An Roinn Iompair
Department of Transport

Cumann Lucht Bainistíochta Contae agus Cathrach
County and City Management Association

ROADS Services Training Group

LOCAL AUTHORITY ROADS CONFERENCE and EXHIBITION - 2022

Radisson Blu Hotel & Spa, Sligo May 2022

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LOCAL AUTHORITY ROADS CONFERENCE and EXHIBITION – 2022

Guidelines for Road Drainage 2nd Edition

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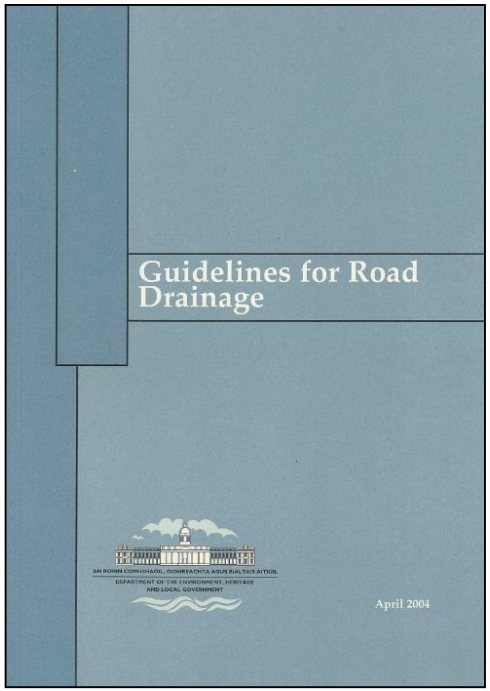
Overview

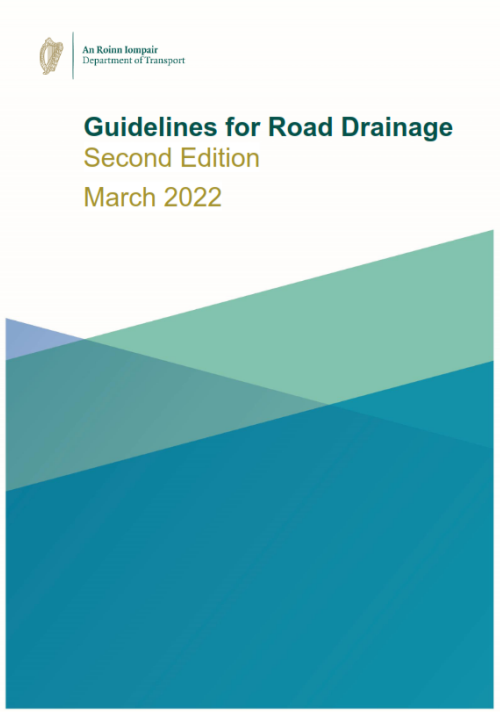
- History of the Document
- Document Structure
- Drainage Types
- Drainage Selection
- Drainage Assessment
- Project Level Assessment
- Drainage Design
- GA Drawings for Rehabilitations
- Next steps

Guidelines for Road Drainage

- History of Guidelines for Road Drainage



Previous Version April 2004



2nd Edition March 2022

- Information Gathering circular issued to all LA in March of 2020
- Working Group Formed to develop Requirements

Guidelines for Road Drainage

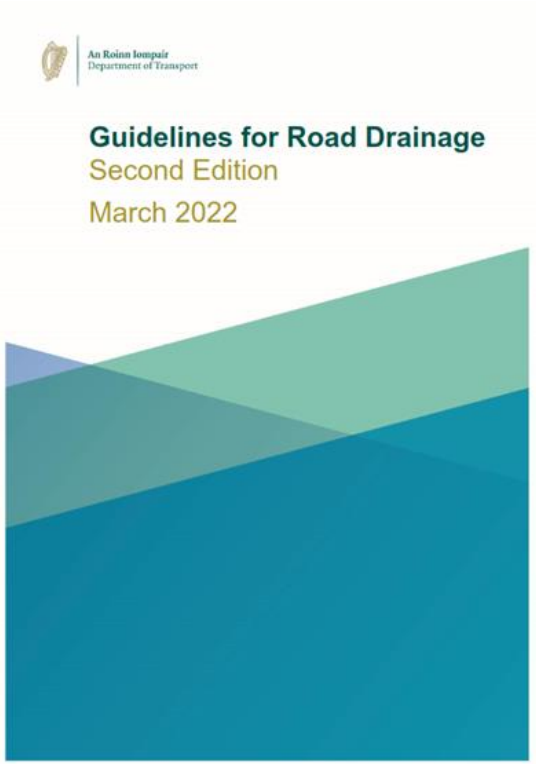
- Road Drainage
  - Road drainage is a process of removing and controlling surface water and sub-surface water. This includes the interception and diversion of water from the roadway and sub-surface levels.

- Objectives
  - Provide means of standardising the practices used in the maintenance of the road drainage network;
  - Provide a consistent and uniform approach to the construction methods associated with road drainage;
  - Provide a mechanism for recording and rating the road drainage network;
  - Provide robust guidance to future proof the road drainage network to cater for the effects of climate change.

NOTE:
This document is not intended to be a comprehensive design manual for the drainage of new roads but concentrates on the design, rehabilitation and maintenance of the drainage network on Regional and Local roads.

