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Structures Inspection

ETE-09-01

Applicability

ARTC Network Wide SMS

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2.5	03 July 2017	ARTC Technical Standards	Stakeholders	Manager Standards	A/GM Technical Standards 08/09/2017

Amendment Record

Amendment Version #	Date Reviewed	Clause	Description of Amendment
1.0	01 Jul 06		First issue. Includes minor editorial changes following final approval of Risk & Safety Committee.
2.0	13 Nov 09		Applicability changed to ARTC Network and some minor corrections to Defect Categories and terminologies. BFB inspection regime reverted to existing monthly intervals
2.1	18 Jun 10		Banner added regarding mandatory requirements in other documents and alternative interpretations.
2.2	24 Oct 11	3	Changes to Frequency and Scheduling of Inspections. Minor editorial change to remove CRN applicability box.
2.3	10 Feb 14	Various	Various changes and clarifications throughout. Clause 7.1 updated with addition of intervention criteria table for Fibre Composite Bridges. Addition of new clause 7.5 Redundant Structures.

2.4	18 Jun 15	Various	Review of Documents to align with Ellipse 8 and AS7636 Railway Structures. Approved by OSERC 13 Nov 2015
	20 Nov 15		Minor editorial updates and document rebranded
2.5	03 Jul 17	Various	Editorial changes Engineering Inspection for large culverts, large retaining walls and tunnels downgraded to Visual Inspection. Communications Towers added to structures group. Exposure and Condition Rating removed as they are no longer utilised. Material Properties and Capacity Factors removed as they are now in AS 5100 and AS 7636.

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Mandatory requirements also exist in other documents.

Where alternative interpretations occur, the Manager Standards shall be informed so the ambiguity can be removed. Pending removal of the ambiguity the interpretation with the safest outcome shall be adopted.

1 Introduction

This document forms an integral part of Section 9 of the ARTC Track and Civil Code of Practice and details the requirements for the inspection of structures.

2 Levels of Inspections

2.1 Engineering Inspections

2.1.1 Purpose

An Engineering Inspection is a detailed inspection carried out on a structure by a Structures Inspector to assess:

- The physical condition and performance;
- The structural integrity;
- Corrective and preventative management requirements.

2.1.2 Scope

The scope of an Engineering Inspection shall include;

1. Review of previous engineering and visual inspections, and engineering investigation reports
2. Review and update the inventory information
3. Review, and update where necessary, the mandatory defect data and priority of previously identified defects. Refer to EGW-10-01 for the mandatory data requirements
4. Identify any new defects in all elements (including below ground and water level where applicable) requiring maintenance. Recommend the repair priority and any short-term mitigation actions required to ensure safe operation until repair of the defect can be completed
5. Overall paint condition rating for steel structure
6. Capture a photographic record of the structure and any deficient element
7. Undertake measurements and non-destructive testing as required to determine the extent of deterioration
8. Provide/review a comprehensive load carrying capacity rating for the structure, including identifying under-strength elements
9. Provide/review a fatigue assessment
10. Identify structures and/or elements which warrant further investigation
11. Nominate those defects which require specific monitoring as part of a Special Inspection
12. Liaise with the structures personnel as deemed necessary.

2.2 Visual Inspections

2.2.1 Purpose

A Visual Inspection is carried out on a structure by a Structures Inspector to assess;

- The physical condition of structures;
- The structure is safe for operational purposes.

2.2.2 Scope

The scope of a Visual Inspection shall include;

1. Review of previous inspection reports
2. Review and update the inventory information
3. Review, and update where necessary, the mandatory defect data and priority of previously identified defects. Refer to EGW-10-01 for the mandatory data requirements
4. Identify any new defects in all elements (including below ground and water level where applicable) requiring maintenance. Determine the repair priority and any short-term mitigation actions required to ensure operation safety until repair of the defect can be completed
5. Capture a photographic record of the structure and any deficient element
6. Identify defects in elements which warrant further investigation
7. Identify defects / elements which require monitoring
8. Liaise with the structures personnel as deemed necessary

2.3 Special Inspection

2.3.1 Purpose

A Special Inspection is undertaken outside of the prescribed inspection schedule of engineering and visual inspections. The reasons for special inspections are varied and include, but not limited to:

- Monitor specific defects;
- Reassessment of defects;
- Inspect for anticipated hazards following an event such as heavy rain, an earthquake or fire;
- Following an unforeseen event, such as impact from a road vehicle or derailed rolling stock.

