

SUPPLIER DAY

T1159: Evaluating variability in train driving under different adhesion conditions

22 October 2018



Agenda

- RSSB Research & Development Programme
- *The ADHEsion REsearch challenge (ADHERE)*
- Background to T1159 and other research projects on Cross-city line
 - ADHERE: Piloting Enhanced Sanders on the GB mainline
 - ADHERE: Quantifying the effects of Railhead Treatments on adhesion
 - ADHERE: Autumnsense - Wet rail monitoring using a network of sensors to improve autumn resilience
 - **ADHERE: T1159 Evaluating variability in train driving under different adhesion conditions**
- Questions

RSSB Research & Development Programme



Knowledge Search

Aim

To collate existing knowledge and research in a scientific or engineering field. To identify opportunities for knowledge transfer. To assess emerging and disruptive technologies.

Process

RSSB members or cross-industry groups can submit a request.

Timeframe

Submission of request to delivery of report / presentation is usually possible in one month.

It works best when...

The information sought is in the public domain, of a scientific or technological nature, outside GB rail's traditional knowledge base and not commercially sensitive.



Grant Scheme

Aim

Where an RSSB member wishes to lead the delivery of R&D which will bring short term benefit to their organisation, but which has potential benefits more widely in the industry, R&D grant funding is available to provide additional resource.

Process

RSSB fund up to 50% of the project cost, consortium members contribute at least 20% in cash and the remainder in-kind, industry partners manage the project, all parties share the intellectual property rights.

Timeframe

RSSB typically makes a funding decision within four weeks of receiving an application.

It works best when...

An industry player identifies a specific opportunity to improve an existing technology or solution that benefits its business, and is prepared to share the findings in return for a funding contribution.



Strategic Research Pipeline

Aim

To help industry deliver long-term innovative developments via significant change in railway operations or engineering (normally over two or more Control Periods in the future).

Process

Through the guidance of strategic industry groups, RSSB helps to scope the low technology readiness level research, define clear outputs and facilitate measurable progression towards strategic goals.

Timeframe

Projects typically take 1-4 months to develop and 3-12 months to deliver outputs.

It works best when...

An engaged industry group is striving to fundamentally improve an aspect of the rail industry aligned with a cross-industry strategy, which, if researched, could materially benefit the whole industry and wider society.



Tactical Research Pipeline

Aim

To help industry make incremental improvements to business or operations within the current or subsequent Control Period.

Process

RSSB member(s), supported by a cross-industry group, can submit an idea form. RSSB helps to scope the research, define clear outputs and determine and agree a path to implementation.

Timeframe

Projects typically take 1-4 months to develop and 3-12 months to deliver outputs.

It works best when...

An engaged member, or small group of member organisations, is concerned with a specific, short-term problem that, if researched, could benefit themselves and other industry organisations.



Academic research

Aim

To help RSSB members find novel solutions to industry challenges that require early stage R&D.

Process

The academic community are encouraged to form consortia with industry representatives and suppliers. RSSB monitor projects and industry advisory boards are setup to ensure that the results meet industry needs.

Timeframe

RSSB takes 6-8 weeks to initiate a call for research and funded projects typically last 9-12 months.

It works best when

There is clear industry challenge with no evident off-the-shelf solution and novel, blue-sky thinking unconstrained by the railway of today is necessary.
The programme also co-funds projects with Research Councils, PhDs and larger research calls.

Other RSSB activities

If your challenge falls outside of the scope of the R&D programme, there may be other ways that RSSB can support you.

Please get in touch via the relevant RSSB Engagement Manager or the enquiries desk:

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The ADHEsion REsearch challenge (ADHERE)

Achieve 'adhesion conditions that are unaffected by and independent of the weather and climate.'

Driver behaviours

Improving driver confidence and performance in low adhesion conditions

Fundamental science and modelling

Advancing the ability to model low-adhesion contaminants and braking; and enhancing knowledge on low adhesion caused delay

Changes to train design

Exploiting train-borne technologies, including sanders and magnetic track brakes

Rail cleaning and re-contamination

Enhancing knowledge on the effect of rail cleaning activities and treatments

Forecasting adhesion

Achieving better adhesion forecasting and observation capabilities to improve decision making



Current Planned Research on this route



▪ IMP-T1107

Piloting enhanced sanders on the GB Mainline



▪ COF-AUT

Autumnsense: Wet rail monitoring using a network of sensors to improve autumn resilience



