



Midlands Highway Alliance Plus

Highways & Transport: The Future

Wednesday 23 September 2026



Workshop 4: Resilient Networks

Climate Risk & Vulnerability Assessment (CRVA Tool)

Network Resilience Index

TfWM managing the West Midlands regional network



Regional Transport Coordination Centre & Traffic Network Coordination Team

**Adam Holland – RTCC Manager
Darren Thrupp – TNC Manager**



00:00.00



RTCC Charter (partner signatories)

Signatories



RTCC Data and Systems

Report ID
RTCC Pulse Report 003

Date
15/03/2025 16:00

Overall RAG Rating
Amber

Pulse Time	Overall	National Highways	LA Highways	Bus	Metro	Rail
12:00	Green	Green	Green	Green	Green	Green
14:00	Green	Green	Green	Green	Green	Green
16:00	Amber	Green	Amber	Amber	Green	Green

RAG Rating Notes
Delays of 20-30 minutes on routes around Holloway Circus, from CCTV issues with junction blocking across

Weather
Today: Cold start as mist clears. Cloud building through the day, though some sunny spells still emerging during the afternoon. A few light showers, but many places staying dry. Gentle winds. Maximum Temperature 9C.

Planned events

Event	Time
West Bromwich Albion FC v Hull City AFC (Kick Off: 15:00, The Hawthorns)	15/03/2025 3:00 PM
Jimmy Carr: Laughs Funny - Symphony Hall, Birmingham	15/03/2025 8:00 PM

Weather Warnings
More info

Total IMS Incidents
13

Bus	Rail	Metro	Road	Sprint	Strategic
12	1	1	13	1	0

Birmingham

Coventry

Dudley

Sandwell

Solihull

Walsall

Wolverhampton

Staffordshire

Warwickshire

Worcestershire

Traffic Irregularities
9

National Highways
1

Social Media Links

Link	Platform	Account
	X	Transport for West Midlands
	f	WM Roads
	f	Transport for West Midlands
	f	WM Roads
	f	TWMM Website

TWMM RTCC Operations Dashboard

Regional Transport Coordination Centre

Local Authority Filter
All

Authority Filter
All

RTCC Disruptions
3

Irregularities
8 on KRN 7

New Congestion Disruptions
5 Existing Disruptions: 50

National Highways Disruptions
4

SATC Traffic Count Alerts
1

Bus Disruptions
23

Metro Disruption
0

Rail Disruptions
1

Flood Disruption
0

Weather Warnings
0

Overall RAG
Green
31/03 06:25

Local Authority Highways
Green

National Highways
Green

Bus
Green

Metro
Green

Rail
Green

Highways

Waze Irregularities
Sorted by time delay

Impact: Moderate - Smiths Wood - Smiths Wood Highways: True
extra delay: 15:00 minutes jam length: 3 miles
current speed: 12.90 mph Regular Speed: 55.70 mph
Alert time: 01/04/2025, 09:05 Last detected: 01/04/2025, 09:51
KRN:

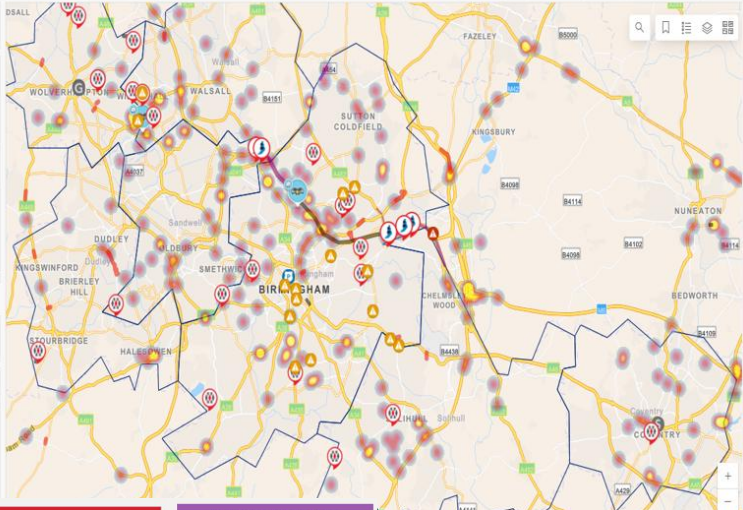
Impact: Moderate - A454 - Walsall Rd Highways: False
extra delay: 8.90 minutes jam length: 1 mile/s
current speed: 3.50 mph Regular Speed: 20.50 mph
Alert time: 01/04/2025, 09:17 Last detected: 01/04/2025, 09:51
KRN: Birmingham Cross City

Public Transport and others

Bus Disruptions

Total Services: 3: Carolean Coaches - 23, NX - 529, Carolean Coaches - 23A
Disruption/Reason: Roadworks - WMMet: N
Start Date: 03/02/2025, 00:00 End Date: 29/08/2025, 01:00

Total Services: 4: Diamond Bus - 50A, Diamond Bus - 50, NX - 50, NX - 35
Disruption/Reason: Kings Heath railway station works - WMMet: N
Start Date: 23/03/2025, 00:00 End Date: 10/05/2025, 01:00



Open Incidents

Incident Date & Time: 17/02/2025

INC - 25.03.2025 - 4
Type: Road Works
Title: B4484 Bilston Street, Willenhall - TfWM w/road closure - until August (CCTV 1066)
Incident Date & Time: 21/03/2025

INC - 24.03.2025 - 3
Type: Road Works
Title: A435 High Street, Kings Heath - TfWM works w/traffic signals - until 11th May
Incident Date & Time: 24/03/2025

INC - 25.03.2025 - 8
Type: Road Works
Title: A452 Chester Road - Cadent w/traffic signals (adjacent to rail station) - until 31st March
Incident Date & Time: 25/03/2025

Overall RAG
Red
31/03 11:04

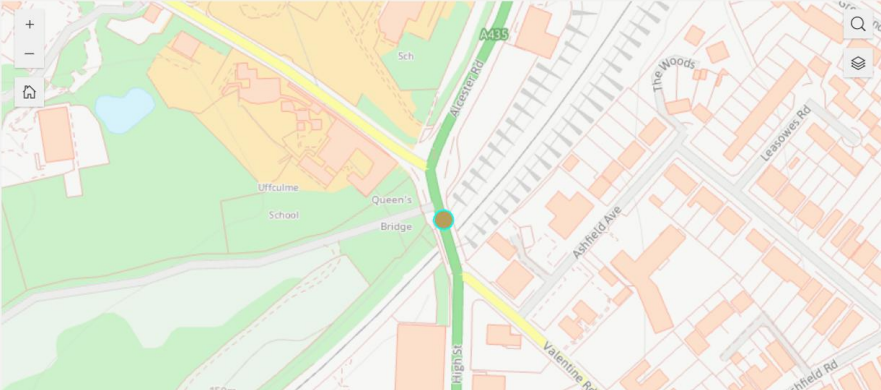
Local Authority Highways
Amber

National Highways
Green

Bus
Amber

Metro
Green

Rail
Red



Incident Counters

0 Severe Incident(s)

1 Moderate Incident(s)

0 Low Impact Incident(s)

0 Planned Event(s)

Incident Information

INC - 24.03.2025 - 3

Title: A435 High Street, Kings Heath - TfWM works w/traffic signals - until 11th May
Category: Moderate
Type: Road Works

Initial Description:
A435 High Street, Kings Heath, 3-way traffic signals in place at Queensbridge Road junction for TfWM works around new Kings Heath rail station, until 11th May. Valentine Road also closed to/from High Street. •NX 1, 35, 50, Diamond 50.

