19 November 2024

Michael Irons
Property Manager Wagga
Australian Rail Track Corporation
PO Box 2150
Wagga Wagga NSW 2650

Request LW S4A-01 - Request for Change to Subsidence Management 98.74 km to 101.16 km

Dear Michael,

The Rail Management Group has advised that a minor change can be made to the methods of subsidence management as described in Section 1.12 and 5.4 of the Management Plan, which is titled *MSEC1201 SIMEC Mining – Tahmoor Coal Management Plan for extraction of LW S1A-S6A beneath the Main Southern Railway, Revision C*.

Tahmoor Coal has shortened LW S4A by approximately 104 metres at the commencing end, as shown in Drawing No. MSEC1446-01. While the predicted maximum subsidence movements due to the modified LW S4A is unchanged compared to the original layout, the extent of subsidence along the railway is slightly reduced at the southern end, as shown in Drawing No. MSEC1446-07.

The Management Plan documents the commencement of monitoring measures for LW S4A, most of which are defined based on a length of extraction. As LW S4A has been shortened at the commencing end, the lengths of extraction requires a change in the commencement of monitoring measures.

Based on the above, the Rail Management Group has reviewed the risk control procedures in Table A.1 of the Management Plan with respect to LW S4A. Please also see attached revised Drawings Nos. MSEC1201-02-4A and MSEC1201-04-4A.

In addition to the above, the Rail Management Group has also reviewed the designed layout of the Track Expansion System and recommends a minor change. It is proposed to lengthen the distances between the expansion switches and anchor points in Zones 6 and 7 as summarised in the Revised Table 3.3 of the Management Plan.

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MEMBER OF GFG ALLIANCE

Revised Table 3.3 Locations of Anchor Points and Expansion Switches
(amended for LW S4A in blue)

Zone	Anchor Point Locations		Zone Length	Expansion Switch Location	LW S1A	LW S2A	LW S3A	LW S4A	LW S5A	LW S6A
	City	Country								
1	98.020	98.380	360 m	98.200	✓					
2	98.380	98.740	360 m	98.560	✓	✓				
3	98.740	99.100	360 m	98.920	✓	✓	✓			
4	99.100	99.460	360 m	99.280	✓	✓	✓	✓		
5	99.460	99.780	320 m	99.590		✓	✓	✓	✓	
6	99.780	100.200 ~~100.140~~	420 m ~~360~~ m	99.960			✓	✓	✓	✓
7	100.200 ~~100.140~~	100.690 ~~100.500~~	490 m ~~360 m~~	100.450 ~~100.320~~				✓	✓	✓
8	100.500	100.860	360 m	100.680					✓	✓

Please refer to an accompanying report by rail engineer Pidgeon Civil Engineering (PCE, 2024) in support of the proposed change. As discussed in the report, the Rail Management Group has previously successfully operated the Track Expansion System with lengths of free rail at 240 metres.

As shown in the Revised Table 3.3, the effect of the change is to manage potential adverse changes in rail stress due to the extraction of LW S4A over a longer length of section of track under the Track Expansion System compared to the original plan.

It can also be seen from Revised Table 3.3 that Zone 8 has been coloured grey. The Rail Management Group plans to review observations during the extraction of LW S4A before deciding whether potential adverse changes in rail stresses due to the extraction of LWs S5A and S6A can be effectively managed without installing Zone 8. Tahmoor Coal may make a separate request to ARTC prior to the commencement of LW S5A following the outcome of this review.

We seek ARTC agreement of the proposed changes.

