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Intercity Express Programme (IEP)

Train Infrastructure Interface Specification

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Intercity Express Programme (IEP)

Train Infrastructure Interface Specification (TIIS)

"ITT"

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1 EXECUTIVE SUMMARY

- The purpose of this Train Infrastructure Interface Specification (TIIS) is to provide information concerning the Network Rail infrastructure on which the Intercity Express Programme (IEP) trains will operate from the date of their introduction.

- The TIIS will also support the development of a train design compatible with this infrastructure and facilitate discussion and optimisation of infrastructure – train system interfaces to achieve the best whole life whole system solutions.

- The TIIS provides information on the Network Rail infrastructure, so as to enable optimisation of whole life whole system solutions through train design or infrastructure changes. To enable this the TIIS covers key areas of infrastructure- train interfaces (gauge, wheel-rail, structures, energy, signalling, etc.) and train-infrastructure systems; Electro Magnetic Compatibility (EMC) and vehicle acceptance.

- Requirements which qualify the ‘Rolling Stock’ Technical Specification for Interoperability (TSI), that are necessary to ensure compatibility with Network Rail’s Infrastructure, have been included in the TIIS where known to Network Rail. It is possible that Bidders may identify further areas that need to be qualified in the development of their bids and detailed design.

- The TIIS does not address depots, or servicing and stabling location. No gauge assessment work has been undertaken for any depots or approach to depots.

- Remote monitoring aspects for infrastructure, relevant for the IEP train design, have been included in the Train Technical Specification (TTS) and are therefore not included in TIIS.

- There are areas identified in the TIIS where bidders may wish to provide proposals to the DfT & Network Rail that may provide better whole life whole system solutions.

- The TIIS provides a technical framework to develop additional detail as required through the design process.

2 INTRODUCTION

2.1 Purpose

The purpose of the TIIS is to:

- Provide the TSP with information about characteristics of Network Rail infrastructure relevant for IEP trains and routes (Appendix B).

- Reduce the risk of incompatibility between the train and infrastructure by providing railway infrastructure information to support the development of a compatible train design.

- Support the development of the best whole life, whole system solutions consistent with obtaining best value.

- Identify some of the key information required to support the approvals process.

2.2 Scope

The TIIS provides details of the railway infrastructure and information concerning the train-infrastructure system interfaces, for the new IEP trains to support the TSP in achieving compatibility.

Whilst IEP trains will be compliant with the Interoperability Requirements for the Trans-European high speed rail system and associated TSI the current and proposed infrastructure for operation of IEP trains is not required to meet the Infrastructure System TSI. This aspect is important for the TSP to understand as they are building a TSI compliant train which will also need to meet the local requirements for operational compatibility.

Where compatibility with Network Rail's infrastructure is not fully covered by the Interoperability TSI and associated standards, additional details have been provided in the TIIS. These include requirements which qualify the High Speed Train TSI. However, it is the TSP's responsibility to ensure compliance with relevant Railway Group Standards.

Systems that need both train borne and infrastructure fitted equipment to function correctly e.g. Automatic Train Protection (ATP) are listed in the TIIS and details provided for the TSP to ensure compatibility of the train with the infrastructure fitted equipment.

Where infrastructure details may not be available in sufficient detail to define the interface from an infrastructure perspective, then to ensure railway system compatibility it may be necessary to optimise these interfaces between Network Rail and the TSP and agree any additional data requirements and the final solution to interface issues.

The TIIS relates to compatibility with Network Rail infrastructure. There are sections of the network managed by Network Rail which adjoin infrastructure controlled by others (e.g. LUL, Tyne and Wear Metro) these are not covered by this document.

The TIIS does not address depots, or servicing and stabling locations. Bidders will have to satisfy themselves of the suitability of any depots, servicing and stabling locations, including access to these facilities, as part of their proposed maintenance, servicing and stabling strategy. No gauge assessment work has been undertaken within existing depots, servicing or stabling facilities or depot approach routes (i.e. routes between the access to the facility and routes detailed in (Appendix B).

2.3 Technical Compatibility

[The following Technical Compatibility statements are included in the ITT and are repeated here for clarity.]

The IEP shall achieve technical compatibility to the Network Rail infrastructure over which it is planned to operate including diversionary routes and access to any depots that TSP intend to use. The intent of the IEP is that achievement of compatibility should extend to a fully optimised system based on a whole life, whole system cost basis; in particular the imposition of low physical impacts on the infrastructure and train and low energy requirements.

It is anticipated that the IEP shall be authorised into service under the Railways (Interoperability) Regulations 2006. These mandate conformity with relevant Technical Specifications for Interoperability, relevant Notified National Technical Rules and verification of compatibility between the Train and the rail system within which it will operate. That rail system will not necessarily be TSI compliant and the assessment of compatibility will need to consider the appropriateness of full TSI compliance for the Rolling Stock. Chapter 7 of the TSI makes reference to this scenario and the TSP should discuss any areas where full compliance is not appropriate with the notified body to agree the standards that will be used in the conformity assessment process.

Details on how technical compliance to the existing Network Rail infrastructure might be achieved are identified in Railway Group and Network Rail Company Standards. Where compliance with these standards or with the TSI requirements acts against the intent of compatibility extending to a fully optimised system based on a whole life whole system cost basis, in particular the imposition of low physical impacts on the infrastructure and train and low energy requirements, then the standards should be challenged by the TSP. Early challenge is to be encouraged.

Throughout the standards challenge, infrastructure compatibility and system optimisation phases Network Rail and Department for Transport would wish to maintain a regular dialogue with TSP. The TSP is also advised to initiate and maintain a regular dialogue with HMRI through out in order to facilitate acceptance of the IEP onto the network.

For some infrastructure interface issues it may be more cost effective or more beneficial to the overall system optimisation to modify the infrastructure rather than to modify the train design. Any such proposals should be discussed and agreed with Network Rail and DfT before completion of the train concept design.

The adherence to standards is only one element of the demonstration of compatibility between IEP trains and the existing infrastructure. The TSP should also produce a Risk Assessment and a File demonstrating conformity to the existing infrastructure and other railway undertakings trains in operation and showing the system optimisation. This process is described in Group Standard GE/RT8270 issue 2 and the TSP should acquaint itself with this.

The TSP should note that the scope of the Railways (Interoperability) Regulations 2006 extends to Maintenance Depots. Technical compatibility between these and the existing infrastructure and rolling stock is also necessary (although interfaces with Depot infrastructure are not defined in the TIIS and need to be assessed by the TSP).

3 INFRASTRUCTURE TRAIN INTERFACES

3.1 Gauge

Studies have been undertaken, on the basis of the likely service and diversionary routes (Appendix B), to determine the optimal space available within the existing infrastructure to accommodate the IEP trains. These studies have considered clearances to lineside structures, and also passing clearances with other vehicles likely to operate over the sections of route, as well as clearances to platforms (but not detailed stepping arrangements).

From these studies, a limiting 'swept envelope' within which the IEP vehicle and all movements and behaviours (determined in accordance with the methodology, and supporting definitions of terms, contained within Railway Group Standard GM/RT2149 (Issue 3) *Requirements for Defining and Maintaining the Size of Railway Vehicles*, including any stowed pantograph and stepping arrangements, must fit is provided.

The profile has been derived based upon a vehicle having up to 17 metres between bogie centre pivots (conventional or articulated) and an overall length up to 26 metres (over coupling faces).

3.1.1 Swept Envelope

Appendix A1 contains a series of swept envelopes derived for a vehicle having these broad characteristics travelling along a section of track with cant deficiency up to and including 150 millimetres, but the effects of curve overthrow are excluded (as they have been included in Network Rail's gauging development work).

- Drawing 7479-LR-E-032-A3 shows the swept envelope (blue line) applicable to any point along 22.26 metres of the vehicle centred midway between bogie pivots.

- Drawing 7479-LR-E-036-A2 shows the swept envelope (blue line) applicable to the vehicle ends (based upon a maximum overall length of 26 metres over coupling faces).

- Drawing 7479-LR-E-037-A2 is applicable to the stowed pantograph and shows the swept envelope (blue line) at the bogie pivot points (i.e. 8.5 metre from body centreline if bogie centres were 17 metres).

While this swept envelope defines the limiting condition, it will be necessary for the TSP to demonstrate by the derivation of a kinematic envelope that the developed vehicle (including all physical features such as underframe equipment, footsteps, bogies, door light indicators, buttons, plates, and stowed pantograph) and all movements (except curve overthrow) and behaviours (including operation in all degraded conditions) can be accommodated completely within it. This kinematic envelope shall be provided, at all stages in its development, to Network Rail. Any overhang (of leading or trailing vehicles), measured from the nearest axle, shall also be in accordance with this swept envelope or be comparable and fit within the overhang of vehicles already permitted to use the section of route.

The swept envelope profiles do not include any provision for footsteps or other arrangements at the platform interfaces (unless the footsteps are deployable and fit entirely within the swept envelopes when not deployed).

It should be noted that no gauge assessment work has been undertaken for any depots or approach to depots.

3.1.2 Platform Gauging Compatibility

In order to support the TSP in achieving safe stepping distances, access will be given (by keydisk) to the platform profile data contained within the National Gauging Database (NGD) The Intercity Express TSP shall demonstrate compliance with the particular requirements of GI/RT7016 Issue 1 *Interface between Station Platforms, Track and Trains* (also Section B6.3 of GM/RT2149), and HMRI (also see section 3.3.1)

The TSP should assume that new platforms and platform extensions comply with the requirements of GI/RT7016.

3.2 Wheel-Rail Interface

3.2.1 Contact Patch Energy

IEP trains should generate minimum damage to the track, including Rolling Contact Fatigue (RCF) and wear. Minimising the amount of damage caused to the track will also be of benefit to the train operator and maintainer as the amount of RCF and wear generated on the wheels will also be reduced, increasing wheel life.

The risk of RCF and wear can be quantified using the contact patch energy term, $T\gamma$, which is readily available from the results of vehicle dynamics simulations. Figure 1 (below) shows indicative allowable upper boundary limits of $T\gamma$ (as a function of track curvature) for the IEP trains. Curves are given which show the limits of $T\gamma$ on the wheel tread contact conditions when running at cant equilibrium and 80mm cant deficiency, and also for flange contact. These were calculated using the $T\gamma$ algorithms used in the Vampire vehicle dynamics software.

Similar predictions should be provided for the IEP trains, taken from the leading wheel on the high rail of the curve. The $T\gamma$ values should be presented as the average over at least 250m of continuous running over each curve radius for each of the cant deficiency conditions. Separate results should be supplied for the motor and trailer bogies with heaviest axle loads, and the calculations should use the following modelling assumptions:

- Wheel-rail friction coefficient of 0.45
- New (design) wheel profiles
- CEN60E1 (design) rail profiles

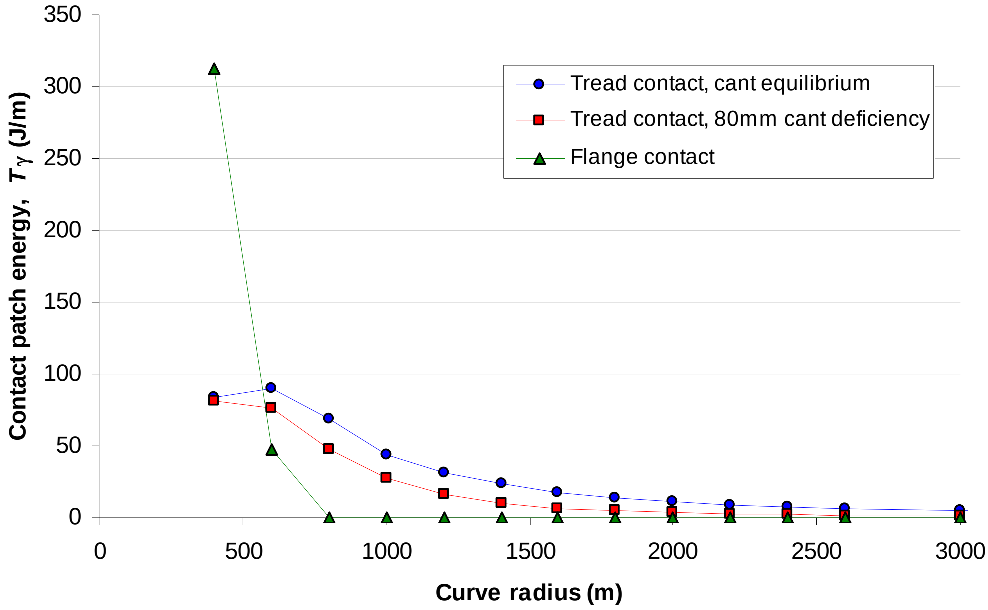

Figure 1: Indicative $T\gamma$ limit for IEP

3.2.2 Track Geometry Quality

Vehicle and track act together as a system in their composite effect upon vehicle ride and the passenger comfort afforded by it; and also of the dynamic forces generated between the wheel and rail that then drive the deterioration rates and service lives of the vehicles and also of the track. The smoothness of the rail running surfaces that contributes to this is described in terms of track geometry quality.

Existing parameters of track geometry are focussed primarily upon addressing passenger comfort and have been substantially informed by analysis of the behaviour of previous generations of rail vehicles. With the introduction of IEP there is the opportunity to examine the relationship between wheel and rail more holistically, taking account of the sophistication of modern vehicle suspension, and to shift the focus to also embrace reducing bogie and vehicle mass to the point where the forces acting at the wheel-rail interface more effectively managed. There are considerable benefits in doing this in terms of the sustainability and durability of the performance of the track and also of the vehicles, and their fatigue and service lives, and upkeep.

Network Rail is committed to a system and collaborative approach to optimising this relationship in the implementation of IEP, so far as this is consistent with other requirements placed upon it by regulators and other stakeholders. In particular, it is very keen to understand at an early stage how by focussing upon particular geometric features to which the proposed vehicle would react, or revised measurable parameters, the masses and resulting dynamic loads acting at the wheel-rail interface can be significantly reduced.

To assist in this goal, Virtual Test Track (VTT) track geometry files and comparators have been generated which are intended to give a clear initial view of the actual track conditions likely to be encountered in service to enable vehicle dynamic simulations to be undertaken from which representative fatigue load cases can be defined. It is intended that these results will enable lighter vehicles than those produced otherwise based upon the current absolute vehicle design values. This exercise, supported by the use of the 'sensitivity comparator' files, should also enable particular track features that are likely to significantly affect vehicle behaviours and therefore bogie mass (based upon considerations of fatigue life) to be identified and addressed. To gain the benefits of this innovative approach it is essential that the outputs and findings from these train simulations can be shared with Network Rail at the earliest opportunity.

