Newcastle University
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Contents – Impacts of adverse and extreme weather to the UK Rail Network

- **What is the National Weather Team? What do we do?**

- **Improvement of assurance process and development of the RM3 Maturity Process**

- **Development of the Hot Weather Approach Document**

- **Development of the Seasonally Agnostic Railway Model**

- **Network Performance Board (NPB) - Feedback and Escalation from SCSG**

- **Weather related recommendations and the Weather Academy**

- **Innovation and collaboration**

- **Enhancement of Key Route Strategies**

Derailment inside Summit Tunnel, near Todmorden, West Yorkshire, 28th December 2010.
Source: RAIB

Snow - Maidstone East – 11.03.21- Phil
Barker Network Rail

Heat (Buckled Rail) - Oakenshaw Jn –
24072019 - Brett Hill (Network Rail)

Frozen brake gear. Source: Mark Molyneux RDG

Frozen Coupler on an Intercity Express Passenger Train (IEP). Source: Mark Molyneux RDG

A damaged wheel caused by sliding on the rail head. Source: AWG. 2019.

Sand being dispensed from the train sand box. Source: RSSB

Forecast - 2 to 5 Days (weather and hazard summary)

Settled conditions prevailing between Thursday and Saturday, as an area of high pressure centred just to the north-west of the UK will bring dry conditions dry conditions with a variable amount of cloud. Rather chilly overnight under clear spells, with air frost in places. Cloudier and more unsettled conditions should develop later on Saturday night and into Sunday, with spells of rain pushing in from the north, these turning to sleet and snow on high ground as cold northerly winds develop. The chance of wintry showers following behind the rain later in the day and overnight, with some sleet, snow and soft hail possibly falling even at low levels.

Summary Hazards – Perth (Scotland)

Day (0600 to 0600)	Wind		Heavy Rain		Snow		Frost		Min Temp Morn (06–11)	Max Temp (06–18)	Min Temp (18–06)	Temp Range		Ice Day		Lightning Risk		Freezing Fog	
	Hazard	Conf.	Hazard	Conf.	Hazard	Conf.	Hazard	Conf.				Hazard	Conf.	Hazard	Conf.	Hazard	Conf.	Hazard	Conf.
Wed		Low	Aware	Low		High	Adverse	Low	2.5	13.5	-3.5		High		High		High		High
Thu		High		High		High	Adverse	Low	-3.0	12.0	-4.0		High		High		High		High
Fri		High		High		High	Adverse	Low	-3.0	11.5	-3.0	Aware	Low		High		High		High
Sat		High		High		High	Aware	Low	-3.0	13.0	0.0	Aware	Low		High		High		High
Sun	Aware	Low	Aware	Low	Aware	Low	Adverse	Low	1.5	10.0	-4.0		High		High		Low		High

Summary Hazards – Glasgow (Scotland)

Day (0600 to 0600)	Wind		Heavy Rain		Snow		Frost		Min Temp Morn (06–11)	Max Temp (06–18)	Min Temp (18–06)	Temp Range		Ice Day		Lightning Risk		Freezing Fog	
	Hazard	Conf.	Hazard	Conf.	Hazard	Conf.	Hazard	Conf.				Hazard	Conf.	Hazard	Conf.	Hazard	Conf.	Hazard	Conf.
Wed		High		High		High	Aware	High	6.0	15.0	-0.5		High		High		High		High
Thu		High		High		High	Adverse	Low	-0.5	12.5	-3.5		High		High		High		High
Fri		High		High		High	Aware	Medium	-3.0	13.0	-1.5	Aware	Low		High		High		High
Sat		High		High		High		Low	-1.0	11.0	0.5		High		High		High		High
Sun	Aware	Low	Aware	Low	Aware	Low	Adverse	Low	2.5	8.0	-4.0		High		High		Low		High

Summary Hazards – Highland (Scotland)

Day (0600 to 0600)	Wind		Heavy Rain		Snow		Frost		Min Temp Morn (06–11)	Max Temp (06–18)	Min Temp (18–06)	Temp Range		Ice Day		Lightning Risk		Freezing Fog	

Example of a 2-5 day forecast for Perth and Glasgow forecast areas with a variation of alerts. Source: MetDesk 31.03.21

