ENGINEERING WAIVER APPROVAL FORM (EWAF)		All fields shall be completed
Waiver Number		800/BS/240409/027
Waiver Title		Guard Rails on Bridges
WAIVER REQUEST		
1	**Waiver Type**	New ☐ Renewal ☒ * Alteration ☐ * * Reason for renewal or alteration: Extended to allow time to amend Standard including Consultation and approvals process, plus notification to ITSR.
2	**Originator**	Name: Peter Prasad Company: ARTC Position: National Bridges & Structures Engineer Email: pprasad@artc.com.au Phone: 02 8259 0737
3	**Network Details**	Corridor: CRN ☐ ** East West ☒ Hunter Valley ☒ North South ☒ Line/Location: All NSW Km:
4	**Waiver Duration**	Permanent ☐ Temporary ☐ Start date: 01/07/2011 Expiry date: 30/06/2012
5	**Infrastructure Assets Affected**	TRACK AND CIVIL ☐ SIGNALLING ☐ ELECTRICAL ☐ COMMUNICATIONS ☐ PLANT AND EQUIPMENT ☐ ROLLING STOCK ☐ GENERAL ☐ OTHER (Structures) ☒
6	**Relevant Standard** *Insert the Standard and*	Number: BDS 05 Guard Rails – Configuration Standards Clause or section: 3, 4 & 5

ENGINEERING WAIVER APPROVAL FORM (EWAF)		All fields shall be completed
Waiver Number		800/BS/240409/027
Waiver Title		Guard Rails on Bridges
	clause being varied. *Copy the exact requirement from the Standard.*	**3. General** Guard rails are to be installed • on underbridges (as set out in the following section) • on track situated at or near vulnerable air space developments Guard rails may also be used in other high risk situations where the consequences of a derailment could be similarly severe. In the case of underbridges, particularly for through girder and through truss types, the guard rails prevent impact with key structural supporting elements. In addition, the guard rails, by way of a baulking effect, provide additional support to the track at the bridge ends. **4. Bridge Locations Requiring Guard Rails** Guard rails are to be installed on the following underbridges: • Through span bridges and their approach spans. • Transom top bridges on Class 1 and 2 lines, and over three metres in length. • Transom top bridges on Class 3, 4, 5 lines and over three metres in length, on a curve or within 100 metres of the trailing end of a curve. • Ballast top bridges with any individual span exceeding twenty metres in length. For other ballast top bridges on Class 1 and 2 lines, a risk assessment should be undertaken to determine whether guard rails are required. The risk assessment should be in accordance with AS/NZS 4360, Risk Management, and consider the following criteria: • Height of bridge • Bridge span • Abutment configuration • Probability and consequence of a derailment • Track alignment and configuration • Train speed, density and type of traffic **5. Guard Rail Details** Guard rail installations are to comply with the following requirements: • Guard rail is to be at least equivalent to siding quality rail • Where running rail is 47kg or greater, guard rail is to be at least 40kg • Top of guard rail is to be no higher than the adjacent running rail • Each guard rail is to be fastened on both sides to every transom/sleeper • On timber ties, guard rails can be directly fixed to the timber with no plates • Tapered nose section ("vee") is to extend for a minimum of 3.6 metres beyond the abutment on the train approach side of the bridge • Rails are to extend parallel for a minimum of 3 metres beyond the abutment on the train departure side of the bridge • Where traffic is bi-directional, the tapered guard rail section is to be installed at both ends of the bridge • Clearance between gauge face of running rail and adjacent face of guard rail is to be a minimum of 200mm and a maximum of 3 80mm • Clearance between gauge face of running rail and adjacent face of guard rail is to be determined by the Structures Representative based on an assessment of requirements for tamping ballast top bridges, tamping bridge ends, the potential for derailed wheels to strike holding down bolts on transom top bridges and the use of plates for mitigating noise and vibration • The maximum clearance is preferable. If the Structures Representative uses a smaller clearance, an effective maintenance regime must be in place for bridge ends • Where transoms are bolted to girders, the spikes are to be adjacent to the rail flange • Where transoms are clipped to girders, the spikes are to be installed through holes drilled in the guard rail flange • Block-out holes for guard rail fastenings in concrete sleepers shall be grouted with an approved high strength grout For fixing details, dimensional set-outs and componentry detail and sizes, Standard Guard Rail drawings are available. For special installations, such as where noise and vibration limiting track fixings are used or where expansion joints exist, specific design details of guard rail installations to suit will be required. Approved track fixings are to be used. The design is to be certified by a competent design engineer. Suitable isolation arrangements are to be made, where required, in track circuited and electrified areas.
7	**Variation Details** *Detail the variation from the Standard*	Variation to waive requirements of guard rails not complying with technical standards i.e. 1. no guard rails 2. missing tapered nose section ("vee") 3. guard rails not correctly spiked
8	**Risk Assessment**	Risk Assessment in accordance with RM-01 Risk Management Procedure shall be attached: ☒

ENGINEERING WAIVER APPROVAL FORM (EWAF)

All fields shall be completed

Waiver Number		800/BS/240409/027
Waiver Title		Guard Rails on Bridges
9	**Controls to be Implemented** *Detail the controls that will be put in place to manage identified risks.*	• **Guard rails on new bridges and on bridges being re-transomed shall comply with all requirements of current standard BDS 05 Guard Rails – Configuration Standards.** • **Existing guard rails shall be spiked at least every third transom on both sides of each guard rail.** • **Submission to be prepared and submitted to ITSR within 3 months to amend the current standard BDS 05.**
10	**Justification** *Include reason for the waiver and details of cost / benefit*	Waiver extension required to allow time for Standard to be amended.
11	**Attachments** *List the attachments that support the waiver*	• Revised Risk Assessment Report dated 20 September 2011. • BDS 05 Guard Rails – Configuration Standards • Original Risk Assessment Report dated 18 November 2008. • Bridge Guard Rails: Review of Policy Report dated 10 Jan 2008.
12	**CRIA Acceptance ****	This waiver does not apply to the NSW CRN network.

WAIVER ENDORSEMENT

13	**Endorsement Authority**	I have reviewed this waiver and accept the variation on the Corridor that I am responsible for and will ensure the controls will be implemented and monitored throughout the life of the waiver.		
		Gerard Withford	*GM Infrastructure & Project, Hunter*	22-9-11
		Simon Bingham	*Infrastructure, Manager NS*	22-9-11
		BEN HESKE	Infrastructure Mgr NSW.	30/9/11
		Name	Position	Signature / Date

WAIVER SUBMISSION

Submit waiver and supporting documents to standards@artc.com.au.

All waivers shall be submitted in Word format, with either a PDF showing appropriate signatures or email from the Endorsement Authority confirming endorsement, to standards@artc.com.au for registration, prior to recommendation and approval.