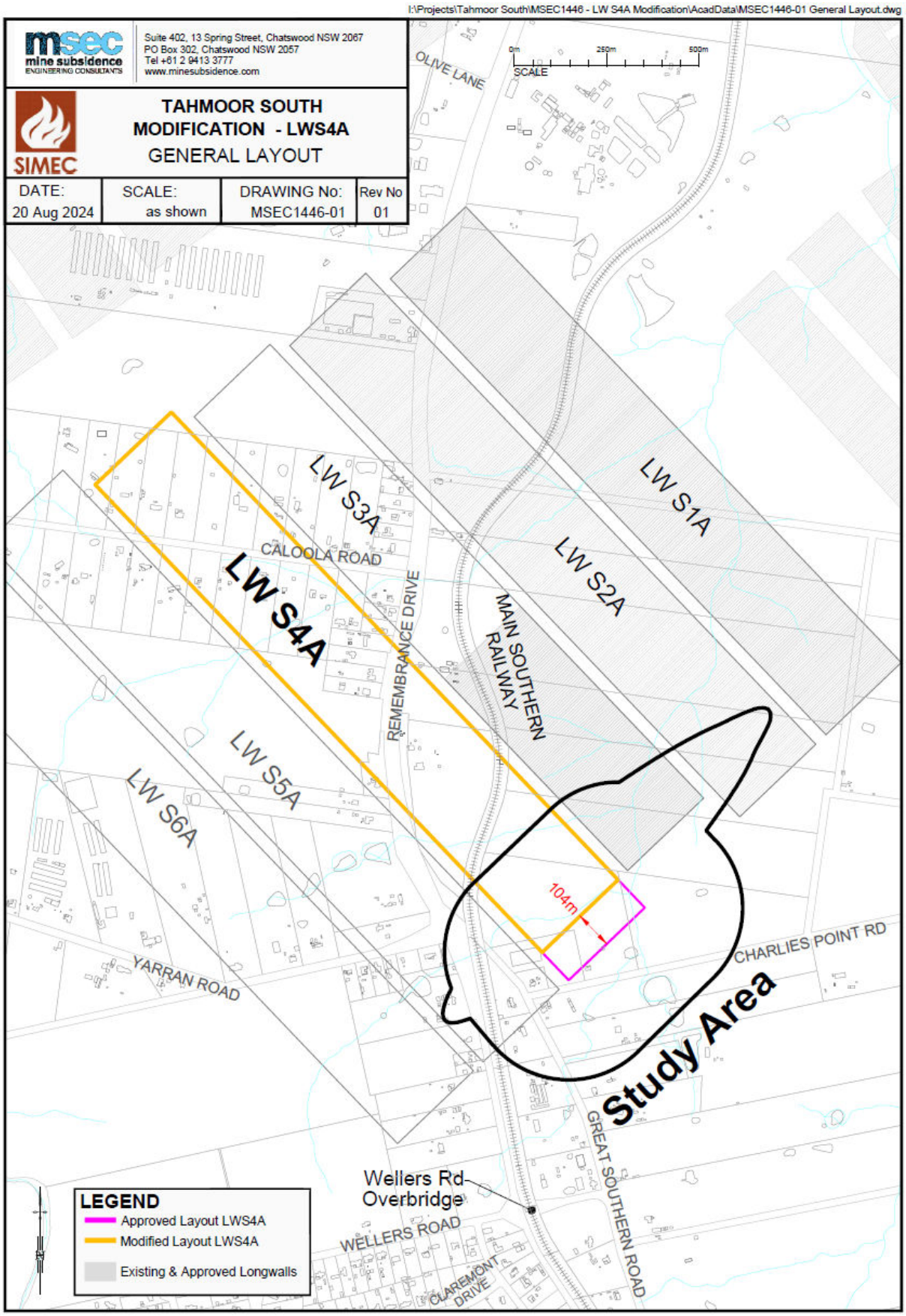
Yours Faithfully

Ross Barber

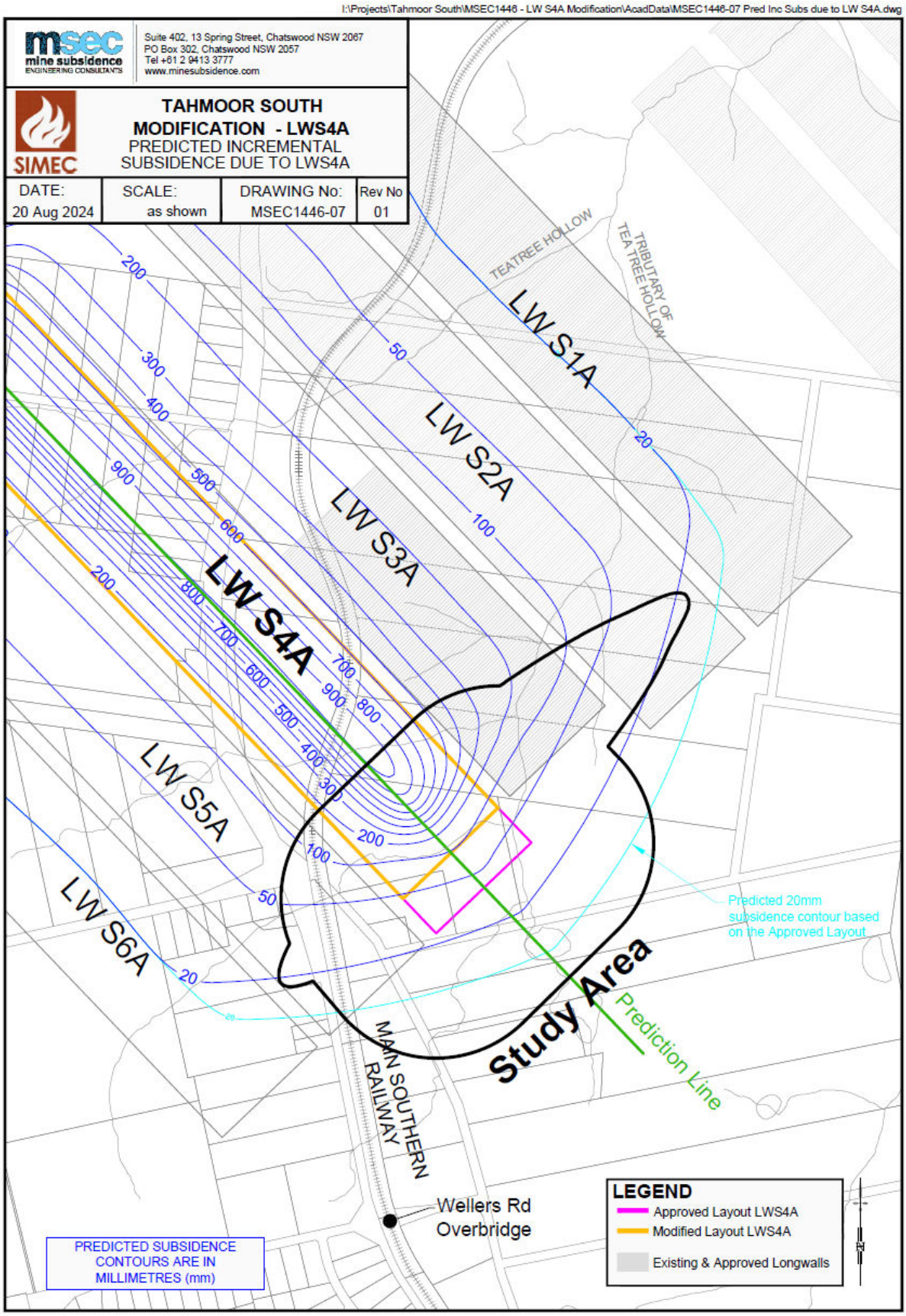
Ross Barber
Project Manager Rail
SIMEC Mining

CC Ian Cochran, Technical Panel Structures Specialist, ONRSR
Ray Ramage, Principal Subsidence Engineer, Resource Regulator

Encl
Amended Table A.1 – Risk Control Procedures (Amended for LW S4A)
Drawing No. MSEC1201-02-4A, Revision D, 13 November 2024
Drawing No. MSEC1201-04-4A, Revision D, 13 November 2024
PCE (2024) *LW S4A Track Report – Review of Bay Lengths ES6 and ES7*, Pidgeon Civil Engineering, R1, 13 November 2024.



Drawing No. MSEC1446-01



Drawing No. MSEC1446-07

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

GENERAL TRIGGER LEVELS

Trigger Level	Description
GREEN	Observations within operating tolerance. Operate as normal.
BLUE	Observations within operating tolerance but nearing limits. Investigate cause. Some action may be required to prevent operating restrictions. Immediately inspect site unless it is obvious that the cause of the trigger cannot be due to physical damage to rail infrastructure. Otherwise inspect within 24 hours. Return status to Green level.
YELLOW	Restrictions on operations. Immediate site inspection. Action required within 6 hours. Appropriate speed restriction may apply until altered to Green or Blue Level.
RED	Stop trains, inspect prior to next train, repair to lower category, pilot trains if safe.

ABBREVIATIONS WITHIN THESE TABLES:

ARTC = Australian Rail Track Corporation
MSO = NSW Department of Planning & Environment, Resources Regulator, Mine Safety Operations
ONRSR = Office of the National Rail Safety Regulator
Globetech = Automated Monitoring Contractor
SRS = Southern Rail Surveys (ground surveys within rail corridor)
SA NSW = Subsidence Advisory NSW
MSEC = Mine Subsidence Engineering Consultants
RMG = Rail Management Group
RMC = Rail Maintenance Contractor
RRG = Rail Response Group
RSRG = Rail Structures Response Group
PCE = Pidgeon Civil Engineering
JMA = JMA Solutions (structural engineer)
SMEC = SMEC (ground surveys beyond rail corridor)
TC = Tahmoor Coal

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
General Procedures				
	GREEN	**EARLY WARNING MONITORING**		
		Continuous GNSS monitoring for S1 to S15 as shown in Drawing No. MSEC1201-03	GNSS units S1 to S15 installed Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S6A.	Tahmoor Coal (Unit Zero)
		Continuous GNSS monitoring at 100.70 km	Install prior to start of LW S4A Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S6A.	Tahmoor Coal (Unit Zero)
		2D survey line along Tahmoor Mine property boundary	Pegs installed. Baseline survey prior to commencement of LW S1A. Monthly survey during LW S1A between 200m and 1300m extraction, and continue if ongoing adverse movements are observed. End of LW S1A.	Tahmoor Coal (SMEC)
		RAILWAY TRACK		
		3D ground survey along rail corridor *Extents for 3D surveys:* *LW S1A: 99.80km to 98.74km (AP2) and then extend to the north to include pegs that are at least 400 metres in front of the LW face, up to 97.70 km. (End of LW from 97.70 km to 99.80km)* LW S2A: *100.20km to 99.46km (AP4) and then extend to the north to include pegs that are at least 400 metres in front of the LW face, up to 98.18 km. (End of LW from 100.20km to 97.70km)* LW S3A: *100.60km to 99.78km (AP5) and then extend to the north to include pegs that are at least 400 metres in front of the LW face, up to 98.38 km. (End of LW from 100.60km to 98.20km)* LW S4A: *101.16km to 100.14km (AP6) and then extend to the north to include pegs that are at least 400 metres in front of the LW face, up to 98.74 km. (End of LW from 100.90km to 98.38km)* *(no change to extent)* LW S5A: *101.16km to 100.14km (AP6) and then extend to the north to include pegs that are at least 400 metres in front of the LW face, up to 99.10 km. (End of LW from 101.16km to 98.92km)* LW S6A: *101.16km to 100.14km (AP6) and then extend to the north to include pegs that are at least 400 metres in front of the LW face, up to 99.46 km. (End of LW from 101.16km to 99.28km)*	Pegs installed initially from 97.7 km to 99.8 km for LW S1A Extend line and baseline survey pegs prior to start of each LW or active LW face approaching within 600 metres of survey line. Monthly 3D surveys commencing as per below (Stage 1): LW S1A: start after 700m extraction LW S2A: start after 550m extraction LW S3A: start after 200m extraction LW S4A: at LW start LW S5A: at LW start LW S6A: at LW start End of LW S1A-S6A.	SRS
		Focussed 2D ground survey along rail corridor *Extents for focussed 2D surveys:* *LW S1A: 99.80km to 98.74km (AP2) and then extend to the north to include pegs that are at least 200 metres in front of the LW face, up to 97.70 km. (End of LW from 97.70 km to 99.80km)* LW S2A: *100.20km to 99.46km (AP4) and then extend to the north to include pegs that are at least 200 metres in front of the LW face, up to 98.18 km. (End of LW from 100.20km to 97.70km)* LW S3A: *100.60km to 99.78km (AP5) and then extend to the north to include pegs that are at least 200 metres in front of the LW face, up to 98.38 km. (End of LW from 100.60km to 98.20km)* LW S4A: *101.16km to 100.14km (AP6) and then extend to the north to include pegs that are at least 200 metres in front of the LW face, up to 98.74 km. (End of LW from 100.90km to 98.38km)* *(no change to extent)* LW S5A: *101.16km to 100.14km (AP6) and then extend to the north to include pegs that are at least 200 metres in front of the LW face, up to 99.10 km. (End of LW from 101.16km to 98.92km)* LW S6A: *101.16km to 100.14km (AP6) and then extend to the north to include pegs that are at least 200 metres in front of the LW face, up to 99.46 km. (End of LW from 101.16km to 99.28km)*	Pegs installed from initially from 97.7 km to 99.8 km for LW S1A Extend line and baseline survey pegs prior to start of each LW or active LW face approaching within 600 metres of survey line. Weekly 2D surveys commencing as per below (Stage 2): LW S1A: start after 900m extraction LW S2A: start after 750m extraction LW S3A: start after 400m extraction LW S4A: start after GNSS at 100.56km subsides more than 20mm after LW start or 200m extraction, whichever occurs first LW S5A: start after GNSS at 100.56km subsides more than 20mm after LW start or 200m extraction, whichever occurs first LW S6A: start after GNSS at 100.56km subsides more than 20mm after LW start or 200m extraction, whichever occurs first End of LW S1A-S6A.	SRS
		Rail creep surveys of expansion switches, anchor points and CWR track (include all track expansion system zones where ZTL clips have been installed)	Weekly after ZTL clips have been installed	SRS
		Long bay length ground surveys *Extents for long bay length ground surveys as per focussed 2D surveys*	Weekly as per focussed 2D surveys (Stage 2)	SRS
		Continuously monitor rail stress, rail temperature and switch displacement *Extents for active subsidence monitoring:* *LW S1A: 99.78km to 98.74km (AP2) and then extend to the north to include gauges that are at least 200 metres in front of the LW face, up to 97.78 km.* LW S2A: *100.14km to 99.46km (AP4) and then extend to the north to include gauges that are at least 200 metres in front of the LW face, up to 98.14 km.* LW S3A: *100.44km to 99.78km (AP5) and then extend to the north to include gauges that are at least 200 metres in front of the LW face, up to 98.38 km.* LW S4A: *101.10km to 100.14km (AP6) and then extend to the north to include gauges that are at least 200 metres in front of the LW face, up to 98.74 km.* *(no change to extent)* LW S5A: *101.10km to 100.14km (AP6) and then extend to the north to include gauges that are at least 200 metres in front of the LW face, up to 99.10 km.* LW S6A: *101.10km to 100.14km (AP6) and then extend to the north to include gauges that are at least 200 metres in front of the LW face, up to 99.46 km.*	Readings every 5 minutes Gauges installed from initially from 97.78 km to 99.78 km for LW S1A Extend and commission system as per timings in Drawings Nos. MSEC1201-04-1A to 6A. Alarmed as per below (Stage 2) LW S1A: start after 900m extraction LW S2A: start after 750m extraction LW S3A: start after 400m extraction LW S4A: at LW start LW S5A: at LW start LW S6A: at LW start	Globetech

