Periodic Review 2013 – Consultation on the allocation of the Variable Usage Charge

December 2012

NetworkRail

CONTENTS

EXECUTIVE SUMMARY

The Variable Usage Charge

The Variable Usage Charge (VUC) is designed to recover Network Rail's operating, maintenance and renewal costs that vary with traffic. The charge ensures that we are compensated for the wear and tear that results from traffic on the GB rail network. In 2011/12 we received £150m, £48m and £3m in VUC income from franchised passenger, freight, and open access operators respectively[1].

The VUC is levied on a 'national average' basis, therefore, the rate applicable to an individual vehicle is the same irrespective of where on the network that vehicle operates. The charge is levied on passenger operators on a pence per vehicle mile basis and is disaggregated by vehicle class. For freight operators, the charge is levied on a pound per thousand gross tonne mile basis (£/kgtm) and is disaggregated by vehicle class, commodity being transported and whether the vehicle is laden or tare.

The Variable Usage Charge and PR13

Broadly speaking, re-calibrating the VUC for Control Period 5 (CP5) comprises two stages:

1. estimating total variable usage costs; and
2. apportioning total variable usage costs between individual vehicle classes.

It is necessary to re-calibrate charges in two stages because, at present, it is not possible to estimate 'bottom up' a separate variable usage cost for each vehicle class.

As part of the 2013 Periodic Review (PR13), we have already carried out significant work in relation to stage one of re-calibrating the VUC – estimating total variable usage costs. Specifically, we have consulted on our initial estimate of total variable usage costs (November 2011) and, following careful consideration of consultation responses, concluded to ORR (March 2012). The analysis in our consultation document was reviewed by the independent reporter, Arup. Following this review ORR requested that we use reasonable endeavours to improve our variable usage cost estimates in respect of civil structures and earthworks. We have recently written to ORR in response to its request[2]. Chapter 1, below provides more detail on the work carried out to date.

As part of PR13, it is Network Rail's responsibility to work and consult with the industry in order to re-calibrate the VUC for CP5. Following the conclusion of this process it will then propose revised VUC rates to ORR. Ultimately, however, any decision on VUC rates for CP5 is a matter for ORR.

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[1] Based on Network Rail's Regulatory Accounts for the year ending 31 March 2011.
[2] Letters from NR to ORR on 18 December 2012. Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx

The purpose of this document

The primary purpose of this consultation is to seek views on the second stage of re-calibrating VUC rates – apportioning total variable usage costs between individual vehicle classes.

Consistent with the current approach for Control Period 4 (CP4), the proposed allocation methodology aims to apportion variable usage costs in a cost reflective way between vehicle classes. Therefore, vehicles that cause less wear and tear on the network should attract a lower share of total variable usage costs than vehicles that cause more wear and tear. As a result, 'track friendly' vehicles will pay lower variable usage charges than 'track nasty' vehicles.

Chapters 2, 3 and 4, below, discuss the proposed methodologies for apportioning total variable usage costs between individual vehicle classes. These methodologies apportion costs based on vehicle characteristics, which we discuss in Chapter 5. In Chapter 5 we also discuss temporary default rates and rates for modified vehicles.

Key issues in this consultation

Set out, below, is a brief overview of the key issues in this consultation, our proposed approach in CP5 and the potential impact on charges. Each of these issues is discussed in more detail in the remainder of this document.

Track variable usage costs

- We estimate that vertical track variable usage costs make up 78% of total track variable usage costs (comprised of vertical and horizontal track variable usage costs) and that total track variable usage costs make up 86% of total variable usage costs (comprised of track and non-track costs).
- We commissioned Serco Technical Services (Serco) to review the current equivalent track damage equation (a measure of 'track friendliness') used to apportion vertical track variable usage costs between individual vehicle classes.
- In order to review the current approach Serco used the Vehicle Track Interaction Strategic Model (VTISM)[3] to assess how damage varies with vehicle weight, speed and un-sprung mass. It then performed regression analysis and expressed its results formulaically.
- The revised formula developed by Serco appears to indicate that damage is more sensitive to axle load and un-sprung mass and less sensitive to vehicle speed than we believed when the CP4 methodology was established. The main implication of this would be that vehicles with a high axle load or un-sprung mass would attract a greater share of variable usage costs than in CP4 and vehicles with a high operating speed would attract a smaller share, all other things being equal. Indicative analysis suggests that this would result in a material increase in VUC rates for laden freight wagons.
- Whilst Network Rail has no reason to doubt the robustness of the work or methodology underpinning the Serco analysis, we fully accept that freight operators may consider that they require more time to better understand the underlying analysis. We consider, therefore, that deferring this work into the

[3] VTISM was developed as part of a substantial research programme managed by RSSB and aims to support the rail industry in managing changes around the wheel/rail interface more effectively and to realise savings through optimised track and vehicle maintenance and renewal.

charges review that the industry has committed to carry out during the early stages of CP5, to inform charges in CP6, should be considered as an option.

Horizontal track variable usage costs

- We estimate that horizontal track variable usage costs make up 22% of total track variable usage costs and 19% of all variable usage costs.
- We have reviewed the existing CP4 approach to apportioning horizontal track variable usage costs between individual vehicle classes. Further to this review, we propose, for CP5, updating the existing methodology to incorporate 4 refinements which are discussed in more detail in Chapter 3, below.
- We consider that these refinements would improve the accuracy of the apportionment of horizontal track variable usage costs. Initial analysis suggests that the proposed changes would generally not result in a significant change in the surface damage costs for each vehicle. However, whereas the CP4 methodology shows the rate of increase in charges reducing at higher yaw stiffness, the initial results for the proposed new methodology are more linear.

Non-track (civils and signalling) variable usage costs

- We estimate that civils and signalling variable usage costs account for 9% and 5% of total variable usage costs respectively.
- Serco were also asked to review the current approach to allocating non-track variable usage costs.
- In CP4, metallic underbridge and embankment renewals variable usage costs were apportioned formulaically to individual vehicle classes using an equivalent structures damage equation (a measure of 'track friendliness'). Serco recommended that the existing CP4 civils equation should be retained for apportioning metallic underbridge variable usage costs. However, based on evidence of fatigue damage in steel bridges, it deemed the current axle load exponent of 4.83 to be too high and recommended using a modified median axle load exponent of 4.
- Serco recommended not using the equivalent structures damage equation to apportion embankments and culverts renewals variable usage costs because the relevant axle load and speed exponents for these cost categories cannot yet be ascertained. It also recommended not applying the equation to brick and masonry underbridge variable usage costs because the axle load exponent cannot yet be determined and the inclusion of axle spacing would need further analysis. Serco considered that it would be more appropriate to apportion embankments, culverts and brick and masonry underbridge variable usage costs using the revised equivalent track damage equation that it has developed using VTISM.
- In CP4, signalling variable usage costs were apportioned on the same basis as the track variable usage costs. Serco reviewed whether this approach continues to be appropriate and concluded that a better approach would be to distinguish between load related and non-load related signalling variable usage costs. Specifically, it recommended that the revised equivalent track damage equation should be used to apportion the 50% of signalling variable usage costs that are estimated to be load related and the remaining 50% of costs should be apportioned based on train movements (vehicle mileage).

- Subject to the revised equivalent track damage equation developed by Serco being implemented in CP5, we propose accepting its recommendations in respect of apportioning civils and signalling variable usage costs. Because the revised equivalent track damage equation has a lower axle load exponent than the equivalent structures damage equation, and 50% of signalling variable usage costs that are estimated not to be load related, these proposed refinements generally serve to reduce the share of civils and signalling variable usage costs apportioned to vehicles with a high axle load.

Vehicle characteristics that inform VUC rates

- Vehicle characteristics are important variables that determine the apportionment of variable usage costs between individual vehicle classes. In order to improve the accuracy of vehicle characteristic data, we have already shared a draft list of vehicle characteristics with stakeholders in advance of this consultation. The more accurate the vehicle characteristics are the more accurate the allocation of variable usage costs to individual vehicle classes.
- We are grateful for the comments that we have already received on the vehicle characteristics spreadsheet, attached to the cover email accompanying this consultation. We encourage all stakeholders to finish their review of these characteristics by the close of this consultation. We propose that, as an industry, we should make reasonable endeavours to set VUC rates based on a robust list of vehicle characteristics at the start of CP5. Then following the commencement of CP5, VUC rates for existing vehicles, not subject to vehicle modification, should be 'locked down' for the control period.

Temporary default rates

- It is important that new vehicles are charged, as early as possible, the appropriate VUC rate. We recognise that sometimes it takes operators a while to gather the appropriate data to calculate their charge.

- At present, a single default rate applies to freight vehicles where a bespoke VUC rate has not been calculated and approved by ORR. It is an 'average' rate that is applicable to all laden and tare vehicles across all commodities. There is currently no default rate for passenger vehicles. Therefore, journeys for passenger vehicles where a bespoke VUC rate has not been determined are assigned, uncharged, to a 'pending' file until an appropriate rate is agreed.
- We propose retaining a default rate for freight vehicles and introducing a default rate for passenger vehicles in CP5. To improve the incentive properties of the existing freight default rate we propose introducing a more disaggregated approach in CP5. We also propose extending this disaggregated approach to include passenger vehicles. Specifically, we propose introducing default rate 'bands' for freight and passenger vehicles.
- We propose that the respective default rate for each band is based on the CP5 price list and is equivalent to the highest vehicle rate in each the band. We consider that this will ensure that Network Rail is compensated for wear and tear on the network in respect of vehicles where a VUC rate has not been determined and provide a strong incentive for operators to provide the necessary vehicle characteristic information such that a bespoke VUC rate can be calculated. Following the calculation of a bespoke rate, we propose that all journeys in the control period (including those already charged at the

default rate) are re-charged at the ORR approved rate. Income already received at the default rate will be refunded (i.e. the net impact on operators will be the difference between the default and ORR approved rate).

Rates for modified vehicles

- VUC rates are calibrated at the start of each control period based on the vehicle characteristics at the time. Based on our experience in CP4, it is not uncommon for individual vehicles, subclasses or entire fleets to undergo modification or re-fitment during the control period.
- Where such modification or re-fitment occurs the new vehicle characteristics may result in different VUC rates being determined. These rates could be higher or lower depending on the type of vehicle modification.
- In CP4, to facilitate the accurate charging of individual vehicles that have been modified to be more 'track friendly', we incorporated additional functionality into our Track Access Billing System (TABS). This functionality allows us to bill the VUC at an individual vehicle level in addition to vehicle class level. We propose that for CP5 this functionality is utilised to charge operators an appropriate, ORR approved, VUC rate where vehicles are modified mid-control period resulting in a different VUC rate becoming appropriate. The amended charge rate would take the form of a bilaterally agreed amendment, subject to normal process including consultation and ORR approval.