RTCC incident/event responses



Event briefs and Operational Orders for expected significant impacts

Response for larger-scale events (Great Birmingham Run, Birmingham Pride, Coventry Motorfest, Dudley Grand Prix cycling)

RTCC extended hours (including Sunday operations) where deemed appropriate.

Increased links with event partners (football clubs, Edgbaston, Utilita, BP Pulse, NEC)

Seasonal response for Digbeth and Birmingham City Centre (Saturdays in November and December)

- Transport Safety Officers (including Drone)
- West Midlands Police resource (within RTCC and police bikes)
- Links with Birmingham UTC
- pVMS
- Traffic signallers through works (notably MMA links)
- Use of CCTV to assist bus operations, notably through Markets area
- Links with car parks and managing traffic around closed entrances

Use of RTCC as wider co-ordination space for CWG (Tactical Transport Facility)

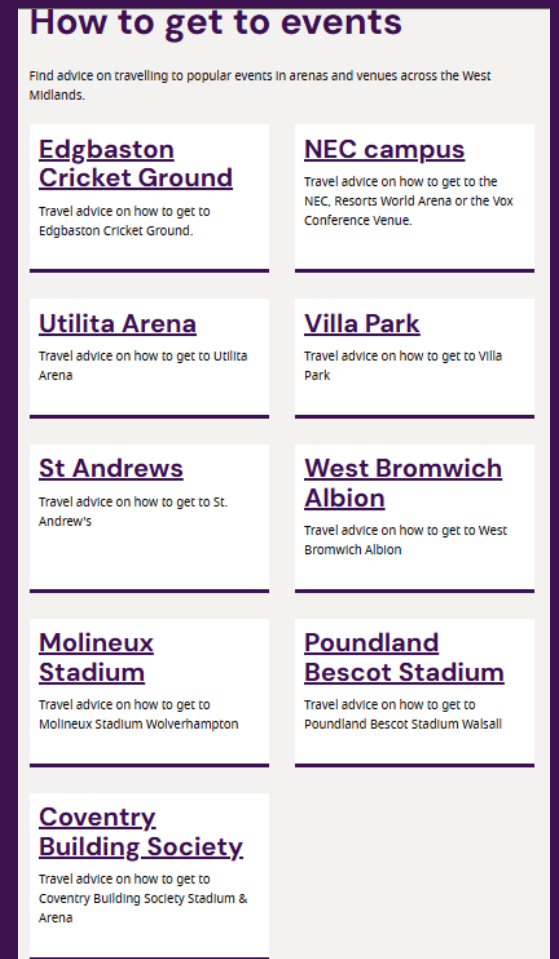
Social media and website comms



Updates to @WMRoads and @TransportforWM Twitter (X) feeds

Amplifying partner comms, including additional information on any delays or cross-modal impacts/mitigations

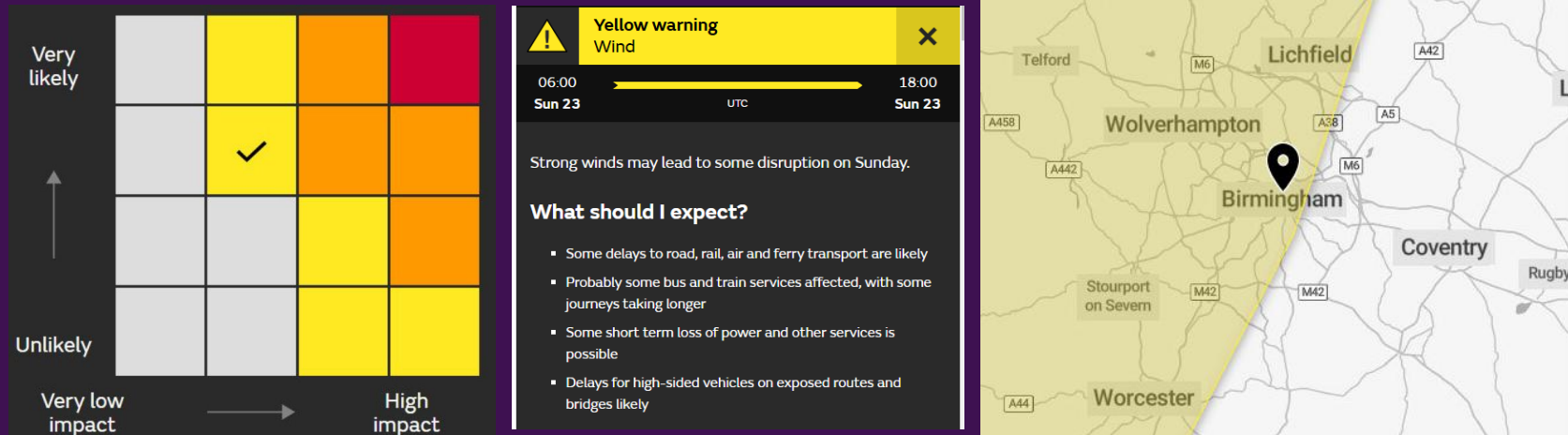
Banner messages, landing pages and disruption links on TfWM website



Weather reporting

Uses information from Met Office (rain, snow, ice, wind, thunderstorms) and UKHSA (heat)

Weather matrix applied for Yellow > Amber > Red alerts



Where Yellow, a basic RTCC alert is issued detailing expected impact (location and date/time), based on Met Office/UKHSA information received

Where Amber/Red, a more detailed RTCC Brief can be issued with more detailed transport network impacts and expected partner responses

On-network outputs

Agreement with Solihull UTC to access and utilise their Variable Message Signals (VMS)

Used for incidents on local routes, National Highways' SRN, and major incident at Birmingham Airport

Portable VMS at various network locations

Used across M42 J6/NEC (junction blocking), supporting Sprint works in Solihull, M5 J1 approaches (traffic signal upgrade), around Birmingham (seasonal response, bus gate, A435 works), and M6 J3 slip road (National Highways support with near-misses)

Bus stop Real Time Information (RTI) screens

Able to update during incidents where services are either diverted or significantly impacted

Links with Coventry (out of hours) and Sandwell (24/7) to assist with traffic signal interface where able and appropriate

Key Message

The TNC team reduces the impact of planned and unplanned disruption through early planning, stakeholder coordination, network monitoring and targeted mitigation measures, helping to keep the West Midlands moving.

Proactive Planning

Identifies potential network impacts from roadworks, events, utility works and major infrastructure schemes. Coordinates with local authorities, contractors and transport partners to reduce disruption before it occurs.

Disruption Monitoring

Maintains oversight of planned and emerging network issues across the region. Uses network intelligence to identify risks and potential congestion hotspots.

Cross-Agency Coordination

Brings together local authorities, National Highways and transport operators. Ensures mitigation measures are aligned across organisational boundaries.

Customer Impact Reduction

Develops mitigation plans to maintain network performance and journey reliability. Supports diversion strategies and temporary traffic management.