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
		Continuously monitor rail stress and rail temperature to monitor residual subsidence effects *Residual subsidence monitoring = at least one working gauge every 120 m along each rail (extent may be reduced from the north based on future assessment)*	Every 5 minutes	Globetech
		Track geometry surveys using Amber track mounted device or equivalent *Extents for track geometry surveys as per focussed 2D surveys*	Weekly as per focussed 2D surveys (Stage 2)	RMC
		Track centre measurements at 98.620 km, 99.600 km and 101.200 km	Monthly when track is in Stage 2	SRS
		Track inspection by qualified track certifier. The inspection will check ARTC infrastructure within the rail corridor, including the track, track expansion system, integrity of monitoring systems, culverts, embankments, cuttings, signals and Loc's and fences *The extent of visual inspections is the same as the extent of track geometry surveys plus dormant expansion switches*	Twice weekly whilst expansion switches are in track Daily as per below (Stage 2) LW S1A: start after 900m extraction LW S2A: start after 750m extraction LW S3A: start after 400m extraction LW S4A: start after GNSS at 100.56km subsides more than 20mm after LW start or 200m extraction, whichever occurs first LW S5A: start after GNSS at 100.56km subsides more than 20mm after LW start or 200m extraction, whichever occurs first LW S6A: start after GNSS at 100.56km subsides more than 20mm after LW start or 200m extraction, whichever occurs first	RMC
		RAILWAY CULVERTS AND EMBANKMENTS		
		Absolute 3D and 2D surveys along monitoring line along the railway	Absolute 3D monthly and 2D weekly as described for railway track	SRS
		Absolute 3D surveys and relative 3D surveys along monitoring lines on the crests and/or toes of the embankments on both sides and at culvert inlets and outlets. The layout of survey marks are shown in Drawings Nos. MSEC1201-05 to 12. *Install Culvert and Embankment at 98.445 km prior to 600 metres of extraction of LW S1A* *Install Culvert and Embankment at 98.739 km prior to 600 metres of extraction of LW S1A* *Install Culvert and Embankment at 99.035 km prior to 600 metres of extraction of LW S1A* *Install Culvert and Embankment at 99.338 km prior to 600 metres of extraction of LW S1A* *Install Culvert and Embankment at 100.121 km prior to start of LW S3A* *Install Culvert and Embankment at 100.425 km prior to start of LW S3A* *Install Culvert and Embankment at 101.000 km prior to start of LW S5A*	Monthly when track above each culvert is in Stage 1 (for LW S4A: Culverts 99.035 km to 100.425 km) Weekly when track above each culvert is in Stage 2 (for LW S4A: Culverts 99.035 km to 100.425 km) End of LW S1A-S6A	SRS
		Automated, continuously operating horizontal extensometers (or equivalent) across the crests of the Embankments at 99.338 km, 100.121 km and 100.425 km *Install 99.338 km prior to 900 metres of extraction of LW S1A* *Install 100.121 km prior to start of LW S3A* *Install 100.425 km prior to start of LW S3A*	Every 15 minutes Operating as per timings in Drawings Nos. MSEC1201-04-1A to 6A. (for LW S4A: Culverts 99.338 km, 100.121 km and 100.425 km) Alarmed when track above each culvert is in Stage 2 (for LW S4A: Culverts 99.338 , 100.121 km and 100.425 km)	Globetech
		Inclinometer surveys of the Embankments at 99.338 km, 100.121 km and 100.425 km *Install 99.338 km prior to 600 metres of extraction of LW S1A* *Install 100.121 km prior to start of LW S3A* *Install 100.425 km prior to start of LW S3A*	Monthly when track above culvert is in Stage 1 and Stage 2 (for LW S4A: Culverts 99.338 km, 100.121 km and 100.425 km)	TC
		Automated, continuously operating water level sensors at culvert inlets to Embankments at 99.338 km, 100.121 km and 100.425 km *Install 99.338 km prior to 600 metres of extraction of LW S1A* *Install 100.121 km prior to start of LW S3A* *Install 100.425 km prior to start of LW S3A*	Every 15 minutes Operating as per timings in Drawings Nos. MSEC1201-04-1A to 6A. (for LW S4A: Culverts 99.338 km, 100.121 km and 100.425 km) Alarmed when track above culvert is in Stage 2 (for LW S4A: Culverts 99.338 , 100.121 km and 100.425 km)	Globetech
		Visual inspection of culverts and embankments by geotechnical engineer	Monthly when track above culvert is in Stage 1 (for LW S4A: Culverts 99.035 km to 100.425 km) Weekly when track above culvert is in Stage 2 (for LW S4A: Culverts 99.035 km to 100.425 km)	Newcastle Geotech

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
	GREEN	**CUTTINGS**		
		Absolute 3D and 2D surveys along monitoring line along the railway	Absolute 3D monthly and 2D weekly as described for railway track	SRS
		Absolute 3D surveys every 20 metres along the crests and/or toes of the cuttings *Install Cutting at 99.690 km prior to 450 metres of extraction of LW S2A* *Install Cutting at 100.700 km prior to start of LW S4A (no change)* *Install Cutting at 101.162 km prior to start of LW S5A*	Monthly when section of track is in Stage 1 Weekly when section of track is in Stage 2 End of LW S1A-S6A	SRS
		Visual inspection of cuttings by geotechnical engineer	Monthly when section of track is in Stage 1 Weekly when section of track is in Stage 2	Newcastle Geotech
		BRIDGES		
		Pre-mining inspection and structural assessment of Bridges	Complete	JMA
		Geological inspection and mapping at Railway Viaduct, Remembrance Drive Bridge over Bargo River and Bargo River Road Overbridge (Potter's Cutting)	Complete	Newcastle Geotech
		Review by Bridge Technical Committee and modify planned management and monitoring measures for Railway Viaduct, Remembrance Drive Bridge over Bargo River, Bargo River Road Overbridge (Potter's Cutting) and Wellers Road Overbridge and implement, if required	Prior to 800 m of extraction of LW S1A	Bridge Technical Committee / Tahmoor Coal
		Brief ARTC on planned management and monitoring measures for Railway Viaduct, Remembrance Drive Bridge over Bargo River, Bargo River Road Overbridge (Potter's Cutting) and Wellers Road Overbridge	Prior to 800 m of extraction of LW S1A	Tahmoor Coal
		Continuous GNSS monitoring for S11, S12 (Railway Viaduct) and S15 (Wellers Road Overbridge) as shown in Drawing No. MSEC1201-03	GNSS units installed Continuous readings, with data averaged over 24 hours and recorded once per day until end of LW S6A.	Tahmoor Coal (Unit Zero)
		Conduct Absolute 3D survey of structure and ground marks on the Railway Viaduct and Remembrance Drive Bridge over Bargo River as per Drawing No. MSEC1201-13	Install and baseline survey prior to LW S1A. Monthly after 1000m extraction of LWs S1A and S2A Monthly after 900m extraction for LW S3A End of LW S1A-S3A.	Tahmoor Coal (SRS)
		Precision 2D survey of closure between ground marks located in stable ground at both ends of the Railway Viaduct and Remembrance Drive Bridge over Bargo River	Install and baseline survey prior to LW S1A. Monthly after 1000m extraction of LWs S1A and S2A Monthly after 900m extraction for LW S3A End of LW S1A-S3A.	SRS
		Baseline detailed visual inspections of Railway Viaduct by UAV	Complete	TC
		Baseline laser scan of Railway Viaduct and Remembrance Drive Bridge over Bargo River	Complete	TC
		Monitoring of existing cracks with crack gauges on Railway Viaduct *Installation is targeted to be completed by 1000 m of extraction of LW S1A. Installation of some gauges may be delayed until rope access is available during an ARTC track possession.*	Install and baseline measure prior to 1000 m of extraction of LW S1A.	TC
		Measure gap between deck and northern abutment of Remembrance Drive Bridge over Bargo River	Install and baseline survey prior to LW S1A. Monthly after 1000m extraction of LWs S1A and S2A Monthly after 900m extraction for LW S3A End of LW S1A-S3A.	Tahmoor Coal (SRS)
		Conduct Local 3D survey of structure and ground marks on the Bargo River Road Overbridge (Potter's Cutting) as per Drawing No. MSEC1201-14, with one mark on the Bridge to be surveyed in Absolute 3D	Install and baseline survey prior to LW S1A.	Tahmoor Coal (SRS)
		Monitoring of existing cracks with crack gauges on Bargo River Road Overbridge (Potter's Cutting)	Install and baseline measure prior to 1000 m of extraction of LW S1A. Monthly after 1000m extraction of LWs S1A and S2A Monthly after 900m extraction for LW S3A End of LW S1A-S3A.	TC

