strip of the main carriageway where they could provide a hazard for cyclists.

4. SURFACE WATER CHANNELS

4.1 Surface water channels provide an economic method of drainage in new construction of rural roads. Research suggests that the channels permitted in NRA HD 137 Hydraulic Design of Road-Edge Surface Water Channels and NRA HD 119 Grassed Surface Water Channels for Road Runoff pose no greater hazard than the stone filter drain or kerb installation and in most situations are potentially less hazardous. The triangular design should be used in normal circumstances with the trapezoidal design being used where a higher than normal capacity is required. However, as deep or steep-sided surface water channels may present a hazard to errant vehicles, there are restrictions regarding their use which must be taken into account (NRA HD 137).

4.2 Rectangular channels or triangular channels deeper than 150mm should be used only when a safety fence is provided in front of them. In addition, these channels should not be located in the zone behind the safety fence into which the fence may reasonably be expected to deflect on vehicle impact. Co-ordination of the layout of safety fences and surface water channels must be arranged at an early stage in design and not left to compromise at a later stage.

4.3 Geometric constraints given in NRA HD 137 and NRA HD 119 are designed to minimise hazard to errant vehicles. The same constraints shall also be applied to channel outfall details.

4.4 The use of surface water channels should be avoided for shallow longitudinal falls where an appropriate self-cleansing velocity cannot be achieved. On long slack gradients, build-up of sediment could result in flat spots in the channel, with consequent safety problems related to flooding and freezing.

4.5 The degree of security against flooding varies and should be dealt with on a case-by-case basis. Also, although a certain amount of flooding may be tolerated in the hard shoulder and verge hard strip, in central reserves it is important to prevent water encroaching on to the fast lane or from overflowing on to the opposite carriageway. Advice is given in NRA HD 137 and NRA HD 119.

5. DRAINAGE CHANNEL BLOCKS

5.1 Drainage channel blocks Types A and B (as shown in RCD/500/23) are intended for use in situations where positive drainage is desirable for dealing with smaller volumes of flow and which would not justify the use of the larger surface water channels. The surcharged levels for drainage channel blocks shall comply with the criteria given for surface water channels.

5.2 Drainage channel blocks Types A and B should be installed parallel to the road and not less than one metre from the edge of the carriageway. They are not permitted as edge drains contiguous with hard shoulders, hard strips, or carriageways. They should also be avoided in verges subject to frequent equestrian use.

5.3 Type C drainage channel blocks are intended for use instead of gullies or grips and to provide drainage across embankments through appropriate gaps in the kerb line.

5.4 Blocks Types D, E and F are intended to take run-off down an embankment slope to a toe ditch (as shown in RCD/500/24).

6. LINEAR DRAINAGE CHANNEL SYSTEMS

6.1 Linear drainage channels are described in Series 500 of NRA SRW and NRA NGSRW. As with other drainage features, they should not be installed in locations where they will be subject to heavy trafficking by high speed Heavy Goods Vehicles. In exceptional circumstances they may be used in trafficked situations, such as crossovers or nosings. Those systems meeting the requirements of Class D I.S. EN 1433 (as given in Series 500 of NRA SRW) will resist occasional overrun by all vehicles permitted on national roads including motorways. All gratings and covers must be of a type that is integral with the drainage channel. Class C channels should only be installed in locations which are protected from direct traffic loading (e.g. behind safety fencing). Refer to NRA HD 33 for permitted drainage options.

6.2 Not all the slot dimensions permitted in Series 500 of NRA SRW may be suitable on safety grounds where they may be accessible by vulnerable road users. The designer should refer to Series 500 of NRA NGSRW and NRA HD 33. In addition, where linear drainage channel systems are considered for areas accessible by vulnerable road users, the advice of the National Roads Authority should be sought.

6.3 Linear drainage channel systems may be used adjacent to vertical concrete barriers as shown in RCD/100/12. Slot widths should generally be as given in Series 500 of NRA SRW with the exception given for motorways where single slotted linear drainage channels are used with a concrete safety barrier, straight slots between 10mm and 32mm may not be restricted to limitations in length. On motorways a wider range of slot dimensions is permitted as pedestrians and cyclists are prohibited. However, the designer should be aware of possible emergency situations.