Stakeholder engagement and next steps

We are committed to continue working with stakeholders and developing CP5 VUC rates in a transparent and consultative way. To date, we have taken the following steps to engage with stakeholders and promote transparency in relation to the VUC in PR13:

- published an industry letter (September 2011) in advance of our 'freight cap' consultation setting out our proposed methodology for estimating variable usage costs;
- published a 'freight cap' consultation (November 2011) to facilitate ORR placing an early cap on freight VUC rates;
- published a letter (March 2012) sent to ORR concluding on our 'freight cap' consultation;
- published the Arup report (March 2012) reviewing our initial variable usage cost estimates;
- published the letters (December 2012) responding to ORR's request for us to use reasonable endeavours to improve our civils structures and earthworks cost variability estimates;
- hosted a workshop (December 2012) to further stakeholders understanding of VTISM;

- presented regularly at the monthly variable track access charging (VTAC) meeting[4]; and

- set-up a cross-industry working group to inform the remit for the work carried out by Serco to apportion variable usage costs between individual vehicle classes.

We will continue to engage with stakeholders in relation to the development of the VUC for CP5. This consultation represents the next step in that process. We will also be seeking stakeholders' views in respect of this consultation at the regular VTAC meeting on 11 January 2013. If you would like to attend this meeting please contact Ben Worley (Ben.Worley@networkrail.co.uk).

Following careful consideration of consultation responses we are aiming to conclude on this consultation to ORR by the end of March 2013. When we conclude to ORR we will publish a draft CP5 VUC price list.

We understand that ORR will publish its decision on potentially capping freight VUC rates, in advance of its final determination, toward the end of December 2012. It will then issue its draft determination in June 2013 which will cover access charges, before publishing its final determination in October 2013. In December 2013 ORR will audit and approve track access charge prices lists, including the VUC price list, before the revised charge rates are implemented on 1 April 2014.

The principal future milestones for the review are set out in the table, below:

Principal milestones	
December 2012	ORR decision on capping freight VUC rates
11 January 2013	Discuss this consultation at the VTAC meeting
1 February 2013	This consultation closes
By 31 March 2013	Conclude on consultation and publish draft price list
12 June 2013	ORR Draft Determination
31 October 2013	ORR Final Determination
By 31 December 2013	Final pricelists made available
1 April 2014	Implement new variable usage charge rates

We would welcome stakeholders' views on any aspect of this consultation. The specific consultation questions are set out in Appendix A. Details on how to respond are provided, below.

[4] This is an open cross-industry meeting that was established in PR13 to provide a regular forum for discussion, principally, in relation to the development of the structure of charges for CP5.

1. INTRODUCTION

1.1. The variable usage charge

As noted above, the VUC is designed to recover Network Rail's operating, maintenance and renewal costs that vary with traffic. The charge ensures that we are compensated for the wear and tear that results from traffic on the GB rail network. In 2011/12 we received £150m, £48m and £3m in VUC income from franchised passenger, freight, and open access operators respectively[5].

The VUC is levied on a 'national average' basis, therefore, the rate applicable to an individual vehicle is the same irrespective of where on the network that vehicle operates. The charge is levied on passenger operators on a pence per vehicle mile basis and is disaggregated by vehicle class. For freight operators, the charge is levied on a £/kgtm basis and is disaggregated by vehicle class, commodity being transported and whether the vehicle is laden or tare. The CP4 VUC price list is published on our website[6].

The charge is designed to be cost reflective and thus vehicles which cause less wear and tear on the network will pay lower charges than those which cause greater wear and tear. This approach provides an incentive for operators to develop and deploy 'track-friendly' rolling stock, and make 'track-friendly' vehicle modifications. Because the charge is designed to be cost reflective it also means that we do not face a disincentive, from a wear and tear perspective, when accommodating additional traffic on the network.

1.2. Background

Broadly speaking, re-calibrating the VUC is comprised of two stages:

3. **Estimating total variable usage costs**. This stage involves estimating a single national average variable usage cost rate for passenger and freight traffic on a pound per thousand gross tonne kilometre basis (£/kgtkm). It is then possible to multiply this average variable usage cost rate by a given traffic level in order to estimate total variable usage costs.

4. **Apportioning variable usage costs between individual vehicle classes**. Following the estimation of total variable usage costs, this stages involves apportioning these costs between the different vehicle classes operating on the network. The apportionment is based on individual vehicle characteristics and aims to reflect the relative wear and tear imposed on the network by each vehicle class.

As noted above, it is necessary to re-calibrate charges in two stages because, at present, it is not possible to estimate 'bottom up' a separate variable usage cost for each vehicle class.

[5] Based on Network Rail's Regulatory Accounts for the year ending 31 March 2011.
[6] Available at: http://www.networkrail.co.uk

As part of PR13, we have already carried out significant work in relation to stage one of re-calibrating the VUC – estimating total variable usage costs. Specifically, we have consulted on our initial estimate of total variable usage costs and, following careful consideration of consultation responses, concluded to ORR. The analysis in our consultation document has been reviewed by the independent reporter, Arup. Following this review ORR requested that we use reasonable endeavours to improve our variable usage cost estimates in respect of civil structures and earthworks. We have recently written to ORR in response to its request. We have summarised in more detail, below, the key documents published to date, which can be found on ORR's[7] and Network Rail's websites[8].

This primary purpose of this consultation is to seek views on the second stage of re-calibrating VUC rates– apportioning total variable usage costs between individual vehicle classes. Chapters 2, 3 and 4, below, discuss the proposed methodologies for apportioning total variable usage costs between individual vehicle classes. These methodologies generally apportion costs based on vehicle characteristics, which we discuss in Chapter 5. In Chapter 5 we also discuss temporary default rates and rates for modified vehicles.

Please note that the cost estimates shown below are in 2011/12 prices and at end CP4 efficiency unless otherwise stated. Moreover, the, below, cost estimates are based on our Initial Industry plan (IIP) cost and traffic data rather than our refined Strategic Business Plan (SBP) data. We will update our cost estimates to take into account the refined SBP cost and traffic data when we conclude to ORR on this consultation in March 2013, following the publication of the SBP.

We are aware that operators will naturally be interested in the <u>prices</u> that they will pay to 'access the network' in CP5. However, this consultation focuses on <u>costs</u>. Ultimately it is for ORR to determine access charges and it has indicated that it is likely to apply a long-run efficiency overlay to our variable usage cost estimates. Therefore, the charges payable by operators are likely to be lower than the, below, variable usage cost estimates because they are likely to incorporate additional efficiency.

ORR first consultation

In May 2011 ORR published its first PR13 consultation[9]. In this consultation it requested views on whether the VUC should be disaggregated by geography and whether it should place a cap on freight VUC rates in advance of its final determination.

Further to this consultation Network Rail wrote to ORR stating that it did no support, at this stage, geographically disaggregated VUC rates. Separately, the Rail Delivery Group (RDG) also wrote to ORR suggesting that geographically disaggregating the VUC should be covered as part of the wider charging review in early CP5, to inform CP6[10].

[7] Available at: PR13 publications - Office of Rail Regulation
[8] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx
[9] Available at: http://www.rail-reg.gov.uk/pr13/PDF/PR13-first-consultation-document.pdf
[10] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.

Network Rail 'freight cap' consultation

In order to facilitate ORR potentially placing a cap on freight VUC rates in advance of its final determination we started work to initially estimate variable usage costs.

In September 2011 we published an industry letter[11] setting out our proposed methodology for calculating these initial cost estimates. In this letter we proposed estimating variable usage costs on broadly the same basis as in the 2008 periodic review (PR08). That is, to adopt a 'bottom up' approach to estimating track variable usage costs and a 'top down' approach to estimating non-track variable usage costs.

In November 2011 we published a consultation document[12] setting out our initial estimate of variable usage costs based on end CP4 traffic, see below:

Asset type	**Cost variability (%)**	**Costs (£M per year)**
Track:		**242.4**
Track maintenance and renewals	27%	242.4
Civils:		**30.7**
Embankments renewals	6%	1.9
Metallic underbridge renewals	20%	9.7
Brick and Masonry underbridge renewals	20%	18.5
Culverts renewals	5%	0.5
Signalling:		**13.6**
Maintenance	6%	8.2
Minor works points renewals	44%	5.4
Total		**286.7**

We noted that track renewal and heavy maintenance variable usage costs were estimated 'bottom up' using the Vehicle Track Interaction Strategic Model (VTISM). VTISM is discussed in more detail, below, and we consider that it represents a material improvement on the PR08 approach to modelling track variable usage costs, which used Network Rail's Infrastructure Cost Model (ICM) track module.

We also stated that we considered it appropriate to retain the 'top down' 6% and 20% cost variability assumptions applied in PR08 to embankment renewals and metallic underbridge renewals respectively. However, we proposed extending the 20% cost variability assumption previously applied to metallic underbridge renewals to brick and masonry underbridge renewals. In addition we proposed applying a 5% cost variability assumption to culverts and increasing the signalling maintenance cost variability assumption from 5% to 6%. We also proposed introducing a 44% cost variability assumption in relation to signalling minor works points renewals.

In addition to the total variable usage cost estimate set out in the table, above, we also estimated:

[11] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.
[12] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.

- an average (passenger and freight) variable usage cost rate of £1.59 per thousand gross tonne kilometre (kgtkm);

- an average passenger variable usage cost rate of £1.62 per kgtkm; and

- an average freight variable usage cost rate of £1.51 per kgtkm.

We noted that due to the uncertainty in relation to our initial cost estimates (including refinement to take account of the CP5 methodology for allocating costs to individual vehicle classes and updated SBP cost and traffic data) we considered it appropriate to apply a +/- 20% confidence interval to the average cost rates.

The, above, average cost rates (excluding the confidence interval) were 6-11% higher than the equivalent CP4 average cost rates. A key driver of this increase was the inclusion of variable usage costs in respect of assets that we now consider vary with traffic and were excluded in CP4 (brick and masonry underbridge renewals, culverts renewals and minor works point renewals).

We received 6 responses to our November 2011 'freight caps' consultation[13]. The following key points were made by stakeholders in their consultation responses:

- supported placing an early cap on freight VUC rates;

- considered that the +/-20% confidence interval was too high; and

- considered that the signalling and civils 'top down' cost variability assumptions should be explained in more detail.

