OPEN TENDER

RSSB INVITATION TO TENDER FOR THE PROVISION OF: RSSB2742 - ADHERE Quantifying the effects of Railhead Treatments on adhesion

Deadline: Friday 2nd November 2018

ITT Reference: RSSB2742 - ADHERE Quantifying the effects of Railhead Treatments on adhesion

# TENDER DOCUMENTS

1.1 Tenders shall be submitted in accordance with the following instructions. It is important that all the information requested is provided in the format and order specified. If the Tenderer does not provide all of the information RSSB has requested within the tender pack, RSSB may reject the tender as non-compliant.

1.2 Tenderers must obtain for themselves, at their own responsibility and expense, all information necessary for the preparation of their tender. Tenderers are solely responsible for any costs and expenses in connection with the preparation and submission of their Tender, and all other stages of the selection and evaluation process. Under no circumstances will RSSB, or its advisors, be liable for any costs or expenses Tenderers, their sub-contractors, suppliers or advisors incur in this process, including if this tendering process is terminated or amended by RSSB.

1.3 Tenderers are solely responsible for obtaining the information that they consider is necessary in order to prepare the content of their tender and to undertake any investigations they consider necessary in order to verify any information RSSB provides during the procurement process.

1.4 All pages of the tender submission must be sequentially numbered (including any forms to be completed and returned).

1.5 All specifications, plans, drawings, samples and patterns and anything else that RSSB issues in connection with this ITT, remains the property of RSSB and are to be used solely for the purpose of tendering.

1.6 At any time prior to the deadline for receipt of questions, RSSB may modify the tender documents by amendments in writing.

1.7 RSSB (at its sole discretion) may extend the deadline for receipt of Tenders.

RSSB reserves the right to modify or to discontinue the whole of, or any part of, this tendering process at any time and accepts no obligation whatsoever to award a contract.

# GENERAL, LEGAL & COMPLIANCE

2.1 RSSB will check each tender for completeness and compliance with the tender instructions. RSSB reserves the right to reject any tenders it considers substantially incomplete, or non-compliant (each tender will be assessed on its own merit, according to the level/importance of omitted or non-compliant content).

2.2The Tenderer will be excluded should any of the grounds for mandatory rejection or discretionary rejection be triggered. Mandatory requirements can be viewed within the Public Contracts Regulations 2015.

2.3 Tenderers are required to confirm in their tender response, they are able to meet all mandatory and discretionary requirements.

2.4 The Tenderer will be excluded should it be assessed that it has a high risk of:

* + Insolvency over the lifetime of the contract; e.g. the Tenderer may be excluded if its current assets to current liabilities ratio is less than 1;
	+ Insufficient financial capacity to deliver the services effectively; or
	+ Over-dependence on RSSB (e.g. the Tenderer may be excluded if its turnover is less than £ [no more than2x the contract value]

# 3.0 TENDER INSTRUCTIONS

3.1 “RSSB” means the contracting authority, seeking to invite suppliers to participate in the procurement process.

“You” or “Supplier” means the legal entity completing these questions, seeking to be invited to the next step of the procurement process Invitation to Tender (ITT)

3.2 Please ensure all questions are completed in full and in the format requested. Failure to do so may result in your submission being disqualified. If the question does not apply you need to clearly state N/A.

3.3 If it is necessary for you to provide additional information this should be provided as an appendix and clearly referenced as part of your declaration.

3.4 **RSSB REPRESENTATIVE**

Your main point of contact is: shareditt@rssb.co.uk

**RSSB OVERVIEW**

If you wish to find out more about RSSB, please visit our website at [www.rssb.co.uk](http://www.rssb.co.uk)

**Timetable**

The timetable for this procurement follows. This is intended as a guide and whilst RSSB does not intend to depart from the timetable, it reserves the right to do so at any stage.

The expected milestones are set out below:

|  |  |
| --- | --- |
|  | **Start Date** |
| Expression of interest meeting (if applicable) | N/A |
| Issued on Contracts Finder | 4 October 2018 |
| Supplier Information DayIf you would like to attend this event please email the following email address by COP Friday 19th:Shareditt@rssb.co.uk  | 22nd October 201815:15 |
| Supplier clarification questions deadline  | 1 November 2018; 12:00 hours |
| **Deadline for Submitting tenders**  | **2 November 2018; 12:00 hours** |
| Post Tender Clarification  | w/c 5 November 2018 |
| Estimated notification of award decision | 16 November 2018 |
| Target contract commencement date | 23 November 2018 |

Note: RSSB reserves the right to amend these dates as business requirements demand and will communicate any changes to tenderers.

3.5 **QUESTIONS**

Should you have any questions relating to the project, please email these before the deadlines detailed in the project timeline above to ensure that these questions can be effectively addressed? To ensure equal and fair treatment to all potential suppliers, RSSB will circulate all questions and responses anonymously.

Questions should be emailed to: shareditt@rssb.co.uk

# 4.0 Evaluation Information

4.1 In the interests of an open, fair and transparent assessment, this document sets out how RSSB intends to evaluate tender responses. It outlines the evaluation criteria and respective weightings, as well as the evaluation methodology to be applied.

4.2 **Verification of Information Provided**

 Whilst reserving the right to request information at any time throughout the procurement process. RSSB may enable the Supplier to self- certify that there are no mandatory/ discretionary grounds for excluding their organisation. When requesting evidence that the supplier can meet the specified questions relating to Technical and Professional Ability RSSB may only obtain such evidence after the final tender evaluation decision and only from the winning Supplier only.

4.3 **Please self-certify whether you already have, or can commit to obtain, prior to the commencement of the contract, the levels of insurance cover indicated below:**

* Employer’s (Compulsory) Liability Insurance = £2M
* Public Liability Insurance = £1M
* Professional Indemnity Insurance = £1M

4.4 **Sub- contracting Arrangements**

 Where the Supplier proposes to use one or more sub- contractors to deliver some or all of the contract requirements, a separate Appendix should be used to provide details of the proposed delivery model that includes members of the supply chain and percentage of work being delivered by each sub -contractor and the key deliverables that each sub- contractor will be responsible for.

RSSB recognises that sub- contracting arrangements may be subject to change and not finalised until a later date. However, Suppliers should be aware that where information provided to RSSB indicates that sub- contractors are to play a significant role in delivering the key requirements and any changes to those sub- contracting arrangements significantly affect the ability of the supplier to deliver key requirements the Supplier should notify RSSB immediately of any changes in the proposed supplier sub-contractor arrangements. RSSB reserves the right to deselect the Supplier prior to any award of contract based on an assessment of the updated information.

