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Structures Inspection Standard

ETS-09-01

Applicability

ARTC Network Wide SMS

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1.0	20 Mar 23	National Bridges & Structures Engineer	Stakeholders	Manager Track and Civil Standards	Head of Engineering Standards 19/06/2023

Amendment Record

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1.0	20 Mar 23		Document renumbered from ETE-09-01 Minor editorial changes

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Mandatory requirements also exist in other documents.

Where alternative interpretations occur, the Manager Track & Civil 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 ETS-09-00 and details the requirements for the inspection of structures.

All inspections shall also comply with the requirements of AMT-PR-010 Asset Management System and AMT-WI-021 Data Classification – Structures (Work Instruction).

AMT-PR-010 details management of asset and work management system and, AMT-WI-021 details capturing of all nameplate attributes, asset configurations, asset description and defect attributes.

Culvert could be defined as arch, pipe or boxed shaped covered opening having walls, invert and roof cast integrally. Culvert unit could also have link slab roof suspended between adjoining box units. The deck width of ballasted culvert is measured between the ballast walls.

All culverts with typically up to 2 pipes with pipe diameter less than 500mm, typically track cess drainage pipes, are inspected and maintained by the local Civil maintenance team. Structures representative to determine which culvert, if any, should be inspected by them and the rest to be passed onto Civil maintenance team who should be made aware of these changes.

2 Levels of Inspection

2.1 Engineering Inspections

2.1.1 Purpose

An Engineering Inspection (also known as Level 3 inspection by other authorities) is a detailed inspection carried out on a structure by a competent structures engineer 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 defect reports, load rating reports, engineering investigation reports, specific maintenance management systems and procedures for specific bridges where documents are made available.
2. Review and update the inventory information as necessary.
3. Review, and update where necessary, the condition of defect, mandatory defect data and repair priority of previously identified defects. Recommend any short-term mitigation actions required to ensure safe operation until permanent repair of the defect can be completed.
4. Identify any new defects in all elements and components (including below water level and in confined space where required) requiring maintenance. Recommend the repair priority and

any short-term mitigation actions required to ensure safe operation until permanent repair of the defect can be completed.

5. All inspections shall be carried out from proximity that will enable capturing all essential details of defects adequately.
6. For all primary elements and components of **steel rail bridge**, the inspection must be carried out from no more than at arm's length.
7. Upload defects with associated photographs in the asset management system (AMS).
8. Capture a photographic record of the structure if required.
9. Undertake measurements and non-destructive testing as required to determine the extent of deterioration.
10. Site measurements of structural elements and components either to confirm drawing dimensions or to ensure adequate details are available for load rating purposes.
11. Identify rate of deterioration likely to occur in any elements prior to the next Engineering Inspection to ensure it is adequately accounted for in the load rating.
12. Prior to undertaking load rating of bridges, all matters listed in AS 5100 Part 7: "Matters for resolution before design commences" must be resolved unless otherwise already clarified in the ARTC structures standards.
13. Provide a comprehensive load carrying capacity of the structure, including identifying under-strength elements. Load rating must be provided for all elements/components of bridge superstructure and only steel elements/components of bridge trestles/piers. The elements/components to be analysed, but not limited to, must include main girders/beams, cross girders, stringers, truss elements, deck slabs, bracing and all element connections and, any splices in them.
14. Where previous load rating is available then the rating must be reviewed and updated as required to account for any further and/or foreseen deterioration in that element and, also to align with current standards.
15. Provide/review a fatigue assessment of steel elements.
16. Identify elements which warrant further investigation.
17. Nominate those defects which require specific monitoring as part of a Special Inspection.
18. Engineering report must encompass all critical findings e.g. defects, load rating results, temporary speed restrictions for trains or load limit for road bridges, any special inspections and structures/elements that warrant special investigation. All calculations, software modelling and any other relevant materials associated with inspection and analysis must accompany the report.
19. Liaise with the structures personnel as deemed necessary.