Following careful consideration of consultation responses, we concluded on our November 2011 'freight caps' consultation to ORR in March 2012[14]. In our conclusions letter we proposed the following:

- that the confidence interval should be reduced from +/-20% to +/-15%;

- that the cost variability assumption applied to brick and masonry underbridge renewals should be reduced from 20% to 14%; and

- that the cost variability assumptions that we proposed for metallic underbridge renewals, embankments renewals and culverts renewals remain appropriate.

A summary of our updated estimate of variable usage costs, taking into account the refined estimate of brick and masonry underbridge renewal costs is shown below:

[13] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.
[14] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.

Asset type	Cost variability (%)	Costs (£M per year)
Track:		**242.4**
Track maintenance and renewals	27%	242.4
Civils:		**25.5**
Embankments renewals	6%	1.9
Metallic underbridge renewals	20%	9.7
Brick and Masonry underbridge renewals	14%	13.3
Culverts renewals	5%	0.5
Signalling:		**13.6**
Maintenance	6%	8.2
Minor works points renewals	44%	5.4
Total		**281.5**

The updated cost estimate resulted in the following changes to the average variable usage cost rates that we estimated:

- a reduction in average (passenger and freight) variable usage cost rate from £1.59 per kgtkm to £1.56 per kgtkm;
- a reduction in the freight average vehicle cost rate from £1.51 per kgtkm to £1.46 per kgtkm.; and
- a reduction in the passenger average vehicle cost rate from £1.62 per kgtkm to £1.60 per kgtkm.

The, above, average cost rates are 5-7% higher than the equivalent CP4 rates.

Arup review of the analysis in Network Rail's 'freight cap' consultation

Following the publication of our November 2011 'freight cap' consultation ORR and Network Rail commissioned the independent reporter, Arup, to review the analysis in our consultation document. The key findings of the Arup review[15] are summarised, below:

- **Track**. The variable track cost estimates were calculated using a sound bottom-up approach. Data was used consistently between the different models. The VUC spreadsheet contained no computational errors. The main cause of uncertainty has been reduced by Network Rail producing more credible results for a traffic reduction scenario.
- **Civils structures**. There was evidence to suggest that brick and masonry underbridges are and will continue to be affected by heavy axle loads. However, no evidence had been provided by Network Rail on the variability impact. There was, therefore, some uncertainty on these variable costs.
- **Earthworks**. There was credible fatigue type mechanisms for higher plasticity Clay embankments that could be induced by railway traffic loading. However,

[15] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.

there was insufficient data to enable a robust estimate of the variable usage charge percentage. In the absence of such information, Network Rail had applied engineering judgment.

- **Signalling**. Network Rail had demonstrated that it had applied a more thorough approach in calculating the proposed variable usage costs than for CP4. Whilst still based upon expert judgement, it enables each sub-category to be quantified individually and enables each sub-category to be seen in the context of the overall usage charge.

It concluded that because the dominant element of the VUC is track an overall rating of uncertainty of 'yellow' would be reasonable. A yellow rating translates as to there being some concerns on method, data or assumptions but no major concerns.

ORR document setting the financial and incentive framework for Network Rail in CP5

Following its first consultation, in May 2012 ORR published a document entitled 'Setting the Financial and Incentive Framework for Network Rail in CP5'[16]. In this document it stated that it may determine geographically disaggregated VUC rates as part of PR13, but require implementation within one or two years of the start of CP5. Alternatively, it may delay implementation to CP6, subject to its determination for that control period.

As noted above, Network Rail wrote to ORR stating that it did not support geographically disaggregating the VUC, at this stage. RDG also wrote to ORR suggesting that this issue should be covered as part of a wider charging review in early CP5 to inform CP6. Further to this correspondence we understand that, as suggested by RDG, geographically disaggregated variable usage charges will be considered as part of a more detailed charging review following the completion of PR13, and are unlikely to be implemented in CP5.

ORR consultation on the variable usage charge and a freight-specific charge

In May 2012 ORR also issued a consultation on the VUC and a freight-specific charge[17]. In this document it proposed placing an early cap on VUC rates. Specifically, it proposed a cap on the average VUC rate, across all passenger and freight services, of £1.79 per kgtkm. This was consistent with our cost estimate of £1.56 per kgtkm plus our proposed confidence interval of 15%. In addition, ORR proposed a cap specific to freight services, assuming charges are not geographically disaggregated in CP5. It proposed a cap of £1.68 per kgtkm, this was consistent with our cost estimate of £1.46 per kgtkm plus our proposed confidence interval of 15%.

In its consultation document ORR also requested that we use reasonable endeavours to improve our estimates of cost variability with respect to civils structures and earthworks, in relation to which Arup had at least one major concern.

Network Rail civils letters

We responded to ORR's request to use reasonable endeavours to improve our estimates of cost variability with respect to civils structures and earthworks by way of

[16] Available at: Setting the financial and incentive framework for Network Rail in CP5
[17] Available at: http://www.rail-reg.gov.uk/pr13/PDF/freight-charge-consultation-may2012.pdf

two letters in December 2012[18]. The first of these letters also responded to a report commissioned by colleagues in the freight industry, and produced by Morgan Tucker, which commented on our cost variability estimates, particularly in relation to brick and masonry underbridges[19]. The second focused on earthworks, culverts and metallic underbridges[20].

The, above, letters provided additional information (including relevant consultancy reports and the cost of remedial works) which we considered supported our civils structures and earthworks cost variability estimates. In these letters we proposed that the civils structures and earthworks cost variability estimates, set out in our March 2012 conclusions letter to ORR, continue to be appropriate.

1.3. Structure of this document

The remainder of this document is structures as follows:

- Review of vertical track costs allocation methodology.
- Review of horizontal track costs allocation methodology.
- Review of non-track costs allocation methodology.
- Other issues.
- Conclusion.
- Appendix 1 – consultation questions.
- Appendix 2 – ratio of vertical and horizontal track costs.
- Appendix 3 – review of surface damage formula
- Appendix 4 – vehicle characteristics.
- Appendix 5 – freight operating speed data.

1.4. Responding to this consultation

This document sets out a number of specific consultation questions, which are summarised in Appendix 1. We would welcome responses to these questions, as well as comments on any other aspect of the PR13 VUC work programme. The closing date for this consultation is **close of business Friday 1 February 2013**. This provides 6 weeks for consultation, allowing 2 additional weeks for Christmas and New Year.

[18] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.

[19] Letter from Network Rail to ORR, Response to the Morgan Tucker report reviewing our Variable Usage Charge estimates and freight caps, 18 December 2012.

[20] Letter from Network Rail to ORR, 'Top down' cost variability assumptions applied to embankment, culvert and metallic underbridge renewals, 18 December 2012.

To be transparent, we intend to publish consultation responses on our website. Therefore, if you submit a response, we would be grateful if you could confirm whether all or any part of it is confidential. If you consider part of your response to be confidential we would be grateful if you could also provide a non-confidential version suitable for publication.

Please address consultation responses and / or any queries to Ben Worley:

By email: Ben.Worley@networkrail.co.uk

By post:

Ben Worley
Senior Regulatory Economist
Network Rail
Kings Place
90 York Way
London
N1 9AG

Tel: 020 3356 9322

This consultation can also be downloaded from our website[21].

1.5. Next steps

Following careful consideration of consultation responses we are aiming to conclude on this consultation to ORR by 31 March 2013. When we conclude to ORR we will publish a draft CP5 VUC price list.

We understand that ORR will publish its decision on potentially capping freight VUC rates, in advance of its final determination, toward the end of December 2012. It will then issue its draft determination, which will cover access charges, in June 2013 before publishing its final determination in October 2013. In December 2013 ORR will audit and approve track access charge prices lists, including the VUC price list, before the revised charge rates are implemented on 1 April 2014.

[21] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.

2. REVIEW OF VERTICAL TRACK COSTS ALLOCATION METHODOLOGY

As noted earlier, as part of PR13, Network Rail has already carried out significant work in relation to stage one of re-calibrating VUC rates – estimating total variable usage costs. Based on an average (passenger and freight) track cost rate of £1.34 per kgtkm and end CP4 traffic levels we have estimated total track variable usage costs to be approximately £242m. Track costs are the most material variable usage cost category accounting for approximately 86% of total variable usage costs.

The second stage of re-calibrating VUC rates is to apportion these track variable usage costs, and other variable usage costs (i.e. civils and signalling costs), between individual vehicle classes. Consistent with the approach adopted in CP4, we propose using separate methodologies for apportioning vertical and horizontal track variable usage costs. This chapter reviews the existing approach to apportioning vertical track variable usage costs between individual vehicle classes. The review of the methodology for apportioning horizontal costs is set out in the following chapter.

2.1. Proportion of vertical and horizontal track variable usage costs

Before apportioning vertical and horizontal track variable usage costs to individual vehicle classes it is necessary to determine the proportion of track costs that relate to vertical and horizontal forces respectively. In CP4 it was determined that 70% of track variable usage costs related to vertical forces and 30% could be attributed to horizontal forces.

As part of this work we have reviewed the split between vertical and horizontal track variable usage costs. Specifically, we have reviewed each of the maintenance and renewal activities included in our cost modelling and estimated the extent to which each of these are undertaken to remedy the impact of horizontal rail forces. Our assumptions in respect of the proportion of each activity that we have estimated is undertaken in response to horizontal rail forces is set out in Appendix 2.

Based on the assumptions set out in Appendix 2, we have estimated that 78% and 22% of track variable usage costs related to vertical and horizontal rail forces respectively. This represents an increase (8%) in the proportion of total variable usage costs related to vertical forces relative to CP4. If this revised split were to be adopted in CP5, a larger proportion of track variable usage costs could be apportioned using the vertical track costs allocation methodology, discussed in the following section. Please note that because this analysis was derived based on IIP cost and traffic data, when we refine our estimate of track variable usage costs to take account of SBP cost and traffic data, it could affect the proposed split between vertical and horizontal costs. However, as part of this consultation we are primarily seeking comments on the estimated surface damage percentages (i.e. the proportion of each activity that relates to remedying surface damage).

Network Rail position
Based on the surface damage percentages set out in Appendix 2 we proposed that 78% and 22% of track variable usage costs should be attributed to vertical and horizontal rail forces respectively.

Consultation question 1
What is your view on the surface damage percentages estimated for each activity in Appendix 2 and our proposal that 78% and 22% of track variable usage costs should be attributed to vertical and horizontal rail forces respectively?