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
General Procedures (continued)				
	GREEN	**BRIDGES (continued)**		
		Conduct Local 3D survey of structure and ground marks on the Wellers Road Overbridge as per Drawing No. MSEC1201-15	Install and baseline survey prior to LW S1A. Monthly after 200m extraction of LWs S4A to S6A End of LW S1A-S6A.	Tahmoor Coal (SRS)
		Monitoring of existing cracks with crack gauges on Wellers Road Overbridge	Install and baseline survey prior to LW S4A. Monthly after 200m extraction of LWs S4A to S6A End of LW S1A-S6A.	TC
		COAL CONVEYOR CROSSING		
		Survey horizontal distance between conveyor trestles on either side of Railway	Baseline survey prior to 700 m of extraction of LW S1A Weekly surveys after 1100 m of extraction of LW S1A and LW S2A End of LW S1A and S2A	SRS
		Automated, continuously operating laser distancemeter between conveyor trestles on either side of Railway	Installed Hourly	SweetingConsulting
		Visual inspections of conveyor crossing	Daily when track is in Stage 2	RMC
		OTHER MEASURES		
		Undertake investigations as required to assist in identifying potential locations of non-conventional movement. Reconsider management measures in light of new information that becomes available.	Ongoing	RMG
		Dilapidation inspections	Complete	Various
		Standard ARTC maintenance and control procedures - Twice weekly track patrol - AK track recording car - Base Operating Standards Mandatory Responses - Driver reports and temporary speedboards - Signalling and Communications procedures - Ultrasonic rail test (high rail)	As per ARTC procedures	ARTC
		Follow Railway Maintenance Plan including - quarterly manual non-destructive testing of expansion switches - switch inspections and maintenance - clip inspections and maintenance Refer Section 5.8 for details	As per Railway Maintenance Plan	RMC
		Brief and train: - Tahmoor Coal Control Room operators - Relevant ARTC staff Refer Section 5.8 for details	Prior to 900 m of extraction of LW S1A Brief and train new personnel as req'd	Robinson Rail
		Check and Audit maintenance and monitoring system performance	Periodically as determined by RMG	RMG
		Analyse and report results to RMG (no change for LW S4A)	Monthly when section of track is in Stage 1 Weekly when section of track is in Stage 2	Section 6.5
		RMG discuss results and consider whether any additional management measures are required (no change for LW S4A)	Monthly when section of track is in Stage 1 Weekly when section of track is in Stage 2 or as required by RMG	RMG
		RMG discuss progress with MSO and ONRSR	As required	RMG

Note: Unless specified above, each control procedure will continue until such time that the criteria for Stage 3 (post-active subsidence period) are met, as described in Section 5.4: The RMG may extend the monitoring period beyond the timing and frequency described based on assessment of actual monitoring data.

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

<table>
<tr><th>RISK ISSUE</th><th>TRIGGER</th><th>CONTROL PROCEDURES</th><th>TIMING & FREQ</th><th>BY WHOM?</th></tr>
<tr><td rowspan="11">Track Geometry exceeds ARTC National Code of Practice, leading to:
Unplanned maintenance response
Temporary speed restrictions
Track closure
Derailment
TRACK GEOMETRY TRIGGERS<table><tr><th>Units in mm</th><th>Difference from Design Cant</th><th>Twist</th><th>Top Mid-ordinate Vertical Deviation from Design Offset</th><th>Alignment Mid-ordinate Horizontal Deviation from Design Offset in a 10m Chord</th></tr><tr><td>GREEN</td><td><u>Tangents & R>2000m</u>
0 to < 40
<u>R < 2000m</u>
0 to < 14</td><td><u>2m Chord</u>
0 to < 16
<u>14m Chord</u>
0 to < 40</td><td><u>6m Chord</u>
0 to < 26
<u>20m Chord</u>
<u>Inertial</u>
0 to < 28
<u>Krab</u>
0 to < 39</td><td>0 to < 24</td></tr><tr><td>BLUE</td><td><u>Tangents & R>2000m</u>
≥ 40 to < 50
<u>R < 2000m (insufficient cant)</u>
≥ 14 to < 20
<u>R < 2000m (excess cant)</u>
≥ 14 to < 50</td><td><u>2m Chord</u>
≥ 16 to < 18
<u>14m Chord</u>
≥ 40 to < 46</td><td><u>6m Chord</u>
≥ 26 to < 29
<u>20m Chord</u>
<u>Inertial</u>
≥ 28 to < 32
<u>Krab</u>
≥ 39 to < 44</td><td>≥ 24 to < 34</td></tr><tr><td>YELLOW</td><td><u>Tangents & R>2000m</u>
≥ 50 to < 75
<u>R < 2000m (insufficient cant)</u>
≥ 20 to < 40
<u>R < 2000m (excess cant)</u>
≥ 50 to < 75</td><td><u>2m Chord</u>
≥ 18 to < 20
<u>14m Chord</u>
≥ 46 to < 52</td><td><u>6m Chord</u>
≥ 29 to < 32
<u>20m Chord</u>
<u>Inertial</u>
≥ 32 to < 35
<u>Krab</u>
≥ 44 to < 49</td><td>≥ 34 to < 44</td></tr><tr><td>RED</td><td><u>Tangents & R>2000m</u>
≥ 75
<u>R < 2000m (insufficient cant)</u>
≥ 40
<u>R < 2000m (excess cant)</u>
≥ 75</td><td><u>2m Chord</u>
≥ 20
<u>14m Chord</u>
≥ 52</td><td><u>6m Chord</u>
≥ 32
<u>20m Chord</u>
<u>Inertial</u>
≥ 35
<u>Krab</u>
≥ 49</td><td>≥ 44</td></tr></table></td><td>GREEN</td><td>Follow general procedures (including track geometry monitoring)</td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">BLUE</td><td>Contact RRG and arrange teleconference</td><td>Within 15 minutes of determining exceedence of trigger level</td><td>Section 6.2 and Section 6.3</td></tr>
<tr><td>RRG undertake following action(s):
- investigate cause
- assess monitoring data for trends and forecast if and/or when the YELLOW and RED trigger levels might be exceeded
- consider whether to increase survey and/or inspection frequencies
- consider whether to resurface the track
- consider whether any other additional management measures are req’d</td><td>RRG meet via teleconference within 15 minutes of notification of exceedence of trigger level</td><td>RRG</td></tr>
<tr><td>Inspect track at trigger point for visual signs of impact unless RRG is confident that cause of trigger cannot be due to physical damage to the railway
Remain on site until status returns to GREEN level</td><td>Immediately following assessment of RRG via teleconference and arrive within 2 hours, if req’d
Otherwise within 24 hours</td><td>RMC</td></tr>
<tr><td rowspan="5">YELLOW</td><td>Report details of exceedence of trigger level and actions undertaken</td><td>Within one week</td><td>PCE</td></tr>
<tr><td>Contact RRG and arrange teleconference</td><td>Within 15 minutes of determining exceedence of trigger level</td><td>Section 6.2 and Section 6.3</td></tr>
<tr><td>Contact Train Control & introduce track speed of 20km/h. Inspect track at trigger point.</td><td>Immediately</td><td>RMC</td></tr>
<tr><td>RRG undertake following action(s):
- investigate cause and assess monitoring data for trends and forecast if and/or when the RED trigger level might be exceeded
- decide whether to increase survey and/or inspection frequencies
- decide whether to resurface the track
- decide whether any other additional management measures are req’d
- decide whether to introduce speed restrictions
- consider whether to slow or stop mining if impact to rail operations is unacceptable to ARTC</td><td>RRG meet via teleconference within 15 minutes of notification of exceedence of trigger level</td><td>RRG</td></tr>
<tr><td>Report exceedence of trigger level & RRG decisions to RMG, ARTC, MSO, ONRSR and SA NSW</td><td>Within 24 hours if the alarm is real</td><td>TC</td></tr>
<tr><td rowspan="6">RED</td><td>Report details of exceedence of trigger level and actions undertaken</td><td>Within one week</td><td>PCE</td></tr>
<tr><td>Contact RRG and arrange teleconference</td><td>Within 15 minutes of determining exceedence of trigger level</td><td>Section 6.2 and Section 6.3</td></tr>
<tr><td>Stop trains and implement mandatory responses as required. Inspect track at trigger point.</td><td>Immediately</td><td>RMC</td></tr>
<tr><td>RRG undertake following action(s):
- investigate cause
- decide whether to resurface the track
- decide whether any other additional management measures are req’d
- decide whether to introduce speed restrictions
- consider whether to recommend to TC senior management to slow or stop mining if impact to rail operations is unacceptable to ARTC</td><td>RRG meet via teleconference within 15 minutes of notification of exceedence of trigger level</td><td>RRG</td></tr>
<tr><td>Report exceedence of trigger level & RRG decisions to RMG, ARTC, MSO, ONRSR and SA NSW.</td><td>Within 24 hours if the alarm is real</td><td>TC</td></tr>
<tr><td>Report details of exceedence of trigger level and actions undertaken</td><td>Within one week</td><td>PCE</td></tr>
</table>