The inspections are usually carried out by a Structures Inspector, or suitable person as nominated by the Structures Representative.

2.3.2 Scope

The scope of the Special Inspection shall be developed by the Structures Representative and documented prior to commencing the Special Inspection. The scope may include, but not limited to;

1. Review of any previous inspection and testing reports
2. Review of the condition of previously identified defects or structural deficiencies

3. Identify any additional maintenance or repair treatments
4. Record a photographic evident of any deficient element
5. Identify structures and/or elements which warrant further investigation

2.4 Track Patrol

A Track Patrol is carried out to check the general serviceability of a structure for rail operations. Track Patrols assess such matters as the track geometry over underbridges, any general abnormality in structures and any build-up of debris around the structures.

All abnormalities shall be reported to the Structures Representative for further assessment and rectification.

3 Frequency and Scheduling

All nominated inspections shall be carried out within the required timeframes (latitudes) nominated in Table 2 below.

An Engineering Inspection may nominate the inspection frequency for engineering, visual or special inspections for that structure, but recommendations shall not be greater than the mandated frequencies.

Table 1 below documents the mandated minimum inspection frequency for each type of structure on operational lines;

Asset Class	**Structure Type**	**Span Material** **(includes Fibre Composite/** **Timber Deck/transom)**	**Engineering Inspection Frequency (Years)** **(Maximum period between inspections)**	**Visual Inspection Frequency (Years)** **(Maximum period between inspections)**
In Service and Redundant Structures				
Engineering Inspections and Visual Inspection				
Bridge	Underbridge	Steel post 1976, aged up to 40 years	12	2
		Steel (includes wrought iron)	6	2
		Concrete post 1976, aged up to 40 years	12	2
		Concrete (includes Masonry)	6	2
		Timber	4	1
	Overbridge	Timber	6	1

Asset Class	Structure Type	Span Material (includes Fibre Composite/ Timber Deck/transom)	Engineering Inspection Frequency (Years) (Maximum period between inspections)	Visual Inspection Frequency (Years) (Maximum period between inspections)
In Service and Redundant Structures				
		All others	6	2
	Footbridge	All	6	3
Culvert	Large and Small Culverts	All	N/A	2
Tunnel	Tunnel	All	N/A [Note 1]	3
Miscellaneous Structures	Retaining walls ≥ 2m high and Comms Towers	All	N/A	2
	All Other Structures	All	N/A	4
Redundant Structures	All	All	N/A	2
Special Inspection				
Bridge	Underbridge	Broad Flange Beam (BFB) spans over roadways	N/A	Monthly
Bridge & Culvert	All	Temporary Supports	N/A	3 monthly

Table 1 – Inspection Frequencies on Operational Lines

Engineering Inspections take precedence over Visual Inspection. Therefore a Visual Inspection is not required to be undertaken in conjunction with an Engineering Inspection.

Note 1: Laser scan inspection of tunnels every 6 years replaces the engineering inspection. Refer to CoP Section 7.

4 Inspection Latitude

All inspections shall be completed within the latitude shown in the Table 2 below;

Engineering Inspection	Latitude
All	10% of days between any scheduled engineering inspection and the next visual inspection
Visual Inspection	**Latitude**
All	10% of days between any scheduled engineering inspection and the next visual or engineering inspection

Special Inspection	
Unscheduled	As soon as practicable following trigger event
Scheduled	7 Days

Table 2 – Inspection Latitude

The Structures Representative shall seek a waiver from Manager Standards where inspection cannot be undertaken within the specified latitude for a scheduled inspection.