File ▾   Print ▾   E-mail   Burn ▾   Open ▾

Dashboard   Map

Region & Route:
North West & Central ▾

Issue:
2021-06-25 19:30 BST ▾ ▶

COMBINED   OBSERVED   CURRENT & PREDICTED

Select a tile to see full details

Combined Rainfall Alerts   2021-06-25 19:30 BST   North West & Central

NX50-NX94	NY00-NY44	NY05-NY49	NY50-NY94	SD00-SD44	SD05-SD49	SD50-SD94
0 alerts	0 alerts	0 alerts	0 alerts	0 alerts	0 alerts	0 alerts
Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h
0.4mm / 0mm	0.2mm / 0mm	0mm / 0mm	0mm / 0mm	1mm / 0.4mm	1.7mm / 0.7mm	1.4mm / 0.5mm

SD55-SD99	SE00-SE44	SJ05-SJ49	SJ50-SJ94	SJ55-SJ99	SK00-SK44	SK05-SK49
0 alerts	0 alerts	0 alerts	2 alerts	3 alerts	4 alerts	0 alerts
Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h
4.2mm / 3.1mm	0mm / 0mm	3.8mm / 2.3mm	6.4mm / 7.8mm	5.4mm / 10.2mm	11mm / 1.8mm	0mm / 0mm

SO50-SO94	SO55-SO99	SP00-SP44	SP05-SP49	SP50-SP94	SP55-SP99	SU55-SU99
0 alerts	1 alerts	0 alerts	14 alerts	0 alerts	0 alerts	0 alerts
Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h	Prev 1h / Next 1h
0mm / 0mm	12.6mm / 5.8mm	0mm / 0mm	35.4mm / 0.3mm	0mm / 0mm	0mm / 0mm	0mm / 0mm

TL00-TL44	TQ05-TQ49
0 alerts	0 alerts
Prev 1h / Next 1h	Prev 1h / Next 1h
0mm / 0mm	0mm / 0mm

The dashboard cells present the National Grid Reference reference for each 50km grid, the number of the most severe alerts in each cell and the highest accumulations of precipitation within that cell over the last hour and forecast in the next hour.
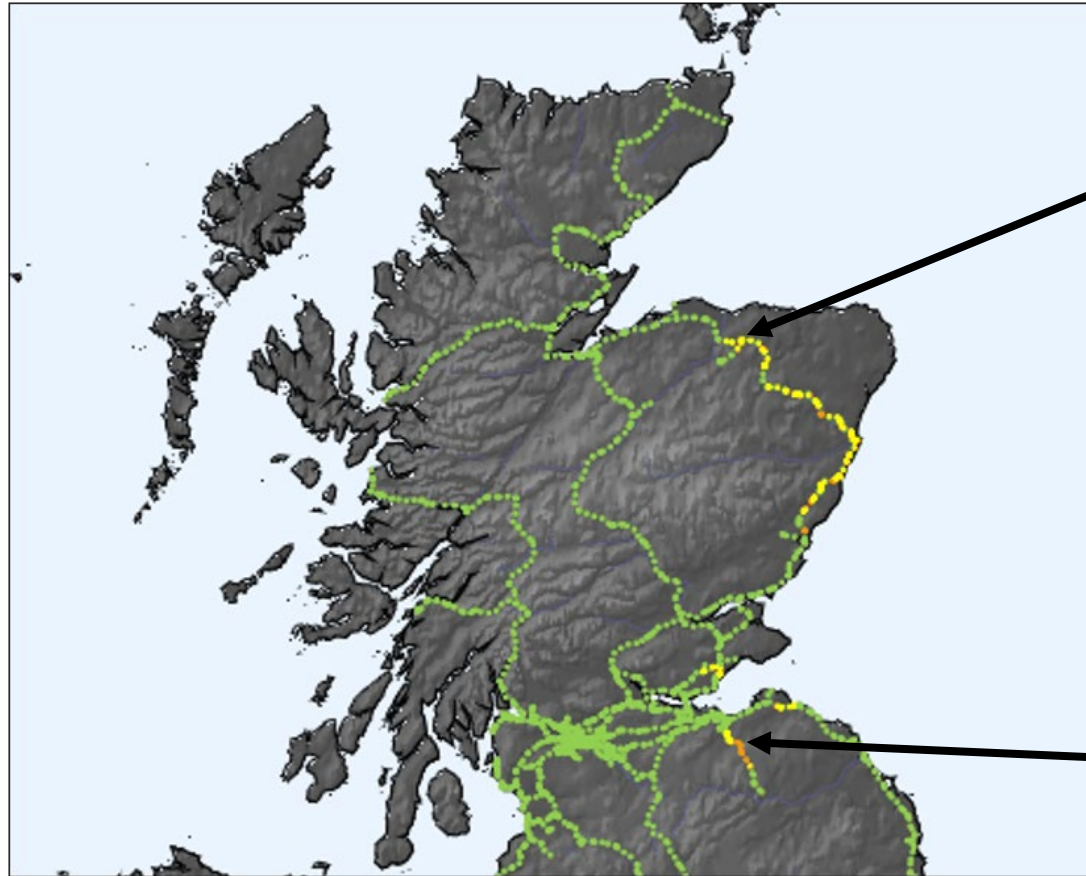
25th June 2021 CAT Alerts