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

<table>
<tr><th>RISK ISSUE</th><th>TRIGGER</th><th>CONTROL PROCEDURES</th><th>TIMING & FREQ</th><th>BY WHOM?</th></tr>
<tr><td rowspan="15">Mining induced ground movements causes excessive compressive stress resulting in either misalignment of track, broken rail or curve pull-in potentially leading to:
Unplanned maintenance response
Temporary speed restrictions
Track closure
Side swipe
Derailment
This risk issue applies to standard CWR track or track with expansion switches and zero toe load clips

or

Zero-toe load clips jam resulting in increase in rail stress potentially leading to:
Unplanned intervention on track
‘
RAIL STRESS TRIGGERS<table><tr><th></th><th colspan="2">Tension</th><th colspan="2">Compression</th></tr><tr><th></th><th>Rail Stress in CWR</th><th>Rail Stress in Free Rail</th><th>Rail Stress in CWR</th><th>Rail Stress in Free Rail</th></tr><tr><th>Units</th><th>MPa</th><th>MPa</th><th>MPa</th><th>MPa</th></tr><tr><td>GREEN</td><td>0 to <114.2</td><td>0 to < 46.4</td><td>0 to > -83.3</td><td>0 to > -46.4</td></tr><tr><td>BLUE</td><td>≥ 114.2 to < 123.8</td><td>≥ 46.4 to < 123.8</td><td>≤ -83.3 to > -92.8</td><td>≤ -46.4 to > -92.8</td></tr><tr><td>YELLOW</td><td>≥ 123.8 to < 128.5</td><td>≥ 123.8 to < 128.5</td><td>≤ -92.8 to > -97.6</td><td>≤ -92.8 to > -97.6</td></tr><tr><td>RED</td><td>≥ 128.5</td><td>≥ 128.5</td><td>≤ -97.6</td><td>≤ -97.6</td></tr></table>Note: Blue trigger levels transition between CWR and Free Rail sections, as recommended by the RMG.</td><td>GREEN</td><td>Follow general procedures (including rail stress, rail creep and switch displacement monitoring)</td><td>-</td><td>-</td></tr>
<tr><td>Install, operate and monitor track expansion system (Note that CWR track will be managed until the track expansion system is installed).</td><td>Switches ES1 to ES4 installed for LW S1A.
Install ES5 to ES8 as required in Revised Table 3.3.
Install ZTL clips prior to longwall face approaching within 400 m of each switch after monitoring system is commissioned
(for LW S4A, ZTL clips installed for ES4, ES5 and ES6. ES7 and ZTL clips will be installed prior to start of LW S4A)</td><td>RMC</td></tr>
<tr><td rowspan="5">BLUE</td><td>Automatically notify RRG as per Alarm Notification Protocol</td><td>Within 15 minutes</td><td>Section 6.2</td></tr>
<tr><td>Immediately inspect track at trigger point for visual signs of impact if on site at time of alarm</td><td>Within 15 minutes</td><td>RMC</td></tr>
<tr><td>RRG undertake following action(s):
- investigate cause
- assess monitoring data for trends and forecast if and/or when the YELLOW and RED trigger levels might be exceeded
- consider whether to increase survey and/or inspection frequencies
- consider whether to adjust the track or expansion switches
- consider whether any other additional management measures are req’d</td><td>RRG meet via teleconference within 15 minutes of alarm notification</td><td>RRG</td></tr>
<tr><td>Inspect track at trigger point for visual signs of impact unless RRG is confident that cause of trigger cannot be due to physical damage to the railway
Remain on site until status returns to GREEN level</td><td>Immediately following assessment of RRG via teleconference and arrive within 2 hours, if req’d
Otherwise within 24 hours</td><td>RMC</td></tr>
<tr><td>Report details of alarm and actions undertaken</td><td>Within one week</td><td>PCE</td></tr>
<tr><td rowspan="5">YELLOW</td><td>Automatically notify RRG as per Alarm Notification Protocol</td><td>Within 15 minutes</td><td>Section 6.2</td></tr>
<tr><td>Contact Train Control & introduce track speed of 20km/h. Inspect track at trigger point.</td><td>Immediately</td><td>RMC</td></tr>
<tr><td>RRG undertake following action(s):
- contact Train Control & introduce track speed of 20km/h if Track Certifier is not on site unless RRG is confident the cause of trigger cannot be due to physical damage to the railway within 5 minutes of alarm notification
- investigate cause and assess monitoring data for trends and forecast if and/or when the RED trigger level might be exceeded
- decide whether to increase survey and/or inspection frequencies
- decide whether to adjust the track or expansion switches
- decide whether any other additional management measures are req’d
- decide whether to introduce speed restrictions
- consider whether to slow or stop mining if impact to rail operations is unacceptable to ARTC</td><td>RRG meet via teleconference within 15 minutes of alarm notification</td><td>RRG</td></tr>
<tr><td>Report exceedence of trigger level & RRG decisions to RMG, ARTC, MSO, ONRSR and SA NSW</td><td>Within 24 hours if the alarm is real</td><td>TC</td></tr>
<tr><td>Report details of alarm and actions undertaken</td><td>Within one week</td><td>PCE</td></tr>
<tr><td rowspan="5">RED</td><td>Automatically notify RRG as per Alarm Notification Protocol</td><td>Within 15 minutes</td><td>Section 6.2</td></tr>
<tr><td>Stop trains and implement mandatory responses as required unless RRG is confident the cause of trigger cannot be due to physical damage to the railway within 5 minutes of alarm notification. Inspect track at trigger point.</td><td>Immediately</td><td>RMC</td></tr>
<tr><td>RRG undertake following action(s):
- investigate cause
- advise ARTC Area Manager Ingleburn that trains can proceed under caution at 20km/h prior to Track Certifier arriving on site if confident that cause of trigger cannot be due to physical damage to the railway
- decide whether to adjust the track or expansion switches
- decide whether any other additional management measures are req’d
- decide whether to introduce speed restrictions
- consider whether to recommend to TC senior management to slow or stop mining if impact to rail operations is unacceptable to ARTC</td><td>RRG meet via teleconference within 15 minutes of alarm notification</td><td>RRG</td></tr>
<tr><td>Report exceedence of trigger level & RRG decisions to RMG, ARTC, MSO, ONRSR and SA NSW</td><td>Within 24 hours if the alarm is real</td><td>TC</td></tr>
<tr><td>Report details of alarm and actions undertaken</td><td>Within one week</td><td>PCE</td></tr>
</table>