2.2 Visual Inspections

2.2.1 Purpose

A Visual Inspection (also known as Level 2 inspection by other authorities) 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 defect report.
2. Review and update the inventory information.
3. Review, and update where necessary, the condition of defect, mandatory defect data and repair priority of previously identified defects. Recommend any short-term mitigation actions required to ensure safe operation until permanent repair of the defect can be completed.
4. Identify any new defects in all elements requiring maintenance, including below ground for timber piles where deemed necessary but no more than 4 years. Recommend the repair priority and any short-term mitigation actions required to ensure safe operation until permanent repair of the defect can be completed.
5. All inspections shall be carried out from proximity that will enable capturing all essential details of defects adequately.
6. For all primary elements and components of **steel rail bridge aged over 40years**, the inspection must be carried out from no more than at arm's length.
7. Upload defects with associated photographs in the AMS as required.
8. Capture a photographic record of the structure if required.
9. Identify defects in elements which warrant further investigation.
10. Two types of communication towers that must be inspected by structures inspector are steel lattice or truss towers and concrete, steel or timber mono poles. Structures discipline is not responsible for the inspection of any mono poles mounted on/to buildings or any antennas attached to any towers, poles or buildings. Structures representative is responsible for all other mono poles.

    The inspection of communication towers also entails the following:

    a. Necessity to isolate microwave dishes, which emit radioactive waves, when accessing top of a tower. Where required, structures representative to arrange isolation of microwave dishes through ARTC Property Manager.

    b. Drone must not be flown within 10m of any microwave dish.

    c. Provide details, coordinates and adequate description of location of communication towers with reference to nearest track kilometrage.

    d. Each leg of lattice tower must be identified in clockwise manner by gluing a numbered 50 x 50mm plaque on exposed face or replace damaged plaque as required. Elements must be identified between the legs by bays, starting at Bay 1 at ground level between 1st and 2nd horizontal bracing from footing. All other conventions to be as per Structures Inventory Procedure ETP-09-01.

11. 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 inspection is 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 photographic evidence of any defective 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.

3 Technical Maintenance Plan

All nominated inspections shall be carried out within the required timeframes (latitudes) nominated in Section 4 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. An engineering waiver must be sought for any alteration in mandated inspection frequencies and latitudes.

Table 1 below documents the mandated minimum inspection frequency for each type of structure on operational lines as well as for redundant structures:

Asset Class	Structure Type	Span Material (includes Fibre Composite/FFU/ Timber Deck/transom)	Engineering Inspection Frequency (Years) (Maximum period between inspections)	Visual Inspection Frequency (Years) (Maximum period between inspections)
In Service Structures				
Engineering Inspections and Visual Inspection				
Bridge	Underbridge	Steel and Concrete aged up to 40 years	12	2
		All other Steel (includes wrought iron) and Concrete (includes Masonry)	6	2
		Timber	N/A (Capacity of timber elements is now based on pre-determined pipe sizes for all Grade F22 standard components)	1
	Overbridge	Steel & Concrete aged up to 40 years	12	2
		Timber	N/A (refer underbridge)	1
		All others	6	2
	Footbridge	Steel & Concrete aged up to 40 years	12	2
		All others	6	2
Culvert	Culverts	All	N/A	2
Tunnel	Tunnel	All	N/A	2
Miscellaneous Structures	Retaining walls ≥ 2m high and Comms Towers	All	N/A	2
	All Other Structures	All	N/A	4
Redundant Structures				
Redundant Structures	All	All	N/A	2

Asset Class	Structure Type	Span Material (includes Fibre Composite/FFU/ Timber Deck/transom)	Engineering Inspection Frequency (Years) (Maximum period between inspections)	Visual Inspection Frequency (Years) (Maximum period between inspections)
In Service Structures				
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

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

4 Inspection Latitude

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

Engineering Inspection	
All	10% of days between any scheduled Engineering Inspection and the next Visual Inspection.
Visual Inspection	
All	10% of days between any scheduled Engineering Inspection and the next Visual or between 2 Visuals or between Visual and next Engineering Inspection.
Special Inspection	
Unscheduled	As soon as practicable following trigger event.
Scheduled	7 days for frequencies < 40 days, 14 days for 40 to 180 days and 10% as for Visual Inspection above for > 180 days.