Continuous Improvement

Reviews lessons learned from major schemes and events. Identifies opportunities to improve future disruption management and network resilience.

RTCC & TNC: Working Together to Keep the Network Moving



Key Message

The TNC team looks ahead to minimise disruption, while the RTCC manages the network in real time. Together they provide a continuous cycle of planning, response, learning and improvement.

RTCC - Monitor & Coordinate

- Real-time network monitoring
- Incident response & escalation
- Operational decision support
- Stakeholder communication
- Regional situational awareness

TNC - Plan & Optimise

- Coordinate roadworks & events
- Identify future network risks
- Develop mitigation strategies
- Minimise planned disruption
- Improve network performance

How we connect

- TNC provides: planned works, events, risks, and mitigation plans
- RTCC provides: live network intelligence, incident impacts, trends, and lessons learned
- Together we deliver: safer journeys, reduced disruption, improved customer experience, and better network performance

TfWM & National Highways Interface



The RTCC and National Highways work together to coordinate incidents, planned works and real-time network operations, ensuring a resilient transport network and minimising disruption across both local roads and the Strategic Road Network

Joint Network Management

RTCC works closely with National Highways to monitor and manage the strategic road network, including the M5, M6, M42 and M54, which are critical to movement across the West Midlands.

Real-Time Information Sharing

Exchange of live traffic, incident and congestion information to maintain situational awareness across both local and strategic networks. Coordinated messaging helps ensure consistent travel information for customers and stakeholders.

Incident & Emergency Coordination

Joint response to major incidents, severe weather, emergencies and unplanned network disruption. Supports diversion planning and minimises wider impacts on the regional transport network.

Planned Works Coordination

Collaboration on roadworks, maintenance schemes and major infrastructure projects. Aligning activities reduces network conflicts and helps maintain journey reliability.

Supporting Regional Resilience

Through TfWM's Network Resilience function, the RTCC brings together local authorities, transport operators and National Highways to keep people and goods moving efficiently across the West Midlands.

What's next?



Assistance to LHAs where requested/agreed around traffic signal control/fault escalation and VMS (previously noted agreements with Coventry, Sandwell and Solihull)

West Midlands Bus Limited acquisition of National Express West Midlands

Bus franchising (TfWM bringing the bus network under public control, commences October 2027)

Police/emergency services interface (via presence within RTCC)

Increased partner presence within RTCC (for significant events and/or day-to-day operations)

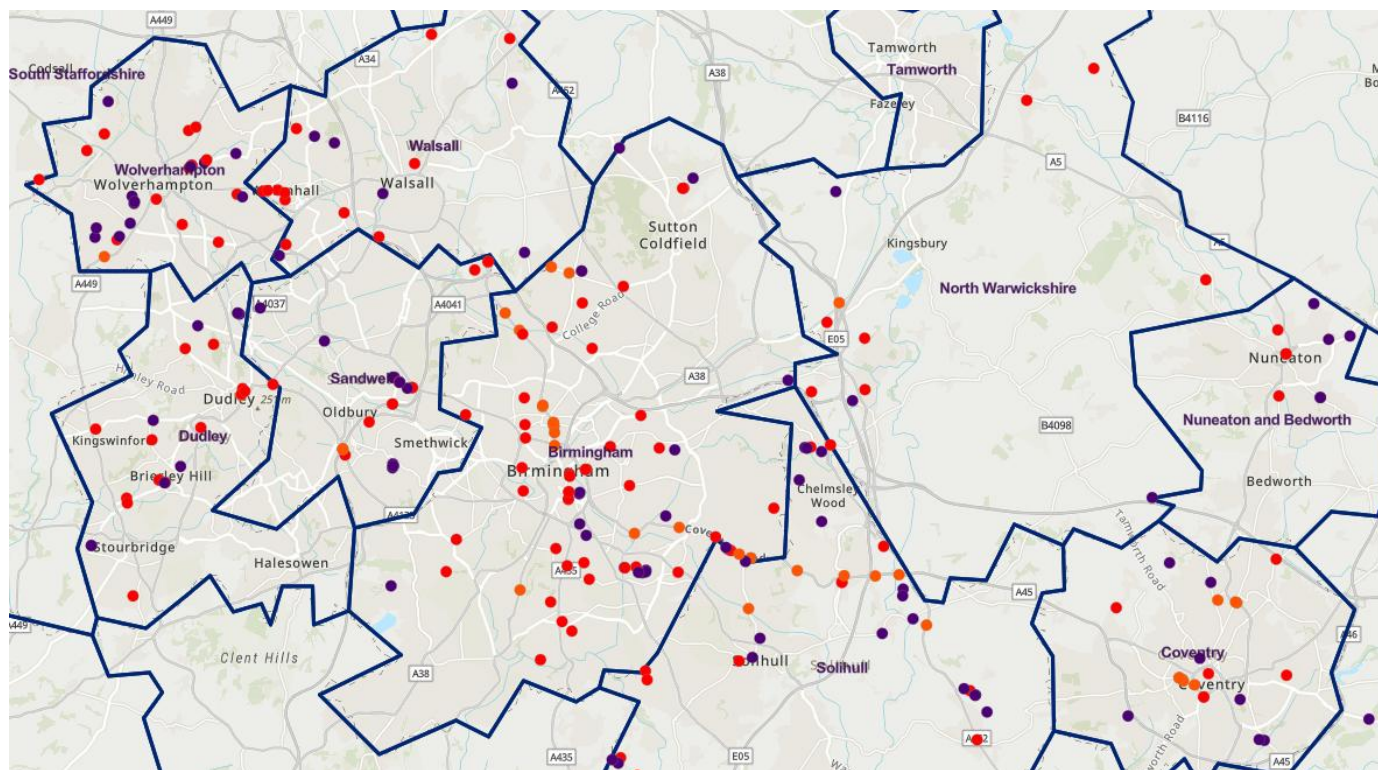
Use of AI

Increased use of TfWM TSOs and Drone team

European Athletics Championship 2026 and Euro 2028



BUSCO – Bus Route and Streetworks Coordination tool



Why we're doing this



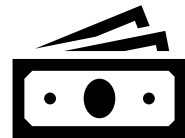
Hundreds of permits granted in the region on daily basis



Zero notice/ Immediate permits - 18%



NXBus lost mileage – 10,000km



and over £22,000 revenue loss

Who it's for

- Utility companies
- Bus operators
- Traffic planners and managers
- Scheme project managers and coordinators
- Local Highway Authorities



BUSCO – Bus Route and Streetworks Coordination tool

4 proactive opportunities to improve the customer experience

Works
planning

Works promoter

- Consider existing works on the route
- Explore alternative dates to reduce disruption
- Collaborate to minimise network impacts
- Provide supporting evidence

Works
Permit
approval

LA Permit Teams

- Review planned works and impacts
- Approve or refuse permits
- Apply conditions where needed (e.g. traffic signal controls)

Mitigation
measures

TfWM & bus operators

- Challenge permits and add conditions where appropriate
- Use data to assess impacts
- Implement mitigations (e.g. diversions, traffic management)
- Inform customers of delays and encourage journey planning