4.5 **Consortia Arrangement**

 If the Supplier completing this tender submission is doing so as part of a proposed consortium the following information must be provided:

* Names of all consortium members;
* The lead member of the consortium who will be contractually responsible for delivery of the contract (if a separate legal entity is not being created); and
* If the consortium is proposing to form a legal entity, full details of the proposal should be submitted as an Appendix with this Tender.
* RSSB may require the consortium to assume a specific legal form if awarded the contract. If it is deemed that a legal incorporation is necessary for the satisfactory performance of the contract.
* All members of the consortium will be required to provide the information required in all sections of the Tender as part of a single composite response to RSSB i.e. each member of the consortium is required to contribute to completing the response document.

4.6 **Confidentiality**

 RSSB reserves the right to contact the named customer contact and the nominated customer does not owe RSSB any duty of care or have any legal liability, except for any deceitful or maliciously false statements of fact.

 RSSB confirms that it will keep confidential and will not disclose to any third parties for any information obtained from the named customer contact, other than to the Crown Commercial Services and or contracting authorities defined by the Public Contract Regulations.

# 5.0 Evaluation Process

5.1 The process that will be used to select an appropriate Tenderer and award the contract for this procurement is available in more detail in the Evaluation Criteria.

The open procedure is a single stage process.

5.2 **Marking for Award Criteria**

An evaluation panel consisting of representatives of key stakeholders within RSSB will carry out the evaluation. The procurement team will only act as moderator during the assessment phases of the evaluation.

Each evaluation area is weighted to show the relative importance significance of the criteria specific area’s for assessment.

# 6.0 PROCESS AND PREPARATION OF RESPONSES

6.1 The Supplier shall not enter in any agreement or arrangement with any third party which would in any way cause RSSB or its members to incur any financial obligations to the Supplier or any third party.

6.2 The Supplier shall not approach any Customer employee, the Customer’s Representative or its agents to discuss any aspects of the Tender. All communication should be conducted via the Customers Representative.

6.3 The Supplier shall not canvass support for the award of the contract by approaching any employee of RSSB, its Representative or its agents.

6.4 The documents as enclosed are to be accepted in their entirety. No alteration Representative before the date stated for the receipt of tenders. If any alteration is made or these instructions to Suppliers are not fully complied with the tender may be invalidated.

6.5 The conditions of contract included in this Invitation to tender apply. The Suppliers standard terms of business or trade will not be accepted.

6.6 Any requested changes to the conditions of contract must be detailed on the Contract Issues Memo document included for consideration. If this is not completed, it is assumed that the Supplier has accepted all terms and conditions detailed and no further changes will be accepted.

6.7 The Supplier shall be deemed to have satisfied itself as to the nature, extent and the content of the goods, services or works to be provided, the extent of staff required and all other matters, which may affect the tender.

6.8 All prices quoted to be GBP (unless otherwise requested in the Invitation to Tender) exclusive Value Added Tax and firm.

 It is the Suppliers responsibility to ensure the tender is correct at the time of submission. No amendment to the tender will be allowed after the due date.

6.9 Any questions must be emailed to the main point of contact no less than five days before the return date. Note: questions/responses will be circulated anonymously to all Suppliers invited to tender. Tenders received after the closing date and time will not be considered.

6.10 The Customers Representative reserves the right to correct any omissions or inaccuracies in the Invitation to Tender and to clarify and/or amend any of the Customers’ requirements, up to seven days before the return of tenders.

6.11 All information supplied by RSSB must be treated in confidence and not disclosed to third parties except insofar as this is necessary to obtain sureties or tenders required during the preparation of the Tender. All information provided by Suppliers will be treated in confidence except in stances where references may be sought.

6.12 RSSB reserves the right to cancel this Tender at any point and any cost incurred in the preparation of this Tender is at the Bidder’s expense.

6.13 Tenders must remain open for acceptance for a period of 180 calendar days from the submission date.

6.14 The tenderer should include the following information as part of their tender response:

Legal entity name of Tenderer

|  |
| --- |
|  |

Contact person's name, email address, telephone number and postal address for enquiries relating to this procurement

|  |
| --- |
| Name: |
| Postal address: |
| Telephone number: |
| Email address: |

Tenderer’s registered address

|  |
| --- |
|  |

Tenderer’s website address (if available)

|  |
| --- |
|  |

Please tick the box for the legal form of the Tenderer

|  |
| --- |
| * Sole Trader [ ]
* Partnership [ ]
* Limited Liability Partnership [ ]
* Private Limited Company [ ]
* Public Limited Company [ ]
* Local Council [ ]
* Voluntary/ charitable/ not for profit organisation [ ]
* Other (please specify below) [ ]
 |

If ‘Other’ has been selected from the question above please provide details.

|  |
| --- |
|  |

If your business is a registered company, charity or any other registered organisation (including limited, non-limited or Industrial and Provident Society), please state your registration number. This must be the registration number of the Tenderer, providing the country and date of incorporation / registration if other than the UK.

|  |
| --- |
|  |

Name of ultimate parent company (if this applies)

|  |
| --- |
|  |

Companies House Registration number of ultimate parent company (if this applies)

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| --- |
|  |

**Additional Notes**

* Fully answer the question given and consider the weighting for the section
* Explain how you will meet the criteria and provide evidence to support your response.
* Further reading on how to complete the tender is available in section 10

| **Selection criteria** | **Detail** | **Evaluation Criteria** |
| --- | --- | --- |
| S1 Supplier’s organisational experience analysing large data sets[Max 1 page] | The tenderer should provide a short description of at least two projects/contracts completed within the past five years that involved the analysis of large data sets | **Pass:** The tenderer provides a short description of at least two projects or contracts completed within the past five years that involved the analysis of large data sets. Further the tenderer provides RSSB with a strong degree of confidence in its experience analysing large data sets**Fail:** The tenderer either fails to provide evidence of at least two examples of projects or contracts completed within the past five years that involved the analysis of large data sets or fails to provide RSSB with sufficient confidence in its experience analysing large data sets |
| S2 Supplier’s organisational experience and knowledge of the GB rail industry[Max 1 page] | The tenderer should provide a short description of at least two projects/contracts completed within the past five years that focused on the GB rail industry. | **Pass:** The tenderer provides a short description of at least two projects or contracts completed within the past five years that focused on the GB Rail Industry. Further, The tenderer provides RSSB with a strong degree of confidence in its experience and knowledge of the GB rail industry**Fail:** The tenderer either fails to provide evidence of at least two examples or contracts completed within the past five years that focused on the GB Rail Industry or fails to provide RSSB with sufficient confidence in its experience and knowledge of the GB rail industry |
| S3 Summary of the proposal[Max 1 page] | The tenderer must provide a concise summary highlighting the key aspects of the proposal and will be used to contextualise the supplier’s response. | **Pass:** The tenderer has provided a concise summary highlighting how the proposal addressed the objectives, scope and deliverables described in this specification.**Fail:** The tenderer has not provided a concise summary that addressed the objectives, scope and deliverables described in this specification or fails to provide RSSB with a strong degree of confidence in its experience and knowledge. |

# 7.0 TENDER EVALUATION (SELECTION CRITERIA

# 8.0 TENDER EVALUATION (AWARD CRITERIA)

8.1 **ITT Assessment**

**The Contract Award decision is solely based on the basis of Tenderer proposal and price offering.**

8.2 RSSB uses the following quality / price ratio to determine the outcome of the evaluation where quality (technical evaluation) and price are weighted and scored individually before being combined.