2.2. Serco review of vertical track costs allocation methodology

In CP4 vertical track variable usage costs were apportioned between individual vehicle classes based on ‘equivalent track damage’. Equivalent track damage is a measure of ‘track friendliness’, therefore, less ‘track friendly’ vehicles attract a lower share of vertical track variable usage costs than ‘track nasty’ vehicles.

In CP4 the following equation was used to estimate the equivalent track damage of each vehicle class:

Equivalent Track Damage = $Ct * A^{0.49*} * S^{0.64} * U^{0.19}$ (per tonne.mile) * GTM

Where:
Ct = 0.89 for loco-hauled passenger stock and multiple units, and 1 for all other vehicles
A = axle load (tonnes)
S = vehicle operating speed (miles/hour)
U = un-sprung mass (kg/axle)
GTM = Gross Tonne Miles

* Note: The axle load exponent of 0.49 is used when the formula is expressed in terms of per tonne.mile and 1.49 when expressed in terms of per axle.mile, given that there is an additional axle load multiplier in GTM.

As noted above, we commissioned Serco to re-calibrate the CP4 equivalent track damage equation. The remit for this work was developed in conjunction with a cross-industry working group (Network Rail, ATOC, Freight Operators and ORR) and required Serco to establish a mathematical relationship for track damage as a function of speed, axle load and un-sprung mass. It did not include a review of the Ct factor because this would have resulted in a disproportionate number of additional VTISM runs. Moreover, the mileage of locomotive hauled passenger stock has declined since the start of CP4, therefore, reducing the influence of this factor on total costs. For CP5, we propose retaining the Ct factor in order to reflect the lower traction forces imposed by loco hauled passenger stock and multiple units. Hence, if the revised equivalent track damage equation developed by Serco were to be introduced in CP5, we would also propose incorporating the existing Ct factor in its current format.

We have summarised, below, the results of Serco's re-calibration work. However, the full report[22] is attached to the covering email accompanying this consultation and sets out Serco's analysis in more detail.

Serco used VTISM in order to re-calibrate the, above, equation. VTISM was developed as part of a substantial research programme, led by the Vehicle/Track Systems Interface Committee (V/T SIC) and managed by the Rail Safety and Standards Board (RSSB). VTISM aims to support the rail industry in managing changes around the wheel/rail interface more effectively and to realise savings through optimised track and vehicle maintenance and renewal. VTISM has been widely used in the rail industry, with users including the Department for Transport (DfT) and the Office of Rail Regulation (ORR), who have used it to evaluate new rolling stock bids and route strategies respectively.

Re-calibration Methodology

VTISM allows the user to define an investment scenario in terms of a specific route section, traffic / vehicle conditions and track renewals and maintenance strategy, over a defined period. The model then simulates deterioration of individual track sections, renewal and maintenance according to the defined strategy. It produces a 'bottom up' work bank and cost associated with the defined strategy, which serves to show the relative vertical damage between vehicles with different characteristics.

VTISM was used to run 48 variant cases, based on the following combinations of vehicle characteristics:

1. 4 axle load variants (5, 10, 17.5 and 25 tonnes)
2. 4 operating speed variants (25, 50, 75 and 100 mph)
3. 3 un-sprung mass variants (1,000, 2,000 and 3,000 kg)

Based on the 48 variant cases, the following five steps were taken to re-calibrate the CP4 VUC equation:

- **Step 1**: A large representative sample of the GB rail network was selected from the VTISM track database. The data was an averaged-based sample of the network in terms of route, track construction, condition and traffic.

- **Step 2**: VTISM traffic files were created. The overall approach was to introduce an artificial vehicle as incremental traffic on existing base traffic levels so that the incremental cost could be derived.

- **Step 3**: Based on the variant cases, VTISM vehicle files (definition of vehicle and axle parameter, assuming a 4-axle vehicle) were created for each artificial vehicle variant case (with the varying axle load, speed and un-sprung mass parameters set out, above).

- **Step 4**: A Track – Strategic Planning Application (T-SPA) projection criterion was set up. T-SPA is the part of the VTISM tool that is used to simulate track deterioration, work volumes and costs over time. Standard Network Rail renewal, maintenance and inspection policy criteria and unit costs were used.

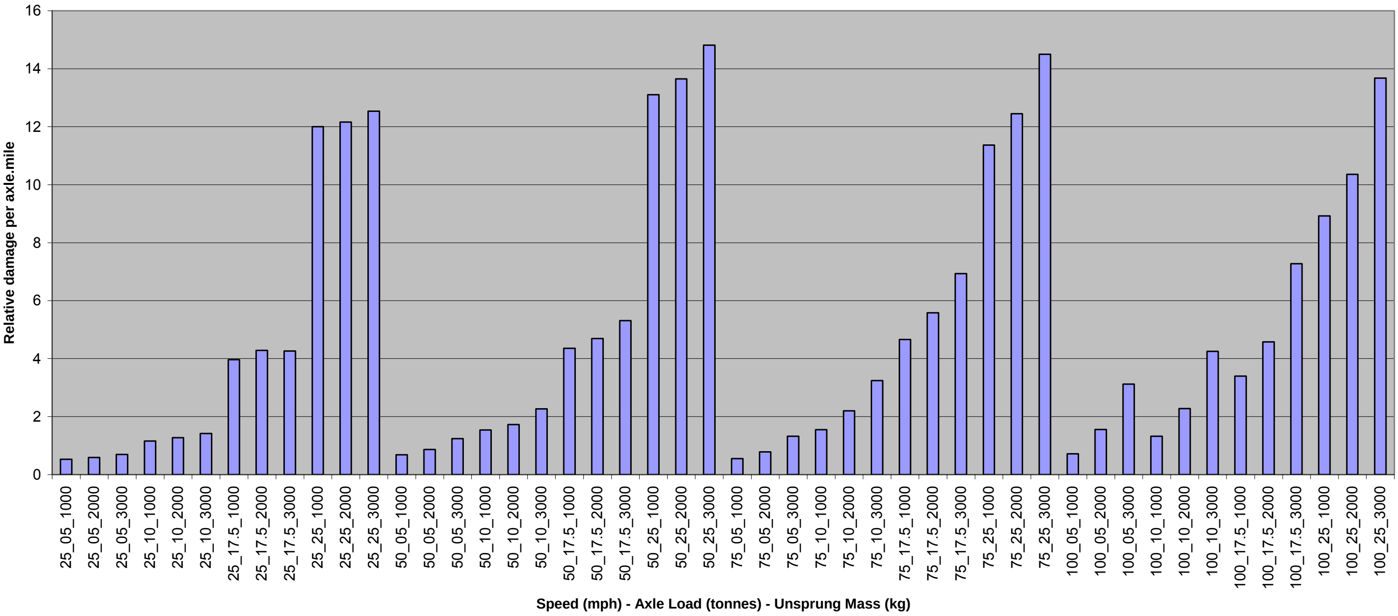
[22] Available at: http://www.networkrail.co.uk/PeriodicReview2013.aspx.

A 37 year projection period was employed. This projection period provides results to within +/- 1% accuracy of using a longer 60 year period (which was considered sufficient for the purpose of this study), however, reduces VTISM processing time. The 37 year projection period concludes at the end of CP11 and it is in line with ORR's sustainability requirement.

- **Step 5**: The VTISM batch processing function was used to automatically execute the 48 variant cases.

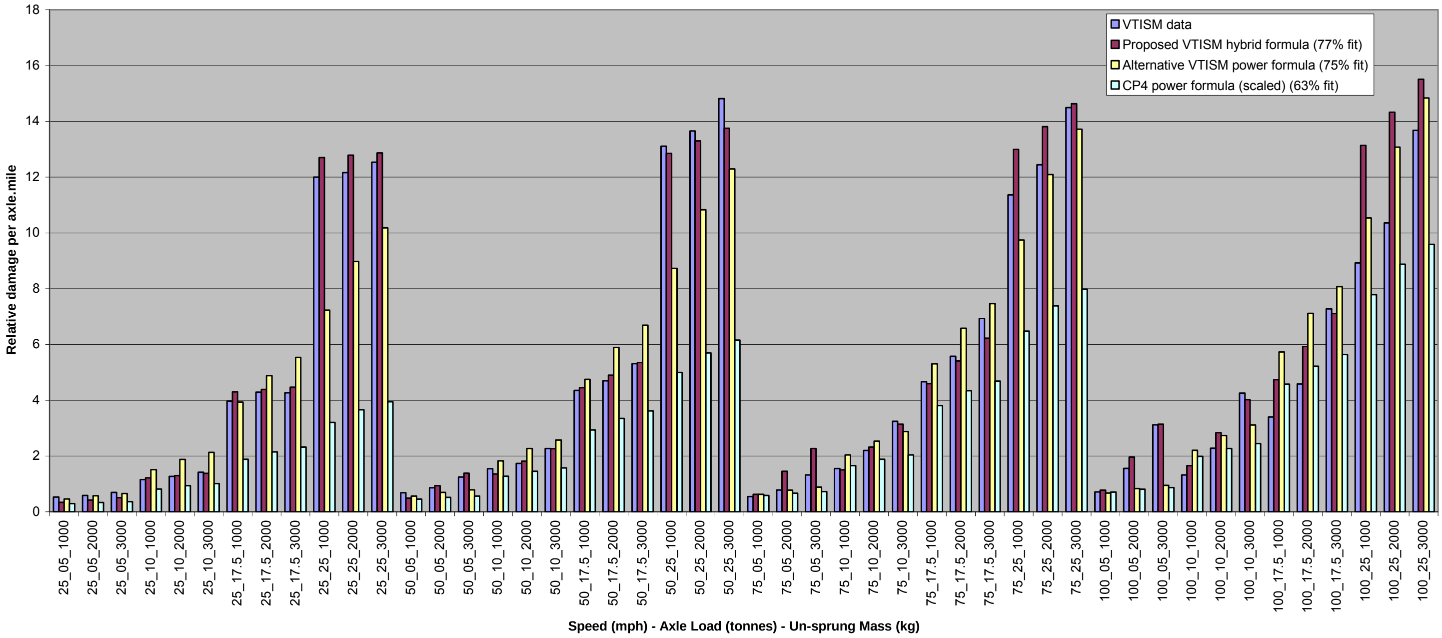
Results

Using the five step methodology described, above, Serco derived the following damage scores for the 48 variant cases. As one would expect, these show that the relative damage per axle mile increases with axle load, speed and un-sprung mass.