Guidelines for Road Drainage

- Document Structure
  - Section A
    - Legal Frameworks
    - Drainage Types
    - Drainage Assessment
    - Drainage Design
  - Section B
    - Drainage Rehabilitation
    - Maintenance of Drainage System



Guidelines for Road Drainage

Legal Basis

Roads Act

- Section 76 of the 1993 Roads Act
- Powers to the road authorities to ensure adequate drainage of public roads
- Summary of the 17 subsections included.

Rights & Responsibilities of Riparian Landowner

Drainage Types

- Piped Systems
  - Kerb and Gullies,
  - Rural Gullies
  - Drainage Kerbs,
  - Kerb Inlet Gullies,
  - Aco Drains and
  - Slot Drains
- Filter Drains
- Open Drains
- Verge Removal
- Concrete Channels
- Over the Edge Drainage
- Soakaway & Infiltration Trench
- Bio –Retention
- Attenuation Basins
- Attenuation Tanks
- Swales and Wetlands

Guidelines for Road Drainage

- Communication
  - Section 76 of the Roads Act should be the last resort
  - Initial correspondence with landowners ahead of the enforcement of the roads act
  - Owners of property where there is a watercourse within or adjacent to the boundaries of their property are a riparian landowner

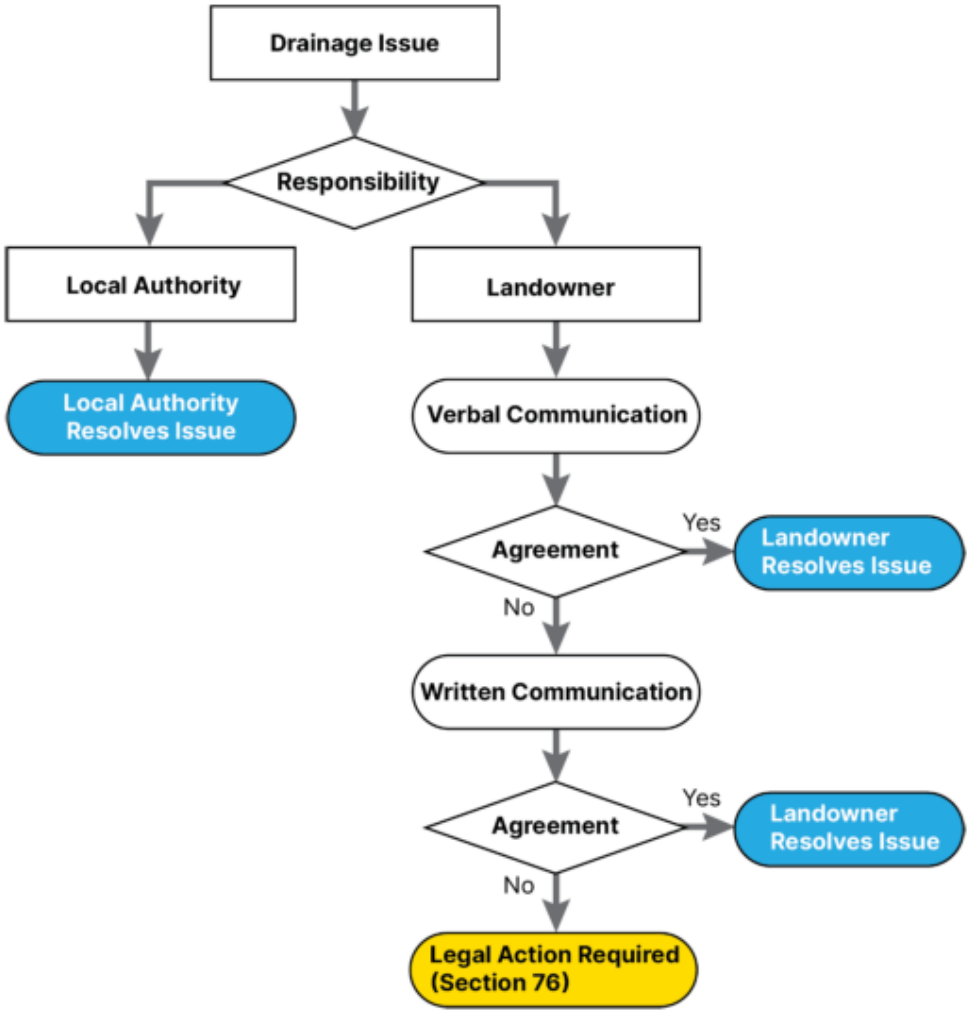
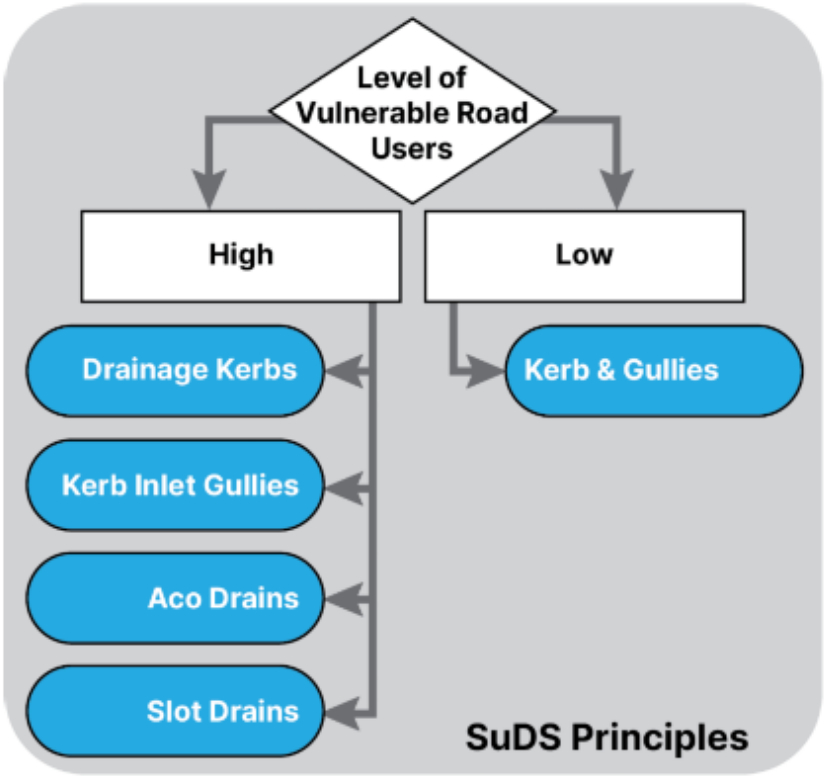