5 Inspection Requirements

The inspector shall create a record for each new defect found against a structure. The inspector is also responsible for reviewing all existing defects recorded against a structure during each inspection.

All elements shall be numbered in accordance with the requirements described in ETG-09-01.

All identified defects shall be recorded in Ellipse, in accordance with the data requirements specified in EGW-10-01 and Section 5 of this procedure.

5.1 Defect Category

During an inspection, each defect is required to be allocated a Defect Category and the actions undertaken as nominated in the Table 3 below:

Defect Category	Inspector Response	Structures Representative Response
DEFECT		
A	Immediately stop trains in the case of an underbridge, culvert or tunnel; or close if an overbridge or footbridge. Advise Structures Representative immediately for further assessment	As soon as Practicable
B	Immediately impose a 20km/h speed restriction in the case of an underbridge, culvert or tunnel. For footbridges and overbridge, the area is to be barricaded. Advise Structures Representative immediately for further assessment.	Assess within 24 hours of notification.
C	Report to Structures Representative within 2 working days.	Assess within 2 working days of notification.
D	Report to Structures Representative within 5 working days.	Assess within 7 days of notification.
MONITOR		
M	Record in inspection report, and submit within the timeframes described in Table 8.	Assess within 4 weeks of submission when requested by the Inspector.

Table 3 – Defect Category

Note:	*Defects allocated a Defect Category M do not compromise the immediate or short term safety of a structure, but need to be recorded and monitored for deterioration.* *Some Category M defects will be of such a nature that ongoing deterioration will occur and must be programmed for rectification as part of future major periodic maintenance work. The defect shall be reviewed at each inspection to evaluate if rectification work needs to be accelerated.* *Other Category M defects may not require rectification if there is no further deterioration. In these cases, the Category M defect shall be reviewed at subsequent inspections to ensure ongoing deterioration is not occurring.*

Appendix 1 provides a general guide to defect limits and associated actions to be taken by the inspector.

Where communication is verbal (or via e-mail) to meet the required timeframes, it shall be subsequently documented in Ellipse within the timeframes nominated in Table 8.

5.1.1 Short Term Actions

Depending on the nature of the defect, the inspector may recommend a short term action to be implemented such as:

- Impose a temporary speed limit on the structure;
- A special inspection of the defect, until the defect is rectified and/or;
- Temporary work, such as propping, until the defect is rectified.

The appropriate inspection interval should be set for monitoring the short term actions (if different from the normal inspection cycle for the structure or element of the structure).

Recommended short term actions shall be recorded in the defect comments by the inspector. The structures representative shall be responsible for reviewing the defect and actioning any short term actions as required.

5.1.2 Defect Repair Priority

5.1.2.1 Allocation of Defect Repair Priority Codes

For each defect identified or reassessed during the inspection the inspector shall recommend a repair priority code as specified in table 4 below. A repair priority shall be allocated for all defects (A-D and M defects). The repair priority shall take into account, but not be limited to, the following factors;

- the criticality of the structure
- the severity of the defect
- the urgency and nature of the work that will be performed

Structures inspectors shall not use ‘MM’ or ‘MY’ Priority Codes during the recording of a new defect.

The inspectors original repair priority will be stored against the defect and as the originators priority within the associated work order. The Structures Representative's repair priority will be stored as the planner's priority within the associated work order.

5.1.2.2 Responsibilities

The Structures Representative has authorisation to change the repair priority assigned to the defect by the inspector, within the constraints determined by the assigned defect category (refer to the "Application" heading, table 4). This includes both the structures representatives' initial assessment of the defect and any subsequent changes, e.g. due to ongoing project planning and work prioritisation. The structures representative shall provide sufficient justification and controls to support any changes to the inspectors repair priority. Justification shall be stored in the completion comments of the work order or via documentation attached to the work order.

The repair priority assigned to a defect will, in conjunction with the raised date, determine the required by date for compliance within Ellipse. If the structures representative varies the inspectors recommended repair priority, the structures representatives repair priority will take precedence.