6.4 When used on shallow gradients linear drainage channels may be prone to maintenance difficulties. The consequent potential hazards associated with a possible high level of maintenance should therefore be considered.

7. COMBINED DRAINAGE AND KERB SYSTEMS

7.1 Combined drainage and kerb systems are described in Series 500 of NRA SRW and NRA NGSRW. They are useful where kerbs are necessary at locations of little or no longitudinal gradient. They are particularly useful at roundabouts where there is little fall and in urban areas where there is a high incidence of public utility services because they do not need as great a depth of excavation as a typical piped system. Refer to NRA HD 33 for permitted drainage options.

7.2 Where drainage and kerb systems may be subject to vehicle over-run, care should be taken to ensure that the system is designed both for accidental loading and impact. Because combined drainage and kerb systems are by their nature hollow, they may not be as robust as solid kerbs of the same general dimensions.

7.3 As described in Chapter 3, kerbs for combined drainage and kerb units should normally be 75mm high and fully battered in rural locations. For urban locations refer to advice in Chapter 3 or seek advice from the National Roads Authority.

8. COMBINED SURFACE AND GROUNDWATER FILTER DRAINS

8.1 Where combined filter drains are used care should be taken to minimise potential stone scatter problems. Stone scatter presents a safety hazard especially when a hard shoulder is used as a running lane in contraflow. Stone scatter from central reserve drains presents an even greater safety hazard. Refer to NRA HD 33 for further guidance on stone scatter mitigation. The maximum drop at the pavement edge should be in accordance with RCD/700/1.

8.2 Where the degree of porosity is significantly reduced by the introduction of a less permeable material in the top layer, it is necessary that a slight dishing should be provided in the top surface of the drain to allow water to be channelled along the surface and into catchpits during heavy rainfall.

8.3 The emphasis on central reserve drainage must be on minimum maintenance due to difficulty of access. The use of filter drains are suitable in central reserves for wide & unpaved scenarios where the impacts of stone scatter are low. Refer to Figure 3.2 of NRA HD 33 for permitted central reserve drainage options.

8.4 As filter drains have a gravel (or other unbound) surface, their use should be avoided in narrow verges subject to use by equestrians.

8.5 The use of crushed rock in combined filter drains, being more angular, is likely to be less hazardous than rounded gravel or beach shingle.

9. OVER-THE-EDGE DRAINAGE

9.1 Where the topography and soil permit it, the use of over-the-edge drainage will be an acceptable and economic option. Its use is described in NRA HD 139. For new construction, the level of the grass verge shall be set at or slightly below carriageway level to minimise the effect from the build-up of grass kerbs. The maximum drop from the pavement edge should be in accordance with RCD/700/1.

9.2 Where the verge is higher than carriageway level there will probably be a need for grips to be cut through the verge. As a general rule the grips should be adequately wide and shallow-sided. This will extend the period before they need re-cutting or cleaning and will minimise the difficulty for motorists to pull onto them in an emergency.

10. SPECIAL CONSIDERATIONS

Porous Asphalt

10.1 Porous asphalt has a number of advantages over conventional materials in that it can reduce traffic noise, spray and glare. However, it has the disadvantage in that the most efficient method of water removal requires an open, free face at the edge of the carriageway. The maximum drop should be in accordance with RCD/700/1. Advice on possible alternative edge details is given in UK Highways Agency HA 79.

10.2 Where porous asphalt is used in conjunction with surface water channels, the vertical distance between the top of the porous asphalt layer and the invert of the channel should not exceed 150mm.

10.3 Because it is not easily seen, a step down off the edge of the carriageway is more likely to be hazardous to many road users than a similar step up. This is particularly true for pedestrians and riders of two wheel vehicles.

10.4 The use of porous asphalt with free edges with over-the-edge drainage, a kerbed channel or a surface water channel is not suitable on roads frequented by pedestrians or cyclists because of safety hazards. Safety considerations are therefore especially important when porous asphalt in used in urban areas.