WAIVER TECHNICAL REVIEW

14	**Endorsed after technical review by:**	Technical Review completed:		Yes ☒	No ☐
		Robert Taylor	Asst Infrastructure Manager, Hunter		22nd Sept 2011
		Name	Position	Signature	Date

WAIVER RECOMMENDATION AND APPROVAL

15	**Waiver Approval Conditions**			
16	**Risk and Safety Committee**	Is Risk and Safety Committee Approval required?	Yes ☐	No ☑
17	**Regulator Notification**	Regulator Notification required in accordance with SP-02-12?	Yes ☑ ***	No ☑
		Notification period required:	☑ At least 28 days prior to commencement or introduction	☑ At least 7 days prior to change coming into effect
			☐ As soon as practicable after approval	☐ As soon as practicable after modification/change takes affect
		Responsible for Notifying Regulator:		

ARTC

Form number: EGP0201F-01

ENGINEERING WAIVER APPROVAL FORM (EWAF)					All fields shall be completed
Waiver Number		800/BS/240409/027			
Waiver Title		Guard Rails on Bridges			
18	**Recommendation Authority**	Recommended for approval:		Yes ☑	No ☐
		TONY FRAZER	GM NORTH SOUTH		22/9/11
		Name	Position	Signature	Date
19	**Approval Authority**	**Approved** ☑		**Not Approved** ☐	
		M. van de Worp	EGM TS		7/10/11
		Name	Position	Signature	Date
20	**Acceptance of Approval Conditions by Endorsement Authority** (if applicable)	I accept the Approval Conditions imposed by the ARTC Recommendation Authority.			
		Name	Position	Signature	Date

21	REGULATOR NOTIFICATION ***					
Regulator's Notified:		☐ SA	☐ WA	☐ VIC	☒ NSW	☐ QLD
Date of Notification:						
Notification period ends:						
Acceptance received:						

These details must be provided to standards@artc.com.au. This waiver will not come into affect until the end of the required notification period and/or acceptance by the Regulator.

WAIVER CLOSE OUT					
22	**Close Out Statement (Endorsement Authority)** *Include reason for waiver close out*	This waivr only applied in NSW. CoP section got implemented in Feb 2012. It states 'Guard Rails are not req'd on bridges			
		Name PRASAD	Position NBSE	Signature	Date 4/4/12
23	**Close Out Authorisation**	P. CAMPBELL	GM TS&E	P.N.C.	13/4/12
		Name	Position	Signature	Date

ARTC

AUSTRALIAN RAIL TRACK CORPORATION LTD

GUARD RAILS STANDARD

RISK ASSESSMENT REPORT

September 2011

Document Status

Version	Date Reviewed	Prepared by	Reviewed by	Endorsed
1.0	20 September 011	Peter Micenko Act Standards Engineer	Peter Prasad National Bridges & Structures Engineer	Graeme Templer Executive Manager Maintenance

Approved by:

.....

Tim Ryan
Executive General Manager

28/10/11

.....

Date

Guard Rail Risk Assessment

A detailed "Guard Rails Standards - Proposed Changes" Risk Assessment dated 18 November 2008 was undertaken by Max Shuard and Associates Pty. Ltd in accordance with ARTC Procedure SP-03-00: Safety Procedure.

This risk assessment is a conversion of the risk assessment in the above report into the format of RM01 and SFAIRP guidelines and a review of the risk assessment.

Reference Documents

- Guard Rails Standards Proposed changes Risk assessment report 18 November 2008 Rev 0.

Guard Rails RISK ASSESSMENT - 20 September 2011

This risk assessment is a conversion of the "Guard Rails Standards-Proposed Changes" RA report dated 18 November 2008 by Max Shuard and Associates Pty. Ltd to SFAIRP and RM01 format.
The original risks identified in column 1.1 have not been changed.

Bridges with NO Guard rails

1. RISK IDENTIFICATION						2. ANALYSIS AND EVALUATION												5. VALIDATION AND CLARIFICATION	
1.0 Risk No.	1.01 Element or Category (column may be "hidden"	1.1 Hazard or scenario or circumstance	1.2 Caused by	1.3 Leading to an Outcome		2.0 Existing Control	2.01 Control type	2.1 Responsible Party / Comments					2.2 Current consequence	2.3 Current likelihood	2.4 Current risk level	5.0 Has this workshop adequately addressed this risk?	5.2 Comments / clarification
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11					Moderate	Rare	L	Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11								Derailments known to date has not caused any extensive damage to rail br	
						welded track, ultrasonic car	Administrative	TMP11									
1	Derailment on High Bridge	Damage to bridge, rollingstock etc	Derailment			train drivers report(TCR)	Administrative	Train Operating									
						3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
				Damage to bridges and rollingstock	Train toppling off of bridge leading to fatality	3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level	Yes	
															#REF!		
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11					Moderate	Rare	L	Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11								Not aware of any public injury incidents	
						welded track, ultrasonic car	Administrative	TMP11									
2	Bridge crossing sensitive area	Risk of injury to public	Derailment			train drivers report(TCR)	Administrative	Train Operating									
						3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
				Practically impossible	Public fatality	3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level		
															#REF!		
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11					Not Significant	Rare	L	Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11								Not known to have occurred	
						welded track, ultrasonic car	Administrative	TMP11									
3	Bridge crossing sensitive area	Public perception	Derailment			train drivers report(TCR)	Administrative	Train Operating									
						3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
				Minor Adverse publicity	Major Adverse publicity	3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level		
															#REF!		
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11					Moderate	Rare	L	Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11								track on bridges are maintained to very high standards	
						welded track, ultrasonic car	Administrative	TMP11									
4	Track Alignment	Risk of derailment	Derailment			train drivers report(TCR)	Administrative	Train Operating									
						3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
				Conceivable that bridge suffer damage	Fatality	3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level		
															#REF!		
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11					Moderate	Rare	L	Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11								No different to any other derailment on the network.	
						welded track, ultrasonic car	Administrative	TMP11									
5	High Traffic Density	Disturbance to operation	Derailment			train drivers report(TCR)	Administrative	Train Operating									
						3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
				Traffic will be interupted	Business loss	3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level		
															#REF!		

Bridges WITH Guard rails																	
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11								Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11					Moderate	Rare	L	Ensure all proceedures are followed	
						welded track, ultrasonic car	Administrative	TMP11									
						train drivers report(TCR)	Administrative	Train Operating									
6	Not removed for tamping of approaches	Derailment on non tamped track	derailment	Derailment is conceivable but no different to derailment on normal track	Structural and Operational losses	3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
						3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level		
															#REF!		
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11								Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11					Minor	Rare	L	Known to have happened once in Vic. Ensure g/r noses are	
						welded track, ultrasonic car	Administrative	TMP11									
						train drivers report(TCR)	Administrative	Train Operating									
7	Nose lift to create hazard	damage to rollingstock	Derailment	Remotely possible to get caught by dragging chain or by locomotive cowcatcher	Fatality	3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
						3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level		
															#REF!		
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11								Yes	
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11					Extreme	Rare	M	Remove guard rail nose.	
						welded track, ultrasonic car	Administrative	TMP11									
						train drivers report(TCR)	Administrative	Train Operating									
8	Misdirect derailed wheel to wrong side of guard rail	Create worse derailment situation by directing derailed wheel to edge of bridge	Derailment	structural and operational losses	Fatality	3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
						3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level	Yes	
						remove guard rail nose	Administrative	Minimal	Minimal	Adopt	Asset maint	If adopted	Moderate	Rare	L	All g/r noses to be removed if g/r are to be retained	
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11								Yes	Remoce guard rail noses
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11					Extreme	Rare	M	Remove guard rail nose.	
						welded track, ultrasonic car	Administrative	TMP11									
						train drivers report(TCR)	Administrative	Train Operating									
9	Misdirect derailed wheel	Damage to nose of guard rail creating further hazard to subsequent vehicles	Derailment	structural and operational losses	Fatality	3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
						3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level	Yes	
						remove guard rail nose	Administrative	Minimal	Minimal	Adopt	Asset maint	If adopted	Major	Rare	L	Remove guard rail nose.	
				Most Likely (Credible) Outcome	Worst Case (Credible) Outcome	track inspections, AK Car,	Administrative	Technical Maintenance Plan TMP11								Yes	Remove Guard Rails as soon as practical
						track patrol, eng insp, trackside equipt(eg hotbox/wild/etc)	Administrative	TMP11					Major	Rare	L		
						welded track, ultrasonic car	Administrative	TMP11									
						train drivers report(TCR)	Administrative	Train Operating									
10	Guard rail without nose	derailed wheel hitting end of guard rails	Derailment	structural and operational losses	fatality	3. PROPOSED ADDITIONAL RISK TREATMENT							4. RESCORE TO REFLECT SFAIRP OUTCOMES			5.1 Do the decisions	
						3.0 Proposed Additional Control	3.01 Control type	SFAIRP TEST 3.1 BENEFIT	3.2 COST	3.3 Decision	3.4 Responsible Party	3.5 By when	4.0 Revised consequence	4.1 Revised likelihood	4.2 Revised risk level		
															#REF!		