Figure 2.2 Process Flow Chart for Communication

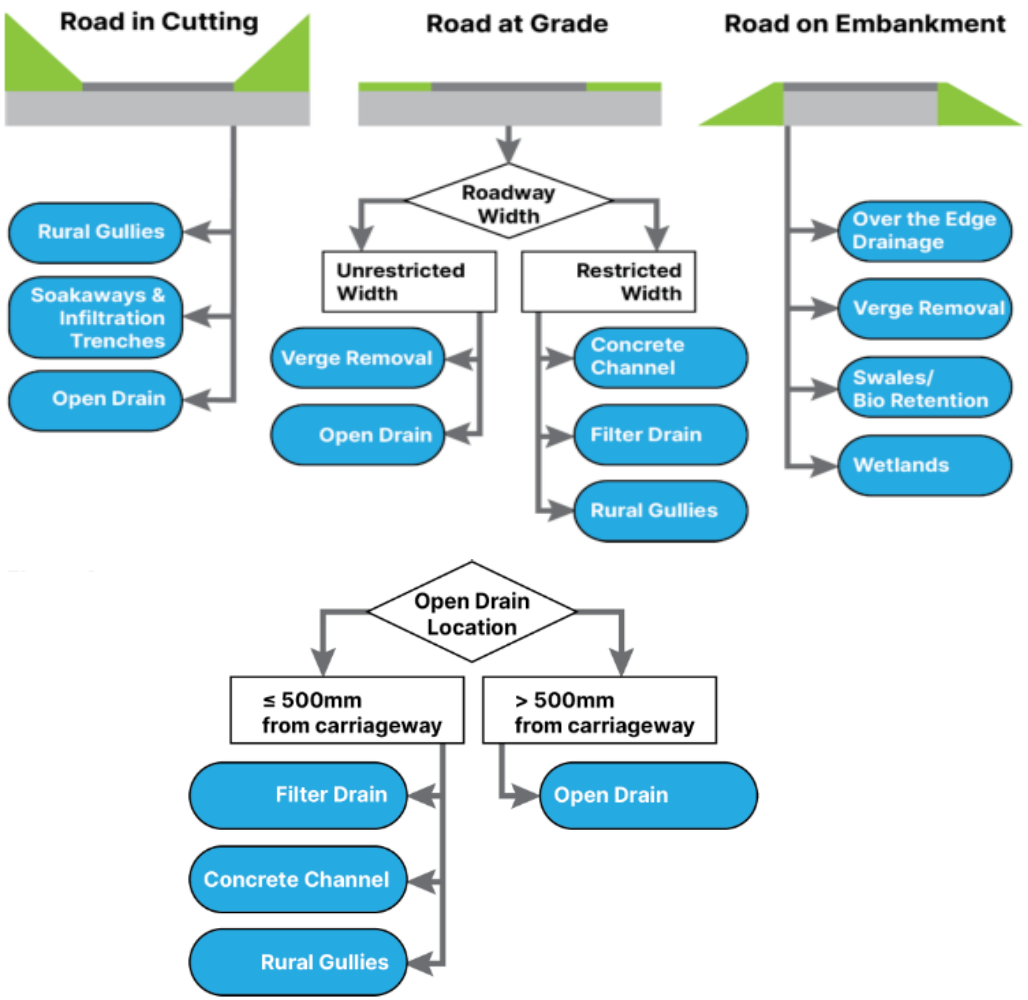
Guidelines for Road Drainage

- Drainage Type Selection Assistance
  - Urban Selection



Guidelines for Road Drainage

- Drainage Type Selection Assistance
  - Rural Selection
  - Open Drain



Guidelines for Road Drainage

- Drainage Assessment
  - An assessment is essential to determine how the infrastructure is or is not operating.
  - Four Intervention Categories outlined
  - Ensure consistency of approach
  - Intervention is defined as action taken that results in the drainage system functioning adequately.

Intervention Category	Description
Routine Maintenance	Refers to any maintenance task that is done on a planned and ongoing basis aimed to prevent problems before they result in drainage operational issues.
Reactive Maintenance	Refers to repairs or actions carried out to drainage that is non-functional, to restore the drainage to its normal operating condition.
Rehabilitation	Refers to the action of restoring drainage that has been damaged to its former normal operating condition.
Improvement	Refers to new drainage infrastructure or the enhancement of existing drainage infrastructure.