Numerous ORSs within the 50km grid square register as 'Extreme'. The table on the right details ORS progression over the last three hours and the forecast over the next three hours.
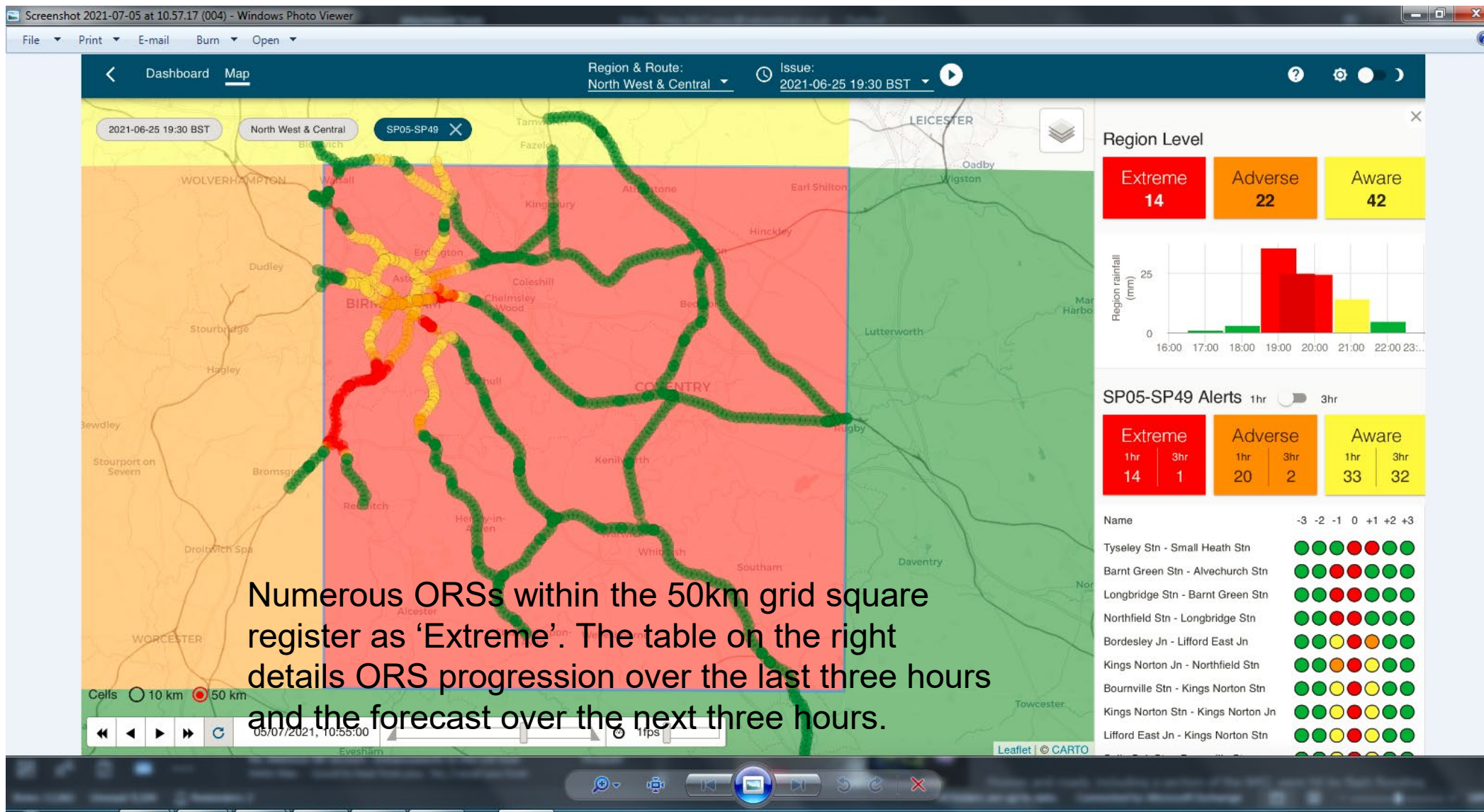
Decider Tool – Prototype Kilometre-Scale Forecasting System