 Quality 80%: Price 20%

8.3 Technical criteria are weighted and scored as a percentage of the maximum score available with a minimum quality threshold set.

 **Technical Evaluation**

8.4 Tenders are assessed on how well they satisfy the technical evaluation criteria.

 The relative importance of each criterion is established by giving it a percentage weighting so that all the weightings equal 100%. The Evaluation Matrix provides details of the weightings that RSSB will use in assessing Tenderer proposals.

 The Technical Evaluation will be carried out using Tenderer responses to the tender specification using the scoring scheme (identified in Table below).

8.5 The scored responses are generally assessed out of a maximum of five (5). The Evaluation Panel will not be allowed to give partial scores (for example 3.5); however, once all scores are aggregated, the technical scores will be rounded to two decimal places prior to consolidating with the price evaluation.

8.6 The following shall constitute a failure to evidence satisfactory delivery of the requirement(s) of the procurement and will automatically disqualify the Tenderer:

1. A grade of zero (0) in any of the evaluated technical/quality questions in Section D of Schedule One (a) of Part B of the ITT before the weightings are applied; or
2. a grade of one (1) in more than one of the evaluated technical/quality questions in Section D of Schedule One (a) of Part B of the ITT before the weightings are applied

8.7 Those Tender Responses which fail to demonstrate satisfactory delivery of the requirement(s) of the procurement by reason of failing to achieve these minimum thresholds will be set aside and not considered further.

|  |  |
| --- | --- |
| **Grade** | **Definition of grade** |
| 5 | A wholly excellent Tender Response that (where applicable):* Addresses all aspects of the question in an informed and comprehensive manner;
* Demonstrates a thorough understanding of what is being asked for;
* Provides evidence of how that understanding can be applied in practice;
* Offers full confidence that the Tenderer will deliver the service in full;
* Addresses the majority of areas of doubt and uncertainty; and
* Provides certain, unambiguous commitments or statements of intent that permit reliance through translation into contractual terms
 |
| 4 | * A good Tender Response that (where applicable):
* Addresses all aspects of the question and is generally of a good standard;
* Demonstrates a good understanding of what is being asked for;
* Provides a worked-up methodical approach;
* Offers confidence that the Tenderer will deliver the service in full with limited areas of doubt or uncertainty;
* Addresses key areas of doubt and uncertainty; and
* Provides commitments that can be translated well into contractual terms
 |
| 3 | A satisfactory Tender Response that (where applicable):* Addresses the majority of the question and is generally of a good standard but lacks substance or detail in some areas;
* Demonstrates an understanding of what is being asked for;
* Provides a satisfactory approach;
* Offers a general level of confidence that the Tenderer will deliver the service (but with room for doubt in some areas);
* Address some areas of doubt and uncertainty; and
* Provides some commitments that can be translated well into contractual terms.
 |
| 2 | A Tender Response that (where applicable):* Addresses some of the question but *either* lacks relevant information and detail *or* lacks substance in a manner that would suggest the response is a “model answer”;
* Demonstrates some understanding but with a lack of clarity in key areas;
* Provides an approach which is not wholly appropriate or viable orlacks evidence;
* Shows that the level of confidence that the supplier can deliver does not outweigh the doubt;
* Does not address many areas of doubt and uncertainty; and
* Does not offer sufficient commitment (with doubt as to the extent to which would translate into contractual terms)
 |
| 1 | A generally unsatisfactory Tenderer response that (where applicable):* Does not address the question or has omissions;
* Lacks understanding in significant areas:
* Provides an approach which has gaps or creates concerns;
* Shows that the level of confidence that the supplier can deliver is low;
* Creates uncertainty; and
* Displays significant lack of commitment (with doubt as to the extent to which would translate into contractual terms)
 |
| 0 | A wholly unsatisfactory Tenderer response that (where applicable):* Provides no response or omissions/oversights that prevent scoring;
* Refuses to deliver the requirement; and
* Creates concerns so significant that the response would be detrimental to the interests of RSSB
 |

#  9.0 ITT Evaluation Matrix (Award Criteria)

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| --- |
| **Evaluation matrix[[1]](#footnote-1)** |
| **Award criteria** | **Detail** | **Evaluation Criteria** | **Weighting**  |
| **W1** Demonstrating technical competence handling, collating and understanding large data sets[Max 3 pages] | The tenderer should demonstrate their technical competence (both at a company and individual level) in handing and collating large data sets. They should demonstrate their competence in creating, maintaining and updating databases utilising complex and varied data sources.  | The tenderer:1. Provides clear evidence of their technical competence in creating, maintaining and updating databases utilising complex and varied data sources.
2. The tenderer demonstrates how this competence will be brought to the project to improve the likelihood of success.
 | 15% |
| **W2** Demonstrating technical competence analysing large data sets[Max 3 pages] | The tenderer should demonstrate their technical competence (both at a company and individual level) in analysing large data sets.  | The tenderer:1. Provides clear evidence of their technical competence in analysing large data sets.
2. The tenderer demonstrates how this competence will be brought to the project to improve the likelihood of success.
 | 15% |
| **W3** Method statement – ability to meet deliverables[Max 6 pages] | Tenderers should provide a method statement detailing how they propose to fulfil the work package requirements as described in ‘Objectives’, ‘Scope’ (In Scope) and ‘Deliverables’ | The tenderer’s response:1. Demonstrates their understanding of the context of the work, illustrating how the work package objectives, scope and deliverables are related to the wider project objectives;
2. Propose a clear approach to developing and implementing the database and database information guide
3. Propose a sound analytical approach to establish and compare the performance of the different railhead treatments
4. Propose approach disseminates findings to inform industry in their preparations for autumn 2019.