Guidelines for Road Drainage

- Drainage Survey Condition Index (DSCI)
  - Captured via MapRoad PMS using Field Apps
  - DSCI allows road drainage condition to be systematically identified
  - Four Ratings for drainage performance

Consistency of approach

DSCI Rating	Description:	Action:	Intervention(s)
Functional Drainage	Drainage adequately facilitating the displacement of surface water from the road pavement	Monitor	None
DSCI Rating	**Description:**	**Action:**	**Intervention(s)**
Functional Drainage	Initial indicators that drainage may not facilitate the adequate displacement of surface water from road pavement	Intervention	Routine Maintenance
DSCI Rating	**Description:**	**Action:**	**Intervention(s)**
Non - Functional (Pre Road Damage)	Drainage **not** facilitating the displacement of surface water from the road pavement AND has NOT yet affected the road structure	Intervention	Reactive Maintenance
		Project Level Assessment	Rehabilitation, Improvement
DSCI Rating	**Description:**	**Action:**	**Intervention(s)**
Non - Functional (Post Road Damage)	Drainage **not** facilitating the displacement of surface water from the road pavement AND HAS affected the road structure	Intervention	Reactive Maintenance
		Project Level Assessment	Rehabilitation, Improvement

Guidelines for Road Drainage

- Project Level Assessment
  - The aim in the first instance of the DSCI rating is to establish the operational capacity of the drainage and to determine the appropriate intervention required to return it to a functional operational level i.e. DSCI.
  - Project Level Assessment is where works are outside

Intervention Category
Routine Maintenance
Reactive Maintenance

  - PL Assessment is required to determine which of the following is appropriate

Intervention Category	Description
Rehabilitation	Refers to the action of restoring drainage that has been damaged to its former normal operating condition.
Improvement	Refers to new drainage infrastructure or the enhancement of existing drainage infrastructure.

Guidelines for Road Drainage

- PL Assessment exercise is required to gather “site” information to ensure accuracy in decision making
- Gathering “site” Information
  - Desktop study of the site and surrounds
  - Pavement Survey Condition Index can be viewed for the site
  - MapRoad 3rd party datasets are a valuable source of information

Table 1: The PSCI Rating System

Overall PSCI Rating	Primary Rating Indicators*	Secondary Rating Indicators*
10	No Visible Defects.	Road surface in perfect condition.
9	Minor Surface Defects[1]. Ravelling or Bleeding ≤10%.	Road surface in very good condition.
8	Moderate Surface Defects[1]. Ravelling or Bleeding 10% to 30%.	Little or No Other defects.
7	Extensive Surface Defects[1]. Ravelling or Bleeding > 30%.	Little or No Other defects. Old surface with aged appearance.
6	Moderate Other Pavement Defects[2]. Other Cracking < 20%. Patching generally in Good condition. Surface Distortion requiring some reduction in speed.	Surface defects[1] may be present. No structural distress[3].
5	Significant Other Pavement Defects[2]. Other Cracking > 20%. Patching in Fair condition. Surface Distortion requiring reduction in speed.	Surface defects[1] may be present. Very localised structural distress[3] (< 5 m² or a few isolated potholes).
4	Structural Distress[3] Present. Rutting, Alligator Cracking or Poor Patching for 5% to 25%. Short lengths of Edge Breakup/Cracking. Frequent Potholes.	Other defects may be present.
3	Significant Areas of Structural Distress[3]. Rutting, Alligator Cracking or Poor Patching for 25% to 50%. Continuous lengths with Edge Breakup/Cracking. More frequent Potholes.	Other defects may be present.
2	Large Areas of Structural Distress[3]. Rutting, Alligator Cracking or Very Poor Patching for > 50%. Severe Rutting (> 75mm). Extensive Very Poor Patching. Many Potholes.	Very difficult to drive on.
1	Extensive Structural Distress[3]. Road Disintegration of surface. Pavement Failure. Many large and deep Potholes. Extensive Failed Patching.	Severe Deterioration. Virtually undriveable.

* Individual pavements will not have all the types of distress listed for any particular rating

Organisation	Identify Mapped Areas
Geological Survey Ireland	Bedrock, Groundwater, Geotechnical, Geological heritage, Marine, Geophysics Geochemistry etc.
Teagasc	Soil Classification Maps
Met Eireann	Rainfall frequency
OPW Flood Studies Update Web Portal	Rainfall frequency Flood estimation (Gauged) Flood estimation (Ungauged)
DATA.GOV.IE	Environment Section

Table 4.3 Relevant 3rd Party Data Sets

Guidelines for Road Drainage

- Visual Site Inspection
  - Objective is to collect data on the drainage infrastructure, road pavement and surrounding areas.
  - Inspection should be undertaken in two conditions:
    - Dry Weather:
      - A safe and unperturbed inspection allowing better visual exposure to establish the physical condition of the drainage network.
    - Wet Weather :
      - Undertaken during or after a period of rainfall and will help to establish the sources, patterns, obstructions, and the effects of flowing water.
  - Inspection should be recorded using photographs at a minimum.
  - Ensure the 3 sections of a drainage system are picked up @ Inspection
    - Section 1 – Collection Points
    - Section 2 – Transmission Network
    - Section 3 – Discharge Element

Guidelines for Road Drainage

- Projects
  - Project Level assessment will determine if it shall be placed on the yearly drainage programme and scheduled. The DSCI rating (DSCI or DSCI) will aid project prioritisation
  - DSCI has NOT affected the road structure where DSCI has affected the road structure
  - An intervention when the drainage is rated as DSCI will ensure that the road structure will not deteriorate further, and the longevity of the carriageway can be maintained
  - In most cases the drainage rated as DSCI will require a greater level of intervention in parallel with works being undertaken to the carriageway.