The Structures Representative shall not vary the original defect category assigned to the defect by a qualified engineer without the prior written approval of either the original inspector or the NBSE.

5.1.2.3 Management of Repair Priorities

Where the structures representative has determined that repair work on a critical defect (A-D) will not be performed within the maximum available rectification window (i.e. RY2 – Repair within 2 years) they shall have the option of assigning a 'MM' or 'MY' repair priority. The reinspection regime created by the Repair Priority shall be associated with the defect, not the structure, and the correct reinspection frequency should be selected to ensure any deterioration of the critical defect is identified before operational safety is compromised.

Use of the 'MM' and 'MY' Repair Priorities will be undertaken using the RPPD provisions provided in EGP-10-01.

5.1.2.4 Conflict Resolution

Where the Structures Representative has concerns over the defect category allocation; in the first instance the issue should be discussed with the Structures Inspector. If it is agreed that the Structures Representative should vary the assessment of the defect, the Structures Inspector should provide written confirmation of the agreed change(s) that should be filed with the inspection records.

If the Structures Representative and the Structures Inspector cannot reach an acceptable course of action, the matter should be referred to the National Bridges & Structures Inspector for further review. If, following the review, it is agreed that the Structures Representative should vary the assessment of the deficiency; the National Bridges & Structures Engineer must provide written confirmation of the change(s), which should be filed with the inspection record.

Code	Meaning	Application
E	Repair work to commence within 24 hours	Applies to "A" Defects
RM1	Repair within 1 month	Applies to "B" to "D" defects
RM6	Repair within 6 months	Applies to "B" to "D" defects
RY1	Repair within 1 year	Applies to "B" to "D" defects

Code	Meaning	Application
RY2	Repair within 2 years	Applies to “B” to “D” defects
RY5	Repair within 5 years	Applies to “M” defects
RYX	No repair within 5 years	Applies to “M” defects
MM1	Monitor/reinspect monthly	Applies to “B” to “D” defects
MM6	Monitor/reinspect 6 monthly	Applies to “B” to “D” defects
MY1	Monitor/reinspect yearly	Applies to “B” to “D” defects
AXX	Reinspect at next inspection	Applies to “M” defects

Table 4 – Defect Repair Priority Codes

Figure 1: Defect Review and Conflict Resolution Flow Chart

5.2 Load Rating

As part of an Engineering Inspection, the Structures Inspector shall undertake a load rating for the bridges for the “As-New” and “As-Is” conditions and fatigue assessment in accordance with the procedures documented in the ARTC Code of Practice – Section 9.

Load rating shall be carried out for all types of superstructure of every bridge and only for bridge substructures constructed of steel and / or timber unless otherwise specified in the scope of work.

6 Structures Inspection Submission Timeframes

All data entry shall be completed within the timeframes shown in Table 8 below following the on-site inspection of individual structures:

Submission	**Timeframes**
Engineering Inspection	**After completion of on-site inspection**
Submission of individual defect (Defect Category A-D)	1 week
Submission of Defect Report (including Defect Category M)	2 weeks
Submission of final engineering report	10 weeks
Visual and Special Inspection	**After completion of on-site inspection**
Submission of individual defect (Defect Category A-D)	1 week
Submission of final Report	2 weeks
Structures Representative’s Acceptance	**After submission date of Final inspection report**
Acceptance of completed inspection report	4 weeks

Table 8: Structures Inspection Submission Timeframes

7 Appendix 1 – Intervention Criteria Guidelines

This appendix provides a general guide to defect limits and associated actions to be taken by the inspector. The inspector shall use engineering judgement and experience when determining the Defect Category for each individual defect.

In general, the limits and defect sizes have been set on the basis of them being located at the most highly stressed area of the elements.