Enhanced
service

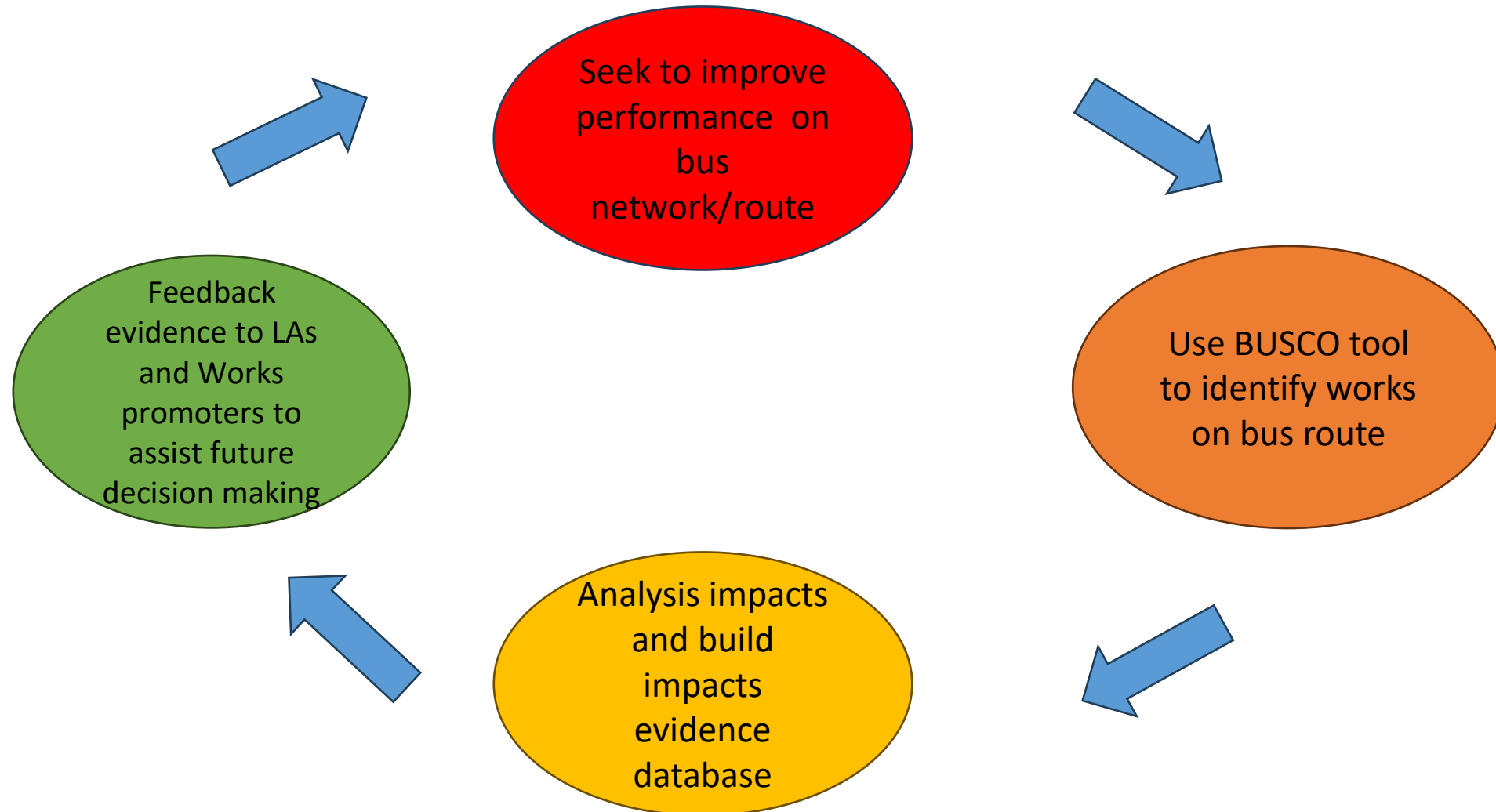
Bus Operators

- Communicate disruption to customers
- Consider enhanced services to maintain headways

Reactive use of the BUSCO tool

- Delays on bus route detected
- BUSCO tool used to identify Streetworks along the route
- Contact with LA permit teams to request mitigation measures, such as manual operation of temporary traffic signals, if appropriate
- Can assist real time decisions by NX representatives in RTCC and other bus operators – better comms
- Trigger to gather data evidence to share with LAs and works promoters for future decision making

