

Letter of instruction

Information for users

The following document:

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Issue 3

has had changes made to it, most recently, with effect from **23 September 2013**.

Instructions for use

It is essential that you first read and understand each letter of instruction pertaining to the standard before proceeding to use the standard. You must then apply the requirements of each letter to the standard.

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Railway Drainage Systems Manual

Part 3B: Maintenance

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1 Purpose

The purpose of this Part of the Manual is to specify requirements for Maintenance so that there is no unacceptable risk to safety or performance as a result of the condition or use of a Drainage System.

2 Scope

This Part specifies requirements for planning, prioritising and implementing Maintenance, and provides guidance on Maintenance methods.

This Part does not apply to Inspection of Drainage Systems - this is covered in Part 3A.

3 Principles

Drainage Maintenance shall be carried out on a risk-assessed basis.

The risk-based priority plan for Maintenance shall be defined in the DMP.

All necessary consents and licences shall be obtained before Maintenance commences (see Part 1).

Records of Maintenance shall be maintained.

Drainage Systems require regular maintenance: the frequency and type of maintenance depends upon the type of System and its constituent components. However, in most instances all that is necessary is for the existing drains to be cleared of silt, ballast, vegetation or other debris.

Maintenance should identify and treat the fundamental cause of the problem rather than addressing its symptoms.

The need for Maintenance should be determined through an evaluation of an Inspection, but some Maintenance can be carried out during an Inspection.

Maintenance of Track Drainage includes:

- cleaning pipes, Catchpits and Manholes, and clearing Ditches and Channel Drains;
- replacing covers to Catchpits and Manholes.
- replacing or repairing components.

Maintenance of Off-track Drainage includes:

- clearing Ditches, Trash Screens and Security Screens;

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- removing vegetation from Channel Drains, Ditches and flumes.

Maintenance of counterfort drains is impractical, and so when problems with these are identified consideration should be given to replacing the drain.

The priority for undertaking Maintenance should be in accordance with Appendix B.

Common problems with Drainage Systems are:

- vegetation growing in open Channel Drains;
- siltation in pipes;
- accumulation of debris in open Channel Drains and pipes;
- blockage of Trash Screens, Security Screen and Outfalls.

Localised repair of a Drainage System might be undertaken to provide a short term remedy ahead of more extensive work.

4 Riparian responsibilities

As a riparian owner of Watercourses, Network Rail has a common law responsibility to allow the flow of water without obstruction, pollution or diversion affecting the rights of others. Network Rail has a responsibility to maintain the bed and the banks of Watercourses (including any trees and shrubs growing on the banks) and to clear debris (natural or otherwise), including litter, even if it did not originate from Network Rail land.

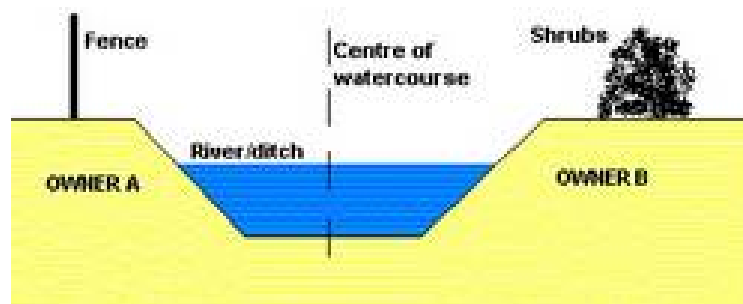


Figure 4.1: Riparian ownership of a Watercourse

Where a Watercourse is sited between two or more property boundaries each owner can be equally responsible.

5 Maintenance of drainage components

5.1 Channel Drains and Ditches

The effectiveness of Channel Drains can be much reduced by the ingress of rubbish, and so defective or missing covers should be replaced. Furthermore,

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the sides of unlined Channel Drains are susceptible to collapse and vegetation can grow within the Drain.

Common problems and their remedies are described in Table 4.1.