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

<table>
<tr><th>RISK ISSUE</th><th>TRIGGER</th><th>CONTROL PROCEDURES</th><th>TIMING & FREQ</th><th>BY WHOM?</th></tr>
<tr><td rowspan="6">Switch fails potentially leading to:
Unplanned maintenance response
Speed restrictions
Track closure
Derailment
or
Switch exceeds operational limits due to excessive differential subsidence movements potentially leading to:
Intervention on track
Speed restrictions
TYPE 5 EXPANSION SWITCH DISPLACEMENT TRIGGERS
(TYPE APPROVAL 15/34296)<table><tr><th></th><th>Switch Opening</th><th>Switch Closure</th></tr><tr><td>Units</td><td>mm</td><td>mm</td></tr><tr><td>GREEN</td><td colspan="2">Centre ± 135</td></tr><tr><td>BLUE</td><td>Centre ≤ -135</td><td>Centre ≥ 135</td></tr><tr><td>YELLOW</td><td>N/A due to stop blocks</td><td>N/A due to stop blocks</td></tr><tr><td>RED</td><td>N/A due to stop blocks</td><td>N/A due to stop blocks</td></tr></table>Note: Expansion switch triggers apply to each switch blade and are measured from edge of base plate.</td><td>GREEN</td><td>Follow general procedures (including rail stress, rail creep and switch displacement monitoring, maintenance plan)</td><td>-</td><td>-</td></tr>
<tr><td rowspan="5">BLUE</td><td>Automatically notify RRG as per Alarm Notification Protocol</td><td>Within 15 minutes</td><td>Section 6.2</td></tr>
<tr><td>Immediately inspect track at trigger point for visual signs of impact if on site at time of alarm</td><td>Within 15 minutes</td><td>RMC</td></tr>
<tr><td>RRG undertake following action(s):
- investigate cause
- assess monitoring data for trends and forecast if and/or when the YELLOW and RED trigger levels might be exceeded
- consider whether to increase survey and/or inspection frequencies
- consider whether to adjust the track or expansion switches
- consider whether any other additional management measures are req’d</td><td>RRG meet via teleconference within 15 minutes of alarm notification</td><td>RRG</td></tr>
<tr><td>Inspect track at trigger point for visual signs of impact unless RRG is confident that cause of trigger cannot be due to physical damage to the railway
Remain on site until status returns to GREEN level</td><td>Immediately following assessment of RRG via teleconference and arrive within 2 hours, if req’d
Otherwise within 24 hours</td><td>RMC</td></tr>
<tr><td>Report details of alarm and actions undertaken</td><td>Within one week</td><td>PCE</td></tr>
<tr><td rowspan="2">Braking / acceleration loads resulting in rail creep that potentially leads to intervention on track (limits function of expansion switch)</td><td rowspan="2">GREEN</td><td>Follow general procedures (including rail stress, rail creep and switch displacement monitoring)</td><td>-</td><td>-</td></tr>
<tr><td>Install anchor points as per design</td><td>-</td><td>RMC</td></tr>
<tr><td>Switch allows excessive opening of a broken rail underneath rail traffic potentially leading to derailment</td><td>GREEN</td><td>Follow general procedures (including quarterly non-destructive testing of welds, maintenance plan). Note that rails are in zero-toe load track, which has effectively unstressed the rail and should not break.
Blue, Yellow and Red triggers and responses under “Switch Failure” also apply to this risk.</td><td>-</td><td>-</td></tr>
<tr><td>Switch becomes unserviceable due to uneven wear, inherent design or quality of steel</td><td>GREEN</td><td>Follow general procedures (including maintenance plan).</td><td>-</td><td>-</td></tr>
<tr><td rowspan="4">Switch or switches destroyed due to unrelated derailment, such that switches are removed and replaced by straight rail, potentially leading to train delays due to undertaking frequent adjustments of CWR track in response to continued mine subsidence movements</td><td rowspan="2">GREEN</td><td>Follow general procedures, including standard ARTC wayside detection, redundant monitoring controls (ground survey, track inspections, amber track geometry and automated monitoring systems) and on call maintenance.</td><td>-</td><td>-</td></tr>
<tr><td>Store critical spare parts on site</td><td>Prior to subsidence</td><td>RMC</td></tr>
<tr><td rowspan="2">Switch or switches destroyed by unrelated derailment</td><td>Notify RMG in accordance with Alarm Notification Protocol</td><td>Immediately</td><td>RMC</td></tr>
<tr><td>RMG meet and consider in consultation with ARTC Incident Management Team, MSO and ONRSR the implementation of additional control measures. These may include:
- repair switches and replace with spare parts as required
- introduce speed restrictions once track is re-opened by ARTC
- consolidate all remaining operational switches to one track and conduct single line working
- spread out all remaining operational switches on both tracks and reassess with smaller trigger levels for switch displacement due to longer free rail lengths
- increase monitoring frequency
- regular cut and re-stress of CWR track based on ground monitoring data
- consider need to stop or slow longwall progress until switches are operational</td><td>Within 24 hours</td><td>RMG</td></tr>
<tr><td rowspan="3">Damage to track circuits, from installation of expansion switches potentially leading to:
Signal failure leading to train delays</td><td>GREEN</td><td>Install appropriate bonding</td><td>During installation of expansion switches</td><td>RMC</td></tr>
<tr><td rowspan="2">Bonding damaged</td><td>Repair bonding</td><td>As required</td><td>RMC</td></tr>
<tr><td>Report impact and actions taken to RMG, ARTC, MSO & ONRSR</td><td>Within one week</td><td>RMC</td></tr>
<tr><td rowspan="3">Damage to signals, potentially leading to:
Signal failure leading to train delays</td><td>GREEN</td><td>Follow general procedures (including visual inspections within rail corridor)</td><td></td><td></td></tr>
<tr><td rowspan="2">Signals damaged</td><td>Repair signals</td><td>As required</td><td>RMC</td></tr>
<tr><td>Report impact and actions taken to RMG, MSO, ONRSR & SA NSW</td><td>Within one week</td><td>TC</td></tr>
</table>

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
Reduction in track centres at 98.620 km, 99.600 km and 101.200 km, where centre are currently tight	**GREEN**	Follow general procedures (including ground surveys, track centre surveys at 98.620 km, 99.600 km and 101.200 km and visual inspections within rail corridor)	-	-
	Reduction in track centres > 5 mm or Change in Cant in either track > 5 mm	RMG meet and consider whether any additional management measures are required, including: - detailed measurement of track centres - locally redesign track alignment - resurface track in accordance with redesign	As required	RMG
		Report details of RMG decision and actions undertaken	Within one week	Globetech
Loss of track geometry due to **localised ponding, or** **Loss in drainage grade** of culverts due to mining-induced tilts, potentially leading to: • Unplanned maintenance response	**GREEN**	Follow general procedures (including visual inspections within rail corridor)	-	-
	Ponding observed	Regrade drainage line	As required	RMC
		Report impact and actions taken to RMG	Within one week	RMC
Damage to Formation due to mining-induced surface cracks forming a bog hole in formation causing a loss of track geometry, potentially leading to: • Unplanned maintenance response	**GREEN**	Follow general procedures (including visual inspections within rail corridor)	-	-
	Surface crack observed	Repair crack or regrade drainage line or repair sewer pipes	As required	RMC
		Report impact and actions taken to RMG	Within one week	RMC
False alarms from automated monitoring systems potentially leading to: • Unnecessary speed restrictions	**GREEN**	Follow general procedures (including multiple redundancies in monitoring system)	-	-
		Develop maintenance, testing and audit program for automated monitoring systems	Prior to subsidence	Globetech/ PCE / Robinson Rail
		Develop alarm programming methods to filter obvious false alarms (refer Section 5.5.5). Reduce number of gauges with alarms enabled, where possible in accordance with the Management Plan.	Prior to subsidence	Globetech / RMG
	Excessive false alarms occur	RMG meet and consider whether any additional management measures are required, including: - reduce incidence of false alarms - replace or adjust gauge or cable - increase monitoring and reporting procedures	As required	RMG
		Report details of RMG decision and actions undertaken	Within one week	Globetech
Loss of all or part of automated monitoring system due to power surge, lightning strike, vandalism, power/comms failure, trackwork	**GREEN**	Follow general procedures (including multiple redundancies in monitoring system)	-	-
		Install back-up systems for power (battery), dual SIM, internet link to Tahmoor Coal Control Centre	Prior to subsidence	Globetech
		Program alarm alerts at off-site computer	Prior to subsidence	Globetech
		Store spare parts on site (gauges, loggers, batteries, router)	Prior to subsidence	Globetech
	GREY	Notify RRG in accordance with Alarm Notification Protocol	Within 15 minutes	Section 6.2
		Inspect track at trigger point if on site at time of alarm	Within 15 minutes	RMC
		RRG meet and consider whether any additional management measures are required, including: - investigate cause - install replacement battery - install secondary wireless network card - replace damaged components - increase monitoring and reporting procedures	RRG meet via teleconference within 15 minutes of alarm notification	RRG
		Inspect track at trigger point for visual signs of impact unless RRG is confident that cause of trigger cannot be due to physical damage to the railway Remain on site until status returns to GREEN level or until approved by RRG	Immediately following assessment of RRG via teleconference and arrive within 2 hours, if req'd Otherwise within 24 hours	RMC
		Report details of alarm and actions undertaken	Within one week	Globetech
False readings due to installation problem, failed gauge, software failure, programming error	**GREEN**	Follow general procedures (including multiple redundancies in monitoring system, regular analysis cross checking and reporting)	-	-
	False readings are found	Repair cause of false reading	As required	Globetech
		Report details of RMG decision and actions undertaken	Within one week	Globetech

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
Damage to cutting face potentially leading to: • Blockage of drainage line	**GREEN**	Follow general procedures (including dilapidation survey, visual inspections of cutting, and ground surveys)	-	-
		Clear debris from cesses at base of batter slopes	As required	RMC
	Instability observed to cuttings	Notify RMG in accordance with Alarm Notification Protocol	As required by Track Certifier depending on severity of impact	RMC
		RMG meet and consider whether any additional management measures are required, which may include: - undertake geotechnical inspection - increase monitoring and reporting procedures - clear debris from cess at base of cutting faces	RMG meet via teleconference as required by Track Certifier depending on severity of impact	RMG
		Report impact and actions taken to ARTC, MSO & ONRSR	Within one week	TC
	Cutting closure exceeds 20 mm	Notify RMG in accordance with Alarm Notification Protocol	Within one week	RMC
		RMG meet and consider whether any additional management measures are required, which may include: - undertake geotechnical inspection - increase monitoring and inspections for potential impacts on track geometry and - increase reporting procedures	RMG meet via teleconference within one week	RMG
		Report trigger exceedence and actions taken to ARTC, MSO & ONRSR	Within one week	TC
Damage to optical fibre cable, potentially leading to: • Loss of security monitoring • Lack of train information service • Lack of other commercial use	**GREEN**	Follow general procedures (including visual inspections within rail corridor)	-	-
	Ground strain exceeds 3 mm/m (tensile or compressive	Notify RMG	As required by RMC depending on severity of impact	RMC
		RMG meet and consider whether any additional management measures are required, which may include: - undertake inspection by signalling expert - increase monitoring and reporting procedures - consider undertaking additional tests on optical fibre cable - consider exposure of cable and provide freedom of cable movement in vicinity of ground deformation	As required	RMG
		Report impact and RMG decisions to ARTC, MSO, ONRSR & SA NSW	Within one week	TC
	Cable damage	Repair cable	As required	RMC
		Report impact and actions taken to RMG, ARTC, MSO, ONRSR & SA NSW	Within one week	TC
Breakage of buried copper cable, potentially leading to: • Signal failure leading to train delays • Wrong Side Failure	**GREEN**	Follow general procedures (including dilapidation survey, visual inspections, ground survey, standard ARTC 'failsafe' signalling system, automated monitoring of signal)	-	-
		Inspect condition of cable	Prior to 900m of extraction of LW S1A	TC
		Conduct electrical tests on spare cores	Prior to 900m of extraction of LW S1A End of LW S1A-S6A	TC
	Ground strain exceeds 3 mm/m (tensile or compressive)	Notify RMG	As required by RMC depending on severity of impact	RMC
		RMG meet and consider whether any additional management measures are required, which may include: - undertake inspection by signalling expert - increase monitoring and reporting procedures - consider undertaking additional electrical tests on signal cable - consider exposure of cable to provide freedom of cable movement in vicinity of ground deformation	As required	RMG
		Report impact and actions taken to RMG, ARTC, MSO, ONRSR & SA NSW	Within one week	MSEC
	Cable damage	Repair cable	As required	RMC
		Report impact and actions taken to RMG, ARTC, MSO, ONRSR & SA NSW	Within one week	MSEC