▪ T1159

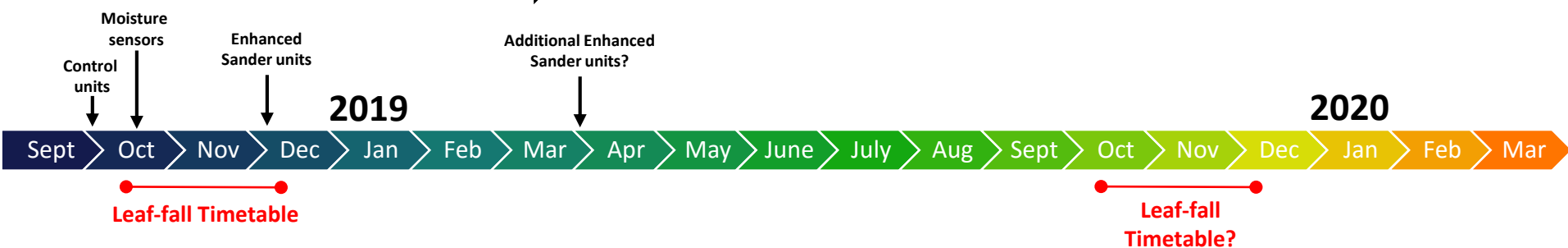
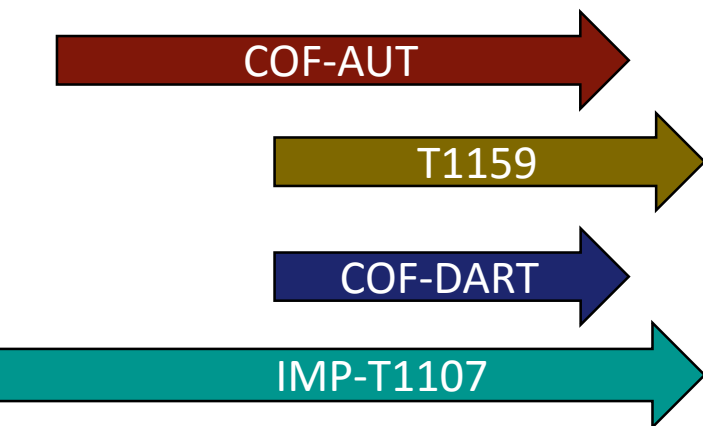
Evaluating variability in train driving under different adhesion conditions



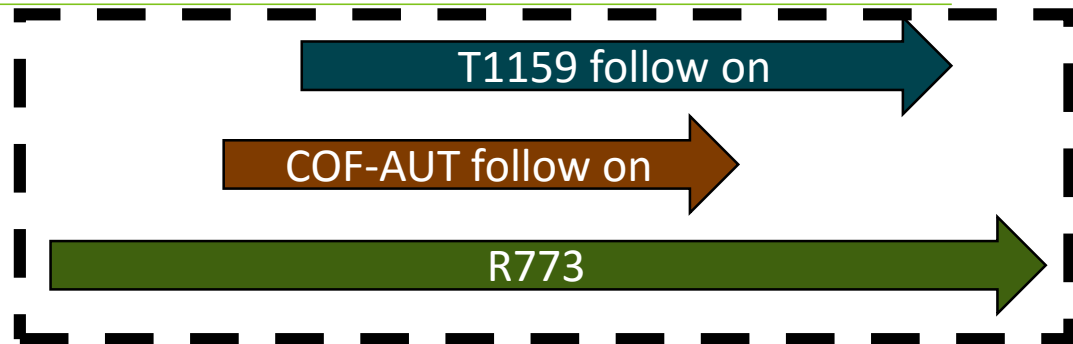
▪ COF-DART

Quantifying the effects of Railhead Treatments on adhesion

Project timelines



Currently ideas – timeframes TBC pending endorsement



Current Planned Research



▪ IMP-T1107

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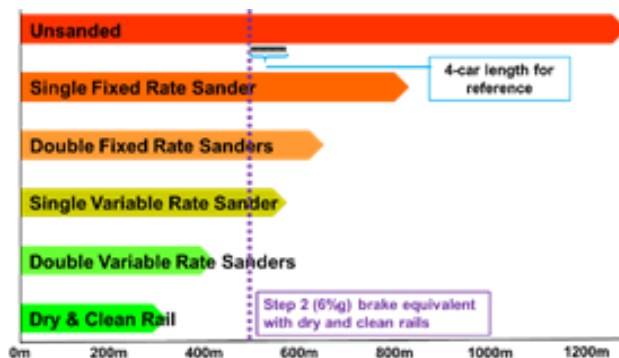
▪ COF-DART

Quantifying the effects of Railhead Treatments on adhesion

Piloting enhanced sanders on the GB Mainline

Background

T1107 delivered conclusive findings of the relative performance of different sander configurations in low adhesion conditions.