3.2.2.1 Changes to Track Geometry Measures from February 2008

Track Geometry Quality describes the smoothness of the rail running surfaces offered up to vehicles. It is a measure both of the ‘degree of adjustment’ of the track’s position relative to a robust design (and is related to the maintenance effort to keep it there) as well being an indirect product of the underlying asset and component condition (as being capable of this degree of fine-tuning and control). It is managed at least three levels, by controlling:

1. the magnitude and incidence of discrete faults (using key parameters of vertical ‘Top’, lateral ‘Line’, Twist (over 3metres) and (track) Gauge);

2. the consistency over a fixed segment (based on Top & Line measures taken over eighth-mile segments); and

3. the proportion of better (or not) track over the network or a section of route (using parameters of Good Track Geometry (GTG), Poor Track Geometry (PTG) and incidence of discrete faults).

Measures of Top and Line are based upon, and are very sensitive to, the wavelength and associated filtering that is applied. Wavelengths of 35 metres and 70 metres are currently used in the UK, and are intended to primarily address passenger comfort criteria.

All sections of route are already maintained in accordance with limiting discrete fault limits and speed-related standard deviation (vertical ‘Top’ and lateral ‘Line’) criteria as set out in Railway Group Standard GC/RT5021 *Track System Requirements* and Network Rail’s own technical requirements. As a result of focus and attention to faults and in addressing underlying causes, the network has experienced year on year improvement in the incidence and severity of track geometry faults. It is the intention that this trend of continuous improvement continue, supported by enhanced track recording frequencies and the tightening of the requirements and intervention limits, especially on the higher speed routes within Network Rail’s technical standard NR/SP/TRK/001 *Inspection & Maintenance of Permanent Way*.

Through the use of route-wide enhanced monitoring and targeted maintenance and renewals, the improvements achieved to track geometry quality have already been significant; particularly in the reduction in the occurrence of detectable discrete vertical and lateral faults. Current plans over the next seven years are to roll-out the application of regimes of Managed Track Position, similar to that already in place as ‘Absolute Track Geometry’ (ATG) on the West Coast Main Line, on main routes to enable a greater degree of control over track position and higher levels of sustainable geometry quality.

The revised intervention fault magnitudes replacing the ‘Level 2’ limits previously set out in Table 8 of TRK/001, and which will be supported by clearer early indications of deterioration by new alert limits (corresponding to the historical and discontinued ‘Level 1’s’) will be implemented from February 2008. The revised values at higher speeds applying across the whole network are set out below in table 1:

Speed	**Immediate Action Limit (IAL)**			**Intervention Limit (IL)**		
	Twist (3m)	Vertical Top(mm)	Lateral Line (mm)	Twist (3m)	Vertical Top(mm)	Lateral Line (mm)
All	1:90 (33mm)			1:125 (24mm)		
80 to 100 mph		30	28		19	13
101 to 125mph		26	21	1:143 (21mm)	18	12

Table 1

In summary, the main changes affecting higher speed routes are:

- The tightening of the (3-metre) Twist limit, requiring repair within 36 hours, at line speeds of 100mph and above (from 1 in 143) to 1 in 125;
- General tightening of the (wide) Gauge limits;
- Tightening of the Top (vertical) Intervention Limits, requiring repair within 14 days, at speeds above 100mph (from 20mm) to 18mm, and a new requirement that faults of 26mm are repaired within 72 hours;
- Tightening of the Top (vertical) Intervention Limits, requiring repair within 14 days, at speeds between 80 and 100mph (from 20mm) to 19mm, and a new requirement that faults of 30mm are repaired within 72 hours;
- Tightening of the Line (lateral) Intervention Limits, requiring repair within 14 days, at speeds above 100mph (from 15mm) to 12mm, and a new requirement that faults of 21mm are repaired within 72 hours;
- Tightening of the Line (lateral) Intervention Limits, requiring repair within 14 days, at speeds between 80 and 100mph (from 15mm) to 13mm, and a new requirement that faults of 28mm are repaired within 72 hours;
- Introduction of new ‘Alert Limits’ across all geometry parameters set ahead of the current ‘Intervention Limits’ to prompt the planning of maintenance attention well in advance of conditions deteriorating to intervention levels.
- Inclusion of new measured parameters of Top and Line based upon an appropriate Mid-chord value, as Alert Limits intended to predict track effects upon vehicles.

The implementation of the enhanced track geometry quality target values, combined with earlier, or lower, alert and intervention limits, are intended to deliver a step change improvement in the incidence and severity of discrete defects encountered by service trains over future years. This will result in improved performance, targeted especially on the ‘Primary’ main lines, and are reflected in the measures of Intervention and Immediate Action Faults per 100 Km (or per mile), for Poor Track Geometry (PTG), and Good Track Geometry

(GTG). These last two measures highlight the achievement against the eighth-mile Standard Deviation (SD) targets for all four parameters of Top and Line set out by speed band in GC/RT5021 (and TRK/001), where PTG reflects the proportion of track outside the 100% value and GTG is a single ‘percentage’ index (with a theoretical maxima of 150%) reflecting the proportion of track better than the 50% and 90% values. The current plan, across the entire network, is for a 4.4% year on year reduction in the incidence of IL & IAL faults, a 0.025 % point year on year improvement in Poor Track Geometry, and a 0.01% point year on year improvement in Good Track Geometry; this is detailed in table 2:

Measure	**CP3**					**CP4**				
	04/05	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**
GTG (%)	128.6	131.4	132.9	135.2	135.2	135.2	135.3	135.4	135.5	135.6
PTG (%)	3.10	2.80	2.60	2.40	2.30	2.30	2.27	2.25	2.22	2.20
Intervention & Immediate action geometry faults per (100km)	Based on L2’s per 100km across current network					4.4% reduction per annum				
	57.5	51.5	45.3	43.2	41.2	39.4	37.7	36.04	34.5	33.0

Table 2

Significant improvements are also being made in the near future to improve the data quality involving further enhancements of the measuring systems, in line with the new technical standards, and overhaul of the data capture and analysis systems to ensure more frequent, consistent and reliable network coverage. Therefore the full effects of these intended enhancements cannot be finally quantified, and this is the main reason that immediate changes are not currently projected in the next two years. The projections will be reviewed and confirmed, once experience is gained of the full effects of the operation of the revised track geometry limits, and the associated inspection and maintenance regimes.

Better early identification and rectification of faults is already being achieved by more frequent track geometry measurement and further improvement will be enabled by the application of Unattended Geometry Measurement System (UGMS) packages fitted to service trains. The incorporation of these systems onto IEP in conjunction with the manufacturer will enable even better trend analysis and predictive techniques to be applied.

3.2.2.2 Further Developments focussed upon IEP and Bogie Mass

Composite track geometry data files, referred to as VTT files have been produced for sample routes drawn from those currently identified for the operation of IEP services. These show track geometry values against the key parameters of vertical and lateral alignment, and gauge and twist together with curvature and super elevation, and will be supplied.

The VTT is much more than a sample of typical data from a fragment of route. While only 20km long it has been created by the compression of raw geometry data over an entire route while still ensuring that it contains a representative proportion of all the features in terms of incidence and magnitude likely to be encountered. It therefore represents a powerful test bed for examining the predicted dynamic behaviour of the proposed vehicles, and for identifying the main geometry features that shape this.

It is envisaged that the track geometry information provided, in the form of VTT track geometry files supported by other comparators, will be applied to the design of the IEP train in the following ways:

- Vehicle dynamic simulations based upon the VTT track geometry files (for all sample routes) from which more representative fatigue load cases can be defined, resulting in reductions in proposed bogie and vehicle mass when compared to more conventional approaches;

- To establish the degree to which the bogie design, and bogie and train mass are sensitive and would respond positively to changes in particular aspects of track geometry quality, by comparison with similar simulation results based upon use of the 'Sensitivity Comparator' file (see below); and

- Identification of the particular features of the geometry, or combinations of features, which impact critically upon the designed bogie and vehicle mass (to form the basis of further interactions and discussions with Network Rail).

The extent of routes traversed by the IEP trains, and the servicing facilities and diversionary patterns necessary to support and maintain them encompasses routes having differing characteristics. The main service routes over which the IEP trains will predominantly operate are comprised of those categorised as high speed and tonnage mixed traffic 'Primary' routes, constructed and maintained to high levels of consistency (and lower incidence and longevity of discrete faults); this is further improved with the introduction of tighter geometry targets and focussing upon alert limits; which move closer to the current TSI requirements for new build infrastructure.

However, these IEP trains are also expected to operate from time to time over sections of route which are categorised as lower line speed and usage 'Secondary' (mixed) or 'Rural' (with limited Freight traffic) routes and also uncategorised loops, depots and sidings. This range of route conditions is as a result of variations in original construction and inherent overall geometry, current track construction, intensity of current traffic levels and the maintenance regime. Therefore VTT files have also been produced, and should be used, for other sample routes with 'Secondary' and 'Rural and Freight only' characteristics drawn from those currently identified for the operation of IEP services.

While it can be expected that, following the implementation of the revised 2008 standard, the incidence of significant faults will be reduced, there remain uncertainties on the precise future track geometry shape. Rates of track geometry and component deterioration, and in particular the maximum magnitude that a particular discrete fault can reach, are affected by future traffic loading and intensity not only from IEP itself but also other traffic also operating over the same routes, and the resulting access opportunities, as well as the performance of underlying structures and the effects of extremes of climatic conditions Therefore it is not possible to produce equivalent files which portray with any degree of accuracy the track geometry conditions that will prevail when the IEP comes into service.

For this reason an additional 'Sensitivity Comparator' file to the same broad format is provided. This file has been synthesised to show the likely measurable track parameters of an illustrative length of Primary track that would result from the absolute application of the 2008 track standards. This will show reduced fault magnitudes factored to reflect the incremental changes to the intervention limits (shown in the commentary to Table 1), and a reduced incidence of track fault based upon the improvements projected over the next six years (shown in Table 2). This is not intended to represent an actual section of route.

As a result of this approach, it should be possible for the likely vehicle ride and behaviours to be more readily assessed, and for particular geometric track irregularities or amplitudes that significantly affect the designed mass of bogie and train, based upon future fatigue life, can be identified and re-examined. Taken with the emerging experience of the practical effects of the enhancements to the monitoring of track geometry, this will facilitate further co-operation in reviewing opportunities for overall improvements by greater attention to particular vehicle and track geometry features.

To gain the benefits of this innovative and collaborative approach it essential that the outputs and findings from these train simulations can be shared with Network Rail at the earliest opportunity.

3.2.3 Vehicle-Track Impact

Consideration of the impact of the vehicle and bogie behaviour on track will be assessed using the Vehicle Track Interaction Strategic Model (VTISM), details of which are provided in the Invitation to Tender. The aim is to enable the development of designs which support lower vehicle-track impact and rail surface damage.

3.3 Structures

3.3.1 Platforms

Where the TSP believes that non compliances with the stepping distance requirements are best addressed in whole life, whole system terms by modifications to platforms then the TSP may put forward proposals for consideration by the DfT and Network Rail.

In considering proposals, account will be taken of the co-existence of the IEP vehicles with other vehicles using the same platform faces.

Any proposals shall be put forward at the Concept Design Stage.

3.3.2 Bridge Resonance

3.3.2.1 Underbridge deck acceleration and resonance

Underbridge resonance is a phenomenon that occurs when the frequency of loading from rail vehicles matches the natural frequency of the structure or particular elements of the structure and the dynamic load effects build up to values exceeding the dynamic effect resulting from a single load event.

Unacceptable accelerations and displacements of the bridge deck can occur under these conditions leading to ballast instability and consequential deterioration of track quality.

Loadings caused by trains with similar axle loadings throughout the formation, as is the case with trains with distributed power rather than a heavy locomotive and lighter trailer vehicles, are more prone to cause unacceptable deck accelerations.

Network Rail will assess this risk using IEP train details provided by the bidders.

The effect of the axle loadings from IEP train formations on underbridge structures will be assessed by Network Rail once provisional axle spacing and loadings have been provided by the TSP after which any strengthening or mitigation measures to structures shall be determined.

3.3.3 Aerodynamics

[Refer to the TTS clauses TS361 and TS1994]

3.3.3.1 Overturning in Gales

[Refer to the TTS clause TS1995] Where the TSP believes that compliance with the requirements of GM/RT2142 are best addressed in whole life, whole system terms by infrastructure based risk mitigation options, then the TSP may put forward proposals for consideration by the DfT and Network Rail.

3.4 Energy

3.4.1 Power

The infrastructure will provide traction power supplies within the range of voltages and frequencies described in NR/GN/ELP/27010 issue 2 clauses 4.2 and 4.3.

The existing infrastructure shall be compatible with single train currents up to a maximum of 300 Amps.

The maximum short circuit current shall be 15,000 Amps at 27.5 kV for a maximum duration of 1 second, as described in BS EN 50388:2005, section 11.2.

The electrification infrastructure is designed for maximum harmonic currents generated by the rolling stock in accordance with NR/GN/ELP/27010 issue 2 clause 4.8.

Initiation of regenerative braking shall not occur if the line voltage is less than 16.5 kV. If regenerative braking has been initiated, and the line voltage then drops below 14 kV, then regenerative braking shall cease. Regenerative braking shall also cease if the line voltage is higher than U_{max2} (29 kV) as described in BS EN 50163:2004 clause 4.1, or if the train fails to detect the fundamental power frequency.

3.4.2 Overhead Line Equipment / Pantographs

3.4.2.1 Contact wire height

The nominal contact wire height on existing lines is between 4700 mm and 4880 mm.

The actual contact wire height, with maximum permitted tolerances, will vary between a minimum permissible contact wire height of 4140 mm and a maximum of 5940 mm static (6240 dynamic, with 300mm uplift of contact wire).

3.4.2.2 Lateral deviation of contact wire

The maximum lateral deviation of the contact wire is designed to be 560mm at 4.7m, with respect to the nominal position of the track. The maximum position of the contact wire with respect to the centre of the pantograph head will be ±650mm, except at switches and crossings, where the incoming contact wire may be taken up on the pantograph horns.

3.4.2.3 Current collection

The current collection quality and contact forces that can exist on the existing overhead line equipment and pantograph system are shown in NR/SP/ELP/21088 issue 2, clause 12. In addition, the infrastructure is designed for pantographs having a nominal mean static contact force in the range 60N – 90N.

The pantograph should be equipped with an automatic dropping device to lower the pantograph if damage occurs to contact strips that is liable to cause subsequent damage to the overhead line, in accordance with BS EN 50206-1:1998, clause 4.9.

The contact wire is compatible with metallised carbon contact strips as currently approved for use on Network Rail infrastructure.

3.4.2.4 Distances between multiple pantographs – current collection

The existing overhead line catenary is compatible with a maximum train speed of up to 125mile/hr with a single pantograph in use and for operation at up to 100mph with two pantographs with a minimum spacing of 85m.

The existing overhead line catenary will not support higher speeds or closer pantograph distances because the reliability of the overhead line will be adversely affected. This limit is based on existing types of pantograph in operation.

Compliant current collection at 200m pantograph spacing or smaller may be possible with a different design of pantograph, for example one with very low unsprung head mass or with independent suspension of contact strips as per those currently in use on some European high speed lines.