  | 30% |
| **W4** Project management: resource, quality and time [Max 4 pages] | Tenderers should outline the processes and resources it proposes to use in order to fulfil RSSB requirements.Tenderers should:1. Clearly identify each team member’s role (providing one-page CVs for key project members within an appendix)and demonstrate that team members are appropriate to the assigned tasks**;**
2. Provide a schedule to successfully deliver to time, and deliver a quality output to budget;
3. Demonstrate how they would work with RSSB and communicate and engage with relevant industry stakeholders to ensure that the quality and content of the deliverables are fit for purpose;
4. Explain how they would meet the critical success factors for this piece of research.
 | The tenderer’s response shows that it:1. Has identified relevant individuals to deliver the work and that the mix of required skills and seniority is covered;
2. Has provided a credible plan for delivering successful outcomes to time while achieving quality outcomes within the agreed budget;
3. Has identified appropriate ways to engage with RSSB and relevant stakeholders to provide deliverables that are fit for purpose;
4. Has identified suitable ways to address the work package’s critical success factors.
 | 15% |
| **W5** Risk and mitigations [Max 2 pages] | Tenderers should demonstrate:* How they would manage any identified and unforeseen risks to delivering the work package.
 | The tenderer’s response:1. Shows that it has identified risks
2. Proposed effective management and mitigations.
 | 5% |
| **W6** Cost of project | Tenderers should:Provide a fixed cost for the project and the associated cost break down. If the fixed cost is above the budgeted amount of £115,000 then a detailed explanation as to why any proposed increase is necessary, and what added value it may provide.  | * The tender with the lowest total cost will receive 100% of the available weighted score (20%).
* Other tenderer’s will receive a pro-rated score relative to the lowest cost according to the following formula:
	+ Score of other tender = lowest tender total cost / other tender total cost x 100%.
 | 20% |

# 10.0 PRICE EVALUATION

10.1 All prices quoted shall be in sterling (unless otherwise requested in the Tender Documents), exclusive of Value Added Tax and shall be firm.

10.2 A full and comprehensive breakdown of all costs and expenses to provide the goods, services or works requested in this invitation to tender must be provided and all assumptions must be clearly stated.

10.3 Failure to provide adequate detail may cause your tender to be judged non-compliant.

10.4 The construction of the price must be clear and easy to understand. Where appropriate the use of tables to show pricing is preferred. We require the following information:

* + - A breakdown by grade and named individual, indicating the number of days to be worked on each task and the daily rate to be charged.
		- A list of sub-contracts with prices and copies of quotations where available (a similar breakdown by grade, named individuals and rates, as above, is required where the sub-contract is for manpower).
		- Details of any other costs, such as hire charges for equipment.
		- Details of travel and subsistence and all expenses to be incurred. Mileage reclaim will be linked to maximum levels set by HMRC.
		- The above breakdowns should be further broken down into individual work packages.

# 11.0 TENDER EVALUATION CRITERIA AND MINIMUM REQUIREMENTS

11.1 In evaluating tenders, the most economically advantageous tender(s) will be sought. This will be using the evaluation criteria and weightings detailed in **ITT Evaluation Matrix** **Award Criteria**.

11.2 The evaluation criteria detail the minimum requirements. Therefore, any tender which cannot demonstrate that it meets any of the minimum requirements will not be marked and will automatically score zero.

Tenderers are advised to carefully consider the attached specifications, ask clarification questions to ensure these are understood.

# 12.0 CONDITIONS OF CONTRACT

The terms and conditions of the contract are contained with a separate document.

**Qualification of the Contract**

Where Tenderers have any queries or concerns with any specific condition of the terms and conditions of the contract, these should be submitted in writing to **shareditt@rssb.co.uk** as soon as possible, and in any case no later than 10 days prior to the deadline for submission of tenders.  Please ensure the specific condition(s) and proposed amendment(s) are provided.  These will be reviewed by RSSB on a case by case basis, and, if accepted, revised terms and conditions will be issued to all Tenderers.  Failure to accept the terms and conditions of the contract or to qualify the tender in any way, may result in the tender being rejected by RSSB.

## 13.0 RSSB Company Information

 ***Insert Work Package Title*Introduction**

RSSB was established in April 2003. The Company’s primary objective is to facilitate the railway industry’s work to achieve continuous improvement in the health and safety performance of the railways in Great Britain, and thus to facilitate the reduction of risk to passengers, employees and the affected public. The railway is a complex system with multiple interfaces delivered by many different organisations. At RSSB we bring these different organisations together to make collective decisions. We help the rail industry carry out research, understand risk, set standards and improve performance. We provide a constant point of reference in a changing environment.

We support rail in the areas of safety standards, knowledge and innovation and a wide range of cross- industry schemes requiring our knowledge and independence. Our work involves close collaboration, but as technical experts we also appoint suppliers in the wider market to provide an informed view.

**Key elements of the company’s remit are to:**

* Manage Railway Group Standards on behalf of the industry
* Lead the development of long-term safety strategy for the industry, including the publication of annual Railway Strategic Safety Plans
* Propose change through facilitation of the research and development programme, education and awareness
* Measure, report and inform on health and safety performance, safety intelligence, trends, data and risk
* Support cross-industry groups in national programmes which address major areas of safety concern
* Facilitate the effective representation of the UK rail industry in the development of European legislation and standards that impact on the rail system

RSSB is a not-for-profit company owned by major industry stakeholders. The company is limited by guarantee and is governed by its members, a board and an advisory committee. It is independent of any single railway company and of their commercial interests.

# Background

## RSSB Overview

*RSSB* is a membership organisation in the railway that helps industry by understanding risk, guiding standards and managing research. The rail industry in Britain is made up of many different organisations, but they all form a system and share a common purpose, to move people and freight safely and efficiently by rail. *RSSB* brings all parts of this system together to make collective decisions, products and services, to help industry drive out unnecessary cost, improve business performance and develop long-term strategies.

*RSSB’s* activities include:

* **Understanding risk –** Using safety intelligence from across the rail industry and elsewhere with the latest risk modelling to inform members and support safe decision making.
* **Guiding standards** – Creating, reviewing and simplifying GB standards to align with European requirements; managing the *Rule Book* and making it easier for the railway to deliver efficiently and safely.
* **Managing research, development and innovation** – Undertaking, commissioning and managing research and innovation programmes to address current needs, provide knowledge for decision making now and for the future, and promoting step changes to deliver the *Rail Technical Strategy*.
* **Collaborating to improve** – As an independent cross-industry body with a critical mass of technical expertise, supporting activities which require collaboration. These range from supplier assurance schemes (*RISQS, RISAS*) to confidential reporting (*CIRAS*), from health and wellbeing strategies to sustainability principles.

**Specification for research project**

ADHERE: Quantifying the effects of Railhead Treatments on adhesion

COF-DART

# RSSB overview

RSSB is a membership organisation that supports the GB rail industry by understanding risk, guiding standards and managing research. The rail industry in Britain is made up of many different organisations, but they all form a system and share a common purpose, to move people and freight safely and efficiently by rail.