7.1 Asset Class - Bridges

Description	Defect Type	Defect Size	Defect Category
A. Bridges – Steel (includes Wrought Iron)			
For steel, including wrought iron and broad flange beam bridges, items in the table are defined as follows: ***Main structural elements*** are main girders, cross girders, stringers, truss chords, diagonals and verticals, columns, trestle legs and headstocks. ***Primary structural components*** are typically a flange or web and may consist of multiple plates and/or angles. ***Bearing zone components*** are bearing plates, bearing stiffeners and bearings. ***Secondary structural components*** are bracing, gusset plates, web stiffeners, tie bars, etc. For concrete / masonry substructures, refer “Bridges – Concrete”.			
Main Structural Element (excluding Broad Flange Beams)	Crack in a primary structural component	> 80mm long	A
		10mm – 80mm long	B
		< 10mm long	C
Broad Flange Beams	Crack in a primary structural component	> 25mm long	A
		≤ 25mm long	B
Main Structural Element	Corrosion loss in sectional area of any primary structural component	> 50%	B
		20%-50%	D
		< 20%	M
	Missing	Any	A
Bearing Zone	Crack in a bearing zone component	> 250mm	C
		50mm – 250mm	D
		< 50mm	M
	Corrosion loss in sectional area of any individual component	> 50%	D
		≤ 50%	M
	Missing	Any	A
	Bearings locked in position	No movement	M
Secondary Structural Components	Crack	Any	D
	Corrosion loss in sectional area of any individual component	> 50%	D
		≤ 50%	M
	Missing	Any	B
Cast iron caissons of lattice girder truss bridges	Any crack	≥ 200m long	D
		< 200mm long	M

Member	Defect Type	Defect Size	Defect Category
Impact Damage			
Main Structural Element (excluding Trestles)	Out of alignment (causing misalignment to track)	> 50mm	A
		30mm – 50mm	B
		< 30mm	D
	Major structural damage	Structure likely to be unable to carry load	A
	Girder flange outstand deformed vertically	> 60% of outstand	B
		30 – 60% of outstand	C
		< 30% of outstand	M
	Flange deformed horizontally within bracing bay	> 60mm	B
		30mm – 60mm	C
		< 30mm	M
	Element deformed horizontally	> 20mm between bracing bays	C
		≤20mm between bracing bays	M
	Notched	> 30mm	B
		≤ 30mm	C
Trestle	Column deformed in any direction	> 100mm	A
		50 – 100mm	B
		25mm – 49mm	D
		< 25mm	M
Fasteners			
Main Elements - Splice/End Connections	Missing	> 25%	A
		5%-25%	D
		< 5%	M
	Loose/Corroded Heads	> 25%	B
		5%-25%	D
		< 5%	M
Main Elements - Components Connection	Missing (% in a group of any group of 10 continuous rivets or bolts)	> 40%	A
		10% - 40%	D
		< 10%	M
	Loose/Corroded Heads (% in a group of any group of 10 continuous rivets or bolts)	> 40%	B
		10%< 40%	D
		< 10%	M
Main Elements - Others	Missing/Loose/Corroded Heads	> 40%	B
		10% < 40%	D
		< 10%	M
Bearings	Missing bedding grout and/or HD bolts	> 30% per bearing	D
		≤ 30% per bearing	M
Secondary Elements – Connections to Main Members/ Splices, etc	Missing bolts/rivets	> 25%	B
		≤ 25%	M
	Loose/Corroded Heads	> 25%	D
		≤ 25%	M
Stitching rivets	Slackness due to excessive wear & tear	> 2mm play	D
		≤ 2mm play	M
	Corrosion in head	> 75%	D