Network Rail will support bidders, if requested, in developing current collection solutions to enable two pan operation up to 125mph.

3.4.2.5 Compatibility with positions of signals and booster transformer overlap or neutral sections

For train and infrastructure performance reasons, the positions of the pantographs on the train relative to signals and both overhead line neutral sections and booster transformer overlaps needs to be reviewed.

Network Rail will assess this risk using IEP train details provided by the bidders.

3.5 Signalling

3.5.1 Signal Sighting & Drivers Egress

[Refer to the TTS clauses TS1809 and TS1996]

3.5.2 Signalling Principles

3.5.2.1 Acceleration

The following curve (Figure 2) identifies the maximum acceleration which is compatible with existing signalling without constraint. If the IEP train exceeds this limit, the bidder will need to work with Network Rail to identify the optimum solution that may be needed to support it. No such limit applies when working under ERTMS control.

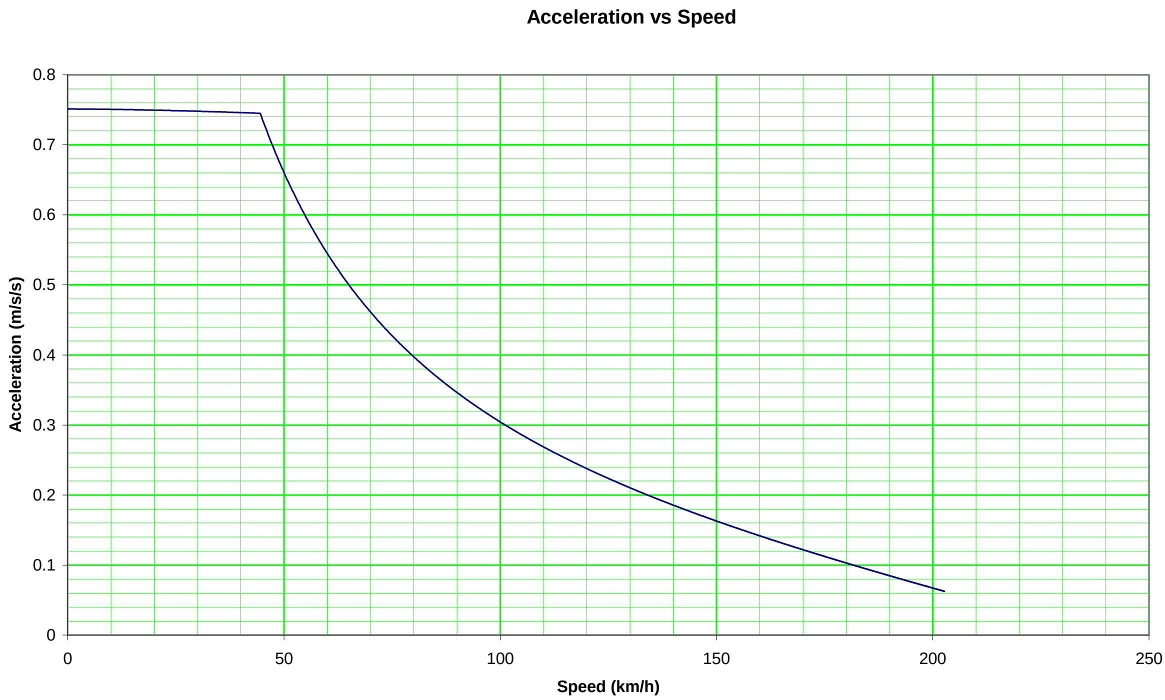

Figure 2: Reference Acceleration

3.5.2.2 Braking

[Refer to the TTS clause TS314]

3.5.2.3 Overhang of train and fouling points

[Refer to the TTS clause TS1814]

3.5.3 Train Detection Systems

3.5.3.1 Track Circuits

[Refer to the TTS clause TS1816]

The IEP train manufacturer shall take note of guidance GK/GN0611 Guidance Note Train Detection and shall operate track circuits reliably without requiring the use of track circuit actuators.

Infrastructure over which the IEP trains will operate is equipped with train detection systems in accordance with RT/E/S11752 Train Detection including but not limited to:

- RT/E/PS/11755 DC Track Circuits
- RT/E/PS/11756 HVI Track Circuits
- RT/E/PS/11757 AC Phase-Sensitive Track Circuits
- RT/E/PS/11764 Track Circuit Interrupters

- Ti21 Track Circuits (refer to section 3.7 Electro Magnetic Compatibility)
- REED Track Circuits (refer to section 3.7 Electro Magnetic Compatibility)
- ASTER Track Circuits (refer to section 3.7 Electro Magnetic Compatibility)
- DC Track Circuits (refer to section 3.7 Electro Magnetic Compatibility)

It shall be confirmed that the IEP train does not adversely affect:

- RT/E/PS/11762 Track Circuits Assister Interference Detectors

3.5.3.2 Onboard Train Locations

[Refer to the TTS clause TS1997]

3.5.4 Train Dispatch

IEP shall be compatible with the current train dispatch arrangements provided on Network Rail infrastructure, these include:

- Self dispatch arrangements, where a member of the train crew manages the opening and closing of the doors, and signals to the driver when it is safe for the train to start once the doors have been closed and locked following completion of station duties. Where there is a possibility that due to volumes of people or curvature that the member of staff responsible for operating the doors cannot see any platform starting signal before indicating to the driver that the train may be started, “OFF” indicators may be provided, which, when displayed, indicate to a member of train staff (other than the driver) that any applicable signal has been cleared.

- Platform staff assisted train dispatch arrangements, where the opening and closing of the doors is carried out by a member of the train crew, but loading and unloading of passengers is supervised by station staff, which indicate to the train crew i) when station duties are complete, ii) it is safe to close the doors, and iii) that there are no obstructions in the doors that would mean that it was unsafe for the train to be started. On some platforms, the platform staff have access to devices that operate indicators to the train crew for this purpose, known as “CD (Close Door) indicators” and “RA (Right Away) Indicators. “OFF” indicators as described above can also be provided.

- Driver Only Operation (DOO) dispatch arrangements, where the train driver alone manages control of the doors at stations, as well as driving the train. In this situation, either mirrors or CCTV displays are mounted along each platform at each stop mark to enable the driver to obtain a view of the length of his train from either the driver’s front window or driver’s side window, or the driver can view the length of his train from an on-board CCTV monitor, operated by on-board CCTV cameras mounted on the body sides.

3.5.5 Front End Lamps, Tail Lamps and Livery

[Refer to the TTS clause TS1822]

3.6 Train-Infrastructure Systems

During the IEP service life it is expected that the train-infrastructure systems will be developed on many of the routes. In anticipation of the train running on multi-fitted journeys it shall be required to interface with all these systems and it shall be able to switch between systems during a journey without service interruption.

3.6.1 Automatic Warning System (AWS)

Network Rail infrastructure is equipped with AWS complying with the system requirements of GE/RT8035 Automatic Warning System (AWS).

IEP trains will operate over routes equipped with both standard strength track equipment and extra strength track equipment and should therefore be compatible with both types.

3.6.2 Train Protection and Warning System (TPWS)

Network Rail infrastructure is equipped with TPWS complying with the system requirements of GE/RT8030 Train Protection and Warning System (TPWS).

3.6.3 Automatic Power Control (APC)

The infrastructure will be fitted with APC equipment to support a train operating in accordance with section 4.10 of NR/GN/ELP/27010s.

3.6.4 Automatic Train Protection (ATP)

The Great Western Main Line (GWML) is equipped with BR-ATP. This will be replaced with ETCS level 2 in the future.

Network Rail will work with the bidders in respect to development of an optimised technical solution for ATP compatibility.

Bidders need to be aware that there are other systems, for example a ‘train stop’ system is fitted on an ECML diversionary route which is shared with Tyne & Wear Metro, but is Network Rail owned. So the IEP trains do not need to respond to the system but they must not interfere with it.

3.6.5 European Train Control System (ETCS)

The IEP infrastructure is being fitted with ETCS Level 2 equipment as specified by the Control Command and Signalling TSI.

Infrastructure shall migrate from conventional signalling to ERTMS Level 2 as specified by the DfT.

[Refer to the TTS clause TS1867]

3.6.5.1 Train Complete

[Refer to the TTS clause TS1872]

3.6.6 Radio Systems

The GSM-R radio system will be introduced on to IEP routes, GE/RT8082 identifies the air interface and train interface requirements for the system.

Railway Group Standard GE/GN8580: Guidance on Train Radio Systems for Voice and Related Messaging Communications is applicable to all new and existing train radio fixed infrastructure.

3.6.6.1 Wireless Connectivity

[Refer to the TTS clause TS1922]

3.6.7 Selective Door Operation (SDO)

The train shall be fitted with an automatic selective door operation system to enable the train to call at stations with platforms shorter than the length of the train on both ERTMS-fitted and non-ERTMS fitted lines. The system shall be designed to meet HMRI guidelines. Attention is drawn to the work currently being carried out by RSSB to develop a Guidance Note for the future design of such systems, aiming to standardise the infrastructure interface. It is expected, but not guaranteed, that the long term future standard will be built around ERTMS, using the Eurobalise. It is also expected that there will be a short term solution for non-ERTMS fitted lines, using a solution based on Radio Frequency Identification (RFId) tags. No additional equipment shall interfere with existing trackside maintenance or require trackside maintenance itself.

3.6.8 Infrastructure Monitoring

Network Rail has agreed with DfT that infrastructure monitoring systems shall be provided on IEP sets and the requirements for this are provided in the TTS.

Some such systems have been developed by Network Rail and are described below for information. Bidders should note that these systems continue to be developed and the equipment described below is therefore likely to change before contract award. Network Rail will work with the bidders to help them understand the available technology and agree how best to deploy it.

Network Rail will also support bidders in defining the outputs to be provided from these monitoring systems.

3.6.8.1 Intelligent Monitoring

An intelligent monitoring unit shall be provided on every train to record infrastructure data collated as the train traverses the network and shall have a facility to enable this data to be down loaded and provided to the infrastructure maintainer at least once every 24 hours. The monitoring system shall record unique identities for each train, the journey and the line which is travelled over including direction, date and timestamp data to the nearest second so each item of infrastructure equipment monitored can be identified.

[Refer to the TTS clause TS 2003]

Many of these monitoring requirements are currently carried out by staff going trackside to carry out measurements according to Network Rail Maintenance standards NR/LS/SIG/10663 though those required for ETCS are currently under development. More specifically for AWS the requirements are listed in NR/SMS/AW11 and NR/SMS/Test/024. For TPWS the requirements are listed in NR/SMS/TP11 and NR/SMS/Test024. It is appreciated that not all the requirements in these current standards will be able to be carried out by onboard monitoring but Network Rail would work with the Bidders to agree the specific details for inclusion in the specifications to be developed by Bidders for infrastructure monitoring.

ETCS specifications are currently under development within Europe and are mandated in the Control Command and Signalling TSI (see section ERTMS). We believe the above requirements are necessary as identifying Eurobalise, EVC and GSM-R system issues in advance of any failure would reduce any affect on service as a result of system failures.

Network Rail see this as an opportunity to work with the TSP to discuss and detail the above requirements, so that it integrates with the train borne architecture and data management already undertaken for operational or other purposes, rather than impose totally additional requirements.

3.6.8.2 Unattended Track Geometry Measurement System (UGMS)

3.6.8.2.1 Background

A UGMS system has already been developed and successfully installed on the following designs of rolling stock MkIII Coach, Class 168 and Class 390. The system works by recording data from bogie mounted sensors to a body mounted UGMS control box. This control box then transmits the data back to Network Rails Engineering Support Centre, using Wifi, where the data is translated into track geometry channels that are fully compatible with the data recorded by Network Rails fleet of dedicated infrastructure inspection trains.

The interface specification given in the following subsections is based on the existing UGMS specification and is provided for information.

The existing UGMS system can be split up into two parts, the bogie mounted equipment and the body mounted equipment.

The bogie mounted equipment typically comprises the following parts:

- Left Laser / Camera Assembly
- Right Laser / Camera Assembly
- Inertial Box
- Left VRVT Transducer
- Right VRVT Transducer
- Left Vertical Accelerometer Assembly
- Right Vertical Accelerometer Assembly
- Rotary Encoder (Tacho)
- AWS Detector Head

The body mounted equipment typically comprises the following parts:

- UGMS processor box
- Instrumentation cabling and connectors
- DGPS antenna & integral cable
- Wireless LAN antenna & cabling
- GSM-R antenna & cable

- Emergency stop buttons
- Three Laser Warning Lights

The items listed above have been provided by Network Rail for past installations. In addition to this, various vehicle specific components are required on the host vehicle. These may include:

- Pneumatic system including pressure actuating timer
- Electrical interface including any terminal boxes for both power and signal cables
- Brackets, sub-frames and associated fasteners
- Emergency system isolation switches
- Laser system remote interlocking device
- Un-interruptible power supply (UPS)
- DC/DC or AC/DC Converter (dependent on vehicle supply type)

Extensive details of the system previously fitted by Network Rail and its installation are available in the document UGMS Hybrid Track Geometry Generic Description of Present System, Network Rail, E&D/SF/001, Issue 1, 4 October 2007.

Module Type	**Mass (Kg without brackets or mounts)**
UGMS Processor Box	25
Inertial Box	12
Laser / Camera Module	7
VRVT Transducer	1.0
Vertical Accelerometers (with terminal box)	1.5
Garmin GA29F Antenna (without cable)	0.2
Garmin GA29F Antenna (with cable)	0.5
Heidenhain ROD 420 Rotary Encoder (Tacho)	0.25
AWS Detector Head	0.85
Wireless LAN Antenna	0.15
Laser Warning Light (single input)	0.86

Table 3: UGMS Component Masses

[Refer to the TTS clauses TS1899, TS1900, TS1902, TS2006 and TS1903 for additional train requirements]

3.6.8.3 Forward Facing CCTV

The system shall include one forward and one rearward facing camera. The cameras shall be optimised to identify track, signals and any approaching activity of interest on track, trackside or station platforms as would be seen a driver.

[Refer to the TTS clauses TS1907 and TS1911 for the train requirements].

The cameras shall (as far as practicable) record the images from the front and rear of the IEP train as seen by the driver, but shall not obscure the drivers visibility. Care shall be taken to reduce the likelihood of the images becoming obscured by dirt and detritus and where the cameras are located behind the windscreen they shall be positioned within the area swept by the wipers. It shall not be possible for the driver to block the camera's field of vision. The field of view (pan and tilt) shall be adjustable only using special tools.

Images shall be passed to the DVR by dedicated wiring. Images are electronically compressed to reduce data storage. Inside one DVR on each train shall be a GSM module and antenna which is used to transmit event recording information triggered by the activation of any Drivers Incident Button, via standard text message. The text message includes the time, date and vehicle number.