Following the derivation of the, above, results Serco undertook regression analysis to establish a mathematical relationship for track damage as a function of speed, axle load and un-sprung mass. It explored different functional forms including power, quadratic, exponential and cubic equations to best represent the relationship between the three variables.

The figure, below, illustrates the fit of the hybrid and power formula, developed by Serco, to the VTISM data. It also shows results from the existing CP4 formula (which provides a weaker fit than the new formula).



Serco recommended using the following hybrid formula to represent track damage as a function of speed, axle load and un-sprung mass because it has the highest degree of fit to the VTISM data. This approach also seeks to strike a balance between accuracy and simplicity.

Proposed VTISM-derived track damage formula based on a hybrid fit:

Relative damage (per axle.mile) $= 0.473.e^{0.133A} + 0.015.S.U - 0.009.S - 0.284.U – 0.442$

where:
A = Axle load (tonnes), within the range: 5 to 25 tonnes
S = Operating speed (mph), within the range: 25 to 100 mph
U = Un-sprung mass (tonnes / axle), within the range: 1 to 3 tonnes

In order to enable comparison with the CP4 equivalent track damage formula, Serco also derived an updated power formula (see the existing and updated exponents in the table below). However, this has a less good fit to the VTISM data and thus, as stated above, Serco considered the hybrid formula to be more appropriate.

Parameter	Exponent (per axle. mile)	
	CP4 power formula	VTISM power formula
Axle load	1.49*	1.71
Speed	0.64	0.27
Un-sprung mass	0.19	0.31
Note *: The axle load exponent of 0.49 is used when the formula is expressed in terms of per tonne.mile and 1.49 when expressed in terms of per axle.mile, given that there is an additional axle load multiplier in GTM.		

The VTISM data, and associated formulae, indicate that damage is more sensitive to axle load and un-sprung mass and less sensitive to vehicle operating speed than was used in the model used to set the charges in CP4. The main implication of this is that vehicles with a high axle load or un-sprung mass would attract a greater share of vertical track variable usage costs than in CP4 and vehicles with a high operating speed would attract a smaller share, all other things being equal. This change in sensitivities reflects the development of our understanding of the drivers of vertical track damage, incorporated in VTISM, since the current equivalent track damage equation was developed prior to CP3.

Impact on VUC rates

At this stage, it is not possible to determine what the precise impact on VUC rates would be if the revised hybrid damage formula proposed by Serco were to be adopted in CP5. Final rates will be determined by ORR and will take account of the updated cost and traffic data included in our SBP, which we will reflect in the proposed price list that we will publish at the end of March 2013 when we conclude on this consultation to ORR.

However, in its report Serco carried out some indicative analysis to assess the potential impact of adopting the new hybrid formula on range of generic vehicles. The analysis is set out in the table, below. To enable comparison between the existing CP4 power formula and new hybrid formula the results are shown relative to an ‘average vehicle’.

This analysis shows, for example, that using the CP4 power formulae the freight 4 axle empty wagon, attracted 55% of the cost of the ‘average vehicle’, however, if the new hybrid formula were to be used this would rise to 56%. The results are consistent with the, above, statement that vehicles with a high axle load or un-sprung mass would attract a greater share of the variable usage costs than in CP4 and vehicles with a high operating speed would attract a smaller share. For laden freight vehicles this increase appears to be very material.

Generic vehicle	Axle load (tonnes)	speed (mph)	Un-sprung mass (kg)	Damage index (per tonne.mile)			Damage index (relative to Average Vehicle)		
				CP4 Power formula	VTISM Hybrid formula	VTISM Power formula	CP4 Power formula	VTISM Hybrid formula	VTISM Power formula
Average vehicle	12.5	50	2,000	0.203	0.203	0.258	1.00	1.00	1.00
Mark 3 coach	9.2	78	1,260	0.212	0.172	0.203	1.05	0.85	0.79
Freight wagon 4 axle - empty	5.5	41	1,380	0.111	0.114	0.122	0.55	0.56	0.47
Freight wagon 4 axle - laden	19	35	1,380	0.185	0.289	0.280	0.91	1.43	1.09
Freight wagon 2 axle - empty	9	41	1,820	0.149	0.151	0.188	0.74	0.74	0.73
Freight wagon 2 axle - laden	21	32	1,820	0.193	0.350	0.320	0.95	1.73	1.24
High speed multiple unit - motor	14.1	81	1,835	0.288	0.257	0.311	1.42	1.27	1.21
High speed multiple unit - trailer	13.6	81	1,699	0.279	0.242	0.296	1.38	1.20	1.15
Multiple unit - motor	12.9	55	1,931	0.217	0.212	0.267	1.07	1.05	1.04
Multiple unit - trailer	10.2	55	1,548	0.186	0.170	0.211	0.92	0.84	0.82
Locomotive	17.5	37	2,200	0.201	0.267	0.310	0.99	1.32	1.20

Network Rail's view

As an industry, our understanding of the drivers of vertical track damage has developed considerably since the current equivalent track damage equation was developed prior to CP3.

We worked closely with an industry working group (ATOC, RFOA and ORR) to formulate the consultancy remit for the Serco analysis such that it took advantage of the improvement in industry knowledge. There was broad agreement that VTISM should be used to inform this work. There was, however, also recognition that any change to the charging approach should be evidenced based and be demonstrably better than the current approach.

Even before the work commenced, freight operators expressed concern about the outcome of the review and whilst accepting that VTISM Is the best industry model available, queried whether it was being used in a way that it was designed for. We are mindful of the fact that rail freight operates in a very competitive logistics market. Against this competitive backdrop, freight operators may find even the consideration of changes to charging approaches unsettling.

Network Rail believes that VTISM is the best track wear model available to the industry. It has been built and empirically verified over a number of years, and enjoys considerable engineering support. However, no model can be 100% accurate.

Caution, therefore, should be applied to the output of any modelling exercise. Models are necessarily very reliant on how they are used and, in particular, on their inputs.

Prior to this re-calibration work, it was generally considered likely that the output of the Serco analysis using VTISM would result in moderate changes to the allocation of variable usage costs to vehicles. However, the results from the Serco analysis suggest substantial changes to the allocation of variable usage costs. As set out in the table, above, initial analysis indicates that VUC rates for laden freight wagons could potentially increase materially.

It is important that charges are as cost reflective as possible. However, we recognise that any changes toward a more cost reflective charging structure would affect the balance of charges between passenger and freight operators. We are also aware that the initial results of Serco's analysis, which suggest that charges for heavy axle load vehicles could increase materially, will be particularly unsettling for freight operators. Passenger operators, on the other hand would be likely to see their average variable usage charges fall, if the Serco work were to be adopted in CP5. Freight operators are questioning whether the VTISM derived results are correct. The analysis underpinning the VTISM work is very specialist and complex. We are mindful that we are coming toward the end of the work to inform ORR's conclusions for CP5. Whilst Network Rail has no reason to doubt the robustness of the work or methodology underpinning the Serco analysis we fully accept that freight operators may consider that they require more time to probe and better understand the underlying analysis. We, therefore, consider that deferring this work into the charges review that the industry has committed to carry out during the early stages of CP5, to inform charges in CP6, should be considered as an option. This would provide the industry with more time to better understand the underlying engineering assumptions and application of VTISM, than would be the case if it was determined that this analysis should be used to inform variable usage charges in CP5. Given the scale of the potential changes to charges indicated by the initial Serco analysis, this could be a reasonable way to proceed.

Network Rail position
Whilst Network Rail has no reason to doubt the robustness of the work or methodology underpinning the Serco analysis we fully accept that freight operators may consider that they require more time to probe and better understand the underlying analysis.. We, therefore, consider that deferring this work into the charges review that the industry has committed to carry out during the early stages of CP5, to inform charges in CP6, should be considered as an option.

Consultation question 2
Do you have any comments on the analysis carried out by Serco in order to re-calibrate the existing equivalent track damage equation?

Consultation question 3
Do you consider that for CP5 we should use the revised 'hybrid' track damage formula derived by Serco, incorporating the existing Ct factor in its current format, to apportion vertical track variable usage costs between vehicle classes? Or Do you consider that the existing equivalent track damage formula should be retained for CP5, alongside a commitment from the industry to, as part of the wider charges review in early CP5, to better understand the Serco analysis for potential implementation in CP6? Ultimately any decisions on charges for CP5 will, however, be a matter for ORR. If it were to be concluded that the existing equivalent track damage equation should be retained for CP5, we would also propose using this equation to apportion the relevant non-track variable usage costs, rather than the revised 'hybrid' track damage formula recommended by Serco.

3. REVIEW OF HORIZONTAL TRACK COSTS ALLOCATION METHODOLOGY

As noted above, based on the assumptions set out in Appendix 2, we have initially estimated that 22% of track variable usage costs (which account for 86% of total variable usage costs) relate to horizontal rail forces. This represents a decrease of 8% relative to the assumption used in CP4. As noted above, the quantum of total track variable usage costs and split between vertical and horizontal track costs may change when our cost estimates are refined to take into account SBP cost and traffic data.

In CP4 different methodologies were used to apportion horizontal and vertical track variable usage costs. The previous chapter summarises the review of the existing approach to apportioning vertical track variable usage costs. This chapter reviews the current approach to apportioning horizontal track variable usage costs. The remit for this review was developed in conjunction with a cross-industry working group (Network Rail, ATOC, RFOA and ORR).

The results of this review are set out, in detail, in Appendix 3 but have also been summarised, below.

3.1. CP4 methodology

The methodology currently used to apportion horizontal track variable usage costs was developed by Transport Technology Centre Inc. (TTCI), on behalf of Network Rail, in PR08. Whilst we consider that this methodology is broadly sound, further to the industry working group meetings, particular aspects of the calculation process have been examined and considered for revision.

The existing process to determine the surface damage component of the VUC (horizontal track costs) associates each vehicle with a 'curving class'. A curving class is a measure of a vehicle's 'track friendliness' with regard to tangential forces generated in the contact patch: these are the forces responsible for rail wear and rolling contact fatigue (RCF). In the current methodology these forces are determined for the vehicle running on a range of curves representing those existing in the GB network and, for each curve radius, the forces are used to determine a measure of the wear and RCF damage generated by the vehicle. These measures of damage are then converted to a cost and weighted by the proportion of curves of that radius on the national network. These costs are then summed to provide a national average cost per vehicle mile of operation on the vehicle.

