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Rail Infrastructure Rolling Contact Fatigue

For decision:

For noting:

Ngā tūtohunga / Recommendations

That the Auckland Transport Board (board):

- a) note the findings and recommendations of the Auckland Metro Rolling Contact Fatigue (RCF) Working Group: Root Cause Assessment report included at Attachment 1.
- b) note the extended timeframe for rail turnout remediation works from March / April to late July 2021 and resultant impacts to Auckland Transport (AT) passenger metro services.

Te whakarāpopototanga matua / Executive summary

1. Rail track becomes worn over time as a result of usage, in the same way that road surfaces deteriorate. In recent years, with increasing traffic on the Auckland metro rail network, one particular type of damage, RCF, has become increasingly prevalent. It occurs when the stress created by contact between rail and the rolling wheel of a train causes the rail to develop cracks, which grow over time.
2. In August 2020, to mitigate the emerging risk of RCF, a precautionary blanket temporary speed restriction was applied over the Auckland Metro Rail Network (AMRN). KiwiRail (KR) and AT immediately established a joint AMRN Programme Control Group (AMRN PCG) and commissioned an independent technical report to investigate the reasons for the exponential growth of RCF.
3. This report presents the findings of the RCF Root Cause Assessment Report (RCF Report), included as Attachment 1, and an update on the ongoing programme of rail track remediation works and timeframe for remediation and return to AT's core operating passenger rail timetable.
4. The RCF Report identified multiple causes for the rapid growth of RCF on the AMRN, the key causes being:
 - Historic under investment in track asset renewals and maintenance.
 - Insufficient rail grinding between 2015 and 2020.
 - The existence of multiple sites where the track condition is sub-optimal in engineering factors known to accelerate the growth of RCF.

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- AT electric multiple unit (EMU) trains are designed with a high primary yaw stiffness to safely negotiate track irregularities and improve passenger ride comfort. However, this may increase a vehicle's propensity to cause RCF.
 - The EMU wheel profile is a modified version of the KR standard; modelling shows the profile may increase wheel rail interface stresses and the propensity to cause RCF.
5. The report makes several recommendations for the two parties to consider and act on. These include:
- On-going programme of rail grinding to ensure RCF initiated defects removal at the linear growth stage, rather than the exponential growth stage.
 - A programme of works to carry out all deferred track maintenance and renewals works.
 - A technical group to review rail track profiles to optimise service needs (e.g. safety, ride quality) and vehicle characteristics to reduce RCF.
 - Collaboration between the asset management goals of all parties to achieve the lowest total cost of ownership (TCO) of the full network.
6. KR ongoing track remediation works since the establishment of the August 2020 blanket track speed restrictions identified a reduction of Temporary Speed Restrictions (TSR) on the AMRN to enable a return to AT passenger timetables by March / April 2021. This was achieved despite a number of turnouts (sections of track that allow trains to cross tracks) still needing remediation or replacement. However, following further track inspections, 16 further turnouts were identified as requiring remediation and replacement. This resulted in further unexpected TSR to be applied and Southern Line weekday peak frequency services reduce from 10 to 20-minute intervals in June 2021. It is expected that the Southern Line will be able to resume a ten-minute frequency by the end of July 2021.

Ngā tuhinga ō mua / Previous deliberations

7. Updates on track maintenance and renewals have been provided to the board through the Chief Executive's Confidential Reports.

Te horopaki me te tīaroaro rautaki / Context and strategic alignment

8. KR is the owner, licensed rail infrastructure manager and Rail Safety Case holder for the national rail network comprising track infrastructure, civil assets, signalling, train control and overhead power supply for trains. KR is also the freight service provider across the network.
9. KR grants access rights to AT to the AMRN for Auckland passenger rail services. Passenger rail services are provided on behalf of AT by Transdev Auckland Ltd (TDAK) through a passenger rail services agreement with AT. TDAK hold the license and Rail Safety Case for passenger rail operations. The AT train fleet is primarily modern EMUs owned by AT and manufactured and maintained by Construcciones y Auxiliars de

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Ferrocarriles (CAF), under agreement with AT. A small number of older diesel units operate on the non-electrified AMRN between Papakura and Pukekohe, owned by AT and maintained by KR.