ENGINEERING WAIVER APPROVAL FORM (EWAF)

All fields shall be completed

1 Engineering Waiver Approval Number

1.1 EWA Number: EWAF 800/BS/240409/027

1.2 Select Waiver Type: New ☐ Renewal ☐ Alteration ☒

2 Organisation Requesting Waiver Approval

2.1 Name of Organisation: ARTC

2.2 Name of Originator: Peter Prasad

2.3 Signature of Originator: see email Date: 05/09/10

3 Network details and Duration of Waiver

3.1 Corridor: All NSW Location:

Line: Km:

3.2 Permanent: Yes ☐ No ☒ Start date: 18/10/10 Expiry date: 30/06/11

4 Organisations affected by Waiver

4.1 ARTC and Operators in NSW

4.2 Applicable to CRN? Yes ☒ No ☒ If yes, CRN endorsement attached ☐

5 Infrastructure Assets affected by Waiver (check relevant box)

TRACK	☐	SIGNALS	☐	STRUCTURES	☒
COMMUNICATIONS	☐	MECHANICAL	☐	ROLLINGSTOCK	☐
RIGHT OF WAY	☐	WAYSIDE	☐	OTHER	☐

6 List of Components affected

Guard rails

7 Details of Waiver Request

7.1 Relevant Standard: BDS 05 Clause or section:

7.2 **Requested Changes:** *(add separate statement if insufficient space)*

To waive requirements of guard rails not complying to technical standards i.e.

1. no guard rails
2. missing tapered nose section ("vee")
3. guard rails not correctly spiked

7.3 **Proposed Controls:**

1. Guard rails on new bridges and on bridges being retransomed shall comply with all relevant standards.
2. Existing guard rails shall be spiked at least every third transom on both sides of each guard rail.

7.4 Attachments:

7.5 Reason for waiver renewal or alteration: Amended to apply to ARTC network only. No longer applies to CRN. Extended to allow for further investigation into guard rail requirements.

7.6 Risk Assessment in accordance with RM-01 Risk Management Procedure attached: ☑

7.7 Cost / Benefit:

8 Waiver Endorsement

(Print Name) (Signature)

Date:

Date:

Date:

Submit Waiver and Supporting Documents to standards@artc.com.au for Approval

9 Request for Waiver Decision

9.1 **Approved** ☑ **Not Approved** ☐

Date: 14/10/2010

Manager Standards (Print Name & Signature)

9.2 Waiver Approval Conditions:

9.3 Regulator Notification required? Yes ☐ No ☐ Date advised

10	**Acceptance of Approval Conditions and/or Controls**	Delivery Manager (Print Name & Signature) Date:
11	**Configuration Records Updated as Appropriate**	R RATH Configuration Manager (Print Name & Signature) Date: 15-10-10
12	**Waiver Close-out**	12.1 Reason for Close-out: Delivery Manager (Print Name & Signature): Date: 12.2 Authorisation to Close-out waiver Manager Standards (Print Name & Signature) Date:

Add further details as required:

ENGINEERING WAIVER APPROVAL FORM (EWAF)

All fields shall be completed

1 Engineering Waiver Approval Number

1.1 EWA Number: EWAF 800/BS/240409/027

1.2 Select Waiver Type: New ☐ Renewal ☒ Alteration ☐

2 Organisation Requesting Waiver Approval

2.1 Name of Organisation: ARTC

2.2 Name of Originator: Peter Prasad

2.3 Signature of Originator: see email Date: 31/01/10

3 Network details and Duration of Waiver

3.1 Corridor: All NSW Location:

Line: Km:

3.2 Permanent: Yes ☐ No ☒ Start date: 01/01/10 Expiry date: 31/12/10

4 Organisations affected by Waiver

4.1 ARTC, RIC and Operators in NSW

4.2 Applicable to CRN? Yes ☒ No ☐ If yes, CRN endorsement attached ☐

5 Infrastructure Assets affected by Waiver (check relevant box)

TRACK	☐	SIGNALS	☐	STRUCTURES	☒
COMMUNICATIONS	☐	MECHANICAL	☐	ROLLINGSTOCK	☐
RIGHT OF WAY	☐	WAYSIDE	☐	OTHER	☐

6 List of Components affected

Guard rails

7 Details of Waiver Request

7.1 Relevant Standard: BDS 05 Clause or section:

7.2 **Requested Changes:** *(add separate statement if insufficient space)*

To waive requirements of guard rails not complying to technical standards i.e.

1. no guard rails
2. missing tapered nose section ("vee")
3. guard rails not correctly spiked

7.3 **Proposed Controls:**

1. Guard rails on new bridges and on bridges being retransomed shall comply with all relevant standards.
2. Existing guard rails shall be spiked at least every third transom on both sides of each guard rail.

7.4 Attachments:

7.5 Reason for waiver renewal or alteration: Awaiting acceptance by Regulator of changes to guard rail requirements

7.6 Risk Assessment in accordance with RM-01 Risk Management Procedure attached: ☐

7.7 Cost / Benefit:

8 Waiver Endorsement

(Print Name) (Signature)

Date:

Date:

Date:

Submit Waiver and Supporting Documents to standards@artc.com.au for Approval

9 Request for Waiver Decision

9.1 **Approved** ☑ **Not Approved** ☐

Date: 3/2/2010

Manager Standards (Print Name & Signature)

9.2 Waiver Approval Conditions: Proposed controls to apply.

9.3 Regulator Notification required? Yes ☐ No ☑ Date advised

10	**Acceptance of Approval Conditions and/or Controls**	Delivery Manager (Print Name & Signature) Date:
11	**Configuration Records Updated as Appropriate**	R Ram Configuration Manager (Print Name & Signature) Date: 5.2.10
12	**Waiver Close-out**	12.1 Reason for Close-out: Delivery Manager (Print Name & Signature): Date: 12.2 Authorisation to Close-out waiver Manager Standards (Print Name & Signature) Date:

Add further details as required:

ENGINEERING WAIVER APPROVAL FORM (EWAF)

All fields shall be completed

1	**Engineering Waiver Approval Number**	1.1	EWA Number:	EWAF 800/BS/240409/027		
		1.2	Select Waiver Type	New ☐	Renewal ☒	Alteration ☐
2	**Organisation Requesting Waiver Approval**	2.1	Name of Organisation:	ARTC		
		2.2	Name of Originator:	Peter Prasad		
		2.3	Signature of Originator:		Date:	24/04/09
3	**Network details and Duration of Waiver**	3.1	Corridor:	All NSW	Location:	
			Line:		Km:	
		3.2	Permanent:	Yes ☐ No ☒	Start date: 01/01/09	Expiry date: 31/12/09
4	**Organisations affected by Waiver**	4.1	ARTC, RIC and Operators in NSW			
		4.2	Applicable to CRN?	Yes ☒ No ☐	If yes, CRN endorsement attached	☒

5 **Infrastructure Assets affected by Waiver** (check relevant box)					
TRACK	☐	SIGNALS	☐	STRUCTURES	☒
COMMUNICATIONS	☐	MECHANICAL	☐	ROLLINGSTOCK	☐
RIGHT OF WAY	☐	WAYSIDE	☐	OTHER	☐

6	**List of Components affected**	Guard rails	
7	**Details of Waiver Request**	7.1 Relevant Standard: BDS 05	Clause or section:

7.2 Requested Changes: *(add separate statement if insufficient space)*

To waive requirements of guard rails not complying to technical standards i.e.

1. no guard rails
2. missing tapered nose section ("vee")
3. guard rails not correctly spiked

This waiver will close out three separate guard rail waiver – 800/BS/240409/027, 800/TR/041005/015 and 800/TR/041005/016

7.3 Proposed Controls:

1. Guard rails on new bridges on bridges being retransomed shall comply with all relevant standards.
2. Existing guard rails shall be spiked at least every third transom on both sides of each guard rail

7.4	Attachments:	Original waivers 800/BS/240409/027, 800/TR/041005/015 and 800/TR/041005/016
7.5	Reason for waiver renewal or alteration:	Awaiting implementation of ARTC CoP Section 9 Structures, expected December 2009
7.6	Risk Assessment	PP169F-02 Waiver Approval Risk Assessment Form attached: ☒
7.7	Cost / Benefit	

8 Waiver Endorsement

	(Print Name)	(Signature)	
DM CRN	Scott Chapman	* see email endorsement	Date: 30/04/09
DM North Coast	John Ogilvy	* see email endorsement	Date: 03/05/09
DM South	Stephen Fleck		Date: 13/5/09
DM Hunter Valley	Clinton Crump		Date: 13/5/09
IM East West	Ben Leske		Date: 14/5/09

Submit Waiver and Supporting Documents to standards@artc.com.au for Approval

9 Request for Waiver Decision

9.1 **Approved** ☑ **Not Approved** ☐

Date: 17/6/09

Manager Standards (Print Name & Signature)

9.2 Waiver Approval Conditions: proposed controls to be implemented

	9.3 Regulator Notification required? Yes ☐ No ☐ Date advised	
10 **Acceptance of Approval Conditions and/or Controls**	Delivery Manager (Print Name & Signature)	Date:
11 **Configuration Records Updated as Appropriate**	P.N Campbell P. CAMPBELL Configuration Manager (Print Name & Signature)	Date: 16/6/09
12 **Waiver Close-out**	12.1 Reason for Close-out:	
	Delivery Manager (Print Name & Signature):	Date:
	12.2 Authorisation to Close-out waiver	
	Manager Standards (Print Name & Signature)	Date:

Add further details as required:

AUSTRALIAN RAIL TRACK CORPORATION LTD

Guard Rail Standards: Proposed Changes

Risk Assessment Report

17 March 2008

Rev 2

MAX SHUARD
& ASSOCIATES
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Rev 2			17 March 2008

Table of Contents

1 Introduction

1.1 General

Max Shuard and Associates Pty Ltd has been engaged by ARTC to:

- Investigate requirements for guard rails on ARTC underbridges;
- Propose a specific uniform policy for adoption across the ARTC network; and
- Facilitate a risk assessment of the changes, in accordance ARTC procedures.

This report describes the risk assessment.

1.2 Background

A guard rail is “a rail (inside or outside the running rail) used to restrain lateral movement of a derailed wheelset, used to protect structures or control the lateral movement of the wheelset on bridges or in other higher risk situations”.[1]

Figure 1 shows a typical guard rail.

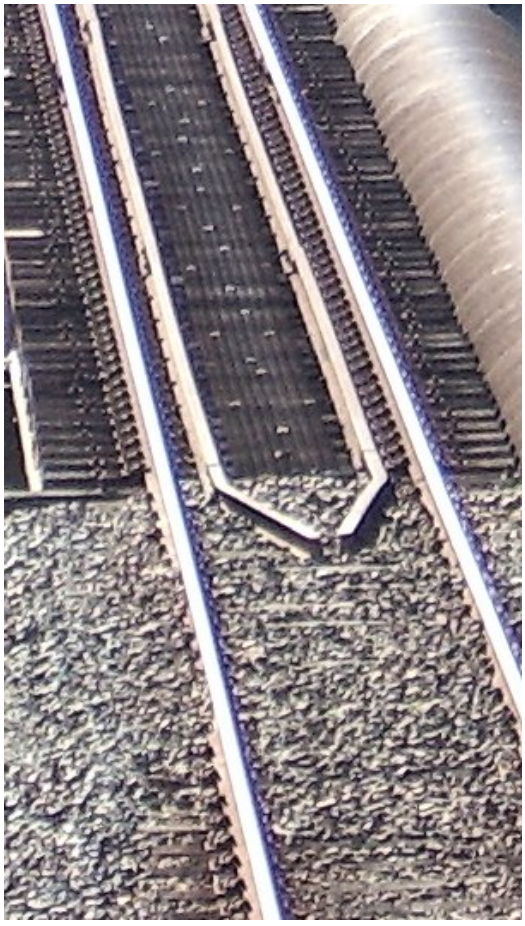

Figure 1 – Typical guard rail

[1] Code of Practice for the Defined Interstate Rail Network, Volume 2: Glossary, Section 4.1.

2 Proposal

2.1 General

This section summarises the proposed changes to guard rail standards. A full discussion paper, as pre-circulated to risk assessment participants, is attached to this report.

2.2 Existing Standards and Practices

Current standards practices for the provision of guard rails vary across the ARTC network.

Engineering Standard BDS 05: Guard Rails – Configuration Standards (applicable in NSW) specifies that guard rails be provided in the following situations:

- Across all bridges containing through spans;
- On transom top bridges on Class 1 and 2 lines which are over 3 m long;
- On transom top bridges on Class 3, 4, 5 lines which are over 3 m long and on a curve or within 100 m of a curve; and
- Ballast top bridges with any individual span over 20 m long.

Provision of guard rails in NSW appears to largely conform to this standard.

There are no specific ARTC standards for the provision of guard rails applicable in Victoria or the Western Jurisdiction.