The Off Train Equipment shall comprise an off train playback station which is used to review hard drives from the train and make it exportable to other storage media (DVD, CD, USB, other PC).

In addition, a programme shall be supplied which can be installed onto a laptop and used to download footage directly from the DVR as well as carry out system maintenance, programme and configure the system.

The recordings shall be playable through any standard media device, using standard formats (mpg, wmv etc).

When it is required to review footage from the IEP train, the hard drive(s) shall be made to be easily removed, and interrogated using the playback station.

3.6.8.4 Unattended Overhead Line Measurement System (UOMS)

3.6.8.4.1 Background

Network Rail has an aspiration to measure the overhead contact wire automatically from IEP trains. Systems with this capability have been developed in the past by suppliers, however their performance has not met Network Rails requirements. The system is termed Unattended Geometry Measurement System (UOMS).

The system will work by recording data from an instrumented pantograph to a body mounted UOMS control box, this control box is likely to be identical to the UGMS control box. The control box then transmits the data back to Network Rails Engineering Support Centre, using Wifi, where the data is translated into information on the overhead contact wire condition.

The interface specification for UOMS given in the following subsections is based on the existing UGMS specification (and this should be used as reference for the control box interfaces and dimensions).

3.6.8.4.2 Number of IEP trains to be fitted with UOMS

Network Rail has agreed with the DfT that IEP sets shall be able to automatically measure the overhead contact wire parameters. Although systems with this capability have been developed in the past, their performance has not met Network Rails requirements. As a result Network Rail will support the Bidders in developing a specification for an Unattended Geometry Measurement System (UOMS).

It is anticipated that the system will monitor overhead line contact wire parameters using an instrumented pantograph that will be connected to a body mounted UOMS control box that transmits the data back to Network Rails Engineering Support Centre, using Wifi, where the data is translated into information on the overhead contact wire condition.

The UOMS system can be considered in two parts, the instrumented pantograph and the body mounted equipment.

- An instrumented pantograph will measure the accelerations and forces on the pantograph at operational speeds.

The body mounted equipment will typically comprise of the following parts:

- UOMS processor box
- Instrumentation cabling and connectors
- DGPS antenna & integral cable
- Wireless LAN antenna & cabling
- GSM-R antenna & cable

The body mounted equipment listed above have been provided by Network Rail for past installations. In addition to this, various vehicle specific components are required on the host vehicle. These include:

- Electrical interface including any terminal boxes for both power and signal cables
- Un-interruptible power supply (UPS)
- DC/DC or AC/DC Converter (dependent on vehicle supply type)

[Refer to the TTS clauses TS1914, TS1915, TS1916, TS1917 and TS2007 for additional train requirements].

3.6.8.5 Automatic Vehicle Identification (AVI)

Network Rail will support Bidders in developing a specification for an Automatic Vehicle Identification (AVI) that the Bidders can offer on IEP trains.

The AVI system will require two tags per IEP train (one on either side). The location will need to be such that it is not protruding and is safe from being hit or damaged, whilst not shielded or obstructed by metal work. The specification for the tags will be developed and discussed with the bidders, but will be based on RFId technology.

[Refer to the TTS clause TS2004 for additional requirements].

3.7 Electro Magnetic Compatibility (EMC)

Network Rail infrastructure does not fully comply with the High Speed and Conventional Command, Control and Signalling TSI Directives.

Specific requirements for IEP are as follows:

- Declaration of conformity with EMC Directive shall be accepted as part of the Process for Assessment of Compatibility of Rolling Stock and Infrastructure.
- EMC compatibility case shall consider all coupling from DC to 2GHz as required by GE/RT8015.
- Compatibility under normal conditions must be evaluated as a pass / fail criteria against the limits from appropriate EN standards and NR EMC specifications.
- Rolling stock in normal and degraded modes of operations shall not be expected to cause excessive interference above declared signalling compatibility limits.
- The established availability/reliability of the signalling system due to EMI in case of train degraded conditions shall not be compromised.
- The rate of failures leading to train interference emissions in excess of declared signalling compatibility limits shall be demonstrated to be commensurable with the applicable safety / availability targets for the victim equipment.
- If EMC with signalling systems is achieved by the deployment of purpose built Interference Current Monitoring Units (ICMU), then the integrity of these units shall be commensurable with the reliability and availability rate of the corresponding signalling system, as appropriate. The safety argument shall be recorded as part of the established Safety Management System (SMS).

The compatibility criteria between trains and infrastructure in the immediate future are contained in the existing NR's EMC specifications which are advised to be used as applicable in demonstrating compatibility."

Table 4: EMC Requirements

Document Number	Title
NR/SP/SIG/50002	Methodology for the demonstration of compatibility with single rail Reed Track Circuits on the AC railway
NR/GN/SIG/50003	Methodology for the demonstration of compatibility with Reed Track Circuits on the DC railway
NR/SP/SIG/50004	Methodology for the demonstration of electrical compatibility with DC (AC-immune) Track Circuits
NR/SP/SIG/50005	Methodology for the demonstration of compatibility with 50 Hz Single Rail Track Circuits
NR/SP/SIG/50006	Methodology for the demonstration of compatibility with 50 Hz Double Rail Track Circuits

Document Number	Title
NR/SP/SIG/50007	Methodology for the demonstration of compatibility with HVI Track Circuits
NR/SP/SIG/50008	Methodology for the demonstration of compatibility with TI21 Track Circuits
NR/SP/SIG/50009	Methodology for the demonstration of compatibility with FS2600 Track Circuits
NR/SP/SIG/50010	Methodology for the demonstration of compatibility with train detection systems in use on non-electrified lines (to be published in Oct 2007)
NR/SP/SIG/50011	Methodology for the demonstration of compatibility with Axle Counters
NR/SP/SIG/50012	Methodology for the demonstration of compatibility with TPWS trackside equipment.
NR/SP/SIG /50013	Methodology for the demonstration of compatibility with Interlockings
NR/GN/SIG/50014	Methodology for the demonstration of compatibility with Lineside Equipment on AC and DC Railways
NR/SP/SIG/50015	Methodology for the demonstration of compatibility with Reed FDM Systems
NR/SP/TEL/50016	Methodology for the demonstration of compatibility with Telecomms Systems
NR/SP/SIG/50018	Methodology for the determination of interaction with Neighbouring Railways

4 VEHICLE ACCEPTANCE

[The following Vehicle Acceptance statements are included in the ITT and are repeated here for clarity.]

The IEP train shall be optimised with the existing infrastructure as described in paragraph 2.3 of this document and be fully compatible with the existing infrastructure over which it will operate. In order to help facilitate the TSP's achievement of both this optimisation and technical compatibility, such as to be acceptable to Network Rail, and also help expedite IEP through the formal authorisations Network Rail wishes to cooperate with the TSP at all stages of the design and build of IEP. This cooperation would be the appointing of a dedicated member of the Network Rail acceptance team to interface with the TSP, in terms of providing information regarding the infrastructure to TSP relating to the achievement of technical compatibility by TSP and optimisation with the existing infrastructure, including challenges to the standards as appropriate.

The TSP shall agree a strategy and time table for achieving acceptance of the IEP into service to meet the DfT delivery schedule with Network Rail.

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APPENDIX A

Swept Envelope

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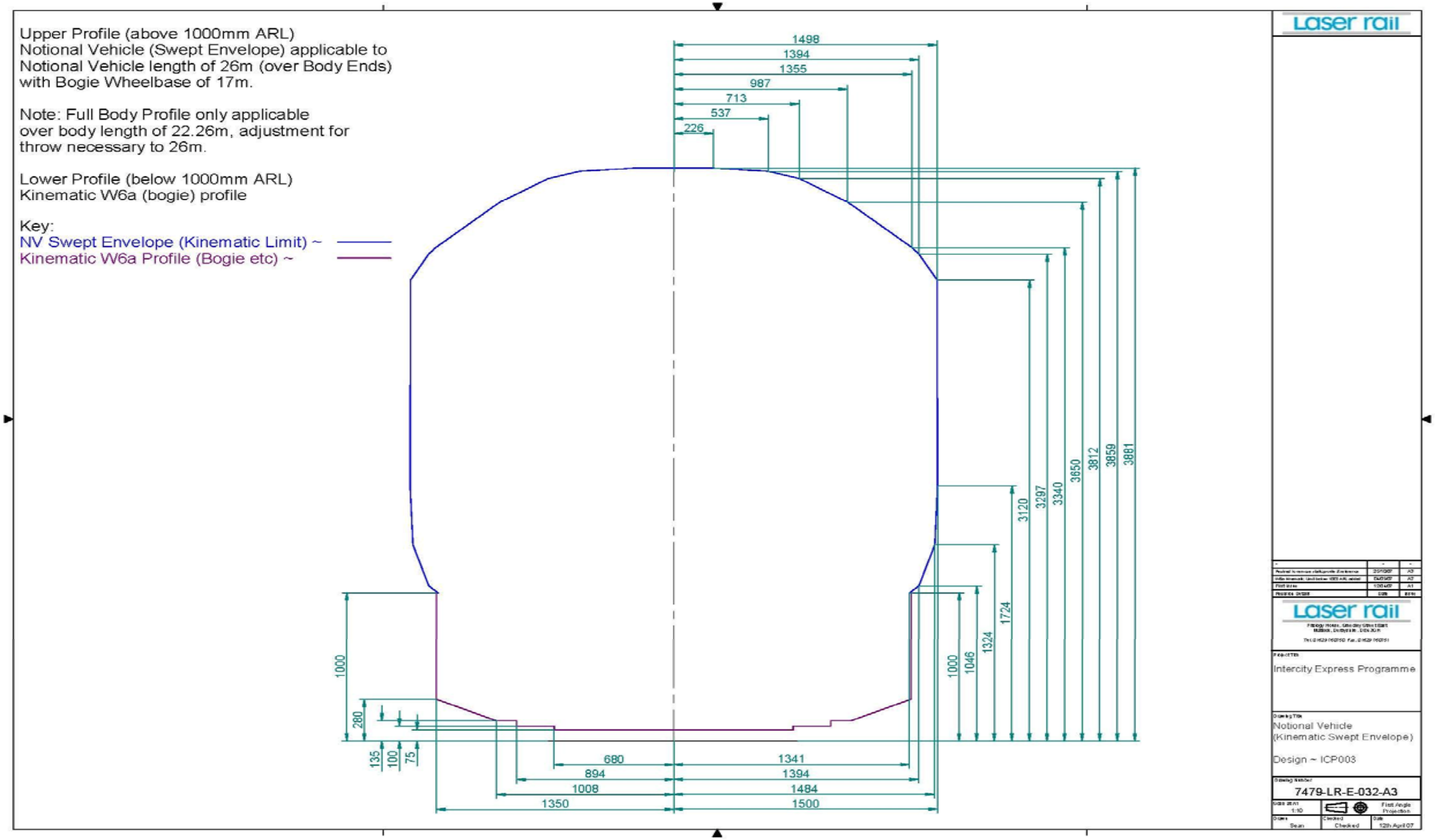
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with Bogie Wheelbase of 17m.
Note: Full Body Profile only applicable
over body length of 22.26m, adjustment for
throw necessary to 26m.
Lower Profile (below 1000mm ARL)
Kinematic W6a (bogie) profile
Key:
NV Swept Envelope (Kinematic Limit) ~
Kinematic W6a Profile (Bogie etc) ~
1498
1394
1355
987
713
537
226
3120
3297
3340
3650
3812
3859
3881
1724
1324
1046
1000
1000
280
135
100
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680
894
1008
1350
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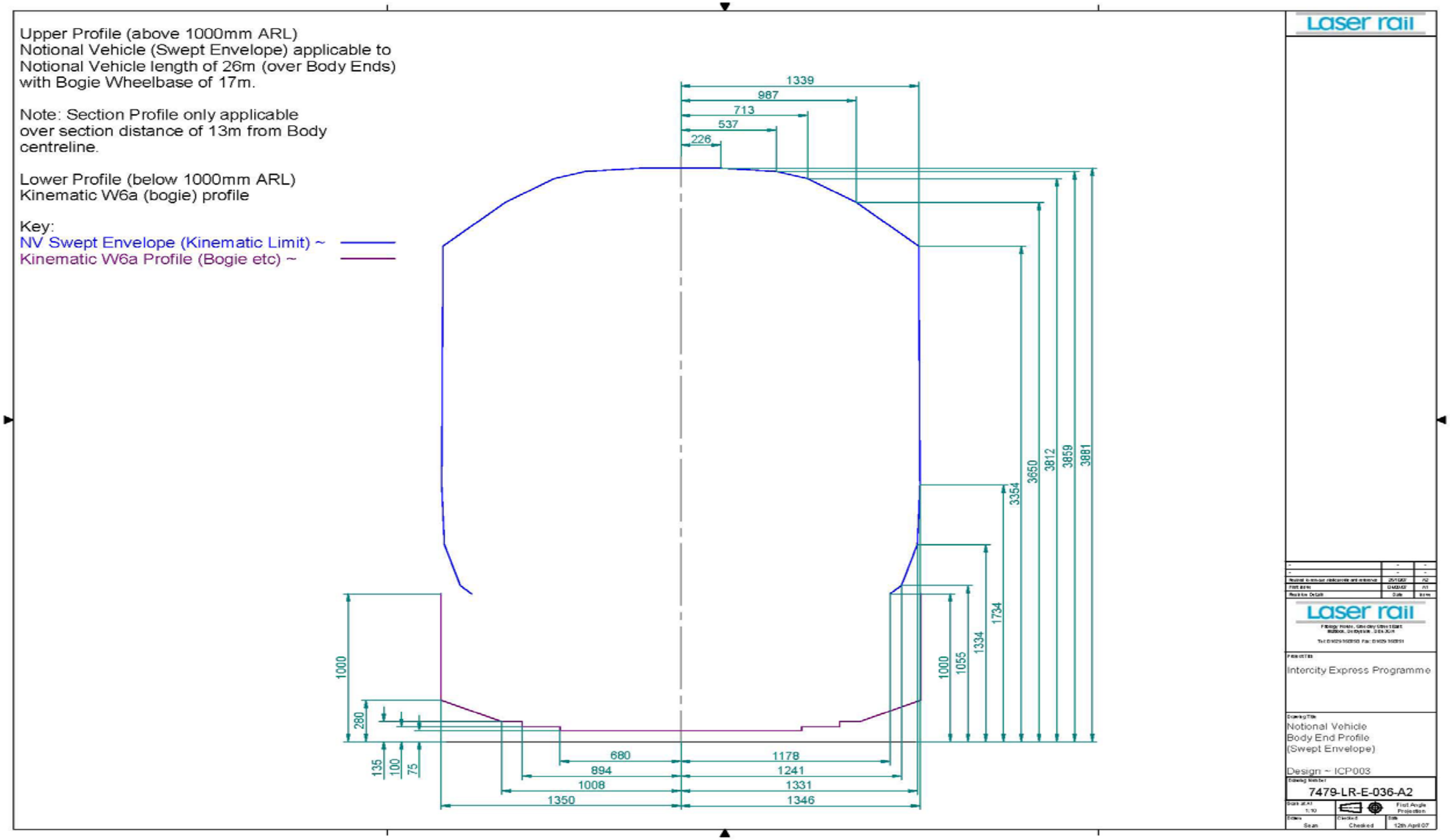
Laser rail
Intercity Express Programme
Notional Vehicle
(Kinematic Swept Envelope)
Design ~ ICP003
7479-LR-E-032-A3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with Bogie Wheelbase of 17m.
Note: Section Profile only applicable
over section distance of 13m from Body
centreline.
Lower Profile (below 1000mm ARL)
Kinematic W6a (bogie) profile
Key:
NV Swept Envelope (Kinematic Limit) ~
Kinematic W6a Profile (Bogie etc) ~
1339
987
713
537
226
3881
3859
3812
3650
3354
1734
1334
1055
1000
1000
280
135
100
75
680
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1350
1178
1241
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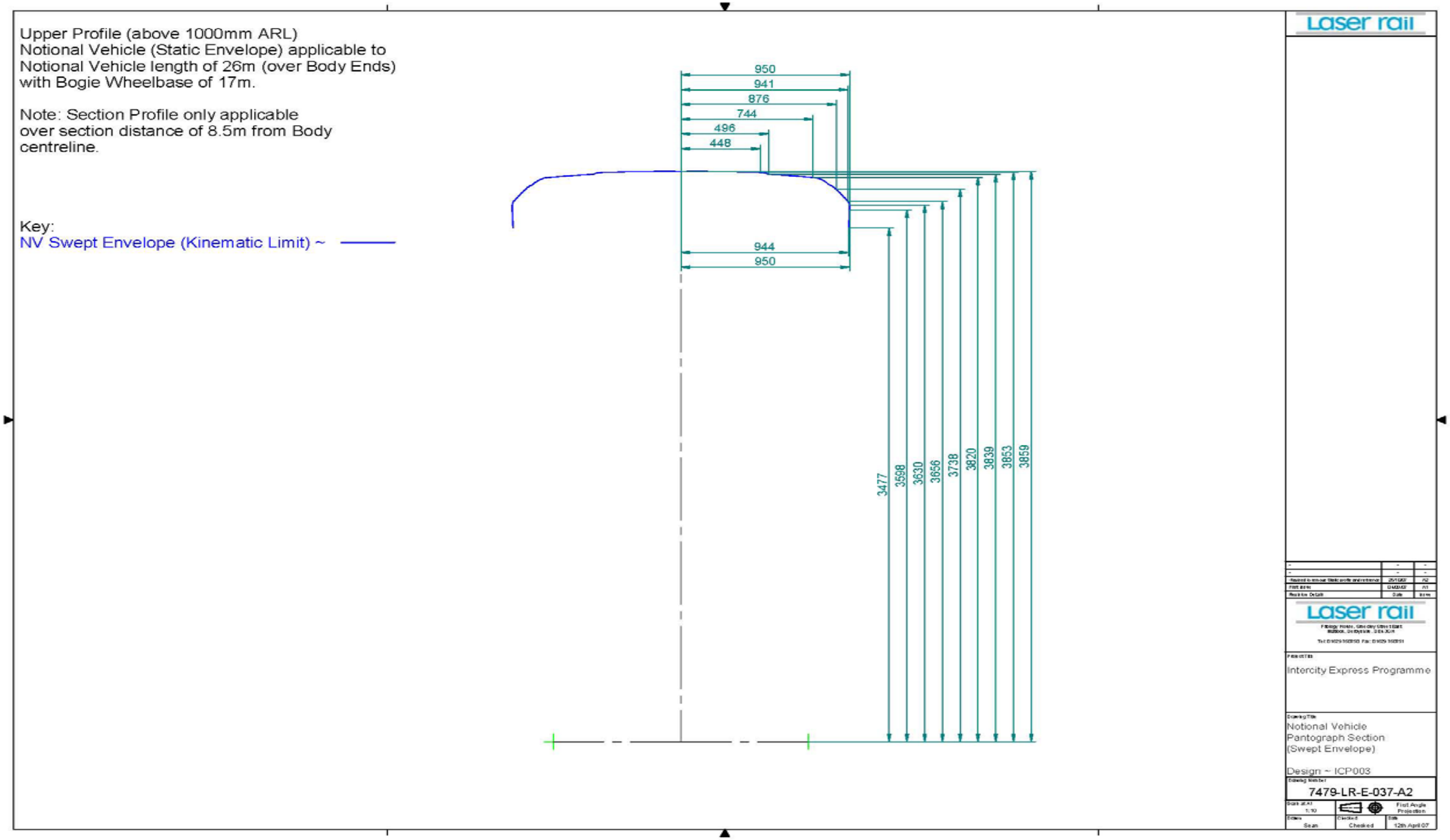
Laser rail
Laser rail
Intercity Express Programme
Notional Vehicle
Body End Profile
(Swept Envelope)
Design ~ ICP003
7479-LR-E-036-A2