10. A history of investments in new assets has been made over the last 15 years, by central government and others, to establish the current electrified AMRN, including additional track (double tracking and branch lines), new stations, new signalling, new overhead lines, and new EMU rolling stock. However, existing track and civil infrastructure, including historic formation was not upgraded under any of those programmes.
11. In 2014, prior to the commencement of the new electrified service, AT engaged Network Rail Consultants to evaluate the overall state of the infrastructure. The evaluation effectively concluded that substantial investment (~\$100m) in the AMRN track assets was needed to ensure it would be fit for purpose for the proposed EMU operation. This investment was not approved, and the parties instead relied on increased inspections for safety, track speed restrictions, and accepted the infrastructure would provide lower levels of service.
12. In 2019, AT engaged consultants WSP, to review the AMRN infrastructure, prior to planned increases in services once the City Rail Link (CRL) was commissioned in 2024. WSP concluded “there has been a +250% increase in rail patronage between 2010 and 2019” and “the existing network infrastructure maintenance programmes, particularly those for track and civil assets, are struggling to support the level of traffic growth that has occurred on the network in recent years and are unlikely to be able to support forecast traffic growth.”
13. With increasing traffic on the AMRN, one particular type of damage, RCF, has become increasingly prevalent. It occurs when the stress created by contact between rail and the rolling wheel of a train causes the rail to develop cracks, which grow over time. The aged rail asset has experienced rapid RCF growth and this has led to accelerated growth of RCF and related, risk-to-service, internal rail defects.
14. Some of the remedial works were already planned by KR for 2020-24 under the Rail Network Growth Impact Management (RNGIM) project - a Transitional Rail funding package to renew and upgrade the AMRN over the next three to four years to ensure that the asset would be fit-for-purpose for operational train service level increases in late 2024 with the opening of the CRL.

Ngā matapakinga me ngā tātaritanga / Discussion and analysis

Joint management oversight

15. KR and AT are seeking to ensure that the AMRN track infrastructure is fit-for-purpose for existing and future planned increases in freight and passenger train service levels over the 10-year plus horizon. KR is seeking to uplift capability and capacity in both the forward maintenance and renewal programme and forward asset management planning of the AMRN track infrastructure to ensure that the ongoing management of the track infrastructure maintains fit-for-purpose status and a modern track infrastructure for Auckland.
16. As well as a focus on remedial works KR and AT commissioned an independent technical report to investigate the reasons behind the exponential growth of RCF.

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17. A PCG was established with senior representatives from AT, KR, Transdev, and the Ministry of Transport (MOT), to provide oversight for the implementation of a programme of physical work to renew and upgrade the AMRN track infrastructure and to uplift the capability and capacity of the forward maintenance and renewal programmes and ongoing asset management planning.
18. The PCG oversees the direction and delivery of five sub programmes or projects:
 - a. **Project 1: 6-Month Critical Upgrade and Renewal Works:** oversee the critical track infrastructure upgrade and renewals activities between August 2020 and March / April 2021.
 - b. **Project 2: RCF Root Cause Assessment:** identify key engineering causes so that all stakeholders have a strong measure of confidence that accelerated RCF leading to difficult-to-manage rail defects will not happen again.
 - c. **Project 3: RCF Deterioration System Issues:** identify any system level issues that require intervention to ultimately ensure that these issues will not occur again.
 - d. **Project 4: 3-5 Year Forward Works Maintenance and Renewal Programme:** ensure forward maintenance and renewals programme through to opening of CRL in late 2024 ensures that full line speeds can be operated and track infrastructure is fit-for purpose.
 - e. **Project 5: AMRN Asset Management Planning Uplift:** ensure that the medium to long term (3 to 30 year) AMR track infrastructure asset management planning regime and framework is of international standard and practice, including ISO (or equivalent) accreditation.

Update Project 1: 6-Month Critical Upgrade and Renewal Works

19. The AMRN programme of urgent remedial work to rectify impacts of RCF was completed in March 2021. A precautionary blanket 40km/h TSR was applied by KR to AMRN. The work included rail, sleeper and turnout replacement, rail grinding and destressing.
20. TSRs were expected to be removed by March / April 2021 to permit resumption of the full passenger rail timetable. The remedial work is complete except for turnout replacement, which is ongoing, and the blanket TSR was removed.
21. However, following track inspections 16 further turnouts were identified as requiring remediation/replacement. This resulted in further unexpected TSRs to be applied and Southern Line weekday peak frequency services reduced from 10 to 20-minute intervals in June 2021. It is expected that the Southern line will be able to resume a ten-minute frequency by the end of July 2021.
22. Materials and parts for full turnout replacement are being accessed and it is expected this could take up to five months, however this will not prevent the 10-minute frequency resuming at the end of July due to multiple TSRs being lifted at that time.

Update Project 2: RCF Root Cause Assessment

23. RCF occurs when the stress created by contact between rail and the rolling train wheel causes the rail to develop cracks, which grow over time. In recent years with increasing traffic on the AMRN RCF has become increasingly prevalent.