As a result, RSSB is co-funding an implementation project with WMT that seeks pilot these variable sanding configurations in a real railway environment.

Why the Cross-City line

The Route

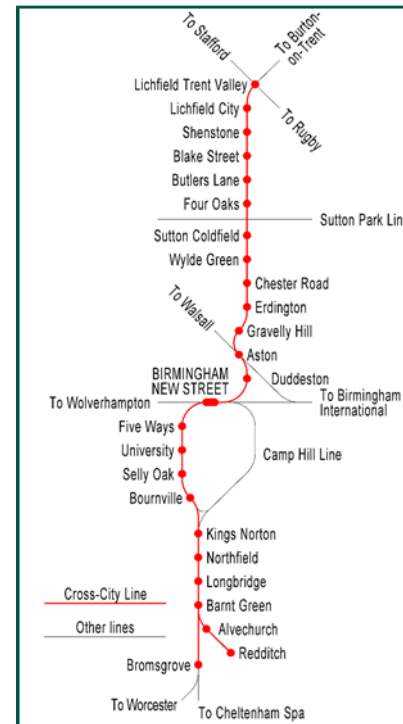
- 32 miles long (>20 stops)
- Intense metro-type service (core 6 tph ↔)
- Operated by class 323 EMUs

Problem

- leafy nature - suffers from low adhesion

Current Mitigation

- 'Skip-stop' leaf-fall timetable
- TGAs
- ATUSTs
- RHTTs/MPVs



Piloting enhanced sanders on the GB Mainline

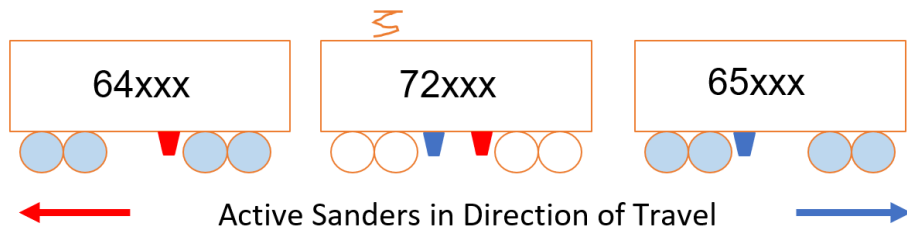
Objectives

- I. Accelerate the roll out of double variable rate sanders by supporting early adopters
- II. Demonstrate in-service benefits to the wider industry
- III. Capture in-service data to unlock longer term capacity gains achievable via improved and reliable braking performance

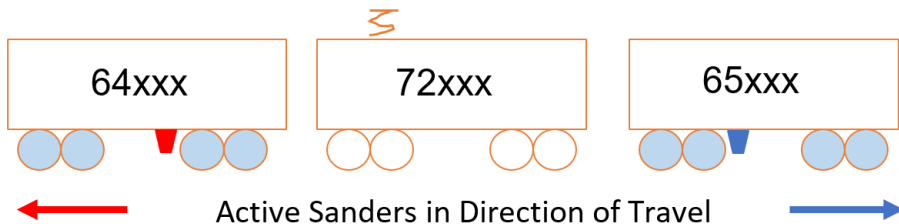


Piloting enhanced sanders on the GB Mainline

2 x Modified Enhanced Sander units (+2 units in 2019)



6 (or 4) x Unmodified units



**Equipped with
Data loggers to
monitor
braking
performance**

Piloting enhanced sanders on the GB Mainline

Success criteria	Data required
A. Anecdotal evidence from driver and DSM	Collect driver / DSM feedback
B. Reduction / removal station overruns	WMT station overrun data Local low speed test
C. Reduction of reported adhesion issues	reported adhesion issues data
D. Improvement in PPM (or CaSL)	PPM (or CaSL) data
E. Achieved decelerations closer to the demanded brake levels	<ul style="list-style-type: none">• Unit deceleration rate (accelerometer & data logger)• Brake demand (Real-time)• Axle 1 & 2 BCP• Sander activity• WSP activity GPS speed and location data
F. Demonstrate 6%g deceleration (if practicable, >6%g demand needed)?	