Upper Profile (above 1000mm ARL)
Notional Vehicle (Static Envelope) applicable to
Notional Vehicle length of 26m (over Body Ends)
with Bogie Wheelbase of 17m.
Note: Section Profile only applicable
over section distance of 8.5m from Body
centreline.
Key:
NV Swept Envelope (Kinematic Limit) ~
950
941
876
744
496
448
944
950
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3598
3630
3656
3738
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3839
3853
3859
Intercity Express Programme
Notional Vehicle
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7479-LR-E-037-A2
1:10
First Angle
Projection
Sean
Checked
12th April 07

APPENDIX B

List of Routes

The description of the routes includes all running lines in signalled direction, including Fast/Main, Slow/Relief and loops, all crossovers and connections between them and all tracks serving all platform faces (including bay platforms). The routes exclude sidings, depots and crossovers/connections between the running lines and those sidings and depots.

It should be noted that some route sections are specified both within the West Coast Main Line South and the Cross-Country routes. These are currently IEP deployment options under consideration, therefore either one or the other (or both) may be required. A comment is provided within the notes column to indicate those routes.

The 'Route Type' is derived from definition used to manage the Track Asset Policy.

			Start		End				
RFS Sub-Route	**RFS Route Description**	**ELR**	**Miles**	**Yards**	**Miles**	**Yards**	**Approx Decimal Miles**	**Route Type (Simplified)**	**Notes**
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	ECM1	0	0	160	1100	160.63	Primary	
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	PMJ	16	1232	22	484	5.58	Secondary	
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	HOS	0	0	1	1013	1.58	Primary	
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	ECM2	160	352	169	352	9.00	Primary	
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	ECM3	169	352	182	1738	13.79	Primary	
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	ECM4	182	1738	188	836	5.49	Primary	
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	ECM5	0	0	80	110	80.06	Primary	
Kings Cross to Newcastle - electrified	Pre-Series East Coast South Main Routes	ECM6	80	110	80	352	0.14	Primary	
Newark to Lincoln	Pre-Series East Coast South Main Routes	NSE	0	0	0	440	0.25	Secondary	
Newark to Lincoln	Pre-Series East Coast South Main Routes	NOB1	17	1628	32	0	14.08	Secondary	
Newark to Lincoln	Pre-Series East Coast South Main Routes	NOB2	32	0	32	1540	0.88	Secondary	
Doncaster to Leeds via Wakefield - electrified	Pre-Series East Coast South Main Routes	DOL1	156	616	175	704	19.05	Primary	
Doncaster to Leeds via Wakefield - electrified	Pre-Series East Coast South Main Routes	DOL2	175	704	185	1597	10.51	Primary	
Hambledon South Junction to Leeds via Micklefield	Pre-Series East Coast South Main Routes	HUL4	10	1100	20	1100	10.00	Secondary	
Hambledon South Junction to Leeds via Micklefield	Pre-Series East Coast South Main Routes	HUL3	4	946	10	1100	6.09	Secondary	
Hambledon South Junction to Leeds via Micklefield	Pre-Series East Coast South Main Routes	HSC	174	220	175	726	1.29	Secondary	
Micklefield to York	Pre-Series East Coast South Main Routes	CFM	10	682	15	1342	5.38	Secondary	
Micklefield to York	Pre-Series East Coast South Main Routes	NOC	5	902	10	1694	5.45	Secondary	
Leeds to York via Harrogate	Pre-Series East Coast South Main Routes	LEH1	0	452	14	1320	14.49	Rural	
Leeds to York via Harrogate	Pre-Series East Coast South Main Routes	LEH2	14	1320	15	440	0.50	Rural	
Leeds to York via Harrogate	Pre-Series East Coast South Main Routes	LEH3	15	440	17	528	2.05	Rural	
Leeds to York via Harrogate	Pre-Series East Coast South Main Routes	HAY2	18	1320	20	836	1.73	Rural	
Leeds to York via Harrogate	Pre-Series East Coast South Main Routes	HAY1	1	1122	18	1320	17.11	Rural	
Leeds to Skipton - electrified (but power restrictions apply)	Pre-Series East Coast South Main Routes	TJC3	195	1188	221	462	25.59	Secondary	
Leeds to Bradford Forster Square - electrified	Pre-Series East Coast South Main Routes	SBF	205	1213	208	1085	2.93	Secondary	
Doncaster to Hull via Selby	Pre-Series East Coast South Main Routes	TCW1	169	352	174	242	4.94	Secondary	
Doncaster to Hull via Selby	Pre-Series East Coast South Main Routes	HUL2	30	880	31	264	0.65	Secondary	
Doncaster to Hull via Selby	Pre-Series East Coast South Main Routes	HUL1	0	0	30	880	30.50	Secondary	
Hertford Loop – electrified	Pre-Series East Coast South Diversionary Routes	HDB	5	154	28	330	23.10	Secondary	
Hitchin to Peterborough via Ely (electrified to Ely)	Pre-Series East Coast South Diversionary Routes	SBR	32	252	55	758	23.29	Secondary	
Hitchin to Peterborough via Ely (electrified to Ely)	Pre-Series East Coast South Diversionary Routes	BGK	53	66	71	1386	18.75	Secondary	
Hitchin to Peterborough via Ely (electrified to Ely)	Pre-Series East Coast South Diversionary Routes	EMP	71	1394	100	1452	29.03	Secondary	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	WEB	79	759	92	1276	13.29	Rural	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	SPD1	44	154	62	286	18.08	Rural	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	SSE	0	0	0	946	0.54	Rural	

RFS Sub-Route	RFS Route Description	ELR	Start Miles	Start Yards	End Miles	End Yards	Approx Decimal Miles	Route Type (Simplified)	Notes
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	SNW	1	704	3	902	2.11	Rural	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	SPD2	62	286	81	550	19.15	Rural	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	SPD3	81	550	98	1210	17.37	Secondary	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	SPD4	98	1518	115	1584	17.04	Secondary	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	SPD5	115	1584	117	880	1.60	Secondary	
Peterborough to Doncaster via Sleaford and Lincoln	Pre-Series East Coast South Diversionary Routes	BCB	115	1581	116	972	0.65	Freight only	
Doncaster to Gilberdyke via Goole	Pre-Series East Coast South Diversionary Routes	DOW	0	0	8	176	8.10	Primary	
Doncaster to Gilberdyke via Goole	Pre-Series East Coast South Diversionary Routes	TJG1	7	1520	9	321	1.32	Secondary	
Doncaster to Gilberdyke via Goole	Pre-Series East Coast South Diversionary Routes	TJG2	0	0	14	0	14.00	Secondary	
Doncaster to Leeds via Knottingley	Pre-Series East Coast South Diversionary Routes	ECM1	155	1694	160	242	4.17	Primary	
Doncaster to Leeds via Knottingley	Pre-Series East Coast South Diversionary Routes	KWS	58	452	68	1672	10.69	Freight only	
Doncaster to Leeds via Knottingley	Pre-Series East Coast South Diversionary Routes	WAG1	47	781	58	440	10.81	Secondary	
Doncaster to Leeds via Knottingley	Pre-Series East Coast South Diversionary Routes	WWK	0	0	0	572	0.33	Secondary	
Doncaster to York via Knottingley	Pre-Series East Coast South Diversionary Routes	FKW	2	594	2	1562	0.55	Secondary	
Doncaster to York via Knottingley	Pre-Series East Coast South Diversionary Routes	SMJ2	0	0	2	594	2.34	Secondary	
Doncaster to York via Knottingley	Pre-Series East Coast South Diversionary Routes	SMJ3	15	88	16	1518	1.81	Secondary	
Doncaster to York via Knottingley	Pre-Series East Coast South Diversionary Routes	NOC	10	1694	15	88	4.09	Secondary	
Selby to Hambleton West Junction	Pre-Series East Coast South Diversionary Routes	HUL3	0	0	4	946	4.54	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	LLP1	28	1672	29	1584	0.95	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	LLP2	42	462	43	13	0.74	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	LLP3	0	0	0	1569	0.89	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	LEN2	0	0	0	827	0.47	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	LEN3	42	1738	101	1266	58.73	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	HLK	0	0	0	1030	0.59	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	KEB	0	0	0	286	0.16	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	PLG1	100	1424	101	330	0.38	Secondary	
Northallerton to Newcastle via Yarm, Hartlepool and Sunderland	Pre-Series East Coast South Diversionary Routes	PLG2	0	0	0	478	0.27	Secondary	
Stockton to Ferryhill	Pre-Series East Coast South Diversionary Routes	STF	0	0	10	1584	10.90	Freight only	
Kings Cross to Edinburgh - electrified	East Coast Main Routes	ECM7	0	0	69	1474	69.84	Primary	
Kings Cross to Edinburgh - electrified	East Coast Main Routes	ECM8	0	618	54	1108	54.28	Primary	
Kings Cross to Edinburgh - electrified	East Coast Main Routes	ECM9	0	0	0	618	0.35	Primary	
Hitchin to Kings Lynn via Cambridge – electrified	East Coast Main Routes	BGK	71	1386	96	1650	25.15	Secondary	
Doncaster to Hull via Selby	East Coast Main Routes	HNC	3	748	4	0	0.57	Secondary	
Edinburgh to Glasgow Central via Carstairs and Motherwell - electrified	East Coast Main Routes	EGM3	0	316	1	462	1.08	Primary	
Edinburgh to Glasgow Central via Carstairs and Motherwell - electrified	East Coast Main Routes	ECA3	99	14	100	924	1.52	Primary	

Edinburgh to Glasgow Central via Carstairs and Motherwell - electrified	East Coast Main Routes	ECA2	74	250	99	14	24.87	Primary	
Edinburgh to Glasgow Central via Carstairs and Motherwell - electrified	East Coast Main Routes	CSP	73	1080	74	250	0.53	Primary	
Edinburgh to Glasgow Central via Carstairs and Motherwell - electrified	East Coast Main Routes	WCM1	73	814	84	218	10.66	Primary	
Edinburgh to Glasgow Central via Carstairs and Motherwell - electrified	East Coast Main Routes	WCM2	84	218	102	546	18.19	Primary	