RSSB’s activities include:

* **Understanding risk** – Using safety intelligence with the latest risk modelling to inform members and support safe decision making.
* **Guiding standards** – Creating, reviewing and simplifying GB standards; managing the Rule Book and making it easier for the railway to deliver efficiently and safely.
* **Collaborating to improve** – As an independent cross-industry body, supporting activities which require collaboration such as supplier assurance schemes, confidential reporting and developing industry strategies.

**Managing research, development and innovation** – Undertaking, commissioning and managing cross-industry research and innovation programmes to address current and future needs.

# Background

Low adhesion is an issue on the railways as it leads to train delays and cancellations due to unpredictable and inefficient braking and traction. The whole system industry costs related to low adhesion during autumn periods has been calculated at circa £345m p.a [[2]](#footnote-2).

Alongside the cost of delays, low adhesion also put the safety of the travelling public and staff at risk, with the increased potential for station over-runs (e.g. Stone Gate[[3]](#footnote-3)), and Signals Passed at Danger (SPADS) (e.g. Chester Buffer Collision[[4]](#footnote-4)). Additionally, poor adhesion damages wheels and rails which can lead to trains being out of service[[5]](#footnote-5) and costs the industry over an estimated £10 million p.a[[6]](#footnote-6)+[[7]](#footnote-7).

Each year, the GB rail industry invests a calculated £49m to mitigate and manage low adhesion problems [[8]](#footnote-8). This investment includes £38m for the procurement, maintenance and operation of Rail Head Treatment Trains (RHTTs)[[9]](#footnote-9)+[[10]](#footnote-10). In addition, manual scrubbers with citrus-based detergents also exist but are resource intensive and need to be targeted at hotspots (i.e. treatment sites) for poor adhesion.

Other low adhesion mitigation measures include the use of Traction Gel Applications, the Adhesion Treatment Using Service Train (ATUST) system and specialist leaf fall timetables with reduced services during autumn.

A previous RSSB research project *T1107: Trial of Sander Configurations and Sand Laying Rates* led by Ricardo Rail and ESG Rail, delivered conclusive findings of the relative performance of different sander configurations in low adhesion conditions[[11]](#footnote-11)+[[12]](#footnote-12). This was achieved using a new approach to evaluate the underlying wheel/rail adhesion level experienced by the train. This novel approach offers a significant breakthrough to measuring real-time adhesion. Details of this approach including assumptions, correction factors and data sense checking are found in the appendices A to H in the T1107 report[[13]](#footnote-13).

RSSB are now working with West Midlands Trains and a consortium of suppliers on a follow-on project (IMP-T1107) to demonstrate these findings on 26 class 323 units running along the Birmingham Cross-City Line. Specifically, this research will monitor and compare braking distances and adhesion levels experienced by units fitted with enhanced sanders against unmodified “control” units. RSSB, in conjunction with West Midlands Trains and Network Rail will collect additional operational data including but not limited to primary delay minutes, driver perception to gain a system view on the effects enhanced sanders can have on mainline operations.

The Cross-City Line was chosen as it is a suburban railway line in the West Midlands region of England. It runs for 32 miles (51 km) from Redditch, and Bromsgrove to Lichfield, via Birmingham New Street. It carries a metro-type service operated by the class 323 EMUs with over 20 station stops. the current service has 6tph running through the majority of the network[[14]](#footnote-14), consisting of:

* 2tph from Lichfield Trent Valley to either Bromsgrove or Redditch
* 2tph from Lichfield City to either Bromsgrove or Redditch
* 2tph from Four Oaks to either Bromsgrove or Redditch

The leafy nature of the line means it suffers from a number of low adhesion high risk sites and It is well documented that the service performance suffers during the autumn leaf-fall season. These factors mean it is a perfect candidate route to pilot enhanced sanders.

One of the mitigations to improve service performance on this route has been the implementation of a ‘skip-stop’ leaf-fall timetable which has been in operation for a number of years[[15]](#footnote-15). However, this strategy remains a source of contention for the travelling public[[16]](#footnote-16). Network Rail and West Midlands Trains are working together to remove the need for this autumn timetable within a few years. To achieve this, they have also worked in partnership on a number of initiatives, including:

1. Installation of Tractions Gel Applicators (TGA) across the route[[17]](#footnote-17)
2. Adhesion Treatment Using Service Train (ATUST) systems on 6 class 323s[[18]](#footnote-18)

 The majority of sites where these initiatives have been implemented are on station approaches i.e. during braking. Some anecdotal evidence from train drivers has suggested these initiatives improve braking in low adhesion along the route but comprehensive data has yet to be collected[[19]](#footnote-19).

RSSB are developing a number of other research activities based around data collected on the Cross-City line. One such project is the installation of moisture sensors to monitor the localised climate near low adhesion high risk sites. Another data analysis project will look to use OTDR data to assess driver variability during periods of Low Adhesion (currently out to tender)[[20]](#footnote-20). All data collected as part of IMP-T1107[[21]](#footnote-21) and the other projects[[22]](#footnote-22), offers a unique opportunity to measure and evaluate the effects of the railhead treatments strategies employed on this route and the supplier will have access to all data collected in the other projects.

A full breakdown of data gathered by these projects to be available to the successful supplier is detailed in Appendix A. The datasets will come from a wide variety of sources and in varied formats. Braking data will be collected from a minimum of 4 control units over a period of roughly 5 months. It is expected that the amount of data captured here alone will to run into terabytes and does not include regular operational data (e.g. train unit diagrams) which will also be used.

The key stakeholders in this project are RSSB, Network Rail, West Midlands Trains, the Adhesion Research Group (ARG)[[23]](#footnote-23) and the Adhesion Working Group (AWG)[[24]](#footnote-24). This research strongly aligns with the Fundamental science and modelling, Rail cleaning and re-contamination and Forecasting adhesion workstreams of the ADHERE (ADHEsion Research challengE) programme of work[[25]](#footnote-25).

# Assumptions and key questions to address

This project is predicated on the assumption that the effects of low adhesion mitigation treatments can be measured and compared through monitoring of train brake performance.

 The key ‘exam questions’ to be answered are:

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

# Objectives

The aim of this research is to enable Railway undertakings and infrastructure managers to better understand the effectiveness of different rail treatment methods by using data collected as part of IMP-T1107 and other projects. It is envisaged that a big data approach is required as numerous data sources must be first collated and cross referenced before analysis can be undertaken. This project will therefore require the creation of a database to define these relationships. This will also enable future deep dive analysis of other questions industry may wish to address.