Problem	Cause	Remedy
Blockage	Spoil tipping	Clean out, line and reprofile
Vegetation	Overgrowth	
Collapse	Bank instability	Line channel to <ul style="list-style-type: none"> • preserve cross-section • reduce maintenance
	Scour	Protect against bank erosion on slopes by using 500mm wide grass strips
	Burrowing animals	On steep slopes, reduce the flow velocity using baffles Control vermin and fill burrows

Table 4.1: Channel Drains and Ditches: common problems and remedies

5.2 Catchpits and Manholes

One of the purposes of a Catchpit is to provide a silt trap. When the level of silt in a Catchpit is above the invert of the pipe the effectiveness of the Drainage System is much reduced and the System is more difficult to clean.

Catchpits should be cleared of silt and debris before their sumps become full. The frequency of cleaning depends upon the rate of ingress of silt and debris, but it should be sufficient to prevent blockage of the pipes. Newly ploughed fields can be a source of silt; persistent silting might be an indicator of land drainage problems and so should be brought to the attention of the Drainage Engineer.

Common problems and their remedies are described in Table 4.2.

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Problem	Cause	Remedy
Silting	Normal operation	Clean out by i) hand excavation ii) mechanical jetting or vacuuming
Blockage Ballast ingress Chambers filled or buried	Damaged or missing covers Poor ballasting practices	Increase frequency of cleaning or <ul style="list-style-type: none"> remove ballast in sump and replace damaged or missing covers to keep ballast out raise Catchpits before ballast drops and/or clean chambers on completion of track work
Collapse	Damage by ground movement or on-track plant	Rebuild Catchpit/Manhole Insert Catchpit liner

Table 4.2: Catchpits and Manholes: common problems and remedies

5.3 Pipes generally

Pipes should be regularly cleaned of silt and debris and damaged pipes replaced.

The presence of silt in the invert impairs the hydraulic efficiency of a pipe. Silting may occur over a period of time where the filter is absent or unsuitable for the ground through which the pipe passes. In such circumstances it will be necessary to clear the silt and replace the filter and/or porous fill.

The cleaning of pipes should always start from the lower end or Outfall, as flooding can occur if pipes at a higher level are cleaned first. Cleaning can be undertaken by pressure jetting, rodding or by winching a drain cleaning device (commonly known as a 'badger') through the pipe. The removal of silt can result in the pipe collars or perforations becoming blocked.

The roots of hedges and/or trees growing in close proximity to a drain can penetrate pipes in search of moisture. It might be necessary to use jetting equipment fitted with a flail to remove roots.

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5.4 Piped Collector Drains

Common problems and their remedies for Piped Collector Drains are described in Table 4.3, but some of the problems with Carrier Drains (see **5.5**) can also apply to Piped Collector Drains.

Problem	Cause	Remedy
Blockage of filter media	Wet Beds	Dig out and replace filter surround
	Ballast attrition	
Hydraulic	Uneven pipe gradient from disturbance of formation	Upgrade/relay drainage before renewing Track Support System
	Inadequate capacity for Catchment runoff	Replace filter surround to improve drawdown from Track Support System and prevent formation of Wet Beds

Table 4.3: Piped Collector Drains: common problems and remedies

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5.5 Carrier Drains

Common problems and their remedies for Carrier Drains are described in Table 4.4.

Problem	Cause	Remedy (depending upon severity)
Blockage	Capacity reduced by ingress of ballast or silt, crushed pipes, poor pipe alignment	Rodding: by hand for clearing of small local blockages and locating larger obstructions Open excavation: dig up pipe, clean out / repair / replace Water jetting: on-track plant ranging from road-railers to drain trains Winching: relies on ability to pass cable through pipe
	Root intrusion	Vegetation management to restrict spread of trees, and <ul style="list-style-type: none"> • drag scraping • flail jetting (spinning) nozzles • pipe replacement
Partial collapse	Major pipe cracking or deformation Holes and collapses of less than one pipe length	Local open cut repair and/or replacement
Complete collapse	Structural failure of more than one pipe length	Renew by open cut
Hydraulic surcharging	Poor fall or pipe alignment	Replace filter surround to improve drawdown from track and prevent formation of Wet Beds Relay drains
	Inadequate pipe capacity	Relay by open cut or increase diameter of pipe - size is a compromise between flow capacity and self-cleansing velocity

Table 4.4: Carrier Drains: common problems and remedies

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5.6 Culverts

Common problems and their remedies for Culverts are described in Table 4.5.