The wheel/rail forces used as a fundamental input to the calculations must be derived from vehicle dynamics simulations for each specific vehicle. These can be obtained from either a full simulation of the actual vehicle or from a 'look-up' table of pre-calculated values for a range of vehicles: in that case the vehicle must be approximated based on the characteristics closest to it in the existing table (based on vehicle mass and primary yaw stiffness).

This review has considered three aspects of the surface damage charging methodology and the process that is used to derive the charges:

1. the damage cost calculation equations;

2. the friction coefficient assumed at the wheel/rail interface when determining the wheel/rail forces; and

3. the level of average track alignment 'quality' assumed when determining the wheel/rail forces.

3.2. Initial results of review for CP5

We have reviewed the, above, aspects of the existing methodology and developed a revised approach to apportioning horizontal track variable usage costs between individual vehicle classes. This approach differs from that used in CP4 in a number of ways:

1. It uses a new damage calculation methodology which incorporates separate components for grinding, RCF and wear;

2. In the vehicle dynamics simulations the coefficient of friction on the flange is reduced to 0.1 to reflect better flange lubrication;

3. Sample track alignment variations (typical of 100mph track) have been assumed in all cases to generate more realistic vehicle responses to track features; and

4. Values of $T\gamma$ for the trailing wheelset of a bogie have also been included since research has shown that, on tight radius curves, this wheelset can cause significant RCF damage to the low rail of curves.

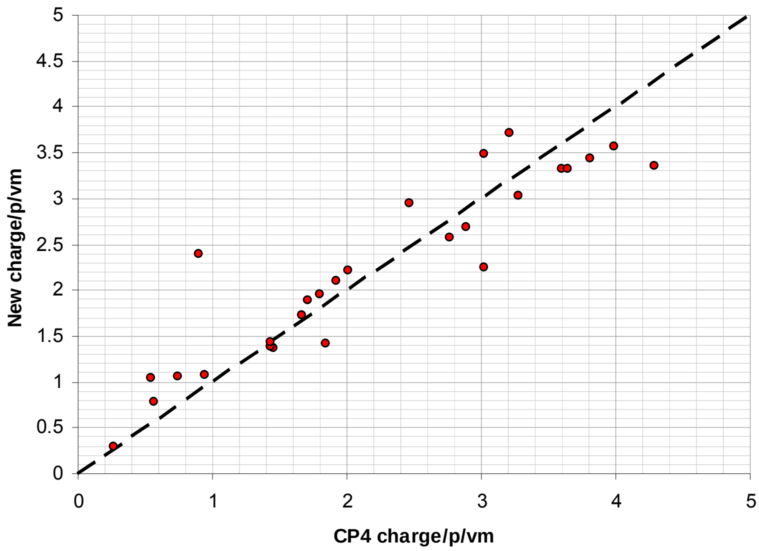
We have applied the revised methodology to an initial selection of vehicles to indicate the effect that these changes may have on the surface damage component of the VUC for these vehicles. However, these calculations cannot be directly compared with those from the CP4 VUC model because the new damage function requires recalibration to the agreed total surface damage cost. This recalibration cannot be undertaken until vehicle dynamics simulations have been undertaken to recalculate the curving classes with data for the adjusted friction coefficients and the track alignment data for all the vehicles in the charging model. The charges shown in the table, below, have been developed from a calibration of vehicles which make up between 75 and 80% of the total vehicle mileage in the CP4 VUC model, so may be subject to change as this percentage increases. However, we believe that they provide a useful indicator of the likely changes with this new procedure. This work will be completed in time to inform the draft CP5 price list that we will publish by the end of March 2013 when we conclude to ORR on this consultation.

Initial results of the calculations with the proposed new methodology are shown in the table, below, with a breakdown of the charges into grinding, RCF and wear components so that the distribution of charges can be seen. Passenger curving classes are expressed in terms of primary yaw stiffness and weight. Hence, the curving class "Coach_8_30", below, indicates that the vehicle has a primary yaw stiffness of approximately 8 MNm/rad and a weight of approximately 30 tonnes.

Curving class	CP4 surface damage (p/vehicle mile)	Proposed CP5 process (p/vehicle mile)			
		Grinding component	RCF component	Wear component	Total
Coach_8_30	0.57	0.41	0.31	0.06	0.78
Coach_12_40	1.46	0.54	0.70	0.11	1.36
Coach_80_50	3.99	0.68	1.31	1.58	3.57
Pacer_10	0.94	0.42	0.16	0.49	1.07
Loco2_50	10.92	1.09	0.00	5.51	6.60
Y25_empty	0.54	0.29	0.71	0.05	1.04
Y25_loaded	0.90	1.12	0.00	1.28	2.40

Comparison of current and proposed surface damage costs for a selection of passenger vehicles

The results for this sample of vehicles shows that, on the whole, there is a not a significant change in the surface damage costs for each vehicle. This is shown in the graph, below, which shows a comparison of the CP4 and the proposed CP5 charge for different vehicles. In the graph it is not possible to identify particular vehicles, but it is possible to see that for some vehicles there is an increase in horizontal charge (points above the diagonal dashed line) whereas for others there is a decrease (points below the diagonal dashed line). These figures are based on the calibration, above, which uses vehicles representing between 75 and 80% of the total vehicle mileage in the CP4 VUC model, so there may be some further changes to this distribution when all the vehicles are modelled, but these may not be expected to be significant.



Comparison of surface damage charge for current and proposed methodology for a range of vehicles

The 'curving classes' for which a charge has initially been estimated in the graph, above, are open to review. Network Rail does not have access to validated vehicle dynamics models of freight vehicles. Therefore, our indicative estimate of a charge for freight vehicles that have a Y25 'curving class' is based on unvalidated vehicle dynamics models. As part of this consultation we request that freight vehicle owners/operators assist us by providing access to better models of freight vehicles so that more reliable definitions of the curving classes can be generated for CP5. In particular, we request models of freight vehicles with 3-piece bogies, swing motion bogies, Y25, TF25, Optitrack, and any other designs for which freight operators would like 'curving classes' generated

Network Rail's view

We consider that the revisions to the CP4 methodology outlined, above (and in more detail in Appendix 3), would improve the accuracy of the apportionment of horizontal track variable usage costs. Therefore, for CP5, we propose updating the existing methodology to take account of these revisions.

Network Rail position
We consider that updating the existing methodology such that it incorporates a new damage calculation methodology (comprised of separate components for grinding, RCF and wear), a coefficient of friction on the flange of 0.1 (to reflect better lubrication), sample track alignment variations and values of $T\gamma$ for the trailing wheelset of a bogie would improve the accuracy of the apportionment of horizontal track variable usage costs. Therefore, for CP5, we propose updating the existing methodology to take account of these revisions.

Consultation question 4
Do you have any comments on the analysis in Appendix 3? What is your view on our proposal to update the existing methodology such that it incorporates a new damage calculation methodology (comprised of separate components for grinding, RCF and wear), a coefficient of friction on the flange of 0.1 (to reflect better lubrication), sample track alignment variations and values of $T\gamma$ for the trailing wheelset of a bogie?

This review also affords the industry the opportunity to revise existing, and introduce new, curving classes in order to make the surface damage component of the VUC more cost reflective in CP5. However, in order to do this we would require access to the relevant tare and laden vehicle dynamics models. As noted above, we request that freight vehicle owners/operators assist us by providing access to better models of freight vehicles so that more reliable definitions of the curving classes can be generated for CP5.

Network Rail position
This review also affords the industry the opportunity to revise existing, and introduce new, curving classes in order to make the surface damage component of the VUC more cost reflective in CP5. However, in order to do this we would require access to the relevant tare and laden vehicle dynamics models.

Consultation question 5
Would you like to provide any tare and laden vehicle dynamics models in order to facilitate revising an existing, or creating a new, curving class for CP5?

4. REVIEW OF NON-TRACK COSTS ALLOCATION METHODOLOGY

As noted, above, although track costs account for the vast majority (86%) of variable usage costs, a small proportion (14%) of variable usage costs relate to non-track assets. A summary of our estimate, of the non-track variable usage costs is shown in the table, below:

Asset type	Cost variability percentage (%)	Costs (£m per year)
Civils:		**25.5**
Embankments renewals	6%	1.9
Metallic underbridge renewals	20%	9.7
Brick and masonry underbridge renewals	14%	13.3
Culverts renewals	5%	0.5
Signalling:		**13.6**
Maintenance	6%	8.2
Minor works points renewals	44%	5.4
Total		**39.1**

Consistent with track variable usage costs, because the, above, cost estimates have already been subject to industry consultation, the focus of this consultation is on apportioning these costs between individual vehicle classes. We asked Serco to review the existing approach to apportioning non-track variable usage costs. We have summarised the findings of the Serco review, below. However, more detail is available in the full report attached to the covering email accompanying this consultation.

4.1. Civils variable usage costs

In CP4 only the relevant proportion of embankment renewals, metallic underbridge renewals and signalling maintenance costs were recovered through the VUC. However, as noted above, in CP5 we also propose recovering the relevant proportion of brick and masonry underbridge renewals, culverts renewals and minor works points renewals costs through the VUC. This reflects the fact that we now consider that the renewal costs associated with these assets vary with traffic.

In CP4 the following equivalent structures damage equation was used to apportion metallic underbridge and embankment renewals variable usage costs to individual vehicle classes. Equivalent structures damage is a measure of ‘track friendliness’, therefore, ‘track friendly’ vehicles will have a lower equivalent structures damage score and thus attract a lower share of the structures variable usage costs. The CP4 equivalent structures damage formula set out, below, was derived by fitting regression relationships to a large number of results produced by fundamental structures damage models, as part of earlier British Rail research.

Equivalent Structures Damage = $Ct.A^{3.83}.S^{1.52}$ (per tonne.mile).GTM

Where:
Ct is a constant: 1.20 for two-axle freight wagons, and 1 for all other vehicles
A is the axle load (tonnes)
S is the operating speed (miles/hour)
GTM is the Gross Tonne Miles

Note: The axle load exponent of 3.83 is used when the formula is expressed in terms of per tonne.mile and 4.83 when expressed in terms of per axle.mile, given that there is an additional axle load multiplier in GTM.

Serco reviewed the, above, equation and considered whether it should be applied to all civils assets. It discussed the applicability of the equation with Network Rail's civil engineers and industry stakeholders (RFOA, ATOC and ORR). There was some concern that it would not be appropriate to apply the, above, equation to several different asset types as there are different drivers for the deterioration of each asset.