A landslip between Keith and Huntly
TOC affected: ScotRail

Heavy snow between Galashiels and Gorebridge
TOC affected: ScotRail

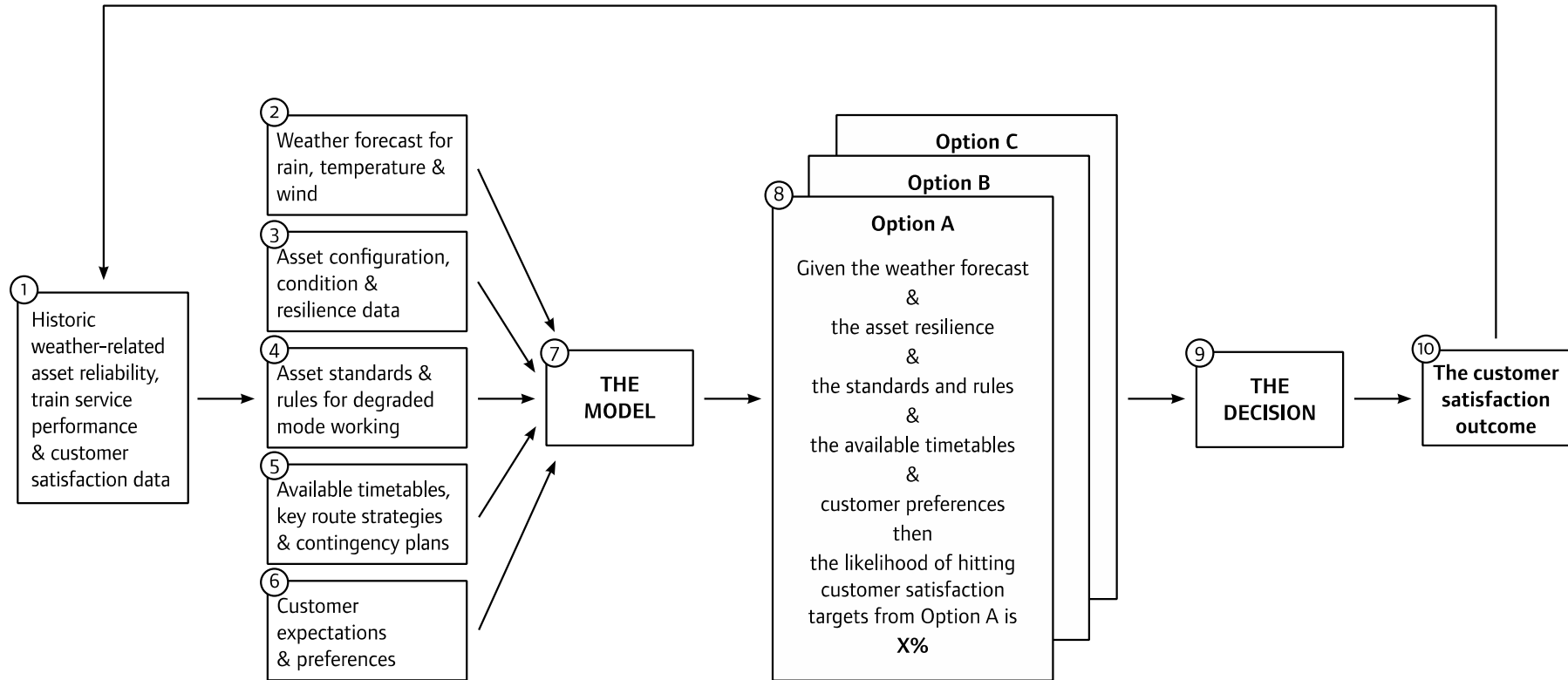**Development of the Seasonally Agnostic Railway Model**

The model, commissioned by NR to Professor John Beckford of Loughborough University, is intended as a decision support tool providing evidence to Route Operations Managers to aid the Extreme Weather Action Team (EWAT) processes and make more customer-focussed decisions about the optimum level of services to provide during periods of extreme weather.