On ARTC lines In Victoria, guard rails tended to be provided on long transom top bridges. Ballast top bridges were generally not provided with guard rails. In the early 1990s, a Victorian policy of discontinuing provision of guard rails was adopted, although some installations remain.

Provision of guard rails on ARTC bridges in South Australia and Western Australia varies, depending on previous ownership of the corridors. In general, guard rails are not provided.

2.3 Issues

Key issues for consideration in reviewing guard rail standards are:

- Are guard rails effective, i.e. do they restrain and guide the movement of a derailed wheel as intended?
- Are they cost effective, i.e. do benefits exceed the cost of their installation and upkeep?
- Are the original reasons for their provision still valid, i.e. has the railway operating environment changed?

2.4 Conclusions from the Investigation

Conclusions from the investigation (refer attached discussion paper for details) are that:

- Guard rails are not necessarily effective, particularly with heavier, faster trains;

- The incidence of derailments where derailed wheels are dragged across bridges is reducing, lowering the potential benefit of guard rails;
- Maintenance of guard rails tends to be of low priority, lessening their effectiveness;
- Some guard rails inherited by ARTC are to obsolete standards (particularly in relation to end configuration), also lessening their effectiveness;
- The presence of the tapered ends of guard rails creates track maintenance issues just off the ends of bridges;
- Guard rails may worsen rather than lessen the consequences of a derailment; but
- Nevertheless, in some situations, the provision of guard rails may be desirable.

2.5 Proposed Policies

The proposed policy is that the need for guard rails be determined on a case-by-case basis, with guidelines:

1 For new or upgraded transom top bridges (including renewal of transoms), where:

- The maximum height of the bridge exceeds 10 metres; or
- The bridge crosses a busy road or an area where the public regularly congregates,

the Asset Manager shall arrange a risk assessment in accordance with the organisation's risk assessment procedures, to assess if guard rails are required.

2 Guard rails may be provided on other bridges at the discretion of the Asset Manager.

3 Existing guard rails, where retained under this policy, shall be upgraded to current standards when next refurbished.

4 Where existing guard rails are not required under this policy, the guard rails and/or their tapered end sections may be removed at the discretion of the Asset Manager.

2.6 Summary of Changes

Proposed changes to guard rail standards are summarised in Table 1.

Existing	Proposed
Guard rails mandatory in defined situations, principally on transom top bridges – NSW.	Risk assessment mandatory in defined situations, optional elsewhere.
No specified requirements – elsewhere.	
–	Where guard rails are required, installations to be upgraded to standard when transoms are renewed.
–	Installations no longer required under the revised policy may be removed at the discretion of the Asset Manager.

Existing	Proposed
–	Tapered end sections on installations no longer required under the revised policy may be removed as desired.

Table 1: Summary of Proposed Changes to Standards

2.7 Impacts

Refer attached discussion paper, section 7.

3 Risk Assessment

3.1 General

A half-day risk assessment workshop to consider the proposed changes to guard rail policy was held in Sydney on Friday 1 February 2008.

3.2 Participants

The risk assessment workshop was attended by 21 representatives from a range of backgrounds and geographical locations.

A schedule of participants is given in Appendix 1.

3.3 Process

The risk assessment was conducted in accordance with ARTC procedure SP-03-00: Safety Procedure. This involves a three-step process:

1 Establishing the context

2 Identifying the risks; and

3 Assessing the risks.

The risk evaluation process is described in Appendix 2.

4 Context, Risk Identification

4.1 Qualifications and Constraints

Identified qualifications and constraints applicable to the risk assessment were:

- Risks associated with current installations of guard rails (particularly on ballast top bridges) are assumed to be acceptable; and
- ARTC's network includes the CRN.

4.2 Objectives

The agreed objectives of the risk assessment were:

- To determine if the introduction of all of the proposed changes to guard rail standards will be acceptable to ARTC;
- To ensure that identified risks are supported by practical mitigations to reduce risks to acceptable levels; and
- To contribute towards policy that will be submitted to the ARTC Safety Committee for approval, and notified to Rail Safety Regulators.

4.3 Stakeholders

Stakeholders with an interest in the guard rail policy were identified as:

- ARTC;
- Customers (operators);
- Alliance partners;
- Rail safety regulators; and
- Public.

4.4 Definitions

For the purposes of the risk assessment, a guard rail was defined as:

- A rail (inside or outside the running rail) used to restrain lateral movement of a derailed wheelset, used to protect structures or control the lateral movement of the wheelset on bridges or in other higher risk situations.

The risk assessment covered only guard rails on underbridge (i.e. excluded the use of guard rails to protect lineside structures or for other reasons.

4.5 Risk Statement

The risk statement applicable to the assessment was defined as being:

- The risks to ARTC, Alliance Partners and other stakeholders associated with the introduction throughout the ARTC network (including CRN) of all of the proposed changes to guard rail standards.

5 Results

5.1 Risk Identification

Potential risks were identified by workshop participants.

All identified risks, together with scoring outcomes, are detailed in Appendix 3.

5.2 Risk Evaluation

Risks were evaluated to determine the risk scores and required actions in relation to each risk. Details are given in Appendix 3.

In Appendix 3, the following abbreviations are used:

FT Failure to;

LO Lack of; and

RI Results in.

5.3 Discussion

Most of the identified risks involved a scenario similar to the following:

- A guard rail is required under the present policy, but is not provided under the new policy;
- A derailed vehicle travels across the bridge; and
- The consequences of this derailment would be less if a guard rail had been provided.

However, the risk scores for all identified risks were less than 20, resulting from low likelihood and exposure ratings. This outcome indicated that no additional risk controls are necessary.

One significant issue which arose related to ballast top bridges. In NSW, the requirements for guard rails on ballast top bridges are significantly less than for transom top bridges. This is because ballast top bridges are generally wider than transom top bridges, often with substantial concrete kerbs.

However, in the Western Jurisdiction, there are many rail deck bridges, which are narrow ballast top structures with sidewalls made from lengths of old rail. If traversed by a derailed vehicle, the outcomes could be expected to be different to what might occur on the type of ballast top bridge typically found in NSW. This aspect illustrates the need for an individual approach to the provision of guard rails, instead of a rigid prescription.

The small number of different risks identified by the participants reinforces the low level of risk associated with introduction of the proposed guard rail policy.

5.4 Risk Treatment

As a result of the risk evaluation, no risks were identified as requiring further mitigation actions.

6 Summary and Conclusions

The present ARTC standards, mandating extensive provision of guard rails in NSW but no requirements elsewhere, is inappropriate.

With heavier and faster trains, but fewer derailments, the need for, and effectiveness of, guard rails is changing.

The proposed policy mandates a risk assessment for provision of guard rails on new or upgraded bridges in the following situations:

- Transom top bridges with a height exceeding 10 m; and
- Transom top bridges over busy roads or areas where the public may congregate.

In comparison to present standards, this risk assessment found no risks requiring additional mitigation measures.

Elements to be considered during individual bridge risk assessments include:

- Height of bridge;
- Length of bridge;
- Configuration of bridge;
- Frequency of train traffic; and
- Configuration of adjoining railway.