Guidelines for Road Drainage

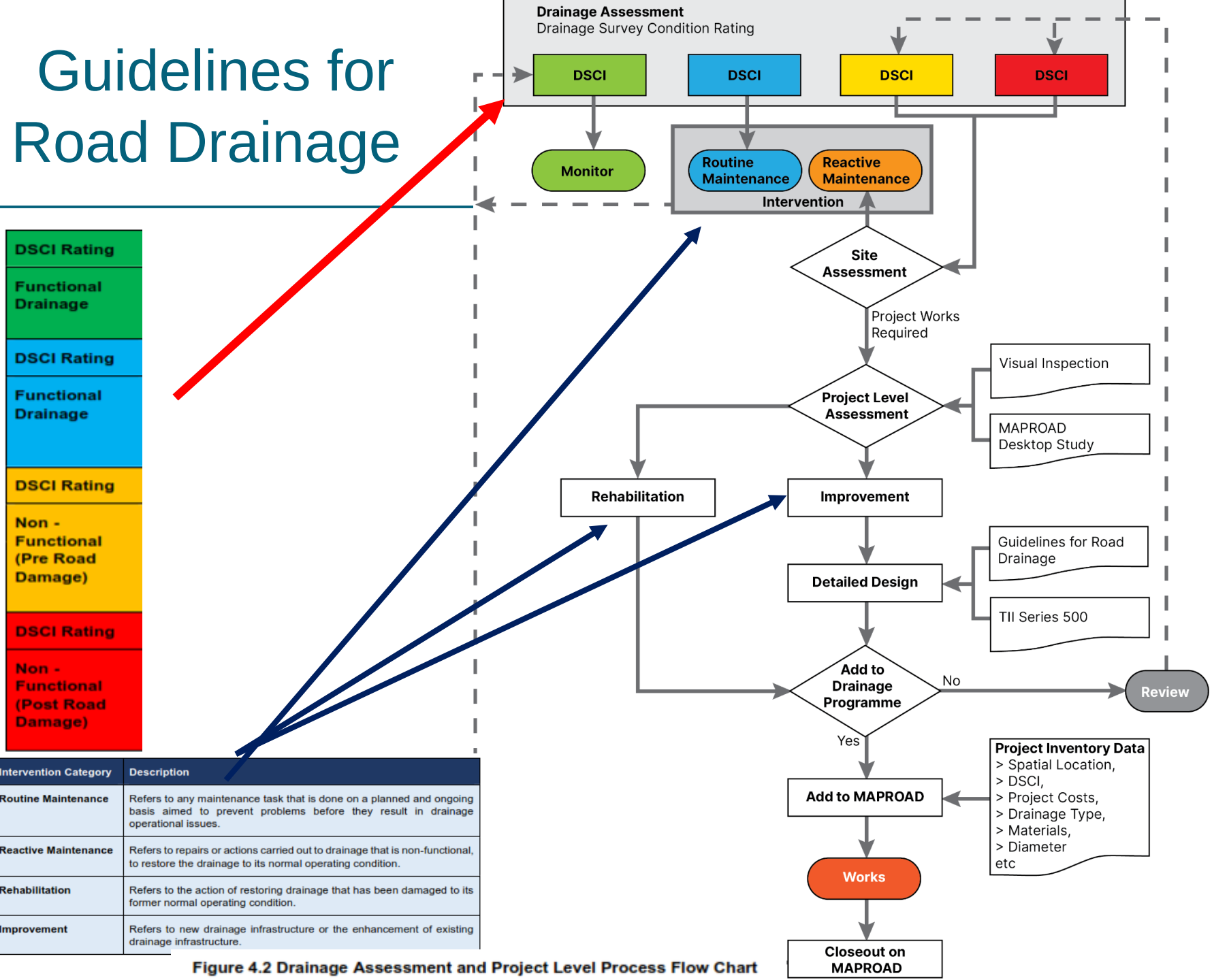


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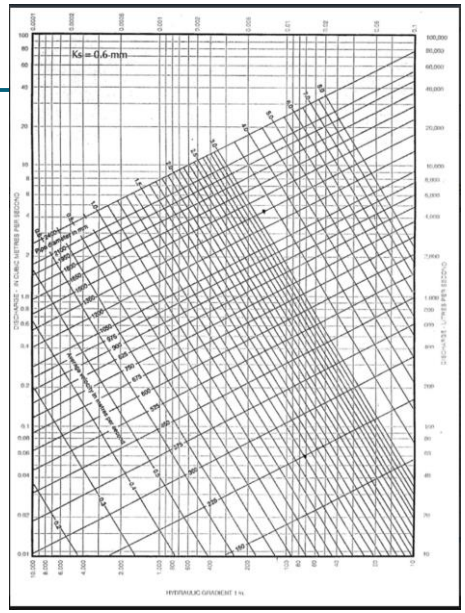
Figure 4.2 Drainage Assessment and Project Level Process Flow Chart

Guidelines for Road Drainage

- Drainage Design
  - Design Principles
  - Return Periods
  - Minimum Pipe Size
    - 225mm longitudinal drains
    - 600mm for transverse pipe
  - Pipe Design Sizing
    - Hydraulic Capacity Tables
    - Colebrook White
      - HR Wallingford Tables