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24. KR and AT commissioned an independent technical report to investigate the reasons behind the exponential growth of RCF. The report identified multiple causes for the rapid growth of RCF:
- Historic under investment in track asset renewals and maintenance.
 - Insufficient rail grinding from 2015 to 2020.
 - The existence of multiple sites where the track condition is sub-optimal in engineering factors known to accelerate the growth of RCF.
 - EMUs are designed with a high primary yaw stiffness to safely negotiate track irregularities and improve ride comfort. The EMU wheel profile is a modified version of the KR standard; modelling shows the profile may increase wheel rail interface stresses.
25. The report makes several recommendations for the two parties to consider and act on. These include:
- On-going programme of rail grinding to ensure RCF initiated defects removal at linear growth stage, rather than exponential growth stage.
 - Programme of works to carry out all deferred track maintenance and renewals works.
 - Technical group to review rail track profiles to optimise service needs (e.g. safety, ride quality) and vehicle characteristics to reduce RCF.
 - Collaboration between the asset management goals of all parties to achieve the lowest total cost of ownership (TCO) of the full network.

Ngā tūraru matua / Key risks and mitigations

Key risk	Mitigation
Recommendations of the RCF Root Cause Assessment report are not implemented.	<ul style="list-style-type: none"> • PCG will oversee and monitor implementation.
On-going testing on the remaining turnouts identifies a high level of RCF which requires further speed restrictions to be applied, insufficient spares in New Zealand to rectify the faults, extension of works due to insufficient resourcing within KR.	<ul style="list-style-type: none"> • Assurance from KR that they have spares available to complete the identified turnout replacement according to plan and timelines. • Confirmation of KR's rail grinding programme that assists to maintain the network and allow time for strategic replacement of turnouts. • Confirmation of spares for further Tranche 3 works if required. • Opportunity to reduce the one-week track consolidation period and overall resource and time for track replacement works by using a stabilising machine.

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Key risk	Mitigation
Further identification of track replacement results in unexpected further network performance reductions and further passenger rail timetable restrictions	<ul style="list-style-type: none"> Continued focus on enhanced forward planning of maintenance and renewals by KR continues to be an oversight of the joint PCG with senior AT and TDAK representation.
Ongoing passenger disruption due to ongoing RCF remediation works, RNGIM pre-CRL upgrade works, other rail upgrade works (including electrification of Papakura to Pukekohe, and third main) and CRL rail works.	<ul style="list-style-type: none"> Risk realised through to CRL opening. Optimisation of rail network closures at weekends, evening and Christmas shutdown periods. Effective customer communications on reasons for rail timetable disruptions. Continued application of alternative bus replacement services.

Ngā ritenga-ā-pūtea me ngā rauemi / Financial and resource impacts

26. The cost of physical upgrade and renewal works is covered by existing KR works programmes.
27. Increases in track maintenance costs may result in Auckland Network Access Agreement (ANAA) cost increases for AT, which is not budgeted for. This risk will be assessed as part of a review by MOT.
28. Reasonable costs of lost fare revenue due to a slow upturn in rail patronage has been covered in the AT budget forecasts up to CRL opening. Any increase in disruptions that reduces further patronage and therefore fare revenue is not covered.

Ngā whaiwhakaaro o te taiao me te panonitanga o te āhuarangi / Environment and climate change considerations

29. Operating an effective and reliable rail passenger service is essential for Auckland to reduce carbon emissions and achieve the goals of Te Taruke-a-Tawhiri (Auckland's Climate Plan). Successful resolution of these rail network issues is critical.

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Ngā reo o mana whenua rātou ko ngā mema pooti, ko ngā roopu kei raro i te maru o te Kaunihera, ko ngā hāpori katoa / Voice of mana whenua, elected members, Council Controlled Organisations, customer and community

30. The EGM Integrated Networks has briefed the Mayor and elected members on the relevant issues.
31. The recent RCF issues involving the 16 turnouts has further compromised the trust and confidence of AT customers in our rail services. Reduced quality of train performance, results in customers deciding to revert to car use, affecting our Statement of Intent patronage number and associated revenues.
32. We continue to work collaboratively with KR and in support of providing timely information to inform our customers and alleviate the adverse impacts of unforeseen impacts to our timetable.

Ngā whaiwhakaaro haumaruru me ngā whaiwhakaaro hauora / Health, safety and wellbeing considerations

33. Rectification of performance issues on the AMRN is critical to operating a safe full passenger rail timetable.

Ā muri ake nei / Next steps




34. The PCG will continue to oversee implementation of the programme of work to upgrade the AMRN to be fit-for-purpose.
35. The RCF Root Cause Assessment will be subject to a media release after the board meeting, including a one-page summary that will be available for media.

Te whakapiringa / Attachment

Attachment number	Description
1	Auckland Metro Rolling Contact Fatigue (RCF) Working Group: Root Cause Assessment report

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Te pou whenua tuhinga / Document ownership

Submitted by	Murray Burt Chief Engineer Stacey van der Putten Group Manager Metro Services	 
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