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
Damage to culverts or culvert floor potentially leading to: • Changes in track geometry resulting from loss of support, leading to intervention • Development of sinkhole and undermining track • Loss of culvert integrity, leading to intervention • Cracking and deformation	**GREEN**	Follow general procedures (including dilapidation survey, ground survey, visual inspections of culverts, track geometry monitoring)	-	-
		De-vegetation of the embankment batters and maintain culverts to keep them free flowing	Before track above each culvert is in Stage 1	TC
		Install above track baulks above culverts	Before track above each culvert is in Stage 2 (for LW S4A: Culverts 99.035 km to 100.425 km)	TC
		Seal gap between the brick arch culvert headwall and concrete pipe extension on the Down side of Culvert at 99.035 km and repair sinkhole	Prior to 900m of extraction of LW S1A	TC
		Reinstate concrete outlet pipe to Culvert at 99.338 km	Prior to 800m of extraction of LW S3A (complete)	TC
		Seal gap between the brick arch culvert headwall and concrete pipe extension on the Down side of Culvert at 100.121 km	Prior to 200m of extraction of LW S4A	TC
	Damage to culvert such as cracking or gaps found at culvert joints or evidence of piping	Notify RMG and ARTC Structures Specialist	As required by RMC depending on severity of impact	RMC
		RMG meet and consider whether any additional management measures are required, which may include: - undertake structural inspection - increase monitoring and reporting procedures - repair culvert or provide additional support to culvert - strengthen track baulk	As required	RMG
		Report impact and RMG decisions to ARTC, MSO, ONRSR and SA NSW	Within one week	TC
		Report details of impact and actions undertaken	Within one week	MSEC
Embankments • Embankment slope failure or collapse of embankment caused by water saturation of fill due to blockage of culvert leading to build up of water, surcharge from impounded water and saturation of fill due to prolonged rainfall. • Displacement / failure of embankment leading to loss of track support. • Surface cracking of crest and embankment batters due to mining-induced vertical or horizontal ground movements, leading to erosion of batters and long-term embankment instability. • Cracking within embankment due to mining-induced vertical or horizontal ground movements and build up of water within embankment, flowing through cracks, leading to piping failure and formation of sink holes under the track • Cracking of culvert causing loss of fill due to pot holing (vertical) due to mining-induced ground movements, particularly valley closure, leading to development of sinkhole and undermining track **Note:** Refer to other sections of the Risk Control Procedures for managing risks associated with changes in track geometry or changes to culverts	**GREEN**	Follow general procedures (including ground surveys, visual inspections, and for Embankments at 99.338 km, 100.121 km and 100.425 km: extensometers, manual inclinometers and culvert water level gauges).	-	-
		Clear vegetation on the embankment batter and maintain culverts to keep them clear of debris to facilitate monitoring of the embankments and culverts.	Before track above each culvert is in Stage 1 (complete for LW S4A)	-
	<u>LEVEL 1</u> Rate of change in crest extensometer distance exceeds 10 mm within 2 hours or Crest extensometer or ground surveys across crest measure extension of 25 mm or Visual signs of distress to embankment, such as tension crack along edge of embankment / access road	For alarms from extensometer: Inspect embankment at trigger point for visual signs of impact.	Immediate callout and arrive as soon as reasonably practicable (target less than 2 hours)	RMC
		If tension crack observed along edge of embankment, Track Certifier to remain on site until such time that RMG agree that continuous 24 hour / 7 days a week presence by Track Certifier is not required.	Immediately following identification of tension crack	RMC
		Undertake additional geotechnical inspection and appraisal	Within 24 hours	Newcastle Geotech
		RSRG meet and review latest monitoring information from automated and manually acquired data for the embankment, culvert and the track, inspections by geotechnical engineer and Track Certifier, and latest weather forecasts. RSRG consider whether any additional management measures are required, which may include: - fill and seal cracks and/or regrade drainage line - increase monitoring and reporting procedures - arrange additional surveys to monitor potential displacement of embankment material	Within 15 minutes	RSRG
		Report trigger exceedance and actions taken to RMG, ARTC, MSO & ONRSR in Railway Status Report	Within 24 hours if tension crack observed Otherwise within one week	TC

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
Embankments • Embankment slope failure or collapse of embankment caused by water saturation of fill due to blockage of culvert leading to build up of water, surcharge from impounded water and saturation of fill due to prolonged rainfall. • Displacement / failure of embankment leading to loss of track support. • Surface cracking of crest and embankment batters due to mining-induced vertical or horizontal ground movements, leading to erosion of batters and long-term embankment instability. • Cracking within embankment due to mining-induced vertical or horizontal ground movements and build up of water within embankment, flowing through cracks, leading to piping failure and formation of sink holes under the track • Cracking of culvert causing loss of fill due to pot holing (vertical) due to mining-induced ground movements, particularly valley closure, leading to development of sinkhole and undermining track **Note:** Refer to other sections of the Risk Control Procedures for managing risks associated with changes in track geometry or changes to culverts	**LEVEL 2** **Rate of change in crest extensometer distance exceeds 20 mm within 2 hours** **or** **Tension crack observed along the shoulder of the embankment within 4 m of the track, or across the access road, or slide in the crest of the embankment along the access road within 4 m of the track**	Contact Train Control & introduce track speed of 20km/h. If not already on site at time of alarm, inspect track and embankment at trigger point. Remain on site until such time that RMG agree that continuous 24 hour / 7 days a week presence by Track Certifier is not required.	Immediately If not on site at time of alarm, immediate callout and arrive as soon as reasonably practicable (target less than 2 hours)	RMC
		Undertake additional geotechnical inspection and appraisal	As soon as reasonably practicable	Newcastle Geotech
		RSRG meet and review latest monitoring information from automated and manually acquired data for the embankment, culvert and the track, inspections by geotechnical engineer and Track Certifier, and latest weather forecasts. RSRG consider whether any additional management measures are required, which may include: - stop trains - temporarily support the ballast shoulder by placing material on the crest of the embankment - place permanent or temporary fill / rock spall to the base of the embankment - tip fill material into scarp of slide until settlement effectively ceases - increase monitoring and reporting procedures - arrange additional surveys to monitor displacement, if required - consider whether to recommend additional Governance Meeting between Tahmoor Coal and ARTC (emergency response)	Within 15 minutes	RSRG
		Report trigger exceedance and actions taken to RMG, ARTC, MSO & ONRSR	Within 24 hours	TC
	LEVEL 3 **Tension crack observed across the access road and under the track, or slump removes access road support for the embankment, or a report of depression in the track by train driver**	Contact Train Control & introduce track speed of 20km/h. If not already on site at time of alarm, inspect track and embankment at trigger point. Remain on site until such time that RMG agree that continuous 24 hour / 7 days a week presence by Track Certifier is not required.	Immediately If not on site at time of alarm, immediate callout and arrive as soon as reasonably practicable (target less than 2 hours)	RMC
		Undertake additional geotechnical inspection and appraisal	As soon as reasonably practicable	Newcastle Geotech
		RSRG meet and review latest monitoring information from automated and manually acquired data for the embankment, culvert and the track, inspections by geotechnical engineer and Track Certifier, and latest weather forecasts. RSRG consider whether any additional management measures are required, which may include: - stop trains - temporarily support the ballast shoulder by placing material on the crest of the embankment - place permanent or temporary fill / rock spall to the base of the embankment - tip fill material into scarp of slide until settlement effectively ceases - add ballast to the railway track and lift track to restore track geometry - provide additional forms of track support under the track as may be appropriate or feasible - increase monitoring and reporting procedures - arrange additional surveys to monitor displacement, if required - consider whether to recommend additional Governance Meeting between Tahmoor Coal and ARTC (emergency response)	Within 15 minutes	RSRG
		Report trigger exceedance and actions taken to RMG, ARTC, MSO & ONRSR	Within 24 hours	TC