Appendices

Appendix 1: Participants

Name	Position	Company
Ross Barber	Team Manager	ARTC, Moss Vale
Ian Cochrane	Safety Engineer	ITSRR, Sydney
Ian Domleo	Technical Engineer	ARTC, Adelaide
Hassan Elaina	Compliance Egn	ARTC, Wagga Wagga
John Furness	Standards Manager	ARTC, Adelaide
Linton Gloster	Delivery Manager	ARTC, Melbourne
Matthew Hart	Delivery Manager	ARTC, Adelaide
Duncan McLeod	Consultant	Max Shuard & Associates
Peter Micenko	Compliance Engineer	ARTC, Wagga Wagga
Walter Morris	Structures Manager	ARTC, Maitland
Brett Pay	Structures Manager	ARTC, Dubbo
Peter Prasad	Nat B & S Engineer	ARTC, Sydney
Tony Rando	Structures Manager	ARTC, Coffs Harbour
Eddy Rawlins	Bridge Examiner	Downer EDI, Melbourne
Colin Rodgers	Structures Engineer	ARTC, Broadmeadow
Mary Roe	Project Engineer	ARTC, Adelaide
Paul Said	Project Planner	ARTC, Broadmeadow
Max Shuard	Consultant	Max Shuard & Associates
Richard Tullo	Configuration Manager	ARTC, Adelaide
Paul Wallace	Structures Manager	ARTC, Tamworth
Jason Walsh	Structures Engineer	ARTC, Broadmeadow

Appendix 2: Risk Evaluation Process

Likelihood

The likelihood of each risk occurring was established collectively by the workshop group, in accordance with the criteria given in ARTC procedure SP-03-00. These criteria are shown in Table 2.

Class	Description
Almost certain	Is the most likely outcome if the event occurs
Very likely	Not unusual – perhaps 50 / 50 chance
Unusual but possible	
Remotely possible	A possible coincidence
Conceivable but very unlikely	Has never happened in years of exposure but is possible
Practically impossible	Not to knowledge ever happened anywhere

Table 2: Likelihood Criteria

Allocated likelihoods are detailed in Appendix 3.

Exposure

The exposure to each risk was established collectively by the workshop group, in accordance with the criteria given in ARTC procedure SP-03-00. These criteria are shown in Table 3.

Class	Description
Continuous	Many times per day
Frequent	Approximately once daily
Occasional	Once a week to once a month
Unusual	Once a month to once a year
Rare	Has been known to occur
Very rare	Not known to have occurred

Table 3: Exposure Criteria

Allocated exposures are detailed in Appendix 3.

Consequences

The consequence of each risk event was established collectively by the workshop group, in accordance with the criteria given in ARTC procedure SP-03-00. These criteria are shown in Table 4.

Class	Description
Catastrophe	Multiple loss of life, or > $20,000,000 damage, or > 5 days track closure
Disaster	Loss of life, or > $5,000,000 damage, or > 1 days track closure
Very Serious	Multiple permanent injury, or > $2,000,000 damage, or > 8 hours track closure
Serious	Permanent or serious injury, or > $500,000 damage, or > 4 hours track closure
Important	Lost time injury, or > $20,000 damage, or > 2 hours track closure
Noticeable	No lost time injury, any damage or any track closure

Table 4: Consequence Criteria

Allocated consequences are detailed in Appendix 3.

Required Actions

Required actions in relation to the overall score for each risk are given in ARTC procedure SP-03-00. These criteria are shown in Table 5.

Risk level	Comment & Actions
>350	Very high – stop activity until risk is reduced
180 - 350	High – deal with immediately
70 - 180	Substantial – correction required
20 - 70	Possible risk – attention indicated
<20	Acceptable – make as low as reasonably practical

Table 5: Required Actions

RISK ASSESSMENT SUMMARY SHEET: Guard Rails

Risk #	Risk/Hazard	Notes	Existing Controls	Likelihood		Exposure		Consequence		Score	Additional Controls
	Description of the possible mistake / error / system shortfall		Existing system defence barriers	Potential for the identified event to occur.	Score	Likelihood of the event leading to the result	Score	Seriousness of the incident	Score	Risk Score	Further controls required to achieve acceptable risk score
1	FT comply with technical standard RI loss of accreditation	(General issue not specifically related to proposed changes to standards)									
2	FT provide guard rails on ballast top bridges RI derailment, similar situation to high embankment		Policy provides for local risk assessment	Conceivable But Very Unlikely	0.5	Very Rare	0.5	Disaster	50	13	
3	LO consistent method of applying risk assessment process RI non-uniform approach	(Not a risk/hazard)									
4	LO scientific rigour in analysing whether guard rails are effective or not RI litigation from stakeholder following derailment			Conceivable But Very Unlikely	0.5	Rare	1	Serious	15	8	
5	FT tamp correctly at bridge abutment because of guard rail RI defect causing	(Proposed policy lessens risk)									
6	Guard rails RI tripping hazard for inspector	(Proposed policy lessens risk)									
7	LO certainty that guard rails protect life and structures RI installation which increases		Risk assessment process	Conceivable But Very Unlikely	0.5	Rare	1	Very Serious	25	13	
8	Inadequate design or installation of end tapers RI derailed wheel climbing guard rail	(Proposed policy does not change design of guard rails)									
9	FT sufficiently identify risks and consequences during risk assessment RI guard rails not being installed, exacerbating consequences of derailment		Detailed documentation will provide guidelines on issues to be considered in risk assessment	Conceivable But Very Unlikely	0.5	Very Rare	0.5	Serious	15	4	
10	LO lateral restraint of ballast on certain structures RI risk assessment of potentially risky site not being undertaken	(Similar to risk 2)									

RISK ASSESSMENT SUMMARY SHEET: Guard Rails

Risk #	Risk/Hazard	Notes	Existing Controls	Likelihood		Exposure		Consequence		Score	Additional Controls
	Description of the possible mistake / error / system shortfall		Existing system defence barriers	Potential for the identified event to occur.	Score	Likelihood of the event leading to the result	Score	Seriousness of the incident	Score	Risk Score	Further controls required to achieve acceptable risk score
11	Removal of tapered ends RI derailment consequences being more severe			Remotely Possible	1	Rare	1	Serious	15	15	
12	FT provide tapered ends RI derailment consequences being more severe	(Similar to risk 11)									
13	LO guard rails over permanent water RI greater consequences of derailment		Detailed documentation will provide guidelines on issues to be considered in risk assessment	Conceivable But Very Unlikely	0.5	Rare	1	Serious	15	8	
14	LO splay rails resultrs in derailment	(Similar to risk 11)									
15	FT instal guard rails on curved bridge over roadway RI train on roadway		Risk assessment mandatory	Conceivable But Very Unlikely	0.5	Very Rare	0.5	Disaster	50	13	
16	FT instal long transoms on bridges RI ineffective guard rail	(Proposed policy change does not cover this issue)									
17	FT remove full guard rail RI rail spearing into wagon during derailment	(Similar to risk 11)									
18	Inadequate guard rail fastenings RI not working as intended	(Not a consequence of proposed policy change)									
19	LO real data to allow new proposals to go forward RI everyone's opinion being wrong	(Have representative group - relates to risk assessment process, not the proposed policy change)									
20	Insufficient data to carry out risk assessment RI poor site specific assessments	(Similar to risk 19)									
21	LO resources to change guard rails to standard RI damage and litigation	(Not a consequence of proposed policy change)									
22	LO consistent method of applying risk assessment results in non-uniform approach despite uniform standard	(Similar to risk 3)									

Attachment: Discussion Paper

AUSTRALIAN RAIL TRACK CORPORATION LTD

Bridge Guard Rails:

Review of Policy

14 January 2008

Version: 1

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1	D McLeod	M Shuard	14 January 2008

Contents

1 Background

Uniformity is needed

The ARTC network comprises infrastructure formerly managed by several authorities, typically on a state-by-state basis.