Table 2 – Inspection Latitude

The Structures Representative shall seek an engineering waiver where inspection cannot be undertaken within the specified latitude for a scheduled inspection.

5 Inspection Requirements

All identified defects shall be recorded in AMS, in accordance with the data requirements specified below and in AMT-WI-021.

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
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 5.	Assess within 4 weeks of submission when requested by the Inspector.

Table 3 – Defect Category

The engineer / structures inspector shall use engineering judgement and/or experience when determining the Defect Category for each individual defect. ***Section 8 – Appendix 1*** *provides a general guide to defect limits and associated actions to be taken by the inspector. The defect categories against defect types and sizes for individual elements are typically based on defects being located at the most highly stressed areas of the elements.*

5.1.1 Category A to D Defects

Each defect, i.e. a deficiency with a Category of A to D, shall be allocated the following by the inspector:

- Element.
- Element Location.
- Defect type and location.
- Repair Priority.
- Recommendation.

5.1.1.1 Element

The structural element on which the defect has been found shall be identified.

5.1.1.2 Element Location

The location of the element that has the defect shall be defined as follows:

- For underbridges, and any other structure with spans parallel to the track, all descriptions are based on observations from the start of a structure, which is the end with the lowest kilometrage using the following abbreviations.
    - A – Abutment.
    - S – Span.
    - P – Pier.

  All elements shall be numbered from the Down side (left hand side when facing in direction of increasing kilometrage) progressing to the Up side (right hand side).

- For overbridges, culverts and any other structure with spans perpendicular to the track the numbering system shall be the same as for an underbridge with the start of a structure located on the Down side of the track.

  All elements shall be numbered from the highest kilometrage side (left hand side when facing the Upside rail) progressing to the lowest kilometrage side (right hand side).

5.1.1.3 Defect Type and Location

A standard defect type and the location of the defect within the element shall be nominated.

5.1.2 Repair Priority

For each defect identified or reassessed during the inspection the inspector shall recommend a repair priority code as specified in Table 4 below. The repair priority shall take into account, but not be limited to, the following factors:

- the criticality of the structure and/or element under consideration.
- The severity of the defect.
- the urgency and nature of the work that will be performed.

Repair Priority Code	Rectification Period
E - Emergency	Rectification work to commence within 24 hours.
P1 – priority 1	Within 7 days
P2 – priority 2	Within 28 days
P3 – Priority 3	Up to 6 months
P4 – Priority 4	Up to 1 year
P5 – Priority 5	Up to 2 years
PN - Normal Schedule Inspection	Monitor

Table 4 – Repair Priority Codes

5.1.2.1 Recommendation

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.

5.1.3 Category M - Monitor

Defects allocated as Defect Category M need to be recorded and monitored for further deterioration.

The defect shall be inspected at each inspection to assess if any rectification work is required.

5.1.3.1 Priority Modification

The structures representative has authorisation to change the repair priority assigned to the defect by the inspector or his own assessments. Sufficient justification and controls to support any such changes shall be documented appropriately.

The structures representative shall not modify the defect category assigned by an inspecting engineer without his prior written approval or approval of National Bridges & Structures Engineer (NBSE).

5.1.3.2 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 allocated rectification period in Table 4 above then the criticality and repair priority of that defect must be re-assessed.

5.1.4 Mandatory Defect Data

The AMS shall record all the reported data and associated documentation, including any urgent repairs, required by the structures representative to assess and manage the risk of each defect to ensure the operational safety of the network.

To ensure sufficient data is recorded by the inspector, completion of the following attributes in the system is mandatory for submission of a defect:

- Equipment Reference (asset’s unique ID number).
- Component identification and location.
- Defect type, size and category.
- Repair Priority.
- Date defect found.
- Recommendations for any repairs with any speed restrictions, inspection frequency changes or any other mitigation actions.

- Photos of Category A to D defects and photos of M defects as required.

5.2 Load Rating

As part of an Engineering Inspection, the structures engineer 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 – ETS-09-00 and Structures Inspection Procedure ETP-09-02.