10.5 External kerbed channels and surface water channels which involve a step-down should not be used immediately adjacent to the edge of the carriageway without a hard strip or hard shoulder, other than alongside the central reserve. Where a step-down is unavoidable the provision of raised rib markings would provide some protection for vulnerable road users.

10.6 Porous asphalt surfaces must be continued across the hard strip and not discontinued at the edge of the carriageway, as this practice might create a step which may be dangerous to cyclists.

10.7 The installation of loops into porous asphalt road surfaces requires a modified loop slot profile and the use of a porous backfill in order to retain porosity of the road surface. A suitable slot profile together with installation specifications is contained in Series 1500 of NRA RCD.

Cyclists

10.8 The hard strips alongside all-purpose roads are not intended to serve as cycle lanes, but it is recognised that they are used by cyclists, as a safety measure, to gain separation from passing traffic. In the absence of alternative provision this is unavoidable, but good maintenance of the hard strip then takes on greater importance. As cyclists are more adversely affected than motor vehicles by glass or other debris, it is important to maintain regular sweeping of edge strips which are used by cyclists.

10.9 The presence of cyclists within the hard strip locally reduces the value of this safety feature. Also, raised rib markings adjacent to the hard strip may cause difficulties for cyclists entering or leaving the marginal strip near junctions.

10.10 Research has indicated that cyclists and motorcyclists are better able to negotiate surface water channels of the geometry permitted by NRA HD 137 and NRA HD 119 than some common features such as gravel drains and kerbs.

Chamber Covers and Gully Gratings

10.11 Chamber covers and gully gratings should not normally be sited in carriageways. By virtue of their need to be removable, their presence in a carriageway is a potential hazard, especially in national road situations. Where this is unavoidable they should be kept clear of the wheel tracks in the running lanes to avoid repeated wheel loadings. I.S. EN 124 requires covers in these locations to be of a certain weight or incorporate a security feature. The designer shall assess the risk of covers/gratings being removed and specify the cover/grate to be lockable in Appendix 5/1. Designers will also need to be cognisant of the possibility that under certain temporary traffic conditions the hard shoulder is used as a running lane. A departure from standard will be required for any chambers located in the carriageway.

10.12 For all national roads chamber covers and gully gratings shall meet the requirements of Class D400 of I.S. EN 124. Where, exceptionally, covers have to be located in areas subjected to large numbers of high speed Heavy Goods Vehicles, covers may have to be upgraded to Class E600 (I.S. EN 124). Advice may be sought from the National Roads Authority.

10.13 Safety problems may arise from relatively minor problems with manhole covers and chambers in that maintenance or repair will require roadworks and lane closures which will, in turn, create a higher risk situation on the road.

10.14 Before permitting trafficking, care must be taken to ensure that all reinstated framework is flush with the paved surface and securely bedded using suitable bedding materials, e.g. quick setting mortar. Advice on suitable bedding materials may be obtained from the National Roads Authority.

10.15 Gully gratings and grids shall have slots at angles that will not affect the passage of cyclists and shall be set flush with the carriageway. Grids and gratings should also be avoided at cyclist crossing points.

10.16 Where chamber tops are likely to be subject to trafficking, including vehicles, cyclists, pedestrians or equestrians, covers proven to provide an adequate level of skid resistance should be selected. Measurement of in-service skid resistance potential should be by means of a Polished Skid Resistance Value (PSRV) in accordance with BS 9124.

Alternatively, direct measurements made on similar covers in similar conditions of use can be used as an indication of expected levels of in-service performance.

An unpolished test value (USRV) will not necessarily indicate the in-service skid or slip resistance of a cover and as such may give rise to safety concerns.

For sites carrying predominantly pedestrian traffic, cyclists or equestrians, a value of not less than PSRV 45 for average or low risk sites or PSRV 60 for potentially high risk sites should be specified. The Unpolished Skid Resistance Value (USRV) is not an acceptable alternative.