The specific objectives of this project are to:

1. Produce a database cross-referencing data sources from IMP-T1107 and others which will be used in the downstream analysis of this project.
2. Measure/determine the available adhesion on the route (when braking)
3. Determine effects and latency of TGA treatment on adhesion conditions
4. Determine effects and latency of ATUST treatment on adhesion conditions
5. Determine effects and latency of RHTT/MPV operations on adhesion conditions
6. Correlate varying levels of moisture on the railhead against low adhesion hotspots
7. Compare the effects of different low adhesion mitigation strategies at different sites and climatic conditions, to determine level of variability and factors that could explain it
8. Map the changing adhesion levels on a route diagram during the operational day.

# Scope

This section defines the tasks to be tendered against, and the technical content against which the submissions will be assessed.

### In scope

The following aspects are to be addressed in the tenderers’ response:

* Analysis of adhesion achieved during braking across the line (including overall variability)
* Other analysis on the data provided that could share light effectiveness of railhead treatments with regards to achieved adhesion (e.g. levels of wheel slide)
* Data collation (cross referencing data points from sources including but not limited data listed in Appendix A).
* Data validation and data cleaning enabling datapoints deemed unreliable to be discounted from this and future analysis (note, discounted data should be retained).
* Database containing the data point relationships defined in data collation
* Calculation of achieved adhesion relating to IMP-T1107 control class 323 units using the method described in T1107[[26]](#footnote-26)
* Identification of changes to adhesion at the wheel/rail interface during braking following treatments:
	+ Traction Gel Applicators
	+ ATUSTS units
	+ RHTT/MPVs
* Comparison of the effectiveness of the above treatments including their latency and variability.
* Identification of relationships between railhead moisture levels and low adhesion hotspots.
* Map the adhesion levels during the operational day in around 1/8th to 1/4 miles sections showing infrastructure features related to braking demand such as stations, signals, PSRs and junctions.

### Out of scope

The following aspects are not expected to be addressed by the tenderers’ response; any proposal which covers these aspects should provide clear explanations on the value being brought through associated work, and should be presented as a separately costed option.

* Analysis of adhesion achieved during traction
* Data Collection: West Midlands Trains and Network Rail will supply all data via RSSB. It is not expected that the supplier will require additional datasets.
* Effects of low adhesion mitigation strategies on Primary PfPI delays, Reactionary PfPI delays, PPM failures and CaSL (Cancellation and significant lateness).
* Effects of sanding on adhesion levels experienced by the class 323s including data collected from IMP-T1107 for class 323 units with enhanced sanders.
* Analysis of driver feedback.

# Project structure

This project is structured in two packages, **of which Work Package COF-DART-02 is subject to tender**.

|  |
| --- |
| Work Package COF-DART-01 |
| **Title** | Quantifying the effects of Railhead Treatments on adhesion - RSSB development activities |
| **Delivery**  | RSSB |
| **Start** | August 2018 |
| **Completion** | October 2018 |

|  |
| --- |
| **Work Package COF-DART-02** |
| **Title** | **Quantifying the effects of Railhead Treatments on adhesion - Delivery** |
| **Delivery** | Competitive tender |
| **Start** | November 2018 |
| **Completion**  | March 2019 |

# Methodology

Suppliers are expected to explain the methodology that they are intending to use to successfully meet the **work package requirements** of this work package. The work package requirements are detailed within the following sections:

* Objectives
* Scope (In Scope)
* Deliverables
* Dissemination

The work package requirements are set in context by:

* Background
* Project structure
* Data and material to be provided to prospective suppliers

Data collection is planned to start in late September with on-going operational data being continually collected up until December . Upon project start , the supplier will have access to all data collected to that point. The supplier will also then begin to receive operational data on an on-going periodic basis (assumed minimum weekly). It is expected that all datasets used in analysis are to be included in the database. Furthermore, the database should be updated to include all data collected on an on-going basis.

It is expected that downstream analysis cannot begin in earnest until an initial version of the database has been built defining the relationships of data points between different data sources. Suggested time scares are:

* Data familiarisation and database build (November – December)
* Data Cleansing and Downstream analysis (December – February)
* Final Report (March)

The suppliers’ project plan should include a number of initial review meetings with an RSSB representative (TBD by RSSB) to discuss database development. Subsequent monthly (as a minimum) reviews to update on progress and initial findings should also be included.

Industry have requested this work as urgent to inform preparations for autumn 2019. It is therefore important the project is completed, and its findings communicated by March 2019. Suppliers should consider how and when they are to communicate interim findings as well as the final report.

# Deliverables

This project will provide the following deliverables:

|  |  |
| --- | --- |
| **Deliverable Title** | Database |
| **Deliverable Type** | Database |
| **Description** | The project requires a substantial amount of data processing, collating and cross-referencing from numerous sources before analysis can be undertaken. This deliverable is the production of 1 or more formalised database(s) required to undertake the analysis, containing: * ALL datasets relevant for downstream analysis i.e. not just individual data points which have been used within the analysis.
* Datasets cross-referenced against each other to facilitate downstream analysis
* Marked and filterable raw datasets/datapoints considered erroneous for analysis.

RSSB will supply unprocessed data from several sources for analysis (a list of identified sources and sample datasets are supplied in Appendix A). Not all data supplied may be required for the analysis and where possible additional datasets may be supplied on request.The outputs of the data processing steps, and the means of their generation, must be stored in a software format that is accessible to, and useable by, RSSB i.e. using commercially off the shelf (COTS) software. |
| **Publication** | The database will be reviewed by the project steering group and RSSB and will be subsequently finalised by the supplier. It is not anticipated that this will be made available to the wider public due to the potentially commercially sensitive nature of the data contained within the database |

|  |  |
| --- | --- |
| **Deliverable Title** | Database Information Guide |
| **Deliverable Type** | Report |
| **Description** | This deliverable is a report that describes the structure of the database(s), containing: * Data sources, data format and structure
* Data processing techniques used and application (including manual entry/processing steps)
* Database structure including what and how data has been cross referenced (e.g. through database relationship maps)