Previous jurisdictions adopted differing policies and standards for the provision of guard rails on bridges.

ARTC seeks to implement a consistent approach to the provision of guard rails throughout its network, based on a uniform technical standard.

This review proposes a uniform policy

The objectives are to:

- Investigate requirements for guard rails; and
- Propose a specific uniform policy.

What is a guard rail

A guard rail is “a rail (inside or outside the running rail) used to restrain lateral movement of a derailed wheelset, used to protect structures or control the lateral movement of the wheelset on bridges or in other higher risk situations”.[1]

This investigation covers the use of guard rails only in relation to underbridges.

[1] Code of Practice for the Defined Interstate Rail Network, Volume 2: Glossary, Section 4.1.

2 Current Practices

Current practices vary

Current practices for the provision of guard rails vary, both within the ARTC network and elsewhere.

On the ARTC leased network in NSW, transom top bridges are to be fitted with guard rails

Engineering Standard BDS 05: Guard Rails – Configuration Standards specifies that guard rails be provided in the following situations:

- Across all bridges containing through spans;
- On transom top bridges on Class 1 and 2 lines which are over 3 m long;
- On transom top bridges on Class 3, 4, 5 lines which are over 3 m long and on a curve or within 100 m of a curve; and
- Ballast top bridges with any individual span over 20 m long.

Provision of guard rails appears to largely conform to this standard (refer also to section 5).

In Victoria and the Western Jurisdiction, practices vary

There are no specific ARTC standards for the provision of guard rails applicable in Victoria or the Western Jurisdiction (refer section 3 re ARTC Code of Practice).

On ARTC lines In Victoria, guard rails tended to be provided on long transom top bridges. Ballast top bridges were generally not provided with guard rails. In the early 1990s, a Victorian policy of discontinuing provision of guard rails was adopted, although some installations remain.

Provision of guard rails on ARTC bridges in South Australia and Western Australia varies, depending on previous ownership of the corridors. In general, guard rails are not provided.

Other systems practices also vary

Queensland Rail requires guard rails (and splay rails) to be provided on all ballast top bridges. On transom top bridges, foot planks may be used as a substitute where maximum line speed is 100 km/h or less.[2]

Guard rails were not fitted to bridges on the Alice Springs – Darwin railway.

WestNet Rail is generally opposed to the installation of guard rails on bridges. When renewals or upgradings are being planned, the need to instal guard rails is considered.[3]

Some systems truncate the tapered ends of their guard rails and/or include portions of approach curves, as shown in Figure 1.

The Federal Railroad Administration (USA) does not mandate that guard rails be provided on bridges. However, photographs suggest that use is widespread.

The UK Office of Rail Regulation specifies that in the design of bridges, "suitable means should be provided to contain the wheels of derailed vehicles".[4]

NZ Railways policy is to provide guard rails on transom top bridges, except on straight track where the bridge is less than 6 m long.[5]

Figure 1 – Guard rail with truncated ends [6]

[2] QR Civil Engineering Track Standards 5.3.2.
[3] As reported by Cardno in Guardrails on Railway Underbridges Stage 1 – Survey of Practices and Requirements, April 2007 report for ARTC.
[4] Railway Safety Principles and Guidance, part 2, section A: Guidance on the Infrastructure.
[5] Railnet Code 1990, section P.134.
[6] Derwent Valley line, Tasmania.

3 Industry Standards

AS 4292 – Railway Safety Management identifies factors to be considered

AS 4292 – Railway Safety Management does not specify if guard rails should be provided. Instead, the standard identifies factors to be considered in developing standards or procedures. [7]

AS 5100 – Bridge Design does not cover guard rails

AS 5100 – Bridge Design does not specify if guard rails should be provided, or how they should be designed.

The ARTC Code of Practice does not specifically address where guard rails should be provided

The Code of Practice for the Defined Interstate Rail Network, Volume 4 Track, Civil and Electrical Infrastructure, Part 2: Infrastructure Principles identifies that the need for installation of guard rails may be based on risk analysis, and details aspects to be considered in developing a policy for their use. [8]

The ARTC Code of Practice (adoption of Code of Practice for the Defined Interstate Rail Network, Volume 4 Track, Civil and Electrical Infrastructure, Part 4) recommends guidelines to be adopted for the design of guard rails, but does not cover where they should be used. [9]

[7] AS 4292 Railway Safety Management Part 2: Track, Civil and Electrical Infrastructure: Section D11.
[8] Section 1, clause 1.1.6 Guard Rail.
[9] Section 1, clause 1.1.6 Guard Rail.

4 Why Provide Guard Rails?

The key function of guard rails is to guide derailed wheels

The key function of a guard rail on a bridge is to guide and constrain a derailed wheel to a path close to the running rail. This is so that the derailed vehicle will not strike the superstructure (on a through span) or fall off the side of the bridge. Consequential damage is therefore minimised.

The likelihood of this function being required is low

The proportion of track located on bridges varies throughout the ARTC network. Between Junee and Melbourne it is 3.0%, and between Telarah and Brisbane (including the Queensland portion) 2.4%. Bridges are relatively frequent on these sectors. At the other end of the spectrum, between Port Augusta and Kalgoorlie, the proportion of track on bridges is negligible.

If it is assumed that there will be one derailment per 1,000 route km each year of the type where a derailed vehicle is dragged for some distance, and that this distance averages 3 km, 0.3% of the route will be affected by derailment each year.

It can therefore be seen that the likelihood of a specific bridge being required to receive a derailed vehicle is low. On average, a derailed vehicle will not traverse a bridge over the life of the transoms.

The operating environment is changing

Guard rails have long been provided on railway bridges in some areas. However, the operating environment has been progressively changing. Changes which potentially influence the need for guard rails include:

- *A reduction in derailments*

  With increasing use of mechanised maintenance and concrete sleepers, track is typically maintained to geometry standards well in excess of intervention limits. The incidence of track geometry caused derailments is much lower than in the past. The most prevalent remaining track related derailment causes, track buckles and broken rails, do not normally result in only a few axles derailing and being dragged for a significant distance. Guard rails are therefore not potentially useful in mitigating the effects of such derailments.

- *Increased wayside monitoring*

  Wayside monitoring detects bearing and other vehicle defects. Bearing failure is the principal cause of derailments which result in one or two derailed axles being dragged for long distances, including across bridges. Because of the introduction of wayside monitoring, the incidence of such derailments is reducing significantly.

- *Heavier wagons, faster trains*

  Historically, freight railways operated relatively light 4-wheel wagons at moderate speeds (50 – 60 km/h). Nowadays, axle loads are higher, and trains run at 80 – 100 km/h or more. The ability of guard rails to guide derailed wheels travelling at such speeds is questionable (see section 5 below).

  A derailed axle travelling at 100 km/h would be required to negotiate the tapered nose portion of a guard rail in 0.13 seconds.