Closing the loop



Bus Route Filters

▼ Operator and Service

Operator is any of

1 Selected

Service is any of

5 Selected

Streetworks Date Filters

▼ Window Start Date

is on or after

17/09/2026 0:00

▼ Window End Date

is on or before

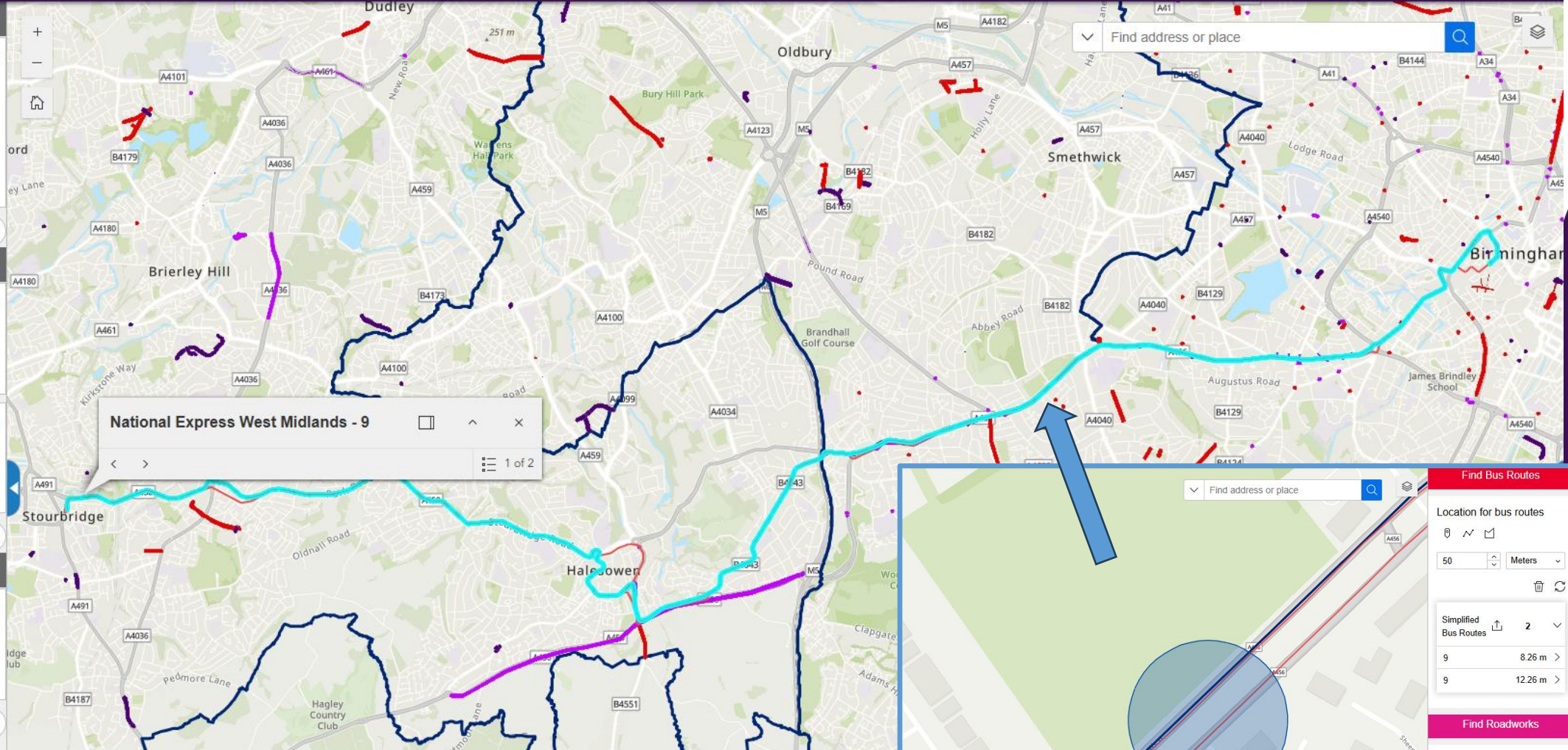
30/09/2026 23:00

TM Type Filter

▼ TM Type

is any of

3 Selected



National Express West Midlands - 9

< >

1 of 2

Find address or place

Find Bus Routes

Location for bus routes

50 Meters

Simplified Bus Routes 2

9 8.26 m

9 12.26 m

Find Roadworks

Location for roadworks

50 Meters

Our Lady of Fatima Roman Catholic Primary School

Transport CRVA Tool

A transport-focused Climate Risk and Vulnerability Assessment tool applied to the West Midlands, evaluating how climate change and severe weather events could affect transport networks, infrastructure, and operations.

The Challenge



Infrastructure investments worth £650bn at risk if climate resilience neglected

By Daniel Gayne | 5 July 2022

Environment Agency chair calls for Treasury review on issue

Nearly £650bn of public and private infrastructure investment planned by 2030 are at risk unless climate impacts are factored into planning and delivery.



UK insurers set to pick up £219mn subsidence claims bill from 2022 heatwave

Further Climate Change is inevitable

Even under the most ambitious global efforts to reduce greenhouse gas emissions, climate change will continue for several more decades.

- Projections suggest that under current emissions scenarios, we can expect around 2°C by 2050 and 2-3°C warming by 2100.
- More extreme warming scenarios remain possible, potentially exceeding 4°C by 2100 – so we need to plan for 4°C increases

An urban area unprepared for extreme weather



Heavy rainfall and storms leading to...

- 1 Surface water flooding obstructs roads and pavements.
- 2 Contaminated water pools on poorly managed derelict site.
- 3 Surface water floods housing where drains struggle with heavy rainfall.
- 4 Increased emergency service demand in response to flooding.
- 5 High river levels flood roads and houses.

High and extreme temperatures leading to....

- 6 Poor ventilation and sun exposure lead high-rise flats to overheat.
- 7 Heat stress of staff lead shops to close due to poor ventilation and no air conditioning.
- 8 Tightly packed housing, with poor energy efficiency and ventilation, with vulnerable residents at high risk.
- 9 Communal car parking has limited public green space and natural shading for respite and shelter.

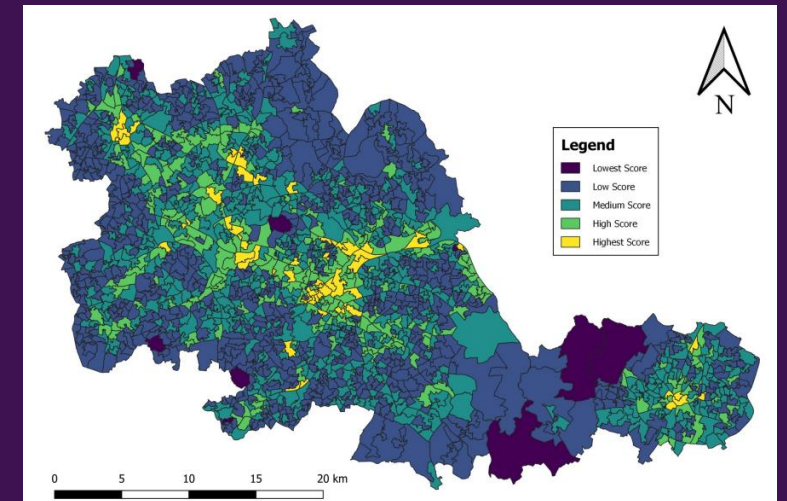
CRVA: Understanding Climate Risk Across the Transport Network

CRVA helps TfWM and its partners anticipate climate-related transport risks before they become operational issues

- Maps flooding, heat and severe weather impacts
- Highlights critical and vulnerable parts of the network
- Supports resilience planning and disruption mitigation
- Enables evidence-based investment decisions

Operational Benefits

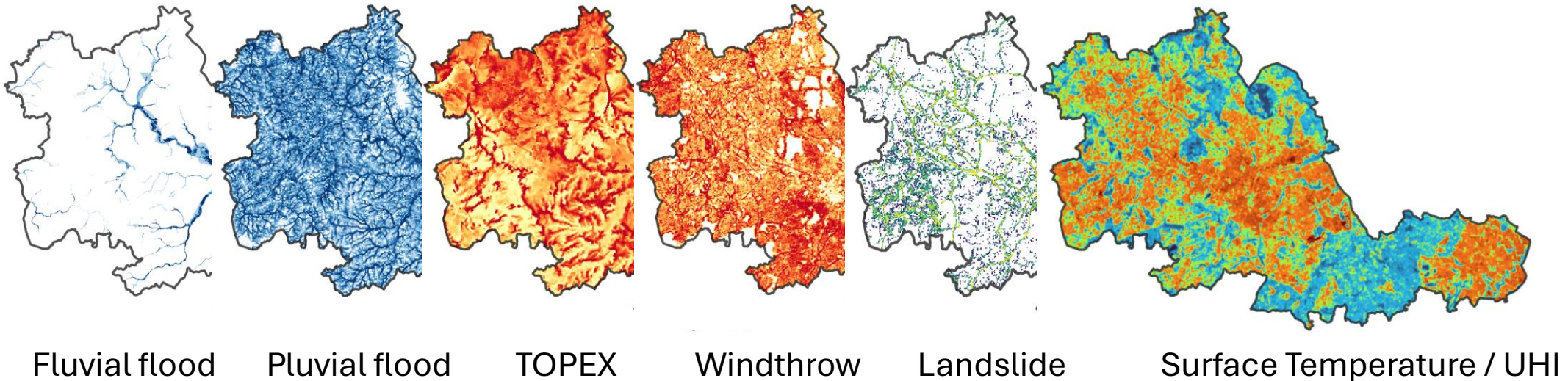
- Supports proactive disruption management
- Identifies network resilience priorities
- Informs investment and maintenance decisions
- Strengthens severe weather preparedness
- Provides a shared evidence base for regional partners



Research paper link - https://pure-oai.bham.ac.uk/ws/portalfiles/portal/258761424/WM-Transport_CRVA_methodology_guidancedoc_00004388_.pdf