Problem	Cause	Remedy
Blockage	Debris	Check / clear Trash Screen
	Silt	Clear non-man entry Culverts by rodding, drag scraping, or water Jetting
		Clear man entry Culverts by water jetting, hand excavation, drag scraping or, if sufficient headroom, by mini digger
		Remove obstructions from downstream body of water
	Rubbish or trash	Fit Trash Screens
Structural	General deterioration	Local repairs: replace missing bricks / repoint mortar joints
		Fill voids / repair lining
	Scour voids	Reline conduit
		Extend headwall or training walls, flumes and aprons
	Collapse	Reconstruct
Insufficient flow capacity	Change in upstream Catchment	Remediation to increase capacity
	Outlet smaller than inlet	

Table 4.5: Culverts: common problems and remedies

5.7 Syphon

Syphon problems and remedies are generally the same as for Carrier Drains, Catchpits, Manholes and Outfalls with the additional specific problem and remedy described in Table 4.6.

Problem	Cause	Remedy
Blockage	Dry weather flow velocity insufficient for self-cleansing	Seek advice from the Drainage Engineer before commencing any work on syphons

Table 4.6: Syphons: particular problem and its remedy

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5.8 Interceptors

Interceptors should be maintained such that their performance is not impaired. Maintenance should include cleaning at a frequency, and in accordance with the manufacturer's recommendations.

5.9 Outfalls

Common problems and their remedies are described in Table 4.7.

Problem	Cause	Remedy
Structural	General deterioration	Local repairs: replace missing bricks / repoint mortar joints
	Scour	Extend headwall or training walls, flumes and aprons
Blockage	Seized flap valve	Repair or replace valve

Table 4.7: Outfalls: common problems and their remedies

Where conditions outside the railway boundary are causing, or likely to cause, a restriction to free flow, the defect should be reported to the relevant Outside Party.

6 Monitoring and maintenance of Sustainable Drainage Systems

SUDS require monitoring and periodic Maintenance. There is a tendency for infiltration systems to become blinded by fine materials, and so periodic Maintenance is required to restore the infiltration facility and capacity. Where sub-surface infiltration systems (such as soakaways and infiltration trenches) are provided with vertical Inspection wells or tubes, the water level in the System should be regularly checked to determine whether Maintenance is required.

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Appendix A: Trenchless maintenance techniques

A1. Introduction

Most Maintenance involves cleaning or open cut replacement of short lengths of pipes. Problems can, however, be solved using trenchless techniques that enable repairs to be carried out without the need to excavate the whole drain.

Most methods do, however, require some excavation to access the pipe or to construct launch and reception pits.

A2. Cleaning

Internal surfaces of drainage pipes can be cleaned to remove deposits that reduce the pipe diameter.

Various designs of 'pig' with their associated launch systems have been developed. Other electrical, hydraulic or pneumatic devices are available which cut and/or scrape material from the pipe wall as they move along it.

High pressure water jets or high velocity gas streams laden with cleaning agent can be used to break-up and remove hardened deposits.

A3. Liners

A3.1 General

Pipes can be relined to provide internal corrosion protection, to isolate the content from the host pipe and, in some cases, to reinforce the pipe.

Linings reduce the bore diameter, but this is unlikely to be significant for large bore pipes.

Cement mortar linings, typically about 4mm thick, can protect pipes against corrosion.

Epoxy spray linings isolate the conveyed medium from the pipe.

Isolation and leakage prevention can be achieved with deformed pipe linings.

There are 4 main types of liner:

- pre-cast concrete units, which are grouted in place;
- in situ steel mesh reinforcement and sprayed concrete, which form a smooth continuous lining;
- bricks and mortar lings, which are useful for repairing short lengths;

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- preformed liners (steel, concrete, and polyethylene up to 1200mm diameter, and concrete or GRP panels for larger sections) to suit the shape of pipe and pushed or pulled into the host pipe or Culvert - after insertion the annulus between the liner and existing pipe is grouted.

Precast invert sections enable the dry weather flow to be maintained at all times. This technique:

- is suitable for any shape of pipe;
- does not interfere with train movements where access is from a position of safety;
- requires man-entry;
- requires access for plant / working area;
- reduces pipe diameter and thus flow capacity.