Using AI and ML the model takes the weather forecast, the resilience of the assets and the engineers' and operators' planned mitigations to these forecasts to predict the effects on services. The finished model aims to provide options and alternatives (e.g., to run the full service but expect severe delays or to run a modified service and provide it at a higher performance level.)

Influence IWMP maturity.

The Pilot for The 'Seasonally Agnostic Railway' Model

1 Historic weather-related asset reliability, train service performance & customer satisfaction data

2 Weather forecast for rain, temperature & wind

3 Asset configuration, condition & resilience data

4 Asset standards & rules for degraded mode working

5 Available timetables, key route strategies & contingency plans

6 Customer expectations & preferences

7 THE MODEL

8 Option C

Option B

Option A

Given the weather forecast
&
the asset resilience
&
the standards and rules
&
the available timetables
&
customer preferences
then
the likelihood of hitting customer satisfaction targets from Option A is
X%

9 THE DECISION

10 The customer satisfaction outcome

Notes
1. 'Assets' include Infrastructure, rolling stock & operational people
2. Asset data is held for each Operational Route Section & fleet type and at sub-system, not component, level
3. 'The Decision' is made by appropriate people at appropriate lead times (e.g. 3 months, 3 weeks, 3 days or 3 hours?)
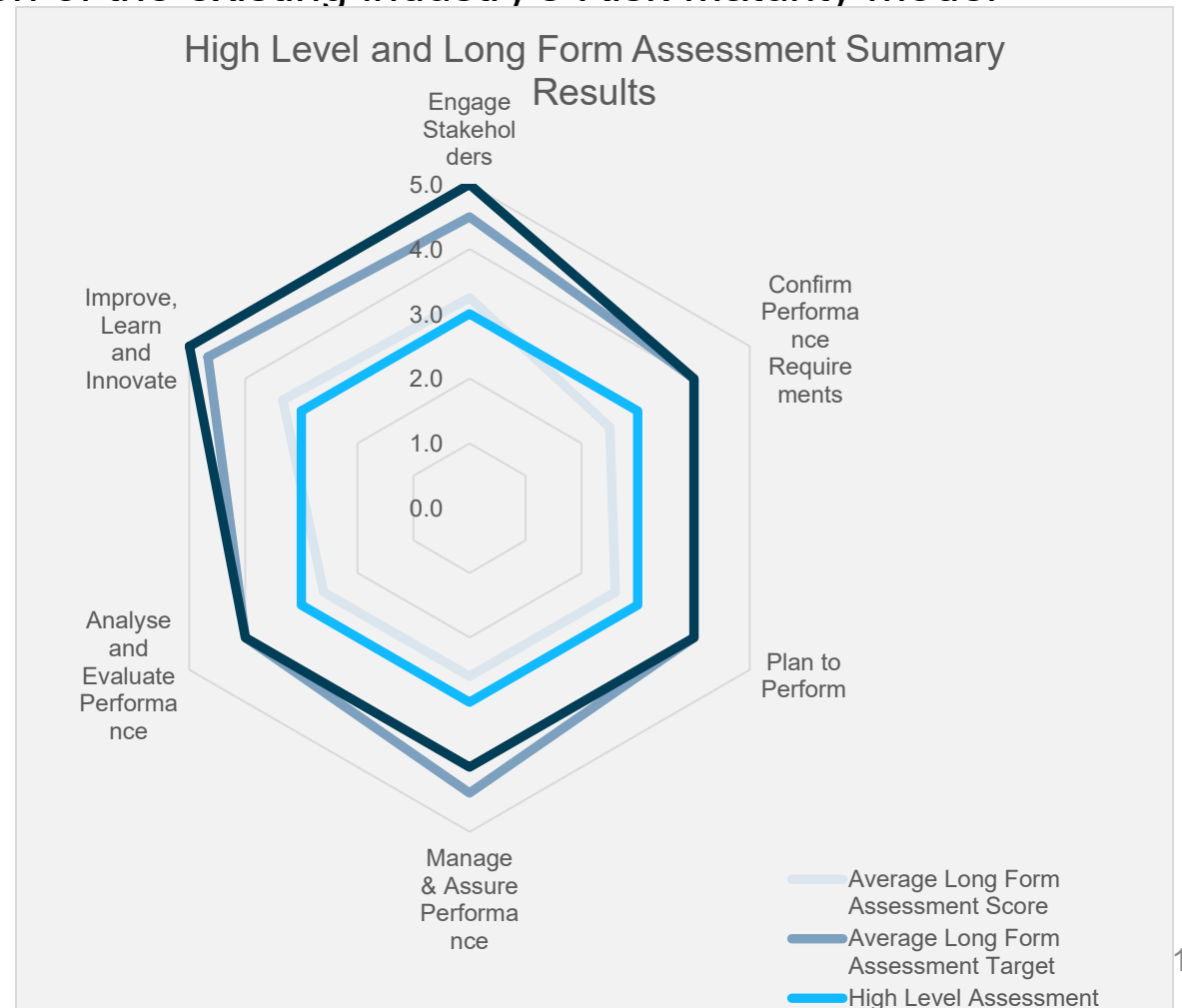
Improvement of assurance process and development of the RM3 Maturity Process