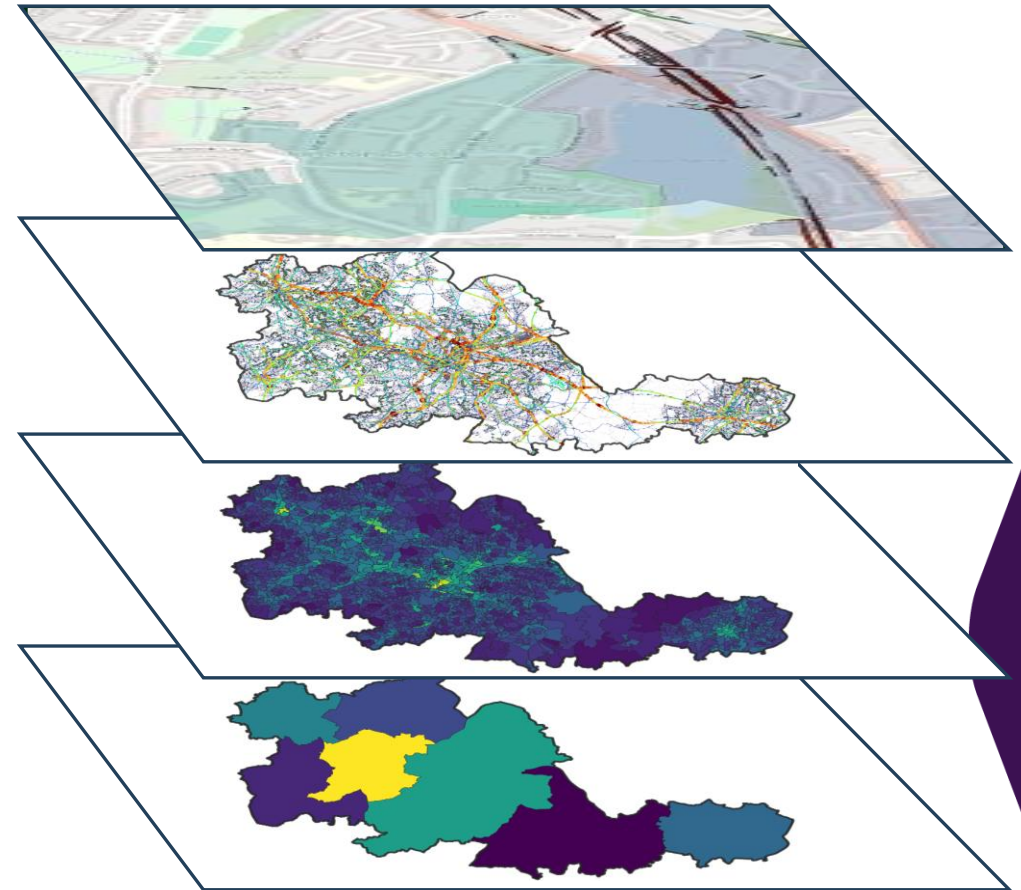
Hazard Mapping

- Standardised methodologies to create hazard layers
- Use of publicly available, validated datasets
- Aggregated to common scale and extents (100m resolution)



Decision making at multiple scales

- Identify locations with high climate-related risk to inform regional climate adaptation priorities
- Rolled up risk as well as individual climate hazard contributions
- Impacts can be determined from regional level to individual asset level
- Supports data aggregation and statistical analysis



Moving from Risk based to resilient

- Dealing with severe weather, such as flooding is becoming the norm rather than an emergency response. What does that mean for contracts and service operation planning
- Need to be prepared to deal with a wide range of weather year round
- Need to adapt our skills, resources, data, kit, materials and operating practices to be future ready – all of this will remain a challenge
- Harness the full potential of technology/digital and AI solutions
- We are on the first steps of a long journey toward adaptation and community resilience
- The need to take the community with us and manage expectations. They need to know what to do, to keep an eye on updates, which roads to avoid etc.

Practitioner Use



Highway Asset and Maintenance

Enhanced inventory & maintenance data, leading to proactive maintenance schedules and long-term renewal programmes.



Policy & Strategy

Incorporate into long-term policy development and evidence investment areas for climate adaptation and resilience.



Transport Scheme Development

Support business cases and early design phases.



Project Delivery

Anticipate climate-related construction challenges and work closely with scheme designers.



Operational & Emergency Planning

Understand network vulnerability, prepare operational response plans, and coordinate with operators & emergency services.

Resilience Index

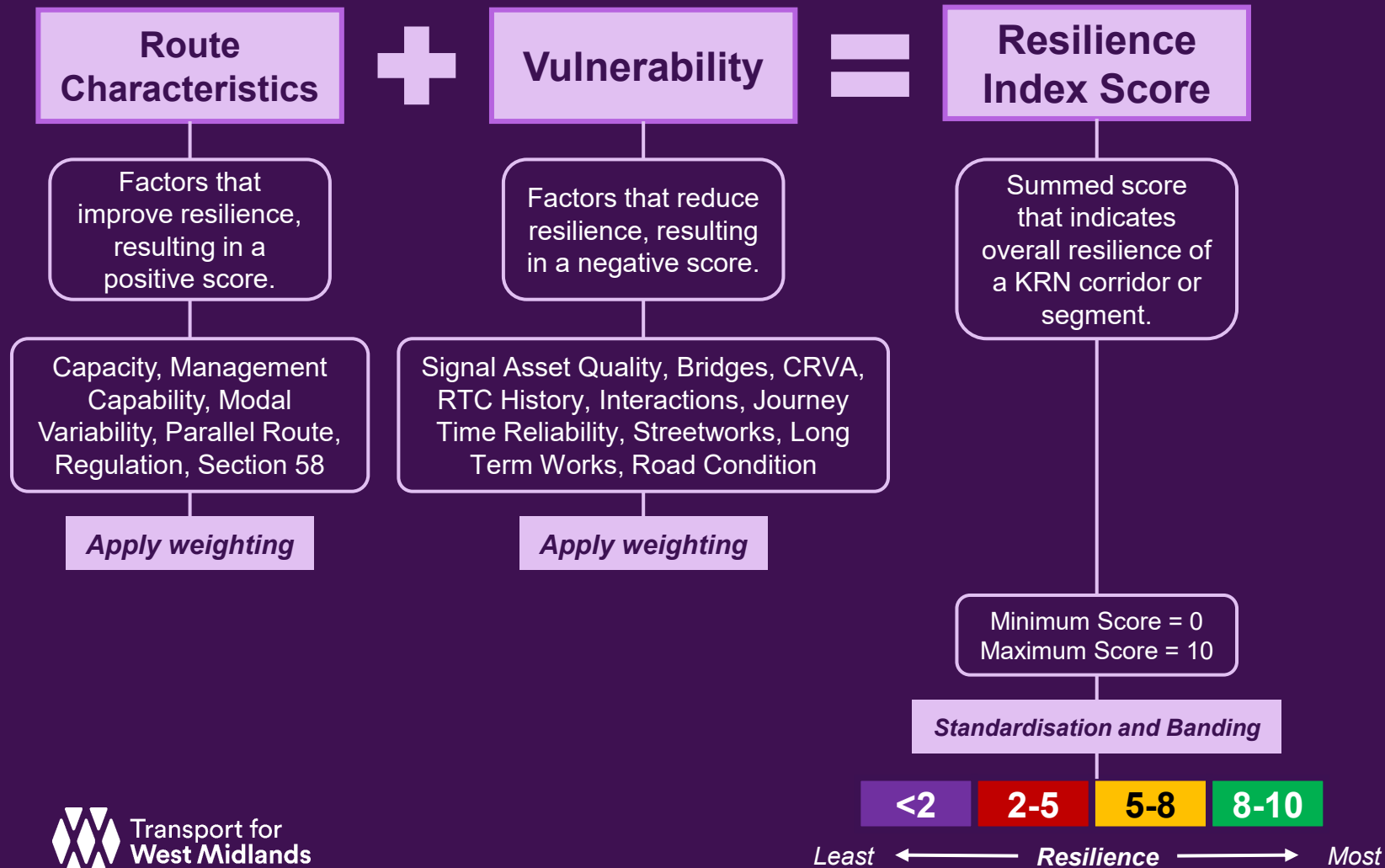
A detailed resilience assessment of the Key Route Network (KRN) in the West Midlands.