Member	Defect Type	Defect Size	Defect Category
		≤ 75%	M
B. Bridges – Timber			
The following maintenance limits are based on nominal 300mm x 300mm F22 timber section. Wherever applicable, the same intervention levels also apply to the BridgeWood deck which consists of specially designed plywood panel for both road and rail bridge applications.			
Girder/Corbel / Solid Headstock	Pipe/Trough in any girder, corbel or solid headstock	> 250mm	A
		226-250mm	B
		200-225mm	C
		151-199mm	D
		50*-150mm	M
	Crushing	Any	B
Girder	Mid span deflection	Exceeds values tabulated below. (Span is the distance between centre line of supports)	B
		Span (m) < 4 | 4-5 | 5–7 | > 7	
		Deflection (mm) 8 | 10 | 15 | 20	
Waling Headstock	Rotted out		B
Body Bolts	Loose in a connection	> 25%	D
		< 25%	M
Corbel bolts	Loose in a connection	> 25%	D
		< 25%	M
Trestle Bolts	Loose in a connection	> 25%	D
		< 25%	M
Piles	Section loss in > 50% of piles in any trestle or abutment	> 75%	A
	Section loss in > 25% of piles in any trestle or abutment	> 75%	B
	Section loss in any pile	> 75%	C
		50-75%	D
		40*-49%	M
	Pumping	Any	D
Transoms	Rotted Out	3 Adjacent	B
		2 Adjacent	C
		One isolated	M

Member	Defect Type	Defect Size	Defect Category
Transom Bolts	Missing	3 in adjacent transoms	B
		2 in adjacent transoms	C
		Both bolts in a transom	M
Decking	Split or rotted out	> 30%	C
		20%* - 30%	M
BridgeWood decking	Surface checking	> 8mm	D
		≤ 8mm	M
	Crushing	Any	B
	Delamination (bubbles)	Any	C
Any Timber Section	Termite infestation	Any evidence of damage	D
C. Bridges – Concrete			
Superstructure structural elements include beams and decks.			
Substructure elements include piers, abutments, wingwalls, pile caps, piles and footings.			
Superstructure structural elements	Impact damage	Structure likely to be unable to carry load	A
	Differential deflection between units under live load	Visible	C
	Cracking	> 3mm	C
		1*- 3mm	M
	Spalled concrete with reinforcement exposed and corroding	> 30% cross section loss to exposed reinforcement	D
		< 30% cross section loss to exposed reinforcement	M
	Spalled concrete with prestressed tendon exposed	Any	C
Substructure structural elements	Cracking	More than 10mm wide	C
		3*-10mm wide	M
	Spalled concrete with reinforcement exposed and corroding	> 40% cross section loss to exposed reinforcement	D
		< 40% cross section loss to exposed reinforcement	M
	Vertical/Lateral dislocation	> 50mm	C
		10*mm - 50mm	M
Deck – joint between slabs	Fouling with ballast/debris	Debris likely to cause deterioration of joint	D
Bearings	Fouling with ballast/debris or any other degradation	Debris likely to cause deterioration of bearing.	D
Bearing Pads	Missing bearing area	> 30%	D
		≤ 30%	M

Member	Defect Type	Defect Size	Defect Category
D. Bridges – Masonry and Concrete Arch			
For piers, abutments, wingwalls and reinforcement see “Bridges – Concrete”.			
Arch Ring	Brickwork dislocation	> 50% in any square metre missing or unbonded	B
		20-50% in any square metre missing or unbonded	D
		10*% - 19% in any square metre missing or unbonded	M
	Lateral cracking	> 3mm wide, through & across full arch width. Visible differential movement under live load	B
		2-3mm & not through & across	D
		< 2mm & not through & across	M
	Longitudinal cracking	> 6mm wide & > 2m long along arch	D
		3-6mm	M
	Distortion of profile	> 50mm – detectable by undulations in top line of spandrel walls/parapets or track	D
		20*-50mm	M
Other than Arch	Brickwork dislocation	> 50% in any square metre missing or unbonded	D
		20-50% in any square metre missing or unbonded	M
Spandrel Wall	Displacement	Lateral > 30mm or > 20mm lateral + 20mm tilt	D
		15*-30mm	M
Invert floor	Heaving	> 100*mm	M
Any other	Brickwork dislocation	Nil	D
E. Bridges – Fibre Composite			
Beams, Decks and Transoms	Coating Chipping (excludes decking)	> 25mm in diameter	D
		≤ 25mm in diameter	M
		> 5mm deep	D
		≤ 5mm deep	M
	Cracking	Any	C
	Crushing at support	Any	C
	Fire / Ultra Violet Radiation damage	Any	C
	Accidental / intentional damage	Any	C
	Excessive wear	Any	C