5 Other Considerations

Are guard rails effective?

Standards and policies for the provision of guard rails implicitly assume that they will perform their intended function when required. This is somewhat doubtful – refer Figures 2 and 3.

Figure 2 – Guard rails had no effect on behaviour of a derailed bogie [10]

Figure 3 – Guard rails failed to protect through truss span [11]

[10] 933 km North Coast line, February 2002.
[11] Ngaruawahia, NZ, July 1974.

Derailed axles tend to track along a consistent path, including across both transom top and ballast top bridges, until encountering some obstacle such as a turnout or road crossing. More severe consequences can then ensue. A guard rail, as an obstacle, could in itself cause rather than prevent a pile-up at a bridge. It is arguably preferable to keep a derailed wheel tracking along an unobstructed path.

Another aspect is that when a derailment is due to a bearing failure, with the axle severed, the wheelset often twists so that both the flange and the outer edge of the tread of one wheel are riding on the sleepers. In such situations, a guard rail at standard spacing from the running rail could hinder the passage of such a derailed wheel across a bridge, as shown in Figure 4.

Figure 4 – A guard rail, if provided, could have hindered the passage of a twisted wheelset across this bridge [12]

On concrete sleepered track, it is arguably desirable that a derailed wheel track towards the centre of the sleeper, rather than immediately adjacent to the running rail. This avoids potential damage to fastenings and to the rail foot. In addition, there is often a covering of ballast over the depressed central portion of a concrete sleeper, which lessens impact damage.

[12] Kingoonya, November 1998.

Overall, there is a lack of specific examples of situations where guard rails can be shown to have actually lessened the potential consequences of a derailment. The cost-effectiveness of guard rails is doubtful.

Guard rails have some disadvantages

Some disadvantages of guard rails include:

- Maintenance tends to be of low priority, lessening potential effectiveness – refer Figure 5;
- The work involved in providing and maintaining guard rails could be redirected to more productive activities (or expenditure reduced);
- Guard rails hinder tamping at bridge ends, an area which requires additional attention due to the change in track modulus (albeit that they do provide some extra rigidity over the interface area);
- Guard rails present a trip hazard for personnel walking on the track; and
- Concrete sleepers specially manufactured to accommodate guard rails are expensive, particularly those required for the tapered ends.

Figure 5 – ARTC guard rail with fastenings, joints and rail length non-compliant with standards specified in BDS 05

The present ARTC NSW standard contains an apparent anomaly

It is not clear why guard rails should be provided on only those ballast top bridges with any individual span exceeding 20 metres in length.[13] The length of an individual span is irrelevant to the behaviour of a derailed axle approaching and traversing a bridge.

[13] BDS 05 clause 4.

Non-standard configurations are provided at some locations

Such arrangements may lessen the effectiveness or negate the function of the guard rail – refer Figures 6, 7 and 8

Figure 6

Figure 7

Figure 8

Non-standard guard rail configurations

6 Policy Issues

The use of guard rails should not be extended

At present, guard rails on the ARTC network are generally provided only on transom top bridges in NSW.

Nothing has been identified to suggest that the provision of guard rails on ballast top bridges, or on transom top bridges outside NSW, would reduce ARTC's costs or significantly improve ARTC's risk profile. For example, Figure 9 shows the consequences of a typical derailment across a ballast top bridge without guard rails – minor damage to the sidewalls.

Figure 9 – Consequences of a derailment across a ballast top bridge [14]

[14] Hesso, September 2003.

Guard rails should generally not be provided

It is proposed that guard rails generally not be provided, because of their doubtful effectiveness, and the costs of maintenance.

This approach is consistent with a philosophy of focussing resources on the prevention of derailments, rather than attempting to lessen the consequential effects of such incidents.

The prevention of derailments is a primary objective of AK car track geometry recording and analysis, ultrasonic rail flaw detection, and wayside monitoring of rolling stock. Significant resources are rightly being applied to these activities.

In special situations, a risk assessment should be carried out

Factors which may warrant a special risk assessment for potential provision of guard rails include:

- A very high bridge (risk of costly damage, e.g. pier collapse);
- Bridges crossing sensitive areas such as a busy road, or a location where people congregate (risk of injury to the public);
- Adverse track alignment and configuration (risk of derailment); or
- Very high traffic density (risk of operational disruption).

The new criteria should not be applied retrospectively

It is not intended that the new criteria should be applied retrospectively. Existing guard rails should remain until expenditure is required for their upkeep.

7 Impacts

ARTC costs will reduce

If the proposed policy is adopted, ARTC's costs associated with the provision and maintenance of guard rails will largely be eliminated. However, the impact on recurrent budgets will be modest.

The main cost savings will be in two areas:

- Eliminating the need to temporarily remove portions of guard rails when tamping bridge ends; and
- Avoiding having to reinstate guard rails on transom top bridges following transom renewal.

These savings will principally occur in NSW, where most transom top bridges are fitted with guard rails.

Based on the doubtful effectiveness of the tapered end sections, it is considered acceptable for these to not be replaced when removed for tamping, even though removal of the remainder of the guard rail may not occur for some time. This would enable cost savings to be realised promptly.

Operational impacts will be minimal

There will be no significant operational impacts resulting from the proposal. The likelihood of the effects of a derailment being greater because the vehicles involved crossed a transom top bridge in NSW which was previously fitted with guard rails is considered very low.

8 Summary

Current provision of guard rails is inconsistent

ARTC Standard BDS 05 requires guard rails on most transom top bridges in NSW.

There are few guard rails elsewhere on the ARTC network.

The nature of railway operations is changing

The number of main line derailments resulting in derailed wagons being dragged for significant distances is reducing.

Trains are heavier and faster, lessening the ability of the tapered sections of guard rails to function as intended.

There are few, if any instances where it can be shown that a guard rail has performed effectively in reducing the consequential damage after a derailment.

9 Statement of Recommended Policies

When renewal of transoms on a bridge is being planned:

1 If the maximum height of the bridge exceeds 10 metres, the Corridor Manager shall arrange a risk assessment in accordance with ARTC Safety Procedure SP-03-00: Rail Safety Risk Management Process, to assess if guard rails should be provided. Manager Standards and Systems shall be consulted during the risk assessment.

2 If the bridge crosses a busy road, or an area where the public regularly congregates, the Corridor Manager shall arrange a risk assessment in accordance with ARTC Safety Procedure SP-03-00: Rail Safety Risk Management Process to assess if guard rails should be provided. Manager Standards and Systems shall be consulted during the risk assessment.

3 Other guard rail installations may be removed when the transoms are renewed.

4 Existing guard rails required under this policy shall be upgraded to current design standards concurrently with renewal of transoms.

Corridor Managers and Manager Standards and Systems may jointly determine that guard rails be provided on other bridges

Justification for such installations shall be supported by the need to mitigate unacceptable risks assessed in accordance with ARTC Safety Procedure SP-03-00 Rail Safety Risk Management Process.

Tapered end sections of guard rails can be removed early

When the tapered end sections of guard rails are removed to facilitate tamping the sleepers at bridge ends (or for other maintenance work), they need not be reinstated on those bridges where guard rails are authorised to eventually be removed.

Tailpiece

Could the tapered portion of this guard rail adequately guide a derailed wheelset travelling at 80 km/h?