This guide should be written in sufficient detail as to allow others, independent of this project to reproduce the database(s) including but not limited to the adding new data sets, data processing and cross-referencing steps. |
| **Publication** | The report will be reviewed by the project steering group and RSSB and will be subsequently finalised by the supplier. This will be done in conjunction with the review of the database. The report be produced in a RSSB Microsoft Word template. It is not anticipated that this will be made available to the wider public due to the potentially commercially sensitive nature of the data contained within the database. |

|  |  |
| --- | --- |
| **Deliverable Title** | Quantifying the effects of Railhead Treatments on adhesion– Final Report |
| **Deliverable Type** | Report |
| **Description** | The report shall cover both the methodology and conclusions for the following:* Measure/determine the available adhesion on the route (when braking)
* Analysis of the effects, latency and variability of TGA treatment on adhesion conditions
* Analysis of the effects, latency and variability of ATUST treatment on adhesion conditions
* Analysis of the effects, latency and variability of RHTT/MPV operations on adhesion conditions
* Correlate varying levels of moisture on the railhead against adhesion levels
* Comparison of the effects of different low adhesion mitigation strategies at different sites and climatic conditions
* Other supplier suggested metrics for measuring adhesion and effects of railhead treatments

The report should include visual representations to illustrate the findings.  |
| **Publication** | The report will be drafted by the supplier and should incorporate appropriate infographics to visualise the key outcomes. The deliverable will be reviewed by the project steering group and RSSB; and will be revised by the supplier (where necessary). The report will be produced in a RSSB Microsoft Word template and will be made available as a PDF on SPARK (a free-to-access interactive web library) to all SPARK users. |

|  |  |
| --- | --- |
| **Deliverable Title** | Quantifying the effects of Railhead Treatments on adhesion – Database User Interface **(Costed: Optional) [[27]](#footnote-27)** |
| **Deliverable Type** | Software  |
| **Description** | An optional (costed) extra will include a user interface to the database which outputs an interactive visual representation with of adhesion properties across the line considering different treatment and environmental factors such as time since treatment (ATUST/TGAs/RHTTs), time of day, moisture levels, forecasted adhesion. This could include a dynamic visualisation of the change in adhesion over a particular time range.  |
| **Publication** | The UI will be built by the supplier and should incorporate appropriate infographics to visualise the key outcomes. The deliverable will be reviewed by the project steering group and RSSB; and will be revised by the supplier (where necessary). It must be stored in a software format that is accessible to, and useable by, RSSB i.e. using commercially off the shelf (COTS) software. |

|  |  |
| --- | --- |
| **Deliverable Title** | Quantifying the effects of Railhead Treatments on adhesion - Research in Brief (draft) |
| **Deliverable Type** | Research in Brief |
| **Description** | The Research in Brief will summarise the aims, findings, impacts and benefits, background and methodology of the project. It is expected the supplier will provide a draft for RSSB to adapt in its Research in Brief publication |
| **Publication** | The deliverable will be drafted and finalised by RSSB and will be made available on RSSB’s and SPARK’s websites as a PDF. The deliverable will be produced in a RSSB Microsoft Word template, no more than four pages in length.  |

# Stakeholder roles and responsibilities

The key stakeholders and their responsibilities are detailed in the table below.

|  |  |  |
| --- | --- | --- |
| **Stakeholder(s)** | **General role in project** | **Specific role in acceptance of deliverables** |
| RSSB Project Manager | The RSSB Project Manager is the first point of contact during project delivery and is responsible for the project management including project schedules, cost reporting and other relevant project management tasks. The Project Manager leads the project in organising meetings, etc and ensures timely and effective delivery towards project objectives. | Facilitates technical review and acceptance processes, identifies and monitors corrective actions where needed, including facilitating decision making. |
| RSSB Technical Lead | Throughout the project, the RSSB Technical Lead ensures that technical aspects are reflected accurately. Technical aspects can refer to specific issues around railway signalling, track engineering, safety relevant operations or any other specialist field. | Reviews emerging outputs from a technical perspective. |
| Industry sponsor  | The industry sponsor acts as figurehead for the research, championing its importance and its outputs. The industry sponsor forms part of the project steering group, however, their key role as sponsor is to provide steer to the research as it progresses and to exert pressure on industry to make use of its findings. | Reviews emerging outputs from a technical perspective. |
| Project steering group | The project steering group ensures the project delivers to industry needs. As such, it helps formulate specifications, assesses tenders, reviews draft and final outputs and other relevant tasks. | Reviews emerging outputs from a technical perspective. |
| Primary client group  | The primary client group is made up of RSSB members and other stakeholders across industry.The group is kept informed of the project’s progress each Period (4 weeks). A presentation is made by the supplier to inform the client group of the project’s deliverables. | Informed of deliverables. |

# Budget, timescales and responsibilities

This work has a budget of £115,000. Where costs are above the budgeted amount, then a detailed explanation as to why any proposed increase is necessary, and what added value it may provide is required. In such cases, RSSB strongly encourages suppliers to provide costed options for consideration.

Please note, this quoted budget of £115,000 does not include the optional User interface deliverable. RSSB encourages suppliers to provide separately costed option within the bid for this deliverable.

RSSB expects the work to start in November 2018 and conclude by early March 2019. Industry have requested this work as urgent to inform preparations for autumn 2019. **It is therefore vital findings from this project are communicated to industry by March 2019 (i.e. for the National Autumn review).**

# Critical success criteria and risk management

The following critical success factors have been identified to ensure successful delivery of this project and increased likelihood of industry acceptance/implementation:

* Ability to establish the efficacy and the variability of the different treatments (TGAs, ATUST and RHTTs/MPVs)
* Ability to identify statistically significant influences that lead to this variability (considering statistical significance of the findings), in order to inform future rail cleaning decisions.

The following risks have been identified:

* Incompatibility of datasets (incompatible file formats, potential discrepancies between datasets (time, etc)
* Staggered provision of data (potential need to re-analyse data, etc)
* Stakeholder engagement and buy-in
* Lack of conclusive findings

A detailed risk and mitigations register should be provided as part of the submission illustrating required actions to support the success of the work package.

**Appendix X Form of Tender**

This section outlines how the offer from the Tenderer is to be constructed. Please return this Tender Declaration along with your Tender and retain a copy for your records.

Having examined the ITT email, the Instructions to Tenderers, the Information Required From Tenderers, the Conditions of Contract, the Specification and this Form of Tender (the “Tender Documents”), we offer to supply all/part of (delete as applicable) the goods, services or works specified in these Tender Documents.

We undertake if selected, to perform the contract in accordance with the Tender Documents, including the Conditions of Contract contained herein.

We agree that this tender shall remain open for acceptance by the Customer for 180 days from the date stipulated for the return of tenders.

We understand that you are not bound to accept the lowest, or any tender you may receive.

We certify that this is a bona fide tender, and that we have not fixed or adjusted the amount of the tender by or under or in accordance with any agreement or arrangement with any other person. We also certify that we have not done and we undertake that we will not do, at any time before the hour and date specified for the return of this tender, any of the following acts:

1. Communicate to a person, other than the person calling for the tenders, the amount or approximate amount of the proposed tender. Except where the disclosure, in confidence, of the approximate amount of the tender was necessary to obtain insurance premium quotations required for the preparation of the tender.
2. Enter into an agreement or arrangement with any other person that he shall refrain from tendering or as to the amount of any tender to be submitted.
3. Offer or pay or give or agree to pay or give, any sum of money or valuable consideration directly or indirectly to any person, for doing or having done or causing or having caused to be done, in relation to any other tender or proposed tender for the said goods, services or works, any act or thing of the sort described herein.