Enhanced sanders on the Cross-City line

**Comparing braking performance of
enhanced sander units vs unmodified units**

However.....

.....Railhead treatments (TGAs/ATUSTs/RHTTs) may muddle results
if “treated” vs “non-treated” rail is are not identified....

.....analysis will need to control for these variables....

....more data required!



Enhanced sanders on the Cross-City line

Comparing braking performance of enhanced sander units vs unmodified units

Treatment	Information required
TGAs	Locations, Activity/Operation/Maintenance, 323 fleet unit diagrams
ATUST	treatment sites, Unit number, Operation/Maintenance, 323 fleet unit diagrams,
RH TT/MPVs	Operation, friction modifier treatment sites, 323 fleet unit diagrams

Current Planned Research



▪ IMP-T1107

Piloting enhanced sanders on the GB Mainline



▪ COF-AUT

Autumnsense: Wet rail monitoring using a network of sensors to improve autumn resilience



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Evaluating variability in train driving under different adhesion conditions



▪ COF-DART

Quantifying the effects of Railhead Treatments on adhesion

Quantifying the effects of Railhead Treatments on adhesion

History of COF-DART

- Anecdotal evidence railhead treatments work - little empirical evidence to corroborate on GB mainline.
 - RHTT - work by ARUP and by Data Alchemist
 - TGAs – work by Liverpool John Moores University
 - ATUST - inconclusive
- Opportunity to utilise IMP-T1107 data to evaluate these treatments in more detail



Quantifying the effects of Railhead Treatments on adhesion

Aim: Use braking data collected in IMP-T1107 to evaluate the effectiveness of Railhead treatment strategies

Key Questions: For TGAs, ATUST units and RHTT/MPVs:

- I. What level of braking improvement is generated by the different treatments immediately after their deployment?
- II. How resilient is the improvement over time?
- III. What is the variability observed in the improvement and what are the key influencing factors?



Current Planned Research



▪ IMP-T1107

Piloting enhanced sanders on the GB Mainline



▪ COF-AUT

Autumnsense: Wet rail monitoring using a network of sensors to improve autumn resilience



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Evaluating variability in train driving under different adhesion conditions



▪ COF-DART

Quantifying the effects of Railhead Treatments on adhesion

Autumnsense: Wet rail monitoring using a network of sensors

Aim

Produce a real time environmental monitoring system to help improve autumn resilience on the railway network by:

- I. Focusing on sensing the key element of moisture, the project will translate an existing sensor prototype developed on pilot project COF- TAR- 01;
- II. Collecting data over Autumn 2018 so that it can contribute to the RSSB Adhesion Forecasting data sandbox and be considered in the context of the WILAC model and other data analysis driven work that RSSB will carry out or commission as result of joint data collection effort with WMT.



Autumnsense: Wet rail monitoring using a network of sensors

Objectives

- I. Modify the prototype moisture sensor so it is suitable for translation into an operational environment (i.e. adjacent to the rail on dummy rail) and equipped with a battery life to last for the entirety of the IMP-T1107 trials providing data for Autumn 2018;
- II. Fitment (by Network Rail) of an agreed number of moisture sensors to a number of agreed sites.
- III. Collection of moisture data to demonstrate the feasibility of the low cost moisture sensors applicability to carry out remote monitoring on the GB mainline;



Current Planned Research



▪ IMP-T1107

Piloting enhanced sanders on the GB Mainline



▪ COF-AUT

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▪ COF-DART

Quantifying the effects of Railhead Treatments on adhesion

T1159

Evaluating variability in train driving under different adhesion conditions

Aim: Use on-board train data (& supporting material) to understand changes to driver behaviour variability under different adhesion conditions.