Preliminary Sizing charts (Capacity in l/s at the various slopes)
Ks = 0.6mm

Slope		Pipe Diameter (mm)								
Gradient	%	225	300	375	450	525	600	675	750	900
1 in 200	0.5	36.6	78.2	141	227.9	341.8	485.5	661.5	872.1	1406.5
1 in 150	0.667	42.3	90.4	163.0	263.3	395.0	561.0	764.3	1007.7	1624.9
1 in 125	0.8	46.4	99.2	178.7	288.8	433.2	615.2	838.1	1104.9	1781.6
1 in 100	1	51.9	111.1	200	323.2	484.7	688.3	937.6	1236	1993
1 in 80	1.25	57.5	123.0	221.5	357.9	536.7	762.2	1038.2	1368.5	2206.5
1 in 50	2	73.7	157.5	283.5	458	686.8	975.1	1328.2	1750.7	2822.4
1 in 40	2.5	82.4	176.2	317.2	512.3	768.2	1090.7	1485.6	1958.1	3156.7
1 in 33	3	90.4	193.1	347.6	561.5	841.8	1195.2	1627.9	2145.7	3458.9
1 in 28.57	3.5	97.7	208.7	375.6	606.7	909.5	1291.3	1758.7	2318.1	3736.8
1 in 25	4	104.4	223.1	401.6	648.7	972.6	1380.8	1880.5	2478.6	3995.5
1 in 22.22	4.5	110.8	236.7	426.1	688.2	1031.8	1464.8	1994.9	2629.4	4238.4

Table 5.1 Preliminary Pipe Sizing

Guidelines for Road Drainage

- Pipe Design Sizing
  - Mannings Equ. Sizing of pipes

Mannings Equation	$V = \frac{R^{2/3} \, x \, S^{0.5}}{n}$
Hydraulic Radius	$R = \frac{A}{P}$
Discharge Flow	$Q = AV$

  - Roughness Coefficient

Material	***Manning's Roughness Coefficient n***
Concrete	0.012 - 0.016
Polyvinyl Chloride PVC - with smooth inner walls	0.09 - 0.011
Polyethylene PE - Corrugated with corrugated inner walls	0.018 - 0.025
Grassed Channel	0.035 – 0.050

  - Design Calculation process provided

1. Length No.	2. Difference in Level (m)	3. Pipe Length (m)	4. Pipe Gradient (%)	5. Assumed Diameter (m)	6. Flow Area of pipe (m^2)	7. Perimeter (m)	8. Hyd. Radius (m)	9. Velocity (m/s)	10. Discharge Flow (l/s)
1.1	2.0	100.00	0.020	0.225	0.040	0.707	0.056	1.512	60.11
1.2	2.0	100.00	0.020	0.225	0.040	0.707	0.056	1.512	60.11
1.3	2.0	100.00	0.020	0.225	0.040	0.707	0.056	1.512	60.11
1.4	2.0	100.00	0.020	0.225	0.040	0.707	0.056	1.512	60.11
1.5	1.0	100.00	0.010	0.225	0.040	0.707	0.056	1.069	42.51
1.6	1.0	100.00	0.010	0.225	0.040	0.707	0.056	1.069	42.51
1.7	1.0	100.00	0.010	0.300	0.071	0.943	0.075	1.292	91.37
1.8	1.0	100.00	0.010	0.300	0.071	0.943	0.075	1.292	91.37
1.9	0.5	100.00	0.005	0.375	0.110	1.178	0.094	1.059	116.97
1.1	0.5	100.00	0.005	0.375	0.110	1.178	0.094	1.059	116.97
1.11	0.5	100.00	0.005	0.375	0.110	1.178	0.094	1.059	116.97
1.12	0.5	100.00	0.005	0.375	0.110	1.178	0.094	1.059	116.97

Table 5.3 Design Table for Pipe Sizing.

Guidelines for Road Drainage

- Green Field Run-off Rate
  - Important part of the design of any drainage type
  - Three different methods
    - Rational Method
    - IH124 Method
    - ADAS Method

Rational Method	$Q = C\,i\,A$	Q = runoff in l/s C = runoff coefficient is regarded as a combination of two separate coefficients C = CvCr i = rainfall intensity (mm/hr) during the design storm of duration A = area of catchment upstream of the point being considered (hectares)
Simplified Rational Method	$Qp = \frac{Ap\ x\ i}{360} = \frac{}{2.78Ap\ x\ i}$	Qp = runoff in m^3/s Ap = impermeable area to be drained (hectares) i = rainfall intensity (mm/hr) during the design storm of duration
Time of Concentration Tc	$T_c = T_e + T_t$	Te = time of entry - time taken for runoff to travel overland from properties, roofs, down pipes, etc, to the 'point of entry' at the road channels Tt = time of flow - length of time to travel in the pipe length under consideration.

Design Calculation process provided

Guidelines for Road Drainage

- Green Field Run-off Rate
  - Important part of the design of any drainage type
  - Three different methods
    - Rational Method
    - IH124 Method
    - ADAS Method

IH124 Method	$QBAR = 0.00108 Area^{0.89} x SAAR^{1.17} x\ SOIL^{2.17}$	QBAR = mean annual flood m^3/s Area = Catchment area km^2 SAAR = standard average annual rainfall in mm) SOIL = Soil index
SOIL	$SOIL = \frac{(0.10S1 + 0.30S2 + 0.37S3 + 0.4S4 + 0.53S5)}{(S1 + S2 + S3 + S4 + S5)}$	S1 to S5 = Proportion of the catchment covered by each soil class.