Improvement of the assurance process by adoption of the existing industry's Risk Maturity model (RM3) performance.

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The National Weather Team have already started to develop the maturity model under the Processes Definition Document (PDD) that now has KPIs, these now need to be tested and scoring measures need to be applied

Assurance Maturity

Quantitively to Qualitative

High Level and Long Form Assessment Summary Results

Average Long Form Assessment Score
Average Long Form Assessment Target
High Level Assessment

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Development of the Hot Weather Approach Document

Approach document around the management of hot weather, capturing what we do, what we should do and what we could do (As the development completion and socialisation of the approach document for management of Adhesion).

Adopted by all regions and mandated by Network Performance Board (NPB).

Cold Weather Approach document commissioned.

Seasonal Challenge Steering Group

GB Rail Industry Approach To Railhead Adhesion Management

Version1.1

Seasonal Challenge Steering Group

GB Rail Industry Approach to Hot Weather Management

Version 1.0

Seasonal Challenge Steering Group

GB Rail Industry Approach to Cold Weather Management

Version 0.0
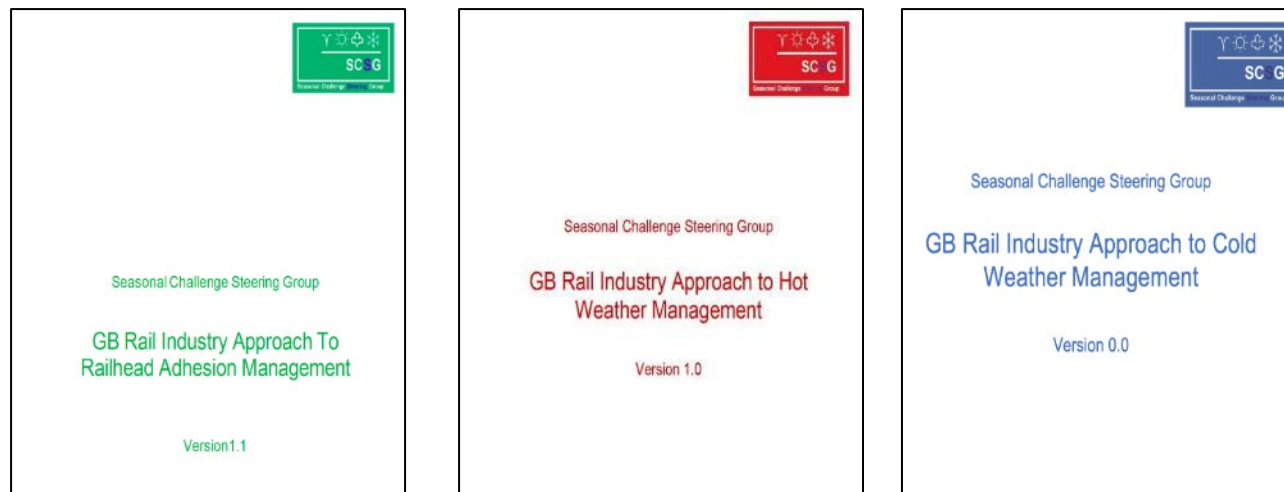
Network Performance Board (NPB) Submissions from SCSG - Papers and Briefings