Compare:

- I. Traction,
- II. Speed &
- III. Braking

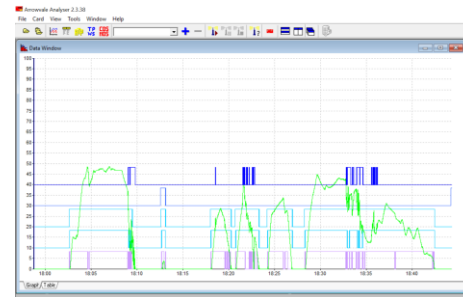


T1159

Evaluating variability in train driving under different adhesion conditions

Project background

- Anecdotal evidence that driving under low adhesion conditions leads to more driving variability than under 'good' adhesion conditions, impacting upon performance and safety. However, little empirical evidence to corroborate on GB mainline.
- Opportunity to utilise Class 323 control unit data from [Piloting enhanced sanders on the GB Mainline \(IMP-T1107\)](#) to evaluate the variability of driving under different adhesion conditions
- Requested by the ADHERE Driver Behaviours workstream subgroup. Endorsed by Adhesion Working Group.



Evaluating variability in train driving under different adhesion conditions

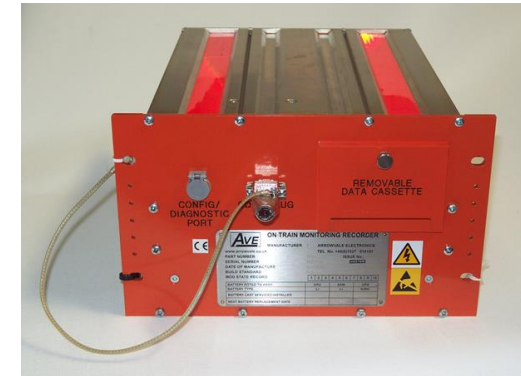
Premises and hypotheses

- I. Driving under low adhesion conditions during the autumn leaf fall period is believed to lead to more driving variability in drivers taking power, permissible line speed/maximum attainable train speed and braking applications than driving under 'good' adhesion conditions on a dry day outside of the autumn period
- II. Some driving variability is expected, however, significant variability in drivers taking power, permissible line speed/maximum attainable train speed and braking applications would mean that there is an opportunity to seek more consistency to improve performance and safety

Arrowvale Analyser 2.3.38
File Card View Tools Window Help

Data Window

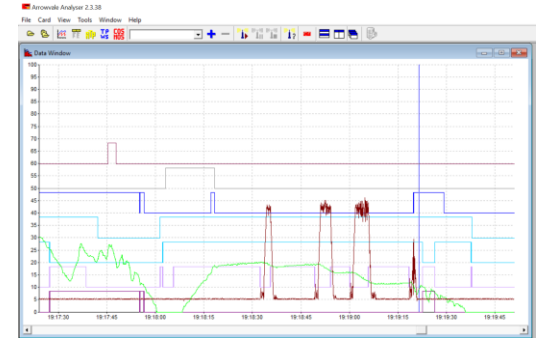
Time	Dist(Miles)	Brake Cod	BrakeCod	BrakeCod	Controller	Speed	WSP oper.
17:58:41	0.000	OH	OH	OH	OH	0	OH
17:58:42	0.000	OH	OH	OH	OH	0	OH
17:58:43	0.000	OH	OH	OH	OH	0	OH
17:58:44	0.000	OH	OH	OH	OH	0	OH
17:58:45	0.000	OH	OH	OH	OH	0	OH
17:58:46	0.000	OH	OH	OH	OH	0	OH
17:58:47	0.000	OH	OH	OH	OH	0	OH
18:00:03	0.000	OH	OH	OH	OH	0	OH
18:00:04	0.000	OH	OH	OH	OH	0	OH