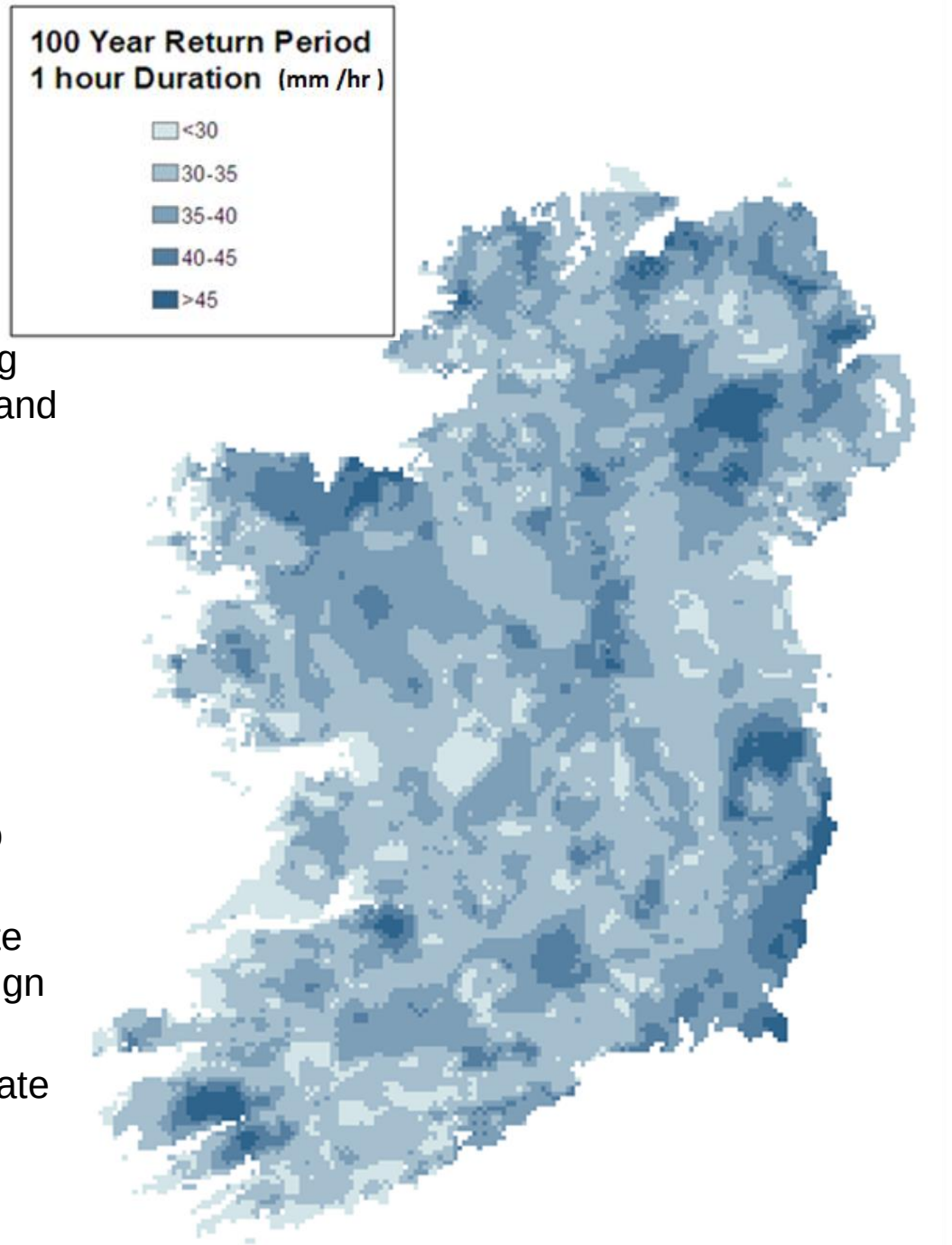
Design Calculation process provided

Guidelines for Road Drainage

- Rainfall Intensities
  - A number of options for determining has been provided.
  - Rainfall intensity for a given location can be determined from a point location on the FSU portal at the link below. This information is developed using a Depth Duration Frequency Model (DDF Model) https://opw.hydronet.com/
  - A step by step process is provided in the document for this calculation.
  - Met Éireann provides a facility where information will be circulated to the designer once a submission has been made with the required co-ordinates. The submission of point data can be done on the following link.