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

RISK ISSUE	TRIGGER	CONTROL PROCEDURES	TIMING & FREQ	BY WHOM?
Embankments • Embankment slope failure or collapse of embankment caused by water saturation of fill due to blockage of culvert leading to build up of water, surcharge from impounded water and saturation of fill due to prolonged rainfall. • Displacement / failure of embankment leading to loss of track support. • Surface cracking of crest and embankment batters due to mining-induced vertical or horizontal ground movements, leading to erosion of batters and long-term embankment instability. • Cracking within embankment due to mining-induced vertical or horizontal ground movements and build up of water within embankment, flowing through cracks, leading to piping failure and formation of sink holes under the track • Cracking of culvert causing loss of fill due to pot holing (vertical) due to mining-induced ground movements, particularly valley closure, leading to development of sinkhole and undermining track **Note:** Refer to other sections of the Risk Control Procedures for managing risks associated with changes in track geometry or changes to culverts	**Forecast of extreme wet weather, as observed by RMG or notified by ARTC to RMC**	RMG meet and review latest monitoring information from automated and manually acquired data for the embankment, culverts and the track, inspections by geotechnical engineer and Track Certifier, and details of extreme wet weather forecast. RMG consider whether any additional management measures are required, which may include: - sealing cracks that may have developed during mining, prior to the weather event - additional inspection by geotechnical engineer to assess whether additional work may be required prior to weather event - additional inspection or monitoring equipment to prepare for weather event - bring forward ground surveys if their scheduled timing coincides with weather event - develop extreme wet weather plan, which may include arranging for Track Certifier on site during weather event, periodic checking of automated monitoring data during event, reporting and communication protocol during weather event.	As soon as reasonably practicable depending on severity and timing of weather event (target less than 24 hours)	RMG
		Report outcome of weather event to RMG, ARTC, MSO & ONRSR in Railway Status Report	Within one week	MSEC
	Water level at Culvert Inlets at 99.338 km, 100.121 km and 100.425 km reaches culvert obvert	Inspect embankment for flooding and condition of embankment and culvert	Immediate callout as soon as reasonably practicable (target less than 2 hours)	RMC
		RRG meet and review latest monitoring information from automated and manually acquired data for the embankment, culvert and the track, inspections by geotechnical engineer and Track Certifier, current weather observations and details of latest weather forecast. RRG consider whether any additional management measures are required, which may include: - continue visual monitoring by RMC until end of weather event - remove cause of blockage of culvert (if any and if possible) - decide whether to slow or stop trains based on other monitoring data	Within 15 minutes	RRG
		Report trigger exceedance and actions taken to RMG, ARTC, MSO & ONRSR in Railway Status Report	Within one week	MSEC
Conveyor Crossing • Loss of integrity of conveyor crossing structure.	**GREEN**	Follow general procedures (including trestle survey, laser distancemeters and visual inspections)	-	-
	Closure between trestles exceeds 10 mm	Notify RMG	Within one week	RMC
		RMG meet and consider whether any additional management measures are required, which may include: - undertake structural inspection - increase monitoring and reporting procedures - elongate bolt holes in trestle column baseplates - strengthen trestle columns - install additional cable-stay bracing - erect temporary support structure on the access roadways on either side of railway	RMG meet via teleconference within one week	RMG
		Report trigger exceedence and RMG decisions to ARTC, MSO, ONRSR and SA NSW	Within one week	TC
Damage to boundary fences potentially leading to: • Livestock entry into rail corridor	**GREEN**	Follow general procedures (including visual inspections within rail corridor)	-	-
	Damage to fence	Repair fence	As required	RMC
		Report impact and actions taken to RMG	Within one week	RMC

Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

<table>
<tr><th>RISK ISSUE</th><th>TRIGGER</th><th>CONTROL PROCEDURES</th><th>TIMING & FREQ</th><th>BY WHOM?</th></tr>
<tr><td rowspan="8">Bridges
• Impact on serviceability of bridge resulting in unplanned maintenance.

<table><tr><th>Trigger Level</th><th>Measured opening or closure between bridge abutments (beyond seasonal fluctuation)</th></tr><tr><td>GREEN</td><td>-</td></tr><tr><td>MONITORING REVIEW POINT TRIGGER</td><td>Remembrance Drive Bridge over Bargo River > 7 mm
Railway Viaduct > 5 mm
Bargo River Road Overbridge (Potter’s Cutting) > 5 mm
Wellers Road Overbridge > 5 mm
Increase in crack widths by more than 3 mm in widths to Viaduct or Bridges</td></tr></table></td><td>GREEN</td><td>Follow general procedures (including GNSS monitoring, ground and structure surveys, and visual inspections).</td><td>-</td><td>-</td></tr>
<tr><td rowspan="3">Monitoring Review Point Trigger for Railway Viaduct</td><td>Notify RMG, Bridge Technical Committee and ARTC (incl. ARTC Structures Specialist)</td><td>Within one week</td><td>MSEC</td></tr>
<tr><td>RMG meet and consider whether any additional management measures are required, which may include:
- undertake structural inspections
- measure changes to crack gauges
- increase frequency of surveys and inspections and reporting
- install temporary track strengthening baulk
- force closure to focus in desired Span 5 by diamond saw cut
- repair cracked masonry
- provide additional support to the arch and parapet walls
- fabricate and erect structural steel supports for the arch
- adjust rail stress
- adjust track geometry
- implement temporary speed restriction or stop trains
- continual review of rate of development of valley closure relative to longwall progress and consider whether to amend the Valley closure trigger of 20 mm
- consider whether to recommend to TC senior management to slow or stop mining if impact to rail operations is unacceptable to ARTC</td><td>As required</td><td>RMG & Bridge Technical Committee</td></tr>
<tr><td>Report trigger exceedence and RMG & Bridge Technical Committee decisions to ARTC, MSO, ONRSR and SA NSW</td><td>Within 24 hours</td><td>Tahmoor Coal</td></tr>
<tr><td rowspan="3">Valley closure at Railway Viaduct > 20 mm

(based on Precision 2D surveys of closure between ground marks located in stable ground at both ends of the Viaduct)</td><td>Stop longwall mining</td><td>Immediately
(subject to mine safety requirements)</td><td>TC</td></tr>
<tr><td>RMG meet and consider whether any additional management measures are required, which may include:
- fabricate and erect structural steel supports for the arch
- consider and implement measures to monitor the condition of the temporary support structures
- consider triggers for adjusting the support structures due to residual subsidence
- adjust the support structures to accommodate residual subsidence movements, if required
- consider works required to permanently restore the Railway Viaduct in consultation and approval by ARTC and government agencies.</td><td>As required</td><td>RMG</td></tr>
<tr><td>Report trigger exceedence and RMG decisions to ARTC, MSO, ONRSR and SA NSW</td><td>Within 24 hours</td><td>TC</td></tr>
<tr><td rowspan="3">Monitoring Review Point Trigger for Remembrance Drive Bridge over Bargo River</td><td>Notify RMG, Bridge Technical Committee and ARTC (incl. ARTC Structures Specialist)</td><td>Within one week</td><td>MSEC</td></tr>
<tr><td>RMG meet and consider whether any additional management measures are required, which may include:
- undertake structural inspections
- increase frequency of surveys and inspections and reporting
- construct temporary props and/or cross-bracing to provide additional support to the piers
- repair cracks in concrete elements
- replace bridge bearings
- resurface affected road pavement
- consider whether to recommend to TC senior management to slow or stop mining if impact to rail operations is unacceptable to ARTC</td><td>As required</td><td>RMG & Bridge Technical Committee</td></tr>
<tr><td>Report trigger exceedence and RMG & Bridge Technical Committee decisions to ARTC, MSO, ONRSR and SA NSW</td><td>Within 24 hours</td><td>Tahmoor Coal</td></tr>
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Revised Table A.1: Risk Control Procedures LW S1A-S6A (amended for LW S4A in blue)

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Wellers Road Overbridge > 5 mm
Increase in crack widths by more than 3 mm in widths to Viaduct or Bridges</td></tr></table></td><td rowspan="3">Monitoring Review Point Trigger for Bargo River Road Overbridge or Wellers Road Overbridge</td><td>Notify RMG, Bridge Technical Committee and ARTC (incl. ARTC Structures Specialist)</td><td>Within one week</td><td>MSEC</td></tr>
<tr><td>RMG meet and consider whether any additional management measures are required, which may include:
- undertake structural inspections
- measure changes to crack gauges
- increase frequency of surveys and inspections and reporting
- install roller steel reinforcement straps to the underside of the concrete arch;
- install mesh to underside of the arch;
- install temporary support structure within the road pavement to provide temporary support to arch;
- provide additional support to parapet walls; and/or
- repair cracked brickwork
- consider whether to recommend to TC senior management to slow or stop mining if impact to rail operations is unacceptable to ARTC</td><td>As required</td><td>RMG & Bridge Technical Committee</td></tr>
<tr><td>Report trigger exceedence and RMG & Bridge Technical Committee decisions to ARTC, MSO, ONRSR and SA NSW</td><td>Within 24 hours</td><td>Tahmoor Coal</td></tr>
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