			Start		End				
RFS Sub-Route	**RFS Route Description**	**ELR**	**Miles**	**Yards**	**Miles**	**Yards**	**Approx Decimal Miles**	**Route Type (Simplified)**	**Notes**
Edinburgh to Aberdeen via Kirkcaldy and Leuchars	East Coast Main Routes	ECN1	0	0	0	316	0.18	Primary	
Edinburgh to Aberdeen via Kirkcaldy and Leuchars	East Coast Main Routes	ECN2	0	316	59	1726	59.80	Secondary	
Edinburgh to Aberdeen via Kirkcaldy and Leuchars	East Coast Main Routes	ECN3	0	462	17	374	16.95	Secondary	
Edinburgh to Aberdeen via Kirkcaldy and Leuchars	East Coast Main Routes	ECN4	17	1210	33	572	15.64	Secondary	
Edinburgh to Aberdeen via Kirkcaldy and Leuchars	East Coast Main Routes	ECN5	203	242	241	176	37.96	Secondary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	EGM2	44	1653	46	0	1.06	Primary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	EGM1	24	1320	44	1653	20.19	Primary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	PMT	21	440	26	752	5.18	Secondary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	SCM3	109	946	123	880	13.96	Secondary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	SCM4	123	880	150	1342	27.26	Secondary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	CDC1	0	0	14	220	14.13	Secondary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	CDC2	44	396	45	1452	1.60	Secondary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	HGL1	150	1342	158	836	7.71	Secondary	
Edinburgh to Inverness via Perth, routing through Stirling or Kirkaldy	East Coast Main Routes	HGL2	7	44	118	30	110.99	Secondary	
Newcastle to Carstairs via Carlisle	East Coast Diversionary Routes	NEC1	0	939	5	616	4.82	Secondary	
Newcastle to Carstairs via Carlisle	East Coast Diversionary Routes	NEC2	3	1716	59	1666	55.97	Secondary	
Newcastle to Carstairs via Carlisle	East Coast Diversionary Routes	CGJ7	68	1474	69	202	0.28	Primary	
Newcastle to Carstairs via Carlisle	East Coast Diversionary Routes	WCM1	0	0	73	814	73.46	Primary	
Newcastle to Carstairs via Carlisle	East Coast Diversionary Routes	ECA1	73	303	73	1340	0.59	Primary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	WWD	84	250	89	1107	5.49	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	SHR	86	1377	87	946	0.76	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	EGS1	0	0	3	1423	3.81	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	SCM1	89	1123	91	176	1.46	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	MDE	0	0	0	679	0.39	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	MDW	91	176	91	1109	0.53	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	HMN1	0	0	1	968	1.55	Secondary	

RFS Sub-Route	RFS Route Description	ELR	Start		End		Approx Decimal Miles	Route Type (Simplified)	Notes
			Miles	Yards	Miles	Yards			
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	HMN2	0	0	6	1342	6.76	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	KHL	95	1721	100	792	4.47	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	CNC	0	0	0	990	0.56	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	CTC	0	0	1	1518	1.86	Secondary	
Diversionary routes into Glasgow, namely Wishaw, Bellshill, Hamilton and Cathcart - electrified	East Coast Diversionary Routes	MEN1	0	407	0	1502	0.62	Secondary	
Inverkeithing to Markinch via Dunfermline	East Coast Diversionary Routes	CWH1	13	438	22	1672	9.70	Secondary	
Inverkeithing to Markinch via Dunfermline	East Coast Diversionary Routes	CWH2	0	0	0	1540	0.88	Secondary	
Inverkeithing to Markinch via Dunfermline	East Coast Diversionary Routes	CWH3	27	0	34	1496	7.85	Secondary	
Inverkeithing to Markinch via Dunfermline	East Coast Diversionary Routes	TNW	0	0	0	1540	0.88	Secondary	
Inverkeithing to Markinch via Dunfermline	East Coast Diversionary Routes	IGE	0	0	0	726	0.41	Freight only	
Kirknewton to Uddingston via Shotts	East Coast Diversionary Routes	EGS2	0	880	23	281	22.66	Secondary	
Perth to Dundee	East Coast Diversionary Routes	SCM5	0	770	21	500	20.85	Secondary	
Aberdeen to Inverness	East Coast Diversionary Routes	ANI1	0	0	53	118	53.07	Secondary	
Aberdeen to Inverness	East Coast Diversionary Routes	ANI2	0	0	30	885	30.50	Secondary	
Aberdeen to Inverness	East Coast Diversionary Routes	ANI3	119	572	143	843	24.15	Secondary	
Paddington to Bristol TM via Bath Spa	Great Western Main Routes	MLN1	0	0	118	682	118.39	Primary	
Bristol TM to Taunton (including Weston Super Mare Avoiding Line)	Great Western Main Routes	MLN1	118	682	163	264	44.76	Primary	
Bristol TM to Taunton (including Weston Super Mare Avoiding Line)	Great Western Main Routes	WSM	135	232	139	124	3.94	Secondary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	BKE	36	369	37	1364	1.57	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	BHL	37	1364	81	418	43.46	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	SWY	81	418	95	727	14.18	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	WES	94	969	97	22	2.46	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	WEY	109	1091	129	1104	20.01	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	FRA	114	834	116	950	2.07	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	CCL	115	715	138	680	22.98	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	MLN1	163	264	246	330	30.83	Primary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	MLN2	247	616	256	836	9.12	Secondary	

RFS Sub-Route	RFS Route Description	ELR	Start Miles	Start Yards	End Miles	End Yards	Approx Decimal Miles	Route Type (Simplified)	Notes
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	MLN3	256	880	305	1430	49.31	Secondary	
Reading to Penzance via Westbury (and avoiding line), Frome (and avoiding line) and Exeter St Davids	Great Western Main Routes	MLN4	305	1474	326	1100	20.79	Secondary	
Newton Abbot to Paignton	Great Western Main Routes	TOR	214	761	223	0	8.57	Secondary	
Par to Newquay	Great Western Main Routes	PAR	281	1258	282	356	0.49	Rural	
Par to Newquay	Great Western Main Routes	NEW	282	356	302	1078	20.41	Rural	
Wootton Bassett Junction to Carmarthen via Bristol Parkway and Swansea	Great Western Main Routes	SWB	83	153	112	1671	29.86	Primary	
Wootton Bassett Junction to Carmarthen via Bristol Parkway and Swansea	Great Western Main Routes	BSW	5	1342	16	1307	10.98	Primary	
Wootton Bassett Junction to Carmarthen via Bristol Parkway and Swansea	Great Western Main Routes	SWM2	148	990	214	1364	66.21	Primary	
Wootton Bassett Junction to Carmarthen via Bristol Parkway and Swansea	Great Western Main Routes	SWM2	214	1364	245	220	30.35	Secondary	
Wootton Bassett Junction to Carmarthen via Bristol Parkway and Swansea	Great Western Main Routes	SWA	214	1382	216	145	1.30	Primary	
Wootton Bassett Junction to Carmarthen via Bristol Parkway and Swansea	Great Western Main Routes	SWL	0	0	0	1162	0.66	Secondary	
Wootton Bassett Junction to Carmarthen via Bristol Parkway and Swansea	Great Western Main Routes	CAN	245	216	245	1441	0.70	Secondary	
Bristol Parkway to Bristol TM	Great Western Main Routes	FEC	111	1747	113	350	1.21	Primary	
Bristol Parkway to Bristol TM	Great Western Main Routes	BSW	0	572	4	792	4.13	Primary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	SWM1	77	715	106	1629	29.52	Secondary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	BGL2	94	1320	99	1518	5.11	Primary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	BGL1	93	107	94	220	1.06	Primary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	SWM2	113	75	114	440	1.21	Primary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	CHL	92	452	93	109	0.81	Primary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	BAG2	68	1320	92	1650	24.19	Primary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	ABW	0	0	0	1562	0.89	Secondary	
Swindon to Worcester Shrub Hill via Gloucester (reverse) or direct (avoiding Gloucester) and Cheltenham Spa	Great Western Main Routes	OWW	117	572	120	1012	3.25	Secondary	

RFS Sub-Route	RFS Route Description	ELR	Start Miles	Start Yards	End Miles	End Yards	Approx Decimal Miles	Route Type (Simplified)	Notes
Didcot Parkway to Banbury (including Didcot East Junnction to Didcot North Junction)	Great Western Main Routes	DEC	52	1184	53	1566	1.22	Primary	
Didcot Parkway to Banbury (including Didcot East Junnction to Didcot North Junction)	Great Western Main Routes	DCL	53	275	86	440	33.09	Primary	
Oxford to Hereford via Worcester and Great Malvern	Great Western Main Routes	OWW	66	700	117	572	50.93	Secondary	
Oxford to Hereford via Worcester and Great Malvern	Great Western Main Routes	WAH	120	1021	148	262	27.57	Secondary	
Oxford to Hereford via Worcester and Great Malvern	Great Western Main Routes	SHL	49	572	51	220	1.80	Secondary	
Hereford to Newport (including Maindee North Junction to Maindee East Junction) (for ECS purposes)	Great Western Main Routes	SHL	51	220	52	409	1.11	Secondary	
Hereford to Newport (including Maindee North Junction to Maindee East Junction) (for ECS purposes)	Great Western Main Routes	HDC	0	0	2	238	2.14	Secondary	
Hereford to Newport (including Maindee North Junction to Maindee East Junction) (for ECS purposes)	Great Western Main Routes	HNL1	2	238	41	1446	39.69	Secondary	
Hereford to Newport (including Maindee North Junction to Maindee East Junction) (for ECS purposes)	Great Western Main Routes	HNL2	149	923	149	1135	0.12	Secondary	
Hereford to Newport (including Maindee North Junction to Maindee East Junction) (for ECS purposes)	Great Western Main Routes	MAI	41	597	41	1430	0.47	Secondary	
Standish Junction to Westerleigh Junction (for ECS and diversionary purposes)	Great Western Main Routes	BGL2	99	1518	120	64	20.17	Primary	
Standish Junction to Westerleigh Junction (for ECS and diversionary purposes)	Great Western Main Routes	YAT	120	64	121	555	1.28	Primary	
Old Oak Common to West Ealing/Hanwell Junctions via Greenford	Great Western Diversionary Routes	ANL	3	427	7	330	3.94	Secondary	
Old Oak Common to West Ealing/Hanwell Junctions via Greenford	Great Western Diversionary Routes	GEC	8	985	8	1547	0.32	Secondary	
Old Oak Common to West Ealing/Hanwell Junctions via Greenford	Great Western Diversionary Routes	WEL1	6	1149	8	990	1.91	Secondary	
Old Oak Common to West Ealing/Hanwell Junctions via Greenford	Great Western Diversionary Routes	HAN	0	0	0	796	0.45	Secondary	
Reading to Waterloo via Ascot and both Twickenham and Brentford*	Great Western Diversionary Routes	RDG1	0	102	36	770	36.38	Secondary	
Reading to Waterloo via Ascot and both Twickenham and Brentford*	Great Western Diversionary Routes	RDG2	61	1628	68	1518	6.94	Secondary	
Reading to Waterloo via Ascot and both Twickenham and Brentford*	Great Western Diversionary Routes	HOU	7	264	14	858	7.34	Secondary	
Westbury to Bathampton Junction (inc Westbury East Loop Junction to Hawkeridge Junction)	Great Western Diversionary Routes	BFB	0	0	9	374	9.21	Secondary	
Westbury to Bathampton Junction (inc Westbury East Loop Junction to Hawkeridge Junction)	Great Western Diversionary Routes	WYL	94	1716	95	702	0.42	Secondary	
Westbury to Bathampton Junction (inc Westbury East Loop Junction to Hawkeridge Junction)	Great Western Diversionary Routes	WEY	104	880	109	1091	5.12	Secondary	
Castle Cary to Exeter St Davids via Yeovil Pen Mill and Yeovil Junction	Great Western Diversionary Routes	WEY	129	1104	141	770	11.81	Secondary	

RFS Sub-Route	RFS Route Description	ELR	Start Miles	Start Yards	End Miles	End Yards	Approx Decimal Miles	Route Type (Simplified)	Notes
Castle Cary to Exeter St Davids via Yeovil Pen Mill and Yeovil Junction	Great Western Diversionary Routes	YJP	0	42	1	953	1.52	Rural	
Castle Cary to Exeter St Davids via Yeovil Pen Mill and Yeovil Junction	Great Western Diversionary Routes	BAE2	122	770	172	200	49.68	Secondary	
Thingley Junction to Bradford South Junction	Great Western Diversionary Routes	WEY	96	189	104	880	8.39	Secondary	
Feeder Bridge Junction to Dr Days Junction	Great Western Diversionary Routes	BLL	117	1111	117	1608	0.28	Secondary	
North Somerset Junction to Bristol West Junction	Great Western Diversionary Routes	BRL	0	9	1	190	1.10	Secondary	
Filton South Junction to Patchway Junction	Great Western Diversionary Routes	BSW	4	792	5	1342	1.31	Secondary	
Narroways Hill Jnc to Patchway and Bristol Parkway via Avonmouth*	Great Western Diversionary Routes	CNX	2	59	9	638	7.33	Rural	
Narroways Hill Jnc to Patchway and Bristol Parkway via Avonmouth*	Great Western Diversionary Routes	AMB	11	1419	14	836	2.67	Rural	
Narroways Hill Jnc to Patchway and Bristol Parkway via Avonmouth*	Great Western Diversionary Routes	AFR	112	115	118	924	6.46	Freight only	
Narroways Hill Jnc to Patchway and Bristol Parkway via Avonmouth*	Great Western Diversionary Routes	PAC	0	0	0	920	0.52	Freight only	
Gloucester to Severn Tunnel Junction via Chepstow	Great Western Diversionary Routes	SWM2	114	440	148	1342	34.51	Secondary	
Cardiff Central to Bridgend via Barry and Rhoose	Great Western Diversionary Routes	BRY	0	220	8	264	8.03	Secondary	
Cardiff Central to Bridgend via Barry and Rhoose	Great Western Diversionary Routes	VOG	0	0	18	1712	18.97	Secondary	
Cardiff Central to Leckwith Loop North Junction via Ninian Park	Great Western Diversionary Routes	RAD	0	554	0	1518	0.55	Secondary	
Cardiff Central to Leckwith Loop North Junction via Ninian Park	Great Western Diversionary Routes	CLL	0	0	0	574	0.33	Freight only	
Bridgend to Margam via Tondu*	Great Western Diversionary Routes	BAL	0	244	3	308	3.04	Rural	
Bridgend to Margam via Tondu*	Great Western Diversionary Routes	POR	0	0	2	964	2.55	Freight only	
Bridgend to Margam via Tondu*	Great Western Diversionary Routes	OVE	0	1738	7	902	6.53	Freight only	
Bridgend to Margam via Tondu*	Great Western Diversionary Routes	NLP	2	1690	3	752	0.47	Freight only	
Briton Ferry to Llandeilo Jn via District Lines*	Great Western Diversionary Routes	SDI1	206	308	208	1071	2.43	Freight only	
Briton Ferry to Llandeilo Jn via District Lines*	Great Western Diversionary Routes	SDI2	0	0	10	1417	10.81	Freight only	
Briton Ferry to Llandeilo Jn via District Lines*	Great Western Diversionary Routes	LLA	0	0	3	1100	3.63	Rural	
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	LEC1	0	0	56	637	56.36	Primary	
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	HNR	56	637	84	885	28.14	Primary	
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	LEC2	83	354	133	110	49.86	Primary	
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	LEC3	133	110	133	1320	0.69	Primary	Also within XC RFS
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	LEC4	133	1320	157	440	23.50	Primary	Also within XC RFS
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	LEC5	157	440	159	0	1.75	Primary	Also within XC RFS
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	CGJ1	159	0	176	0	17.00	Primary	
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	CGJ2	176	0	181	1627	5.92	Primary	
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	CGJ3	181	1627	185	1077	3.69	Primary	