https://www.met.ie/climate/services/rainfall-return-periods

Guidelines for Road Drainage



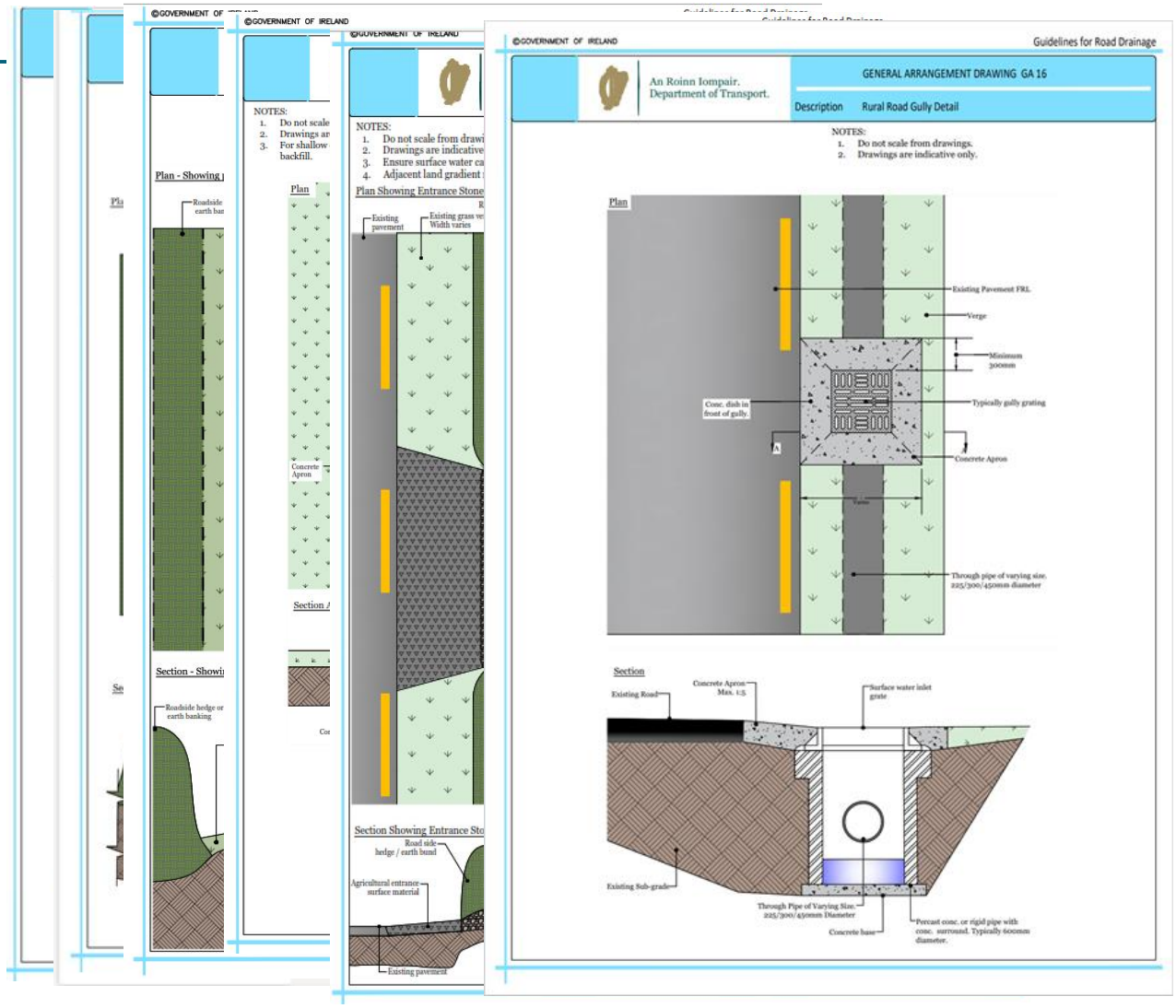
- Rainfall Intensities
  - Return period of 1:100 mapping has also been provided for Ireland
  - mm/hr.

- Climate Change
  - Climate Status Report 2020 average annual rainfall has increased by 7% from 1990 to 2019
  - Allowance for changing climate rainfall intensities used in design must be increased by 20%
  - Allow for future effects of climate change

Guidelines for Road Drainage

6.0 Drainage Rehabilitations

- **GA 1** Over the Edge Drainage
- **GA 2** Open Drain
- **GA 3** Verge Removal
- GA 4 Filter Drain
- GA 5 Urban Swale
- GA 6 Rural Swale
- GA 7 Precast Concrete Soakaway
- GA 8 Granular Soakaway
- **GA 9** Piped Crossing Shallow
- GA 10 Headwall Details
- GA 11 Road Crossing Closed system
- GA 12 Residential Entrance Detail
- **GA 13** Agricultural Entrance Detail
- GA 14 Field Inlet
- GA 15 Gulley Detail
- **GA 16** Rural Road Gulley Detail
- GA 17 Concrete Channel Detail



Guidelines for Road Drainage

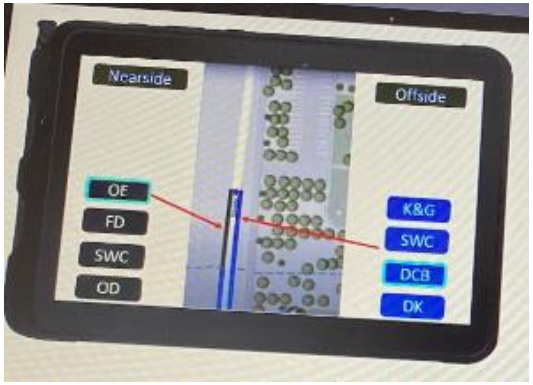
- Drainage Gratings
  - Rural Gratings and Urban Gratings
    - Name of the European Standard-EN 124-2;
    - Appropriate class (e.g. D400);
    - Name and/or identification mark of the manufacturer;
    - Factory of manufacturer which may be in code; and
    - Date or week and year of manufacture (coded or not coded).
  - Principles
    - Approx. grating size
    - Min Waterway area
    - Flat or shaped grating
    - Selection type will have varying maintenance levels

Guidelines for Road Drainage - Training

- **LASNTG :**
  - Surface Water Construction & Maintenance for Operatives
    - Course content is being updated to align with new Guidance.
    - Information on the Drainage Rating Index
    - Target Audience for course
      - Supervisors,
      - General Operatives
      - All Outdoor

Guidelines for Road Drainage – Next Steps

- **Drainage Inventory and Performance Rating :**
  - Working Group Formed to determine approach.
  - Develop software to record information on handheld devices.
  - Pilot the process prior to national roll out.



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Thank You

Contact:
roaddrainage@dotso.ie