A3.2 Cured in place pipe

With this technique, a fabric tube impregnated with resin is inflated in the host pipe and cured with hot water. Many Cured-In-Place (CIPP) systems offer ambient cured patch liners, often as kits in various lengths and sizes, but although these are suitable for small diameter pipes they are not as strong as a full length, hot water cured liners.

This technique:

- is suitable for small and medium diameter circular pipes and Culverts (100 to 900mm);
- requires no excavation where access is provided by Manholes;
- requires a host pipe for structural support;
- reduces pipe diameter, and thus can reduce flow capacity;
- can be installed in long lengths between access points;
- does not interfere with train movements where access is from a position of safety;
- requires access for plant and a supply of water.

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A3.2 Fold and form liners

These are circular (normally woven, high tensile polyester reinforced polyethylene) linings supplied as a factory folded V or C-shapes. The liner is semi rigid when cold, but when inserted into the host pipe and inflated and/or heated it becomes flexible and expands to a circular shape to provide a close fit to the host pipe.

The method is quicker and cleaner than CIPP but the liners are not available in a wide range of diameters. The technique is more commonly used for pressure pipelines than Drainage Systems.

This technique:

- is suitable for small and medium diameter circular pipes and Culverts (100 to 900mm);
- can be used for lengths up to 150 metres;
- does not do interfere with train movements where access is from a position of safety;
- reduces pipe diameter, and might thereby reduce flow capacity;
- requires access for plant.

A4. Grout injection

Grouting is an established technique for testing and sealing joints, and is mainly used for sewers which are structurally sound but which leak. A section packer is positioned across a joint in the pipe and the two end elements are inflated to isolate it and a pressure test applied. If the joint fails the test, resin grout is injected to seal it.

For Culverts, cement grout is used to fill voids and seal and stabilise the ground or backfill behind the Culvert, and thereby restore structural integrity. The technique is also used to fill and seal the annulus between a new lining and an existing pipe.

This technique:

- is suitable for medium to large diameter pipes and Culverts;
- is suitable for any shape of pipe;
- does not do interfere with train movements where access is from a position of safety;
- requires man entry;

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- requires access for plant and a supply of water;

A5. Robotic repairs

This technique entails grinding out cracks or fractures and filling them with an epoxy mortar. The technique has limited availability due to the high cost of the equipment.

This technique:

- is suitable for any shape of pipe including non man entry pipes;
- does not do interfere with train movements where access is from a position of safety;
- requires access for plant.

A6. Replacement of existing pipes

A6.1 Pipe bursting

Pipe bursting is a technique for replacing drains formed from a brittle material (such as cast iron, clay and concrete), and collapsed pipes. A bursting head is introduced into the existing pipe. A radial force applied by the head shatters the pipe and forces the fragments into the surrounding ground. At the same time a new pipe of the same or larger diameter is drawn through it. Short lengths can be inserted from access chambers and joined within the chamber. Upsizing from 100mm to 225mm is well established, although a smaller percentage increase is appropriate for larger diameters. Pipes of 600mm or greater diameter can be replaced using this technique.

For static bursting, a conically shaped bursting head is positioned at the end of the existing pipe adjacent to one access chamber and connected to a winch system at another chamber via the existing pipe. The bursting head is pulled from one chamber to the other, bursting the existing pipe and drawing in the new pipe behind it. The head can incorporate a pneumatic impact mole that applies a high impact force to initiate bursting.

Pneumatic bursting is similar to static bursting, but the bursting head is replaced by a pneumatically operated head that expands periodically to burst the existing pipe. A winch pulls the head along the existing pipe and also drags in the new pipe.

Existing Catchpits or Manholes can be used as access chambers, but lateral connections have to be removed.

Surface displacement can occur with shallow pipes.

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This technique:

- is suitable for non man entry pipes;
- does not interfere with train movements where access is from a position of safety;
- requires access for plant;
- is only suitable for circular cross-sections.

A62.2 Pipe splitting

Pipe splitting is similar to pipe bursting, but is used for pipes formed from materials that do not fracture readily. A splitting head with rotary cutters and a conically shaped section cuts the existing pipe in a longitudinal direction and expands it into the ground. The new pipe is drawn in behind the head.

A6.3 Pipe eating

Pipe eating is a technique based on micro tunnelling in which an existing pipe is removed together with the surrounding ground so that a larger pipe can be installed.