RFS Sub-Route	RFS Route Description	ELR	Start Miles	Start Yards	End Miles	End Yards	Approx Decimal Miles	Route Type (Simplified)	Notes
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	CGJ4	185	1077	187	1672	2.34	Primary	
London Euston to Preston via Northampton and Crewe	West Coast Main Line (South) Main Routes	CGJ5	0	1153	21	1250	21.06	Primary	
Norton Bridge Junctions to Manchester Piccadilly via Stoke on Trent	West Coast Main Line (South) Main Routes	NBS	0	0	3	1245	3.71	Primary	Also within XC RFS
Norton Bridge Junctions to Manchester Piccadilly via Stoke on Trent	West Coast Main Line (South) Main Routes	CMD2	15	1441	27	0	11.18	Primary	Also within XC RFS
Norton Bridge Junctions to Manchester Piccadilly via Stoke on Trent	West Coast Main Line (South) Main Routes	CMD1	0	0	16	0	16.00	Primary	Also within XC RFS
Norton Bridge Junctions to Manchester Piccadilly via Stoke on Trent	West Coast Main Line (South) Main Routes	MCH	0	0	9	808	9.46	Primary	Also within XC RFS
Norton Bridge Junctions to Manchester Piccadilly via Stoke on Trent	West Coast Main Line (South) Main Routes	CMP1	180	1298	182	838	1.74	Primary	Also within XC RFS

RFS Sub-Route	RFS Route Description	ELR	Start		End		Approx Decimal Miles	Route Type (Simplified)	Notes
			Miles	Yards	Miles	Yards			
Norton Bridge Junctions to Manchester Piccadilly via Stoke on Trent	West Coast Main Line (South) Main Routes	CMP2	182	838	188	1556	6.41	Primary	Also within XC RFS
Crewe to Cheadle Hulme	West Coast Main Line (South) Main Routes	CMP1	158	350	180	1298	22.54	Primary	Also within XC RFS
Weaver Junction to Liverpool Lime Street	West Coast Main Line (South) Main Routes	WJL1	174	540	182	1472	8.53	Primary	
Weaver Junction to Liverpool Lime Street	West Coast Main Line (South) Main Routes	WJL2	182	1472	186	1579	4.06	Primary	
Weaver Junction to Liverpool Lime Street	West Coast Main Line (South) Main Routes	WJL3	186	1579	191	1722	5.08	Primary	
Weaver Junction to Liverpool Lime Street	West Coast Main Line (South) Main Routes	WJL4	191	1722	193	1162	1.68	Primary	
Hanslope Junction to Rugby via Weedon	West Coast Main Line (South) Diversionary Routes	LEC1	56	637	83	354	26.84	Primary	
Rugby to Bushbury Junction via Stechford, Aston and Bescot	West Coast Main Line (South) Diversionary Routes	RBS1	83	354	93	1562	10.69	Primary	
Rugby to Bushbury Junction via Stechford, Aston and Bescot	West Coast Main Line (South) Diversionary Routes	RBS1	93	1562	109	352	15.31	Primary	Also within XC RFS
Rugby to Bushbury Junction via Stechford, Aston and Bescot	West Coast Main Line (South) Diversionary Routes	SAS	0	0	2	1340	2.76	Secondary	Also within XC RFS
Rugby to Bushbury Junction via Stechford, Aston and Bescot	West Coast Main Line (South) Diversionary Routes	PBJ	1	1320	15	714	13.66	Secondary	Also within XC RFS
Stechford to Wolverhampton via Birmingham New Street	West Coast Main Line (South) Diversionary Routes	RBS1	109	352	112	1597	3.71	Primary	Also within XC RFS
Stechford to Wolverhampton via Birmingham New Street	West Coast Main Line (South) Diversionary Routes	RBS2	0	106	12	1650	12.88	Primary	Also within XC RFS
Soho Junctions to Perry Barr Junctions	West Coast Main Line (South) Diversionary Routes	SSP	0	0	2	1659	2.94	Secondary	Also within XC RFS
Soho Junctions to Perry Barr Junctions	West Coast Main Line (South) Diversionary Routes	SCL	0	0	0	475	0.27	Secondary	Also within XC RFS
Soho Junctions to Perry Barr Junctions	West Coast Main Line (South) Diversionary Routes	PBL	0	0	0	613	0.35	Secondary	Also within XC RFS
Portobello Junction to Stafford via Wolverhampton	West Coast Main Line (South) Diversionary Routes	PJW	0	93	1	1314	1.69	Secondary	Also within XC RFS
Portobello Junction to Stafford via Wolverhampton	West Coast Main Line (South) Diversionary Routes	RBS2	12	1650	14	949	1.60	Primary	Also within XC RFS
Portobello Junction to Stafford via Wolverhampton	West Coast Main Line (South) Diversionary Routes	RBS3	15	700	28	1089	13.22	Primary	Also within XC RFS
Colwich Junction to Stone	West Coast Main Line (South) Diversionary Routes	CMD2	27	0	38	1347	11.77	Primary	
Kidsgrove to Crewe	West Coast Main Line (South) Diversionary Routes	KCS1	0	0	8	729	8.41	Secondary	Also within XC RFS

Kidsgrove to Crewe	West Coast Main Line (South) Diversionary Routes	KCS2	157	1210	157	1342	0.07	Secondary	Also within XC RFS
Crewe Independent Lines	West Coast Main Line (South) Diversionary Routes	BHI	156	352	158	1679	2.75	Freight only	
Crewe Independent Lines	West Coast Main Line (South) Diversionary Routes	LLI	157	1589	158	1602	1.01	Freight only	
Wilmslow to Slade Lane Junction via Styal	West Coast Main Line (South) Diversionary Routes	STY	0	5	9	968	9.55	Secondary	Also within XC RFS
Acton Grange Junctions to Warrington Bank Quay via Walton Old Junction	West Coast Main Line (South) Diversionary Routes	CHW1	16	387	17	480	1.05	Secondary	
Acton Grange Junctions to Warrington Bank Quay via Walton Old Junction	West Coast Main Line (South) Diversionary Routes	CHW2	17	480	17	1532	0.60	Secondary	
Winwick Junction to Golborne Junction	West Coast Main Line (South) Diversionary Routes	WEE	185	781	187	223	1.68	Secondary	
Winwick Junction to Golborne Junction	West Coast Main Line (South) Diversionary Routes	DSE	14	1650	16	418	1.30	Secondary	
Winwick Junction to Golborne Junction	West Coast Main Line (South) Diversionary Routes	NGJ	0	0	0	1153	0.66	Secondary	

			Start		End				
RFS Sub-Route	**RFS Route Description**	**ELR**	**Miles**	**Yards**	**Miles**	**Yards**	**Approx Decimal Miles**	**Route Type (Simplified)**	**Notes**
Nuneaton to Water Orton (diesel hauled)	West Coast Main Line (South) Diversionary Routes	NWO	0	2	9	1298	9.74	Secondary	Also within XC RFS
Nuneaton to Water Orton (diesel hauled)	West Coast Main Line (South) Diversionary Routes	NWO	9	1298	10	541	0.57	Secondary	
Nuneaton to Water Orton (diesel hauled)	West Coast Main Line (South) Diversionary Routes	DBP3	31	1518	34	1188	2.81	Primary	Also within XC RFS
Manchester Piccadilly to Euxton Junction via Deansgate, Salford Crescent and Bolton (diesel hauled)	West Coast Main Line (South) Diversionary Routes	COL	188	924	190	615	1.82	Secondary	
Manchester Piccadilly to Euxton Junction via Deansgate, Salford Crescent and Bolton (diesel hauled)	West Coast Main Line (South) Diversionary Routes	OLW	190	609	191	225	0.78	Secondary	
Manchester Piccadilly to Euxton Junction via Deansgate, Salford Crescent and Bolton (diesel hauled)	West Coast Main Line (South) Diversionary Routes	MVE1	1	1210	10	880	8.81	Secondary	
Manchester Piccadilly to Euxton Junction via Deansgate, Salford Crescent and Bolton (diesel hauled)	West Coast Main Line (South) Diversionary Routes	MVE2	10	880	25	675	14.88	Secondary	
Edge Hill to Earlestown South Junction (diesel hauled)	West Coast Main Line (South) Diversionary Routes	DSE	1	954	14	1122	13.10	Secondary	
Edge Hill to Earlestown South Junction (diesel hauled)	West Coast Main Line (South) Diversionary Routes	EEE	186	1631	187	322	0.26	Secondary	
Newton le Willows Junction to Ordsall Lane Junction (diesel hauled)	West Coast Main Line (South) Diversionary Routes	DSE	16	418	30	814	14.23	Secondary	
South Kirkby Junction to Sheffield via Moorthorpe	Cross Country Main Routes (Tranche 1)	SKM	0	110	0	1232	0.64	Secondary	
South Kirkby Junction to Sheffield via Moorthorpe	Cross Country Main Routes (Tranche 1)	SMJ2	11	528	17	330	5.89	Secondary	
South Kirkby Junction to Sheffield via Moorthorpe	Cross Country Main Routes (Tranche 1)	SMJ1	166	1298	168	1408	2.06	Secondary	
South Kirkby Junction to Sheffield via Moorthorpe	Cross Country Main Routes (Tranche 1)	TJC3	161	1694	167	0	5.04	Primary	
South Kirkby Junction to Sheffield via Moorthorpe	Cross Country Main Routes (Tranche 1)	TJC2	160	748	163	1628	3.50	Primary	
South Kirkby Junction to Sheffield via Moorthorpe	Cross Country Main Routes (Tranche 1)	TJC1	158	880	160	748	1.93	Primary	
Doncaster to Swinton	Cross Country Main Routes (Tranche 1)	SJM1	166	1249	167	385	0.51	Primary	
Doncaster to Swinton	Cross Country Main Routes (Tranche 1)	SJM2	15	79	15	880	0.46	Primary	
Doncaster to Swinton	Cross Country Main Routes (Tranche 1)	PED4	15	880	15	1408	0.30	Primary	
Doncaster to Swinton	Cross Country Main Routes (Tranche 1)	PED5	15	1408	22	1232	6.90	Primary	

RFS Sub-Route	RFS Route Description	ELR	Start Miles	Start Yards	End Miles	End Yards	Approx Decimal Miles	Route Type (Simplified)	Notes
Sheffield to Birmingham New Street via Derby	Cross Country Main Routes (Tranche 1)	TJC1	146	1298	158	880	11.76	Primary	
Sheffield to Birmingham New Street via Derby	Cross Country Main Routes (Tranche 1)	SPC9	142	211	146	1298	4.62	Primary	
Sheffield to Birmingham New Street via Derby	Cross Country Main Routes (Tranche 1)	SPC8	127	1179	147	1507	20.19	Primary	
Sheffield to Birmingham New Street via Derby	Cross Country Main Routes (Tranche 1)	DBP1	0	4	29	866	29.49	Primary	
Sheffield to Birmingham New Street via Derby	Cross Country Main Routes (Tranche 1)	DBP2	29	859	33	544	3.82	Primary	
Sheffield to Birmingham New Street via Derby	Cross Country Main Routes (Tranche 1)	DBP3	34	1188	41	1303	7.07	Primary	
Sheffield to Birmingham New Street via Derby	Cross Country Main Routes (Tranche 1)	RBS1	112	506	112	1597	0.62	Primary	Also within WC RFS
Birmingham New Street to Abbotswood Junction via Five Ways, and via St Andrew's Jnc, and Bromsgrove	Cross Country Main Routes (Tranche 1)	BAG1	42	932	47	1046	5.06	Primary	
Birmingham New Street to Abbotswood Junction via Five Ways, and via St Andrew's Jnc, and Bromsgrove	Cross Country Main Routes (Tranche 1)	BAG2	46	926	68	1320	22.22	Primary	
Birmingham New Street to Abbotswood Junction via Five Ways, and via St Andrew's Jnc, and Bromsgrove	Cross Country Main Routes (Tranche 1)	SAG	0	2	0	1147	0.65	Secondary	
Birmingham New Street to Abbotswood Junction via Five Ways, and via St Andrew's Jnc, and Bromsgrove	Cross Country Main Routes (Tranche 1)	SKN	41	385	47	43	5.81	Secondary	
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	CMP2	182	838	188	1556	6.41	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	CMP1	180	1298	182	838	1.74	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	MCH	0	0	9	808	9.46	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	CMD1	0	0	16	0	16.00	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	CMD2	15	1441	27	0	11.18	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	NBS	0	0	3	1245	3.71	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	LEC4	133	1320	138	880	4.75	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	LEC3	133	110	133	1320	0.69	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	RBS3	15	700	28	1089	13.22	Primary	Also within WC RFS
Manchester Piccadilly to Birmingham New Street via Stoke on Trent	Cross Country Main Routes (Tranche 2)	RBS2	0	106	14	949	14.48	Primary	Also within WC RFS
Cheadle Hulme to Norton Bridge Junctions via Crewe	Cross Country Main Routes (Tranche 2)	CMP1	158	350	180	1298	22.54	Primary	Also within WC RFS
Cheadle Hulme to Norton Bridge Junctions via Crewe	Cross Country Main Routes (Tranche 2)	LEC5	157	440	159	0	1.75	Primary	Also within WC RFS
Cheadle Hulme to Norton Bridge Junctions via Crewe	Cross Country Main Routes (Tranche 2)	LEC4	138	880	157	440	18.75	Primary	Also within WC RFS
Birmingham New Street to Banbury via Coventry	Cross Country Main Routes (Tranche 2)	RBS1	93	1562	112	1597	19.02	Primary	Also within WC RFS
Birmingham New Street to Banbury via Coventry	Cross Country Main Routes (Tranche 2)	LSC1	106	515	107	138	0.79	Primary	
Birmingham New Street to Banbury via Coventry	Cross Country Main Routes (Tranche 2)	LSC2	0	0	8	995	8.57	Primary	