We recognise that the Customer reserves the right to clarify details of our offer prior to the award of any contract.

We hereby undertake that the period during which this tender remains open for acceptance not to divulge to any persons, other than the persons to whom the tender is to be submitted, any information relating to the submission of this tender or the details contained therein except where such is necessary for the purpose of submission of this tender.

**Appendix X Subcontractors**

All suppliers to RSSB are asked to provide details of all sub-contractors that will be used to perform the contract.

|  |  |  |  |
| --- | --- | --- | --- |
| Name & Address of Sub-Contractor | Service performed for Contractor | Provide details of staff numbers[[28]](#footnote-28) | Provide latest year’s turnover |
| Name:  |  |  |  |  |
| Address: |  |
| Name:  |  |  |  |  |
| Address: |  |
| Name:  |  |  |  |  |
| Address: |  |

**Appendix X Conflicts** **of** **Interest**

**Tenderers have a continuing duty to disclose actual or potential conflicts of interest in respect of itself, its named sub-contractors and / or consortia members.**

**Please describe any (potential) conflicts of interest that the Tenderer has identified and how these will be managed\*:**

If you **DO** **NOT** have any conflicts to declare, please tick this box: **[ ]**

Tenderers are reminded that failure to identify material conflicts of interest may lead to rejection of its tender response.

Guidance to Tenderers:

Tenderers should describe in the detail the perceived conflict (how it could be perceived in the context of this procurement) and the measures it will take to mitigate the conflict through the procurement life-cycle and service delivery

1. The Database User Interface (Costed: Optional) does not form apart of the evaluation process [↑](#footnote-ref-1)
2. Autumn Performance Dip Economic Modelling. Steer Davies Gleave, May 2016 [↑](#footnote-ref-2)
3. Station overrun at Stonegate, East Sussex 8 November 2010, Report 18/2011, RAIB, November 2011 [↑](#footnote-ref-3)
4. Buffer stop collision at Chester station 20 November 2013, Report 26/2014, RAIB, November 2014 [↑](#footnote-ref-4)
5. Wheel damage puts AGA DMUs out of action, <https://www.railmagazine.com/news/fleet/2015/11/17/wheel-damage-puts-aga-dmus-out-of-action>. November 2015 [↑](#footnote-ref-5)
6. <http://www.railway-technical.com/trains/train-maintenance/> [↑](#footnote-ref-6)
7. [https://www.networkrailmediacentre.co.uk/news/biggest-ever-campaign-unveiled-for-autumn-leaf-fall-battle-kent#](https://www.networkrailmediacentre.co.uk/news/biggest-ever-campaign-unveiled-for-autumn-leaf-fall-battle-kent) [↑](#footnote-ref-7)
8. Strategic Business Case, ADHERE (ADHEsion Research challengE), RSSB (internal), Janurary 2018 [↑](#footnote-ref-8)
9. <https://www.rssb.co.uk/Pages/the-adhesion-challenge.aspx> [↑](#footnote-ref-9)
10. The Prize for Managing Adhesion, Stephenson Case Study, Lawton, A., 2014, Slide 7 [↑](#footnote-ref-10)
11. T1107 Report, T1107: Trial of Sander Configurations and Sand Laying Rates. RSSB. April 2018 [↑](#footnote-ref-11)
12. <https://www.rssb.co.uk/research-development-and-innovation/research-project-catalogue/t1107> [↑](#footnote-ref-12)
13. T1107 Report, T1107: Trial of Sander Configurations and Sand Laying Rates. RSSB. April 2018. P95-135 [↑](#footnote-ref-13)
14. https://www.westmidlandsrailway.co.uk/sites/default/files/assets/download\_ct/20180502/O2jija9noo27WMB\_XI3\_cXaSdaxBXvp9cEnmrv-tBvc/wm01\_may\_2018\_revised.pdf [↑](#footnote-ref-14)
15. <https://www.expressandstar.com/news/2017/10/17/leaves-on-the-line-will-force-revised-london-midland-autumxxcn-timetable/> [↑](#footnote-ref-15)
16. <https://bettertransport.org.uk/sites/default/files/16.03.17.west-midlands-franchise.pdf> [↑](#footnote-ref-16)
17. Sixth Edition, Managing Low Adhesion, Adhesion Working Group Manual. Rail Delivery Group, January 2018.P197-8 [↑](#footnote-ref-17)
18. Sixth Edition, Managing Low Adhesion, Adhesion Working Group Manual. Rail Delivery Group, January 2018. P195 [↑](#footnote-ref-18)
19. Sixth Edition, Managing Low Adhesion, Adhesion Working Group Manual. Rail Delivery Group, January 2018 P275-6 [↑](#footnote-ref-19)
20. ADHERE: Evaluating variability in train driving under different adhesion conditions (T1159) [↑](#footnote-ref-20)
21. Piloting enhanced sanders on the GB MainlineIMP-T1107 [↑](#footnote-ref-21)
22. Autumnsense: Wet-rail monitoring using a network of sensors to improve autumn resilience (COF-AUT) [↑](#footnote-ref-22)
23. [ARG](https://www.rssb.co.uk/groups-and-committees/rssb-board/technical-strategy/technical-leadership-group/system-interface-committees/vehicle-track-system-interface-committee/adhesion-research-group) is a cross-industry sub-group of the [Vehicle/Track System Interface Committee](https://www.rssb.co.uk/groups-and-committees/rssb-board/technical-strategy/technical-leadership-group/system-interface-committees/vehicle-track-system-interface-committee/adhesion-research-group) (V/T SIC), facilitated by [RSSB](https://www.rssb.co.uk/groups-and-committees) [↑](#footnote-ref-23)
24. Sixth Edition, Managing Low Adhesion, Adhesion Working Group Manual. Rail Delivery Group, January 2018 P5-6 [↑](#footnote-ref-24)
25. <https://www.rssb.co.uk/pages/adhere.aspx> [↑](#footnote-ref-25)
26. T1107 Report, T1107: Trial of Sander Configurations and Sand Laying Rates. RSSB. April 2018 [↑](#footnote-ref-26)
27. Not included in the tender bid assessment evaluation [↑](#footnote-ref-27)
28. This is the average annual numbers of both staff and managerial staff employed over the last trading year [↑](#footnote-ref-28)