Micro tunnelling equipment, larger in diameter than the existing pipe, is used to break up, crush and remove the fragments of the existing pipe. The equipment is moved along the pipeline by hydraulic jacks located in an access chamber as the new pipe is drawn in behind. The spoil can be transported either by slurry or suction.

Lateral connections to the existing pipe have to be removed.

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Appendix B: Drainage Maintenance prioritisation

Track Drainage			Ellipse priority				
			Track Category				
System	Defect	Action	1/1A	2/3	4/5	6	Comments
Catchpits	Full of debris - unable to inspect	Remove debris to allow flow of water and Inspection	M3	M6	M9	M12	
	Filled with debris or silt above level of bottom of pipe	Remove debris to allow flow of water and Inspection	M3	M6	M9	M12	
	Filled with debris or silt below level of bottom of pipe	Remove debris to allow flow of water and Inspection	M6	M9	M12	M24	
	Collapsed Catchpit	Rebuild Catchpit	M3	M6	M12	M24	M0 on ANY category if track support is compromised
	Missing or ineffective covers	Replace covers immediately to remove Hazard	M0	M0	M0	M0	
Collector Drains	Completely collapsed pipe	Replace collapsed section of pipe	M3	M6	M12	M24	M0 on ANY category if track support is compromised
	Partially collapsed pipe	Replace section or repair pipe	M6	M12	M24	M36	M0 on ANY category if track support is compromised
	Completely blocked by silt or debris	Rodding or jetting to remove silt / debris	M3	M6	M12	M24	M0 on ANY category if track support is compromised
	Partially blocked by silt or debris (less than 50% of bore but more than 25%)	Rodding or jetting to remove silt / debris	M3	M6	M12	M24	
	Partially blocked silt or debris (more than 50% of bore)	Rodding or jetting to remove silt / debris	M3	M6	M9	M12	
	Partially blocked by roots	Specialist treatment to remove roots	M6	M9	M12	M24	
	Hydraulic surcharging - pipes clear and working but system overwhelmed by flow of water	Seek advice from Drainage Engineer	*	*	*	*	Report and seek advice
	Blockage of filter - pipe / Catchpits clear and working but water remains on surface or saturates ground	Excavate to pipe and replace filter surround to pipe	M12	M18	M24	M36	

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Track Drainage			Ellipse priority				
			Track Category				
System	Defect	Action	1/1A	2/3	4/5	6	Comments
Channel Drains & Ditches	Completely collapsed or dislodged channel or completely blocked / filled in Ditch	Replace collapsed section of channel / excavate Ditch	M6	M9	M12	M24	M0 on ANY category if track support is compromised
	Partially collapsed channel or partly filled Ditch (material prevents adequate water flow)	Replace section or channel / excavate Ditch	M6	M9	M9	M12	M0 on ANY category if track support is compromised
	Partially blocked by roots / vegetation	Remove vegetation / roots	M12	M18	M24	M36	
	Missing or ineffective covers	Replace covers immediately to remove Hazard	M0	M0	M0	M0	M0 on ANY category if track support is compromised
	Hydraulic surcharging - channels / Ditches clear and working but system overwhelmed by flow of water	Seek advice from Drainage Engineer	*	*	*	*	Report and seek advice
Carrier Drain	Completely collapsed pipe	Replace collapsed section of pipe	M3	M6	M12	M24	M0 on ANY category if track support is compromised
	Partially collapsed pipe	Replace section or repair pipe	M6	M12	M24	M36	M0 on ANY category if track support is compromised
	Completely blocked by silt or debris	Rodding or jetting to remove silt / debris	M3	M6	M12	M24	M0 on ANY category if track support is compromised
	Partially blocked by silt or debris (less than 50% of bore but more than 25%)	Rodding or jetting to remove silt / debris	M6	M9	M12	M24	
	Partially blocked silt or debris (more than 50% of bore)	Rodding or jetting to remove silt / debris	M3	M6	M9	M12	
	Partially blocked by roots	Specialist treatment to remove roots	M6	M9	M12	M24	
	Hydraulic surcharging - pipes clear and working but system overwhelmed by flow of water	Seek advice from Drainage Engineer	*	*	*	*	Report and seek advice