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

The elements to be analysed must include, but not limited to, the following:

- Main girders/beams.
- Cross girders.
- Stringers.
- All truss posts, diagonals, portals, etc.
- Bracing.
- Deck slabs.
- Connections of the above components.
- Splices in the above components.
- Critical gusset plates, stiffeners or any other elements likely to be overstressed under traffic.

Prior to undertaking load rating of bridges, all matters listed in AS 5100 Part 7: “Matters for resolution before design commences” must be resolved unless otherwise already clarified in the current ARTC structures standards.

6 Structures Inspection Submission Timeframes

All submissions of inspection and/or load rating reports to structures representative shall be completed within the timeframes shown in Table 5 below following the on-site inspection of individual structures:

Submission	**Timeframes**
Engineering Inspection	
Upload all new defects identified, including Category M defects, and update all existing defects as required to ARTC AMS Provide a list of all new and existing defects identified, including Category M defects, if required by structures representative	2 weeks after inspection of individual structure
Submission of draft engineering report	10 weeks after inspection of all nominated structures *(Allow 2 weeks for ARTC review)*

Submission of final engineering report	14 weeks after inspection of all nominated structures unless otherwise extended by structures representative
Visual and Special Inspection	
Upload all new defects identified, including Category M defects, and update all existing defects as required to ARTC AMS Provide a list of all new and existing defects identified, including Category M defects, if required by structures representative	2 weeks after inspection of individual structure
Submission of final report by external inspectors, if required by structures representative	4 weeks after inspection of all nominated structures

Table 5: Structures Inspection Submission Timeframes

7 Document Records

Where communication is verbal or via e-mail with the structures representative, to meet the required timeframes in Table 5, the structures representative shall subsequently document all such communications in the AMS within a reasonable timeframe.

Structures representative to ensure all engineering and visual reports, load rating, defects, calculations, photos and any associated documents are uploaded against respective structure in the AMS within a reasonable timeframe.

8 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.

8.1 Asset Class - Bridge

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”.

Description	Defect Type	Defect Size	Defect Category
Main Structural Element (excluding Broad Flange Beams)	Crack in a primary structural component	> 80mm long	A
		10 – 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	Truss span rocker / roller bearing *(Bearing tolerances specified below)*	Structures Representative to assess any rectification work requirements based on the reported condition of individual bearings on Form ETP0902F-01 against specified tolerances and determine rectification actions and timeframes. Seek engineering advice if required.	
	Crack in a bearing zone component	> 250mm	C
		50 – 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
Impact Damage			
Main Structural Element (excluding Trestles)	Out of alignment (causing misalignment to track)	> 50mm	A
		30 – 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
		30 – 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
		25 – 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
		> 40%	B

	Loose/Corroded Heads (% in a group of any group of 10 continuous rivets or bolts)	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
	Corrosion in head	≤ 2mm play	M
		> 75%	D
		≤ 75%	M

Steel Truss Rocker / Roller Bearing

Structures Representative to assess any rectification work requirements based on the reported condition of individual bearings on Form ETP0902F-01 against specified tolerances below and determine rectification actions and timeframes accordingly. Seek engineering advice if required

TRUSS ROCKER / ROLLER BEARING TOLERANCES

Defect	Description	Tolerance
Over expansion / contraction	Total difference between saddle & bed plates, including any misalignments in rockers/rollers, in 36 to 73m long trusses	± 70 mm
Over rotation	Lean in rocker, difference between top & bottom keeper bar bolts in a rocker	± 11 mm
Rotational misalignment	Inconsistent gaps between rockers/rollers	2 mm
Skew in rocker/roller nest	Rocker/roller skewed between ends on bed plate	5 mm
Skew in bed plate	Bed plate installed skewed to saddle plate	5 mm
Displacement of rocker/roller nest	Off-set in centre of rocker/roller nest & centre of bed plate in longitudinal direction	±22 mm
Corrosion in pivoting pin	Corrosion or pitting on exposed surface of pivoting pin	1 mm deep
Corrosion in tie rods & keeper bars	Loss of sectional area	10%
Corrosion in fasteners	Loss of sectional area	10%
Loose & broken fasteners in tie rods & keeper bars	Defective number of fasteners in tie rods and keeper bars	Nil
Loose & broken fasteners in sole plate and HD bolts	Defective number of fasteners in sole plate to bottom chord connection and HD bolts	1 in 4