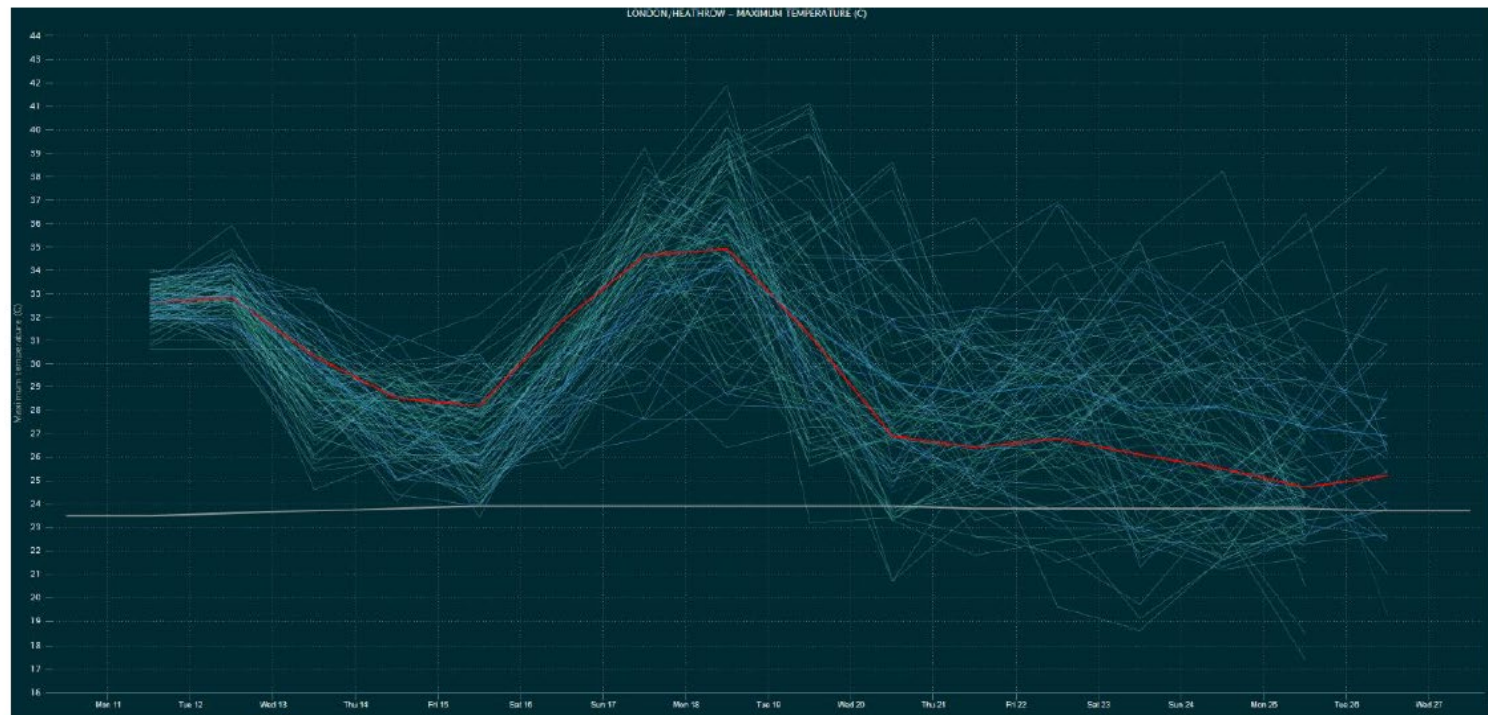Development of Leading Indicators & Targets with Routes and Operators – Setting Targets as presented at the National Adhesion Review (March 2022)

Adoption of leading indicators (use of LRF/Probabilistic Forecasting) – mandated by NPB

Bias Corrected EC Ensembles 8 days ahead of the 40C day on 19 July 2022 for London Heathrow

Hazard	Broad Risk Predictability	Fine Detail Predictability	Risk of forecast model sig. errors within 2-5 days of event	Risk of forecast model sig. errors within 2 days of event
Strong Winds: Parent depression	2-7 days	24-60 hours	Moderate	Low
Strong Winds: Secondary depression	1-3 days	6-36 hours	Very High	High
Strong Winds: Sting Jet	0-3 days	0-12 hours	Very High	Very High
Frontal Rainfall	2-5 days	12-36 hours	High	Low-Moderate
Convective Rainfall inc. thunderstorms	1-4 days	0-3 hours	Very High	Very High
Heatwaves	3-15 days	1-3 days	Low to Moderate	Very Low
Severe Cold	3-10 days	12-72 hours	Moderate	Low
Frontal Snowfall	1-4 days	6-48 hours	Very High	High
Convective Snowfall	1-4 days	1-12 hours	Very High	Very High