Serco recommended that the existing CP4 civils equation should be retained for apportioning metallic underbridge variable usage costs between vehicle classes. However, based on evidence on fatigue damage in steel bridges, where damage is typically based on stress raised to a power between the ranges of 3 to 5 – the current axle load exponent of 4.83 was considered too high. Based on Euronorm standards[23], Serco recommended the use of a modified median axle load exponent of 4. Thus the exponent to use in the equation (per tonne.mile) would be 3 because of the additional axle load multiplier in the gross tonne miles term.

Serco recommended not applying the CP4 civils equation to embankments and culverts variable usage costs because the relevant axle load and speed exponents cannot yet be defined. It also recommended not applying the equation to brick and masonry underbridge variable usage costs because the axle load exponent cannot yet be defined and the inclusion of axle spacing would need further analysis. In respect of these asset categories, Serco, therefore, recommended that the revised equivalent track damage equation that it has developed using VTISM would be more appropriate for allocating these costs because its provenance is known. It also reflects the fact that there are different drivers of degradation in metallic underbridges and other civils assets.

Network Rail's view

For CP5, consistent with Serco's recommendations, we propose:

- Retaining the existing equivalent structures damage equation for apportioning metallic underbridge variable usage costs between vehicle classes. However, consistent with Euronorm standards, using a modified axle load exponent of 4 rather than 4.83; and

[23] Euronorm standards are Europe-wide standards developed by European standards organisations.

- Using the revised equivalent track damage equation for apportioning embankments, culverts and brick and masonry underbridge variable usage costs.

As noted, above, if it were to be concluded that the existing equivalent track damage equation should be retained for CP5, we would also propose using this equation to apportion the relevant civils (embankments, culverts and brick and masonry underbridge renewals) variable usage costs, rather than the revised equivalent track damage formula recommended by Serco.

Network Rail position
We propose retaining the existing equivalent structures damage equation for apportioning metallic underbridge variable usage costs, however, using a modified axle load exponent of 4 rather than 4.83.

Consultation question 6
What is your view on our proposal to retain the existing equivalent structures damage equation for apportioning metallic underbridge variable usage costs but using a modified axle load exponent of 4 rather than 4.83?

Network Rail position
We propose using the revised equivalent track damage equation to apportion embankments, culverts and brick and masonry underbridge variable usage costs.

Consultation question 7
What is your view on our proposal to use the revised equivalent track damage equation for apportioning embankments, culverts and brick and masonry underbridge variable usage costs?

4.2. Signalling variable usage costs

In CP4 only the relevant proportion of signalling maintenance costs were recovered through the VUC. However, for CP5 we also propose recovering the relevant proportion of signalling minor works points renewals through the VUC. This reflects the fact that we now consider that these renewal costs vary with traffic.

As set out above, in our March 2012 conclusions letter to ORR we estimated total signalling variable usage costs to be £13.6m per annum, made up of maintenance and renewal items that are driven by traffic usage. In CP4, all signalling variable usage costs were apportioned on the same basis as the track variable usage costs, for simplicity and mindful of their relatively low absolute level.

Serco reviewed the CP4 approach to apportioning signalling variable usage costs with Network Rail signalling engineers and industry stakeholders (RFOA, ATOC and ORR). Further to this review it was estimated that approximately 50% of total signalling variable usage costs (£6.8m) can be attributed to load related damage.

This is based on engineering judgement and the assumption that two-thirds of the signalling maintenance and renewals costs are classed as load-related damage, however, approximately 25% of the cost is related to non-mechanical systems (e.g. electronics), which is not relevant. Serco recommended that the revised track damage equation should be used to apportion the 50% of signalling variable usage costs that are load related and that the remaining 50% of costs should be apportioned based on train movements (vehicle mileage).

Network Rail's view

Consistent with Serco's recommendation, for CP5, we propose:

- apportioning the 50% of signalling variable usage costs that are estimated to be load related using the revised equivalent track damage formula; and

- apportioning the 50% of signalling variable usage costs estimated not be load related based on train movements, namely vehicle miles.

As noted, above, if were to be concluded that the existing equivalent track damage equation should be retained for CP5, we would also propose using the existing equation to apportion the 50% of signalling variable usage costs estimated to be load-related, rather than the revised equivalent track damage formula recommended by Serco.

Network Rail position
We propose apportioning the 50% of signalling variable usage costs estimated to be load related using the revised equivalent track damage formula and the 50% of signalling variable usage costs estimated not be load related based on vehicle miles.

Consultation question 8
What is your view on our proposal to apportion the 50% of signalling variable usage costs estimated to be load related using the equivalent track damage formula and the 50% of signalling variable usage costs estimated not be load related based on vehicle miles?

5. OTHER ISSUES

In addition to seeking views on the approach to apportioning track and non-track variable usage costs between individual vehicle classes in CP5, we would also welcome views on the following issues:

- vehicle characteristics;
- temporary default rates; and
- rates for modified vehicles;

We discuss each of these issues in turn, below.

5.1. Vehicle characteristics

In Chapters 2, 3 and 4, above, we discuss the proposed methodologies for apportioning total variable usage costs between vehicle classes. These methodologies generally apportion variable usage costs based on vehicle characteristics. The methodologies and vehicle characteristics necessary for apportioning variable usage costs between vehicle classes will be incorporated into the CP5 VUC model that we will develop in order to produce the draft price list that we will provide to ORR when we conclude on this consultation by the end of March 2013.

The allocation methodology aims to apportion variable usage costs based on relative damage incurred. Vehicles that cause less wear and tear on the network should attract a lower share of total variable usage costs than vehicles that cause more wear and tear. Hence, ‘track friendly’ vehicles will be charged lower variable usage charges than ‘track nasty’ vehicles. The more accurate the vehicle characteristics used in the CP5 VUC model the more accurate the apportionment of variable usage costs between vehicle classes.

On 5 October 2012 Network Rail issued a draft list of vehicle characteristics to those stakeholders (including ATOC, freight operators and ORR) who attend the monthly VTAC meeting. We would like to thank those stakeholders who have provided us with comments on that list. We have noted these comments in the “new comments” column on the vehicle characteristics spreadsheet, attached to the cover email accompanying this consultation. Based on the comments we received from stakeholders, we have made changes to certain characteristics on the spreadsheet. Where this is the case, the changes have been noted in the “changes made” column. Comments which we sent out with the spreadsheet as part of our ad hoc consultation on 5 October are noted in the “original comments” column. As part of this consultation, we would like to invite further comments from stakeholders on the draft list of vehicle characteristics. We encourage all stakeholders to finish their review of these characteristics by the close of this consultation. To assist with commenting on the draft list of vehicle characteristics, in Appendix 4, we have defined each of the column headings in the attached vehicle characteristics spreadsheet.

Network Rail position
The more accurate the vehicle characteristics used in the VUC model the more accurate the allocation of variable usage costs to individual vehicle classes.

Consultation question 9
What is your view on the draft list of vehicle characteristics contained in the spreadsheet attached to the covering email accompanying this consultation? Do you consider that any of these should be amended (if so, please provide supporting evidence where possible)?

In addition, we propose that, as an industry, we should make reasonable endeavours to set VUC rates based on a robust list of vehicle characteristics at the start of CP5. Then following the commencement of CP5 (1 April 2014) VUC rates for existing vehicles, not subject to vehicle modification, should be 'locked down' for the remainder of the control period.

We are proposing this because the CP5 VUC model is likely to be a cost allocation model (i.e. we estimate total variable usage costs and then allocate these to individual vehicle classes). Therefore, if one VUC rate were to be adjusted during the control period in light of different vehicle characteristic information, theoretically, all of the other VUC rates should also be adjusted. We believe such an adjustment would be contrary to the spirit of ORR's final determination and would not provide operators with certainty in relation to VUC rates. Not adjusting for different vehicle characteristic information mid-control period should also provide a stronger incentive for operators to review the vehicle characteristic information attached to the covering email accompanying this consultation. We note that it would not be necessary to adjust all VUC rates where a rate is adjusted to reflect a 'physical' vehicle modification during CP5 because, theoretically, there should be a commensurate change in the level of wear and tear on the network.

We also consider that 'locking down' VUC rates for CP5 should mitigate against additional administration costs during the control period. For example, where one party considers the determined VUC rate is either too high or too low, which would lead to considerable effort analysing and determining on the matter.

For the avoidance of doubt, we believe that the 'locking down' of VUC rates should be symmetrical and thus apply irrespective of whether any different vehicle characteristic information would increase or reduce the relevant VUC rate.

We note that an alternative approach to 'locking down' VUC rates for the control period would be to introduce a mechanism to take account of different vehicle characteristic information as it becomes available. If this alternative approach were to be taken forward we strongly consider that it should symmetric (i.e. VUC rates should be corrected in light of different vehicle characteristic information irrespective of whether the correction results in higher or lower VUC rates). However, we consider that this approach would result in higher administration costs mid-control period than if vehicle characteristics were 'locked down' and reduce the incentive that operators face to help ensure that vehicle characteristics are correct prior to the commencement of CP5. It would also lead to a loss of planning certainty for train operators in relation to the price they will be charged during CP5. Therefore, we consider 'locking down' VUC rates for the control period to be a more appropriate approach.

Network Rail position
We propose that, as an industry, we should make reasonable endeavours to set VUC rates based on a robust list of vehicle characteristics at the start of CP5. Then following the commencement of CP5 (1 April 2014) VUC rates for existing vehicles, not subject to vehicle modification, should be 'locked down' for the remainder of the control period.

Consultation question 10
What is your view on our proposal that for existing vehicles, not subject to vehicle modification, VUC rates should 'locked down' for CP5?

Following this consultation, if we are not able to obtain characteristics for certain passenger and / or freight vehicle classes, it will not be possible for us to robustly allocate the relevant proportion of variable usage costs to these vehicles. Therefore, we propose not including such vehicle classes on the CP5 VUC price list that we will publish by the end of March 2013. Instead, we propose that these vehicle classes are charged a temporary default rate until an appropriate vehicle-specific VUC is agreed. We discuss temporary default rates in more detail, below.

5.2. Vehicle characteristics – operating speed

One vehicle characteristic that informs the apportionment of variable usage costs between vehicle classes is 'operating speed' - an operating speed term is included in both the equivalent track damage and equivalent structures damage equation, above. Operating speed is lower than maximum speed and is used for charging purposes to reflect the fact the vehicles do not always operate at their maximum speed.

Serco was also commissioned to review the current approach to estimating operating speed. The findings of its review are summarised, below, but are set out in detail in the report attached to the cover email accompanying this consultation.