			Start		End				
RFS Sub-Route	**RFS Route Description**	**ELR**	**Miles**	**Yards**	**Miles**	**Yards**	**Approx Decimal Miles**	**Route Type (Simplified)**	**Notes**
Birmingham New Street to Banbury via Coventry	Cross Country Main Routes (Tranche 2)	DCL	86	352	106	506	20.09	Primary	
Bordesley Junction to Leamington Spa via Solihull	Cross Country Main Routes (Tranche 2)	BCV	125	1397	128	205	2.32	Secondary	
Bordesley Junction to Leamington Spa via Solihull	Cross Country Main Routes (Tranche 2)	DCL	106	506	126	1298	20.45	Primary	
Reading to Bournemouth via Basingstoke	Cross Country Main Routes (Tranche 2)	BKE	37	1364	51	737	13.64	Primary	
Reading to Bournemouth via Basingstoke	Cross Country Main Routes (Tranche 2)	BML1	47	1144	78	0	30.35	Primary	
Reading to Bournemouth via Basingstoke	Cross Country Main Routes (Tranche 2)	BML2	78	0	108	880	30.50	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	RNJ	67	1688	68	761	0.47	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	GTW2	48	748	61	1628	13.50	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	GTW1	30	682	35	1100	5.24	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	WPH1	30	44	66	388	36.20	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	WPH2	37	557	40	836	3.16	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	FJJ	90	957	91	206	0.57	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	SDP2	84	198	90	946	6.42	Secondary	
Reading to Southampton via Guildford, Havant and Fareham	Cross Country Main Routes (Tranche 2)	SDP1	1	990	14	330	12.63	Secondary	
Wakefield Kirkgate to Wincobank Jnc via Barnsley	Cross Country Diversionary Routes (Tranche 1)	SHB	161	1144	173	1056	11.95	Secondary	
Wakefield Kirkgate to Wincobank Jnc via Barnsley	Cross Country Diversionary Routes (Tranche 1)	PED2	6	946	7	1100	1.09	Secondary	
Wakefield Kirkgate to Wincobank Jnc via Barnsley	Cross Country Diversionary Routes (Tranche 1)	BAH2	45	1232	52	1320	7.05	Secondary	
Wakefield Kirkgate to Wincobank Jnc via Barnsley	Cross Country Diversionary Routes (Tranche 1)	CHS	0	0	1	1166	1.66	Secondary	
Wakefield Kirkgate to Wincobank Jnc via Barnsley	Cross Country Diversionary Routes (Tranche 1)	MVN2	45	836	47	1364	2.30	Secondary	
Ferrybridge to Moorthorpe via Pontefract Baghill	Cross Country Diversionary Routes (Tranche 1)	SMJ2	2	594	11	528	8.96	Secondary	
Mexborough Jnc to Aldwarke Jnc via Thrybergh Jnc	Cross Country Diversionary Routes (Tranche 1)	WME	7	572	10	418	2.91	Freight only	
Aldwarke Jn to Nunnery Main Line Jnc via Rotherham Central	Cross Country Diversionary Routes (Tranche 1)	WME	0	0	7	572	7.33	Freight only	
Aldwarke Jn to Nunnery Main Line Jnc via Rotherham Central	Cross Country Diversionary Routes (Tranche 1)	NUJ1	158	1694	159	726	0.45	Secondary	
Aldwarke Jn to Nunnery Main Line Jnc via Rotherham Central	Cross Country Diversionary Routes (Tranche 1)	NUJ2	41	1496	42	638	0.51	Secondary	
Rotherham Central Jnc to Holmes Jnc	Cross Country Diversionary Routes (Tranche 1)	HCD	0	0	0	1360	0.77	Secondary	
Masborough Jnc to Beighton Jnc	Cross Country Diversionary Routes (Tranche 1)	CHR	155	1012	162	528	6.72	Freight only	
Woodburn Jnc to Tapton Jnc via Beighton Jnc and Barrow Hill	Cross Country Diversionary Routes (Tranche 1)	CHR	146	1298	155	1012	8.84	Freight only	
Woodburn Jnc to Tapton Jnc via Beighton Jnc and Barrow Hill	Cross Country Diversionary Routes (Tranche 1)	BEW	46	1237	48	136	1.37	Secondary	
Woodburn Jnc to Tapton Jnc via Beighton Jnc and Barrow Hill	Cross Country Diversionary Routes (Tranche 1)	MAC3	42	638	46	1232	4.34	Secondary	
Clay Cross Jnc to Trent Jncs	Cross Country Diversionary Routes (Tranche 1)	TCC	119	1516	125	0	5.14	Freight only	
Clay Cross Jnc to Trent Jncs	Cross Country Diversionary Routes (Tranche 1)	TCC	125	0	142	211	17.12	Secondary	
Clay Cross Jnc to Trent Jncs	Cross Country Diversionary Routes (Tranche 1)	TSN1	119	359	119	1516	0.66	Primary	
Trent Jncs to Derby via Long Eaton	Cross Country Diversionary Routes (Tranche 1)	TES	0	0	0	659	0.37	Secondary	
Trent Jncs to Derby via Long Eaton	Cross Country Diversionary Routes (Tranche 1)	SPC6	119	1364	126	594	6.56	Primary	
Trent Jncs to Derby via Long Eaton	Cross Country Diversionary Routes (Tranche 1)	SPC7	126	594	127	1496	1.51	Primary	
Trent Jncs to Stenson Jnc via Sheet Stores Jnc	Cross Country Diversionary Routes (Tranche 1)	SSJ1	119	1354	127	594	7.57	Freight only	

Trent Jncs to Stenson Jnc via Sheet Stores Jnc	Cross Country Diversionary Routes (Tranche 1)	MJS1	127	594	127	1694	0.63	Freight only	
Trent Jncs to Stenson Jnc via Sheet Stores Jnc	Cross Country Diversionary Routes (Tranche 1)	SSJ2	127	1694	132	265	4.19	Freight only	
Wichnor Junction to Proof House Junction via Lichfield City and Aston	Cross Country Diversionary Routes (Tranche 1)	BJW3	16	1254	23	733	6.70	Secondary	
Wichnor Junction to Proof House Junction via Lichfield City and Aston	Cross Country Diversionary Routes (Tranche 1)	ALC1	0	0	5	0	5.00	Secondary	
Wichnor Junction to Proof House Junction via Lichfield City and Aston	Cross Country Diversionary Routes (Tranche 1)	ALC2	5	0	13	828	8.47	Secondary	
Wichnor Junction to Proof House Junction via Lichfield City and Aston	Cross Country Diversionary Routes (Tranche 1)	PBJ	0	0	1	1320	1.75	Secondary	
Kingsbury Jn to Water Orton via Whitacre Jn	Cross Country Diversionary Routes (Tranche 1)	KJW	29	859	31	1551	2.39	Secondary	
Kingsbury Jn to Water Orton via Whitacre Jn	Cross Country Diversionary Routes (Tranche 1)	DBP3	31	1518	34	1188	2.81	Primary	Also within WC RFS
Trent Jncs to Leicester	Cross Country Diversionary Routes (Tranche 1)	SPC4	95	1672	98	1628	2.98	Primary	
Trent Jncs to Leicester	Cross Country Diversionary Routes (Tranche 1)	SPC5	98	1628	118	1320	19.83	Primary	
Trent Jncs to Leicester	Cross Country Diversionary Routes (Tranche 1)	SPC6	118	1320	119	1364	1.02	Primary	
Leicester to Water Orton via Nuneaton	Cross Country Diversionary Routes (Tranche 1)	WNS	0	60	15	698	15.36	Secondary	
Leicester to Water Orton via Nuneaton	Cross Country Diversionary Routes (Tranche 1)	NMA	9	1320	10	1342	1.01	Secondary	
Leicester to Water Orton via Nuneaton	Cross Country Diversionary Routes (Tranche 1)	NWO	0	2	9	1298	9.74	Secondary	Also within WC RFS
			Start		**End**				
RFS Sub-Route	**RFS Route Description**	**ELR**	**Miles**	**Yards**	**Miles**	**Yards**	**Approx Decimal Miles**	**Route Type (Simplified)**	**Notes**
Galton Junction to Worcester Shrub Hill via Kidderminster	Cross Country Diversionary Routes (Tranche 1)	GSJ1	3	1396	4	195	0.32	Secondary	
Galton Junction to Worcester Shrub Hill via Kidderminster	Cross Country Diversionary Routes (Tranche 1)	GSJ2	133	714	141	142	7.67	Secondary	
Galton Junction to Worcester Shrub Hill via Kidderminster	Cross Country Diversionary Routes (Tranche 1)	OWW	126	220	142	1122	16.51	Secondary	
Stoke Works Junction to Droitwich Spa	Cross Country Diversionary Routes (Tranche 1)	STO	126	448	130	561	4.06	Secondary	
Slade Lane Junction to Wilmslow via Styal	Cross Country Diversionary Routes (Tranche 2)	STY	0	5	9	968	9.55	Secondary	Also within WC RFS
Crewe to Kidsgrove	Cross Country Diversionary Routes (Tranche 2)	KCS1	0	0	8	729	8.41	Secondary	Also within WC RFS
Crewe to Kidsgrove	Cross Country Diversionary Routes (Tranche 2)	KCS2	157	1210	157	1342	0.07	Secondary	Also within WC RFS
Bushbury Jn to Portobello Jn	Cross Country Diversionary Routes (Tranche 2)	PBJ	12	1408	15	714	2.61	Secondary	Also within WC RFS
Wolverhampton to Stechford via Bescot and Aston	Cross Country Diversionary Routes (Tranche 2)	PJW	0	93	1	1314	1.69	Secondary	Also within WC RFS
Wolverhampton to Stechford via Bescot and Aston	Cross Country Diversionary Routes (Tranche 2)	PBJ	1	1320	12	1408	11.05	Secondary	Also within WC RFS
Wolverhampton to Stechford via Bescot and Aston	Cross Country Diversionary Routes (Tranche 2)	SAS	0	0	2	1340	2.76	Secondary	Also within WC RFS
Perry Barr Junctions to Soho Junctions	Cross Country Diversionary Routes (Tranche 2)	SSP	0	0	2	1659	2.94	Secondary	Also within WC RFS
Perry Barr Junctions to Soho Junctions	Cross Country Diversionary Routes (Tranche 2)	SCL	0	0	0	475	0.27	Secondary	Also within WC RFS
Perry Barr Junctions to Soho Junctions	Cross Country Diversionary Routes (Tranche 2)	PBL	0	0	0	613	0.35	Secondary	Also within WC RFS
Reading West Jnc to Oxford Road Jnc	Cross Country Diversionary Routes (Tranche 2)	RWC	0	33	0	957	0.53	Secondary	
Worting Junction to Redbridge via Laverstock Loop	Cross Country Diversionary Routes (Tranche 2)	BAE1	50	607	82	110	31.72	Secondary	
Worting Junction to Redbridge via Laverstock Loop	Cross Country Diversionary Routes (Tranche 2)	LAV	82	220	82	860	0.36	Secondary	
Worting Junction to Redbridge via Laverstock Loop	Cross Country Diversionary Routes (Tranche 2)	RTJ1	18	286	23	704	5.24	Secondary	
Worting Junction to Redbridge via Laverstock Loop	Cross Country Diversionary Routes (Tranche 2)	RTJ2	80	748	95	1342	15.34	Secondary	
Romsey to Eastleigh	Cross Country Diversionary Routes (Tranche 2)	ECR	73	660	80	748	7.05	Secondary	

APPENDIX C

Bidder Submission Requirements – Technical Information

IEP – Vehicle Data to be submitted at Bid Stage by the bidders.

- General arrangement drawings for train and for each vehicle showing key dimensions including
    - Vehicle Length (over couplers and over bodyend), Width, Door position (passenger and crew), footstep locations, pantograph positions, bogie centres, wheel centres, nose overhang.
- Vehicle weight – Tare, all seats occupied, crush laden
- Axle load – Tare, all seats occupied, crush laden
- Unsprung mass (powered and non-powered)
- Route Availability (RA)
- Wheel Profile
- Wheel diameter
- T-gamma curves (powered and non-powered bogies)
- Power draw characteristics under all conditions
- Kinematic Envelope
- EMC compatibility with infrastructure
- Coupling compatibility with existing train types (Type & Height)
- Rescue arrangements
- Braking curve (Full Service and Emergency Applications)
- Acceleration Curve
- Visibility from drivers seat (sight lines)
- Testing Proposals & Programme (Factory, Test Track, On track – possession requirements)
- Radio communication system details
- Train Systems - breakdown of novel and existing technology
- Interface with CET emptying facilities - connection details and locations
- Shore Supply requirements – electrical and water
- Dwell Time breakdown (inc. door cycle times)

GLOSSARY OF TERMS

Term	Meaning / Definition
AC	Alternating Current
APC	Automatic Power Control
ARL	Above Rail Level
ATP	Automatic Train Protection
AVI	Automatic Vehicle Identification
AWS	Automatic Warning System
CCTV	Closed Circuit TeleVision
CP4	Control Period 4
DC	Direct Current
DfT	Department for Transport
DOO	Driver Only Operation
DVR	Digital Video Recorder
ECML	East Coast Main Line
ERTMS	European Railway Traffic Management System
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
EN	Euro Norm
ESC	Engineering Support Centre
ETCS	European Train Control System
GRIP	Guide to Railway Investment Projects
GSM	Global System for Mobile Communications
GSM-R	Global System for Mobile Communications – Railways
GWML	Great Western Main Line
HLOS	High Level Output Statement
HMRI	Her Majesty's Railway Inspectorate
HST	High Speed Train
IE	Intercity Express
IEP	Intercity Express Programme
ITT	Invitation To Tender
KE	Kinematic Envelope
LAN	Local Area Network
MML	Midland Main Line

Term	Meaning / Definition
NGD	National Gauging Database
NRN	National Radio Network
OHL	Over Head Line (Electrical Traction Supply)
ORR	Office of the Railway Regulator
PYS	Primary Yaw Stiffness
RCF	Rolling Contact Fatigue
RFId	Radio Frequency Identification
RGS	Railway Group Standards
RSSB	Rail Safety Standards Board
SDO	Selective Door Operation
STM	Specific Trackside Module
TIIS	Train Infrastructure Interface Specification
TOC	Train Operating Company
TPWS	Train Protection and Warning System
TSI	Technical Specification for Interoperability
TSP	Train Service Provider
TTS	Train Technical Specification
UGMS	Unattended Track Geometry Measurement System
UOMS	Unattended Overhead Measurement System
UPS	Uninterruptible Power Supply
VRVT	Variable Resistive Vector Transducer
VTISM	Vehicle Track Interaction Strategic Model
VTT	Virtual Test Track
WCML	West Coast Main Line
XC	Cross Country