Lead-time predictability for different Network Rail weather hazards summary table

Weather related recommendations including (but not limited to) the recommendations arising from the following incidents

2019 Stonehaven
2021 Salisbury
2022 Haddiscoe Flooding
2022 Hot Summer Events

Changes to NOPs, Standards and Processes – captured through the Approach Documents and IWMP development (RM3P)

Weather Academy: Target State

Updated Target state to define WA scopes into key focus areas that will enable product definition and benefit realisation

Community of Practice

Weather Academy Target State

Learning & Sharing

Multidisciplinary groups coming together to share, learn and improve

Collaborative Online Learning Environment

Centralised hub for colleagues to access insights, good practice and to form an active community of practice

Community 'Feel'

Highly collaborative network where you feel like a 'member'

Engaging the Industry

Cross rail industry engagement to facilitate learning and collaboration. Aligning our Train & Freight Operating Companies and other businesses to align to a common vision

Conferences

Regular events to bring the industry together

Knowledge

Robust Professional Development Frameworks

Detailed review of **As-Is** weather related competencies within the industry

Define and validate competency frameworks for critical roles, e. g Ops, SDS / SDM and Asset Mgmt

Develop, deliver **training and awareness plans and materials** to key areas to manage competency gaps

Skills & Culture

Testing Skills & Experience

Integrating tabletop and scenario exercises into everyday practice

Tailored Training to Improve Decision Making

Understanding diverse training needs to develop tailored materials to equip our people with the knowledge, skills to deliver a safe, reliable and resilient service

Culture, Behaviours align to Operational Goals

Positive mindset shift to build basic meteorological knowledge, creating a common language between rail and weather services

R&D & Innovation

A journey of continuous improvement

Driving research and innovation opportunities through the Weather Academy to move towards a culture of continuous improvement

Industry Partnership and Innovation

Capitalising on existing partnerships with CIRO, RIA and APM to drive weather related research and professional development

Academic Partnerships

Partnering with academic institutions to build mixed research teams to tackle challenging strategic questions. Through exchanging knowledge and experience implement tangible improvements

Research Opportunities for Postgraduates

Seizing opportunities to research specific problem statements within our business as post graduate studies to drive improvements and learning

Weather Academy - Products

Skills & Culture

Community & Awareness

Research & Innovation

Knowledge

Summit

Annual event to:

- demonstrate WA tools

- discuss key topics and issues

- learn from across community including Research and Innovation

Workshops

Periodic activity to:

- Connect across community

- Build awareness of WA

- Develop and practice skills

WA Learning Hub

Live, online hub for:

- Collating useful information for WA community including e-learning, news/insights

- Provide portal for community comms and interaction

Communication

Regular comms to:

- Build awareness of WA and products

- Recognise capabilities and promote network

- Maintain presence at forefront

E-Learning

Subject learning material to:

- Self-serve learning to grow competency

- Reference material for use in operation

Virtual Learning

Live/instructor led online learning to:

- Provide flexible access to learning

- Grow competency in subject matter and skills

- Connect with community

Competency Models

Role based profiles to:

- Identify required levels of understanding of weather topics

- Identify required levels of capability in key skills to support weather related activities

- Inform topics/skills to be supported by other WA products

Research Projects

SME led activities to:

- Provide new insights into weather related activities and grow third party relationships

- Develop new capabilities / practices including digital solutions

Weather Risk Task Force

NetworkRail

Innovation and collaboration

The innovation platform has been developed in the commonly used Performance Improvement Management System (PIMs). The platform will need to be updated to include adoptive practices as well as new and emerging innovations.

ARG – Adhesion Related Research
UIC – RAIN – PRECIP Research
UIC – Hot Weather Research
RSSB – OLE Ice Research
SCO – Cryogenics
Met Desk and MO Probabilistic WF
Veg Index
TA - LIDAR

Support the enhancement of Key Route Strategies

Partnership with routes to develop a prototype framework for managing extreme weather conditions.

Best Guide Document has been socialised following collaborative work with Western NW&C and Chilterns.

Questions