Member	Defect Type	Defect Size	Defect Category
F. Bridges – Miscellaneous Items			
Waterway Area			
Bridge Waterway	Scouring under Pier/Abutment	Safety Critical Issue	B
		>10% loss in bearing area	C
		≤10% loss in bearing area or non-safety critical issue	M
	Blockage due to debris buildup	>10% loss in waterway area	D
		≤10% loss in waterway area	M
Walkways, Refuges and Decking			
Handrails	Missing/Broken/ Loose/Decayed	Safety Critical Items	B
		Non-safety critical items	M
Deck	Walkway/refuge planks broken, decayed, missing or displaced	Causing safety concerns	B
		Not causing safety concerns	M
Deck-Nails, Screws	Protrusion above deck	> 10mm	C
		≤ 10mm	M
Clearance Signs	Missing	Any	D
	Illegible	Any	D
Footbridges			
Stairway	Broken front edges, protruding reinforcement or excessive slope	Safety Critical Items	B
		Non-safety critical items	M
Road/Pedestrian Safety Aspects			
Safety Screens/Barrier	Missing/Broken	Safety Critical Items	B
		Non-safety critical items	M
Road & Pedestrian Traffic Barriers	Missing/Broken/ Loose/Decayed	Safety Critical Items	B
		Non-safety critical items	M
Clearance Signs	Missing	Any	D
	Illegible	Any	D
Ballast	Falling	Any	B

7.3 Asset Class – Culverts

Member	Defect Type	Defect Size	Defect Category
A. Culverts			
For undefined elements and components refer to “Asset Class – Bridges”.			
Culvert	Collapse	Subsidence of formation/ballast that undermines track safety	A
		Subsidence of formation/ballast that does not undermine track safety	M
	Blocked – preventing flood flow	> 20%	D
		≤ 20%	M
	Cracked Barrel	> 50mm wide	B
		10mm – 50mm	D
		< 10mm	M
	Joint/Broken Separated	Any	D
	Deformation	> 50*mm	D
Expanda / Rotaloc PVC or HDPE Plastic liners for CSP	Abrasion in sectional area	> 25%	C
		10% - 25%	D
		< 10%	M
	Fire / Ultra Violet Radiation damage	any	C
Headwall/Wingwall	Cracked	> 50mm wide	B
		10 – 50mm wide	D
		< 10mm	M
Apron	Scouring under apron	> 150mm deep	D
		≤150mm deep	M
Floor	Heaving	> 150mm	D
		≤150mm	M

*Note** *Where the defect size is less than that shown * for intervention for Defect Category, there is no need to record the defect.*

7.4 Asset Class – Tunnels

Intervention criteria guideline shall be in accordance with the “Asset Class – Bridges” for the appropriate element type and material.

7.5 Asset Class – Miscellaneous Structures

Intervention criteria guideline shall be in accordance with the “Asset Class – Bridges” for the appropriate element type and material.

7.6 Redundant Structures

Intervention criteria guideline shall be in accordance with the “Asset Class – Bridges” for the appropriate element type and material for undefined elements.

Description	Defect Type	Defect Size	Defect Category
A. Redundant Structures			
Primary redundant structures are typically bridges, tunnels, water structures, platforms and loading banks.			
Structure	Integrity	Refer to ‘Asset Class – Bridges’.	
Vehicle and/or pedestrian access barricade	Damaged/Missing	Safety critical items	B
		Non-safety critical items	M
Fence	Damaged/Missing	Safety critical items	B
		Non-safety critical items	M
Signage	Illegible/Damaged/Missing	Safety critical items	B
		Non-safety critical items	M
Any other issues relating to safety of traffic operation or people on or in vicinity of redundant structures	Other Safety issues	Safety critical items	B
		Non-safety critical items	M