Evaluating variability in train driving under different adhesion conditions

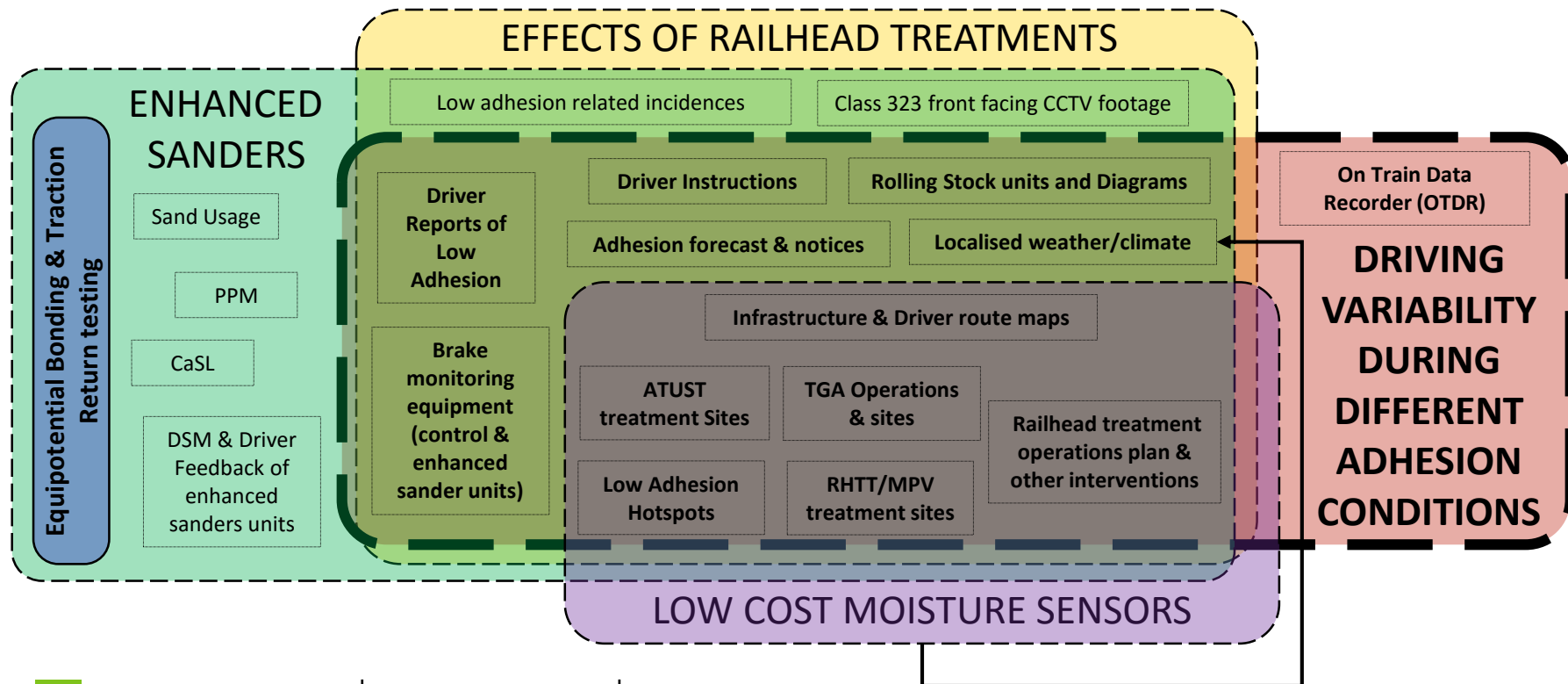
Objectives

- I. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **how and when drivers take power**
- II. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **when and how often sanders are manually activated**
- III. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **what permissible line speed/maximum attainable train speed is reached and maintained**
- IV. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **when and how often braking applications are undertaken (including when and how often brake testing is undertaken)**
- V. Establish **how the extent of driving variability compares to official professional driving policy and braking instructions for autumn**
- VI. **Identify statistically significant influences that lead to greater driving variability in the presence of low adhesion conditions**



T1159 and the data

Projects and relevant data sources



Evaluating variability in train driving under different adhesion conditions

Objectives

- I. Establish and compare the extent of driving variability across drivers within the same fleet and route under different adhesion conditions, to assess **how and when drivers take power**
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- VI. **Identify statistically significant influences that lead to greater driving variability in the presence of low adhesion conditions**



Database

Data to be provided to supplier	Data to be included within database
WMT Class 323 OTDR data (6 control units)	Control unit OTDR data
WMT Class 323 OTDR channels list	Cross-City Line infrastructure
Class 323 brake train wire coding sequence chart	Actual rolling stock and train crew diagrams operated
OTDR download guidance document	Driver reports of low adhesion
Monitoring system data (6 control units)	
Cross-City Line driver route maps and sectional appendix	
WMT rolling stock and train crew diagrams	
WMT rolling stock and train crew diagram allocation changes	
WMT professional driving policy documentation	
WMT seasonal briefing documentation	
WMT Adhesion notices	
ATUST TG60 gel application sites (Cross-City Line)	
ATUST data recorded onboard WMT Class 323 units (Cross-City Line)	
Identified low adhesion hotspots (Cross-City Line)	
TGA sites (Cross-City Line)	
TGA data recorded along the Cross-City Line	
Railhead treatment operations plans (Cross-City Line)	
Driver reports of low adhesion (Cross-City Line)	
Moisture sensor locations and data (Cross-City Line)	



Any Questions