Site risk is defined by the following:

a) Potentially High Risk includes:

i) traffic signals, pedestrian crossings and railway level crossings including 50 m approaches;

ii) roundabouts and their exits, including 50 m approaches;

iii) bends < 100 m radius where the speed limit > 40 mph (65 km/h), including 50 m approaches;

iv) downhill gradients > 10% for more than 50 m (single or dual carriageway);

v) uphill gradients > 10% for more than 50 m (single carriageway only).

b) Average or Low Risk is applied to all other situations on single and dual carriageways:

i) including generally straight sections of carriageway;

ii) approaches to and across major/minor road junctions;

iii) bends of 100 m radius or greater, at any speed limit;

iv) downhill/uphill sections of 10% gradient or less.

Road Markings

10.17 It is essential that road markings do not restrict drainage from the carriageway surface. Even a thin film of standing water can be particularly dangerous in winter when it may freeze. The markings may project up to 6mm above the adjacent surface although the ribs of raised rib markings may be higher. Where continuous longitudinal lines are used, it is permitted to incorporate 'drainage gaps' as required to prevent surface water ponding. These gaps shall be in accordance with specifications in Series 1200 of the NRA SRW.

10.18 Where a kerb exists, a clear space of 225mm should generally be maintained between markings and the kerbed edge of the road. This will allow water to flow freely and help ensure that the markings do not become unnecessarily dirty.

11. REFERENCES

11.1 **NRA Manual of Contract Documents for Road Works (NRA MCDRW)**

a) NRA Specification for Road Works (NRA SRW) (MCDRW 1)

b) Notes for Guidance on the Specification for Road Works (NRA NGSRW) (MCDRW 2)

c) Road Construction Details (NRA RCD) (MCDRW 4)

11.2 **NRA Design Manual for Roads and Bridges (NRA DMRB)**

a) NRA HD 19 Road Safety Audits

b) NRA HD 33 Drainage Systems for National Roads

c) NRA HD 137 Hydraulic Design of Road Edge Surface Water Channels

d) NRA HD 139 Edge of Pavement Details

e) NRA HD 78 Design of Outfalls for Surface Water Channels

f) NRA HD 102 Spacing of Road Gullies

g) NRA HD 119 Grassed Surface Water Channels for Road Runoff

h) NRA TD 16 Geometric Design of Roundabouts

i) NRA TD 19 Safety Barriers

j) NRA TD 69 The Location and Layout of Lay-bys and Location Markers

11.3 **Design Manual for Roads and Bridges (UK Highways Agency DMRB**)

a) HA 79 Edge of Pavement Details for Porous Asphalt Surface Courses

b) HA 104 Chamber Tops and Gully Tops for Road Drainage and Services: Installation and Maintenance

11.4 WALKER C - Safety Aspects of Road Edge Drainage Features. TRL Research Report 422. 1999

11.5 OLSEN et al. - Effect of Curb Design and Location on Vehicle Behaviour. NCHRP Report No 150. Transportation Research Board.

11.6 ROBINSON B. - Assessment of vehicle handling safety when driving into roadside water drainage channels. TRL Research Report 230.1996

11.7 CR2 Contractor Report 2 - The drainage capacity of BS road gullies and a method for estimating their spacing.

11.8 CR76 Contractor Report 76 - Methods for the removal of surface water from trunk roads

11.9 I.S. EN 124:1994 - Gully tops and manhole tops for vehicular and pedestrian areas - Design requirements, type testing, marking, quality control. NSAI, Dublin

11.10 I.S. EN 1433:2002 - Drainage channels for vehicular and pedestrian areas. Classification, design and testing requirements, marking and evaluation of conformity. NSAI, Dublin

11.11 BS 9124:2008 - Specification for steel and aluminium access covers systems with over 1m clear opening.

11.12 Traffic Signs Manual. Department of Transport, Dublin. 2010

11.13 Drainage Design for National Road Schemes – Sustainable Drainage Options. National Roads Authority. 2014.

12. ENQUIRIES

12.1 All technical enquiries or comments on this document, or any of the documents listed as forming part of the NRA DMRB, should be sent by e-mail to infoDMRB@nra.ie, addressed to the following:

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