To strengthen the **resilience** and **reliability** of the KRN by developing a data-driven tool which will enable **proactive planning** and **informed decision-making** to minimise disruption, support funding opportunities, and enable our customer experience principles. ✨

Objectives and Outputs

Objective		Outputs
Evaluate existing resilience on the KRN and understand route characteristics and vulnerabilities on the KRN.		• A methodology document detailing data sources and weighting. • Interactive GIS-based resilience map of the KRN. • Dashboard for decision-makers showing resilience scores by corridor.
Improve journey time reliability.		• Evidence base for future bus franchising proposals. • Inform diversionary routes. • Insights on journey variability across KRN corridors and segments.
Identify opportunities to enhance resilience through scheme development and mitigations.		• Predict disruption impacts for planned works and events. • Mitigation strategies for major schemes and projects. • Influence scheme proposals that would benefit from increased resilience.
Integrate resilience index insights into long-term transport planning and investment prioritisation.		• Resilience-informed prioritisation framework for capital projects. • Guidance document for embedding resilience in scheme appraisal. • Annual resilience performance review to track improvements.

Proposed Methodology



Route Characteristic

Route Characteristic	Definition	Scoring Criteria	Source
CAPACITY	Using Volume Capacity Ratio, where observed number of vehicles using the road is divided by the maximum number of vehicles the road can handle in ideal conditions.	>100% = 0 80-100% = +1 <80% = +2	KRN Capacity Index
MANAGEMENT CAPABILITY	Whether there is signal control and/or UTC control, or the route has no control requirement.	Not required = +1 Signals = +1 UTC = +2	KRN Asset Dashboard
MODAL VARIABILITY	Whether there are non-road transport alternatives e.g. rail or tram. <i>Exact methodology to be revisited.</i>	No = 0 Alternative = +2 Multiple = +4	Network Map
PARALLEL ROUTE	Whether there is an alternative KRN corridor running in close proximity.	No = 0 Alternative = +2 Multiple = +4	KRN Routes
REGULATION	Are there TROs such as yellow lines or red routes to encourage free flow?	Yellow lines = +1 Peak time prohibited loading = +1 Red route = +2	ParkMap

Vulnerabilities

Vulnerability	Definition	Scoring Criteria	Source
SIGNAL ASSET QUALITY	Age of signal asset (if present).	0-10 years = 0 10-20 years = -1 >20 years = -2	Imtrac
BRIDGES	Bridges that run above the carriageway and constitute a strike risk or failure of the bridge would impact use of carriageway below.	No = 0 Yes = -1	KRN Asset Database
CLIMATE RISK	Environmental risk to associated transport infrastructure, using Climate Risk and Vulnerability Assessment Tool.	0 – 0.6 = 0 0.6 – 0.8 = -1 >0.8 = -2	CRVA Tool
IMS / RTC HISTORY	Number of medium or above incidents in the previous 6-months of Incident Management System (IMS) data including RTCs.	0-2 = 0 >2 = -1	IMS
INTERACTIONS	Number of junctions/frontages/ped activity/on-street parking / commercial driveways with activity. Considered as a % of segment length.	0-10% = 0 10-30% = -1 30-50% = -2 >50% = -3	Google Maps, Vaisala
JOURNEY TIME RELIABILITY	Buffer index of average journey time between 0600 and 2000 and 95 percentile journey time in the previous 6-months of data.	0-19.9% = 0 20%-39.9% = -1 >40% = -2	Inrix
STREETWORKS	Number of 3+ day streetworks (lane closure, temp. signals, road closure) in the previous 6-months of streetwork data.	0-5 = 0 >5 = -1	Street Manager
LONG TERM WORKS	Long term streetworks (lane closure, temp. signals, road closure) with a duration of 6-weeks or longer.	No = 0 Yes = -1	Street Manager
ROAD CONDITION	Independent sections of road classified as red on Vaisala Road AI map.	0-3 = 0 >3 = -1	Vaisala Road AI

KRN Resilience Index | Map



- Route Filter
- ☐

12 – Lichfield to Wednesbury
- ☐

13A – North and South Coventry
- ☐

13B – University to North War...

- Layer Filter
- ☒ Total Resilience Score

☐ High

☐ Moderate

☐ Low

☐ Severe
- ☐ Route Characteristic Score

☐ Capacity

☐ Management C...