B. Bridges – Timber			
Member	**Defect Type**	**Defect Size**	**Action / Defect Category**
Girder/Solid Headstock	Pipe/trough in any girder or solid headstock	> 150	Replace within 1 year
		100 - 150mm	Replace within 3 years
	Crushing	Any	Replace immediately
	Troughing	> 150mm	Replace immediately
		100 - 150mm	Replace in 1 year
Corbel	Pipe/trough	Crushing	Replace immediately
		> 125mm	Replace within 1 year
Ballasted deck plank	Decay	> 35% of plank depth	Repair or Replace within 1 year
Waling Headstock	Rotted out		B
Body / Corbel / Trestle Bolts	Loose in a connection	> 25%	D
		< 25%	M
Piles	Section loss in any pile	> 50%	Replace within 1 year for underbridge Replace within 2 years for road bridge
		40* - 50%	Monitor
	Pumping	Any	Replace or install cast-in-situ footing or stump immediately
Transoms	Rotted out	3 Adjacent	B
	Rotted Out	2 Adjacent	C
	Rotted Out	One isolated	M

Timber Underbridge – Mid-span Deflection						
Main Girder	Deflection is based on girder length between nearest corbel bolts from centre of girder	Exceeds values tabulated below	B			
Span (m) (Between centreline of supports)			< 4	4 - 5	5 – 7	> 7
Deflection (mm)			8	10	15	20

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, retaining walls, pile caps, piles and footings			
Description	**Defect Type**	**Defect Size**	**Defect Category**
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* - 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

D. Bridges – Masonry and Concrete Arch			
For piers, abutments, wingwalls and reinforcement see “Bridges – Concrete”.			
Description	**Defect Type**	**Defect Size**	**Defect Category**
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 / Fibre-reinforced foamed urethane (FFU)			
Description	**Defect Type**	**Defect Size**	**Defect Category**
Beams, Decks and Transoms	Coating Chipping (excludes decking)	> 25mm in diameter	D
		≤ 25mm in diameter	M
		> 5mm deep	D
		≤ 5mm deep	M
	Cracking	> 50mm	B
		10 to 50mm	C
		< 10mm	D
	Crushing at support	Any	C
	Fire / Ultra-violet Radiation damage	Any	C
	Accidental / intentional damage	Any	C
	Excessive wear	Any	C
Transom Bolts	Missing	3 in adjacent transoms	B
		2 in adjacent transoms	C
		Both bolts in a transom	M

F. Bridges – Miscellaneous Items			
Waterway Area			
Description	**Defect Type**	**Defect Size**	**Defect Category**
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 build-up	> 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

8.2 Asset Class – Culvert

A. Culverts			
For undefined elements and components refer to “Asset Class – Bridges”.			
Description	**Defect Type**	**Defect Size**	**Defect Category**
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 defect within 2m from nearest rail or between toes of high embankment or within influence line of traffic loading.	D
	Deformation	> 50*mm	D
Expanda / Rotaloc PVC / Berolina 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 with asterix (*) for intervention for Defect Category, there is no need to record the defect.*

8.3 Asset Class – Tunnels

There are no specific intervention criteria for tunnels. Where applicable, intervention criteria guideline in the "Asset Class – Bridges" could be used for the appropriate element type and material.

8.4 Asset Class – Miscellaneous Structures

There are no specific intervention criteria for miscellaneous structures. Where applicable, intervention criteria guideline in the "Asset Class – Bridges" could be used for the appropriate element type and material.

8.5 Redundant Structures

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

A. Redundant Structures			
Primary redundant structures are typically bridges, tunnels, water structures, platforms and loading banks.			
Description	**Defect Type**	**Defect Size**	**Defect Category**
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