☐ Modal Variability

☐ Parallel Route

☐ Regulation
- ☐ Vulnerability Score

☐ Signal Asset Quality

☐ Bridges

☐ CRVA Score

☐ RTC IMS History

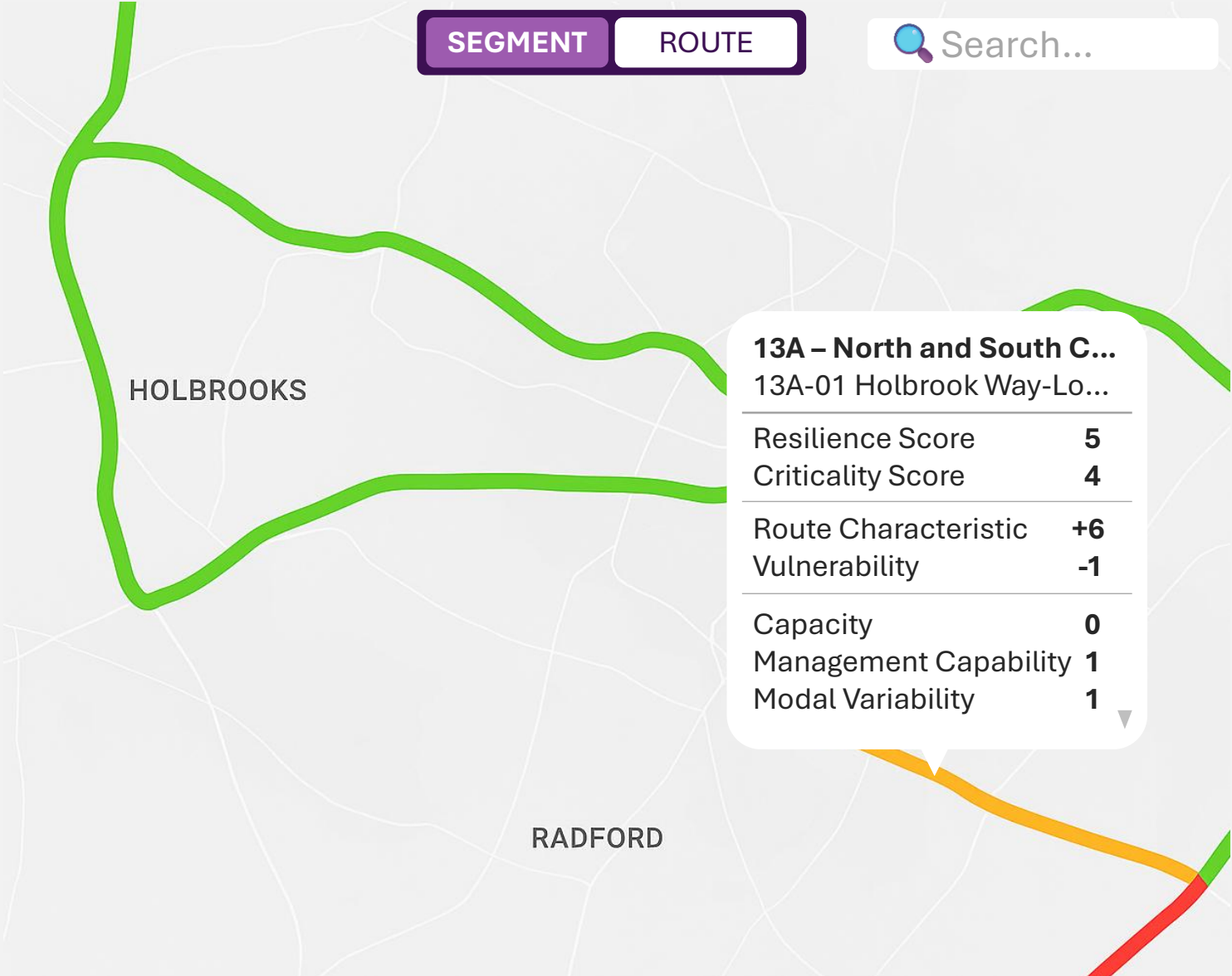
☐ Interactions

☐ Journey Time R...

☐ Streetworks

☐ Long Term works

☐ Road condition
- ☐ Criticality Score



Resilience Index

Short description of what the Index is and shows.

Route Characteristic

Short definition and positive score factor.

Vulnerability

Short definition and negative score factor.

Criticality

Short definition and independence from resilience score.

Legend – Resilience

High	8-10	
Moderate	5-8	
Low	2-5	
Severe	<2	

KRN Resilience Index | Dashboard



Data Displaying

13B – University to North Warwickshire

Route Filter

- ☐ 11A – Cinder Bank Island to Halesowen
- ☐ 11B – Cinder Bank Island to Kingswinford
- ☐ 12 – Lichfield to Wednesbury
- ☐ 13A – North and South Coventry
- ☒ 13B – University to North Warwickshire
- ☐ 14 – Northfield to Wolverhampton

Route Resilience Rank

↑↓ Low to high

17A – Birmingham to M42 via Shirley	1.4
02 – Birmingham Outer Circle	2.6
01A – Birmingham Middleway	3.7
01H – Birmingham Transport Interchange	4.3
15 – Pensnett to Oldbury	5.2
13B – University to North Warwickshire	5.6
10 – Essington to Wednesbury	7.5
01J – Perry Barr to Streetly	8.1
01D – Birmingham to Lichfield	8.7
20 – UK Central to Sutton Coldfield	9.2

25%

Segments with low resilience

5.6

Average resilience score

Tamworth Road

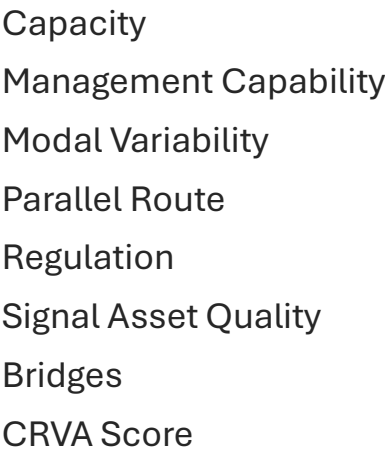
Lowest resilience segment

Radford Road

Highest resilience segment

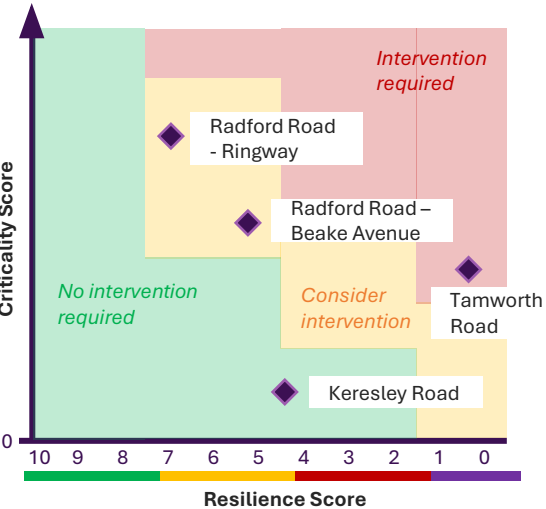


Resilience Factor Contribution to Score



Segment Analysis

Criticality vs Resilience



Data Confidence

The **effectiveness** and **accuracy** of the Resilience Index depends on **high-quality, consistent, and up-to-date** datasets across all local authorities.

Variability in data availability between authorities may lead to gaps or discrepancies in the regional picture; where data is missing or uncertain, the tool will apply a **data confidence level**.

Some **desirable** resilience factors cannot currently be scored because the required datasets do not exist or are not readily accessible.

The tool is designed to be **flexible** and **adaptive**, allowing new datasets to be added as they become available and outdated or low-value datasets to be removed.

Weightings, bandings, and factor definitions can be **refined** over time based on user feedback, improved data quality, and changing operational needs.

Use-cases (1)



Scheme Mitigation and Network Coordination

When long-term highway and/or streetworks are planned on the KRN, there needs to be a data-led approach to consider, develop, and implement mitigation strategies.

Example: A corridor shows low resilience and high criticality → schemes must include mitigation like bus diversions, signal timing changes, off-peak working etc.



Operational and Emergency Planning

Identify low-resilience corridors in proximity to, or a key link to, major venues or events across the region to determine relevant measures that ensure operational viability. With time seasonal variation established.

Example: A segment has high winter vulnerability → prepare, establish, and adjust bus diversion routes. Redundancy modelling, “if x link fails...” what would an emergency response look like and how would this impact the wider network.

Use-cases (2)



Funding Bids and Scheme Development

Corridors with low resilience can be identified as having potential funding opportunities to determine what kind of investment would improve resilience, with corridors prioritised based on criticality.

Example: A corridor carries x% of bus patronage, has low resilience due to signal asset quality and RTC density, and has no alternative options → investment to include signal upgrade, road safety measures, and average speed enforcement.



Bus Performance and Bus Franchising

Identify low-resilience, high-bus-service-frequency corridors to establish patterns and trends relating to bus performance data and the specific vulnerabilities on a corridor, informing bus service and disruption planning.

Example: Output of top 10 segments impacting bus punctuality → targeted location-specific interventions such as signal optimisation, or priority corridors for future bus franchising reliability improvements.

Any Questions?

www.tfwm.org.uk