Background

In CP4, operating speed was estimated in different ways for passenger and freight vehicles. For passenger vehicles, operating speed was either inputted as a 'known value', calculated as a distance-based average, or estimated using the, below, formula based on the vehicle's maximum speed.

$$\textbf{Operating Speed} = \textbf{0.021.Max. Speed}^{1.71}$$

Serco concluded that the, above, formula was derived by carrying out regression analysis to determine the relationship between maximum speed and the distance – based average operating speed (where the distance-based average operating speed had been estimated).

For freight vehicles, the operating speed used in CP4 for each vehicle class was selected from a lookup table of average speeds based on commodity type, loading condition and whether the vehicle is a locomotive. The assumed locomotive operating speed was an average of the laden and tare operating speeds. The CP4 lookup table for freight vehicles is shown, below:

Commodity	Average laden operating speed (mph)	Average unladen operating speed (mph)	Average locomotive operating speed (mph)
Domestic Automotive	46	47	46.5
Domestic Intermodal	46	47	46.5
European Automotive	46	47	46.5
European Intermodal	46	47	46.5
Coal ESI	32	41	36.5
Iron Ore	32	41	36.5
Mail and Premium Logistics	67	67	67
Royal Mail	67	67	67
Chemicals	35	41	38
Coal Other	35	41	38
Construction Materials	35	41	38
Domestic Waste	40	50	45
Engineering Haulage	35	41	38
Enterprise	40	50	45
European Conventional	40	50	45
General Merchandise	40	50	45
Industrial Minerals	35	41	38
Non Reportable	35	41	38
Other	35	41	38
Petroleum	35	41	38
Steel	35	41	38
Biomass	35	41	38

Serco Review

As part of Serco's review of the existing approach to estimating operating speed it met with ATOC, RFOA and ORR. ATOC stated that its preference would be that all passenger vehicle types have an operating speed assigned formulaically for consistency and if a change is required then evidence should be provided. RFOA stated that it would like to review the basis for the commodity categories and associated average speeds. Serco also considered that average speeds may have increased in recent years because of the increased power and improved traction of modern trains.

Serco recommended that a consistent approach is used to determine freight and passenger vehicle respective operating speeds (i.e. all passenger vehicle operating speeds should be determined on the same basis and all freight vehicles operating speeds should be determined on the same basis). Also, if the relevant operational data is available, then there would be merit in reviewing whether the existing vehicle operating speeds used in the charging model continue to be appropriate.

Network Rail's view

In October 2012 we shared a draft list of vehicle characteristics with stakeholders in order to begin the process of validating this data for CP5. In response to this ad hoc consultation Freightliner provided updated operating speed information, based on the timetable, for the following commodity types:

- ESI coal;
- Construction materials; and
- Intermodal.

These speeds were lower than those currently assumed in the CP4 VUC model and Freightliner considered that they were representative of the typical journeys for each of the, above, commodities. We welcome this information provided by Freightliner and have used it in combination with our own analysis in order to estimate revised operating speeds for each commodity group.

Our analysis of average freight operating speeds is based on data from Period 9 of the Working Timetable for the current financial year. A full list of the Working Timetable information that we used to estimate revised operating speeds for freight vehicles in provided in Appendix 5.

Operating speed information, disaggregated by laden and tare journeys, was not easily accessible from the Working Timetable. Therefore, we have estimated a single operating speed that is an average of laden and tare journeys for each commodity. We consider that it would be reasonable to use an average operating speed to inform CP5 VUC rates because the net effect, from a charging perspective, is likely to be broadly neutral (i.e. all other things being equal VUC rates for tare journeys would have been will be marginally higher and VUC rates for laden journeys would have been marginally lower).

For a minority of commodities we were not able to obtain sufficient information from the Working Timetable in order to estimate an average operating speed. We will continue working, during the consultation period, to obtain this data and aim to update our operating speed estimates for these commodities before we conclude to ORR by the end of March 2013. In the interim, however, we have mapped the commodities for which we do not have operating speed data to other commodities for which data is available and that we consider are likely to travel at broadly the same speed. This mapping is shown in the table, below:

Mapping	
Commodity where data was not available	**Mapped to**
Domestic Intermodal	European Intermodal
Engineering haulage	Industrial Minerals
Enterprise	General Merchandise
European Conventional	General Merchandise
Other	Domestic Waste
Biomass	Coal ESI

In addition, the Working Timetable information included in Appendix 5 includes significant 'stopping time' where freight vehicles are stationery. When estimating average freight operating speeds for charging purposes we consider that it is appropriate to exclude ‘stopping time’ in order to avoid artificially reducing the operating speed estimate. Using the operating speed information provided by Freightliner, and information that we have obtained ourselves, we have estimated a percentage uplift on timetabled operating speed to take account of ‘stopping time’. Based on a sample of 8 representative journeys for various different commodities we estimate that, on average, excluding ‘stopping time’ increases timetabled operating speed by approximately 14%. We will continue working during the consultation period to obtain timetable data that excludes ‘stopping time’.

The table, below, sets out our revised operating speed estimates (before and after excluding ‘stopping time’) relative to the operating speeds assumed in CP4.

Commodity	**CP5 Average Speed (mph)**	**CP5 Average Speed excluding ‘stopping time’ (mph)**	**CP4 speed (mph)**	
			Laden	**Empty**
Coal (other)	22	25	35	41
Iron Ore	22	25	32	41
Steel	22	25	35	41
Domestic Waste	21	24	40	50
Construction Materials	26	29	35	41
Petroleum	20	23	35	41
Coal (ESI)	21	24	32	41
European Intermodal	33	38	46	47
Domestic Automotive	22	25	46	47
European Automotive	27	31	46	47
Industrial Minerals	16	18	35	41
General Merchandise	26	30	40	50
Royal Mail	69	78	67	67
Mail and Premium Logistics	69	78	67	67
Domestic Intermodal*	33	38	46	47
Engineering haulage*	16	18	35	41
Enterprise*	26	30	40	50
European Conventional*	26	30	40	50
Other*	21	24	38	41
Biomass*	21	24	35	41
Chemicals	14	16	35	41

* Operating speed estimated based on commodity mapping

The table indicates that, even after adjusting for ‘stopping time’, lower operating speeds are likely to be appropriate for most commodities in CP5.

Therefore, for CP5, we propose basing freight VUC rates on updated operating speed information derived from the Working Timetable and adjusted such that it excludes ‘stopping time’. The operating speed values included in the vehicle characteristics spreadsheet attached to the cover email accompanying this consultation are consistent with our CP5 estimates in the table, above (excluding ‘stopping time’).

Network Rail position
We propose basing freight VUC rates on updated operating speed information derived from the Working Timetable and adjusted such that it excludes ‘stopping time’. Subject to consultation responses and further analysis, we propose basing freight VUC rates in CP5 on the operating estimates (excluding ‘stopping time’) in the, above, table.

Consultation question 11
What is your view on our revised freight operating speed estimates and the methodology used to derive them? Would you like to provide any further information in relation to freight operating speeds?

As noted, above, in CP4, the operating speed for each passenger vehicle class was inputted as a known value, calculated as a distance-based average, or estimated formulaically based on maximum speed.

The advantage of adopting a distance-based average approach is that the estimated operating speed would be based on timetable information which is likely to be a good indication of actual operating speed. However, due to the number of passenger vehicle classes (100+) estimating a bespoke operating speed based on timetable information would require significant analysis. Theoretically, for each vehicle class (which in some instances will be common to more than one operator), one would need to establish the total distance travelled during a given period and the total time required to travel that distance, adjusting for ‘stopping time’ at stations. Whilst still substantial, the amount of analysis required would be reduced if one tried to identify a ‘typical’ journey for each vehicle class. However, seeking to identify a ‘typical’ journey is a somewhat subjective decision that can introduce its own challenges.

The advantage of retaining the existing formula and estimating operating speed formulaically based on maximum speed is that significant analysis of the timetable would not be necessary. It would also continue to reflect the fact that operating speed typically increases with maximum speed. However, this approach would not be based on recent timetable information. Therefore, timetabled operating speeds would almost inevitably be different.

It should be noted that in order to re-calibrate the existing operating speed formula it would be necessary to carry out significant analysis of the timetable. This would entail deriving multiple distance-based average operating speeds for different vehicle classes in order to get enough data points to carry out regression analysis to establish a relationship between maximum speed and operating speed. Paradoxically, therefore, if we did this for every vehicle class it would not be necessary to use the re-calibrated formula because we would have a bespoke operating speed value for every vehicle class.

For CP5, we propose that the default approach to estimating passenger operating speed should be that it is estimated using the existing CP4 formula. However, if based on timetable information as described, above, an operator is able to demonstrate than an alternative operating speed would be more appropriate, we would accept this for charging purposes. If an operator wishes to provide analysis of the timetable and propose an alterative operating speed, they should do so in response to this consultation. This should provide us with sufficient time to review the information and incorporate it, where appropriate, into the proposed CP5 VUC price list that we will publish by the end of March 2013.

The passenger operating speed values included in the vehicle characteristic spreadsheet, attached to the covering email accompanying this consultation, were estimated using the existing CP4 operating speed formula.

Network Rail position
We propose that the default approach should be that passenger operating speeds are estimated using the existing CP4 formula. However, if based on timetable information an operator is able to demonstrate that an alternative operating speed would be more appropriate, we would accept this for charging purposes.

Consultation question 12
What is your view on our proposal that the default approach should be that passenger operating speeds are estimated using the existing CP4 formula unless evidence, based on the timetable, that an alternative operating speed is more appropriate is provided? Would you like to provide any evidence, based on the timetable, that an alternative operating speed is more appropriate?

5.3. Temporary default rates

At present, a single default rate applies to freight vehicles where a bespoke VUC rate has not been calculated and approved by ORR, for example, where vehicle characteristic information is not available. The freight default rate is an ‘average’ rate of £1.82 per KGTM (2009/10 prices) that is applicable to all laden and tare vehicle journeys across all commodities. This rate is set out in section 2.2.5 of the model freight contract[24].

There is currently no default rate for passenger vehicles. Therefore, journeys for passenger vehicles where a bespoke VUC rate has not been determined are assigned, uncharged, to a ‘pending’ file until an appropriate rate is agreed. Once an appropriate rate is determined the journeys in the ‘pending’ file are charged at the agreed rate.

The freight default rate is intended to be a temporary measure employed until the vehicle characteristic data necessary for rate calibration is provided by the operator and a bespoke VUC rate is determined. It is designed to ensure that, on average, we recover the wear and tear costs related to vehicles on the network for which a bespoke VUC rate has not yet been determined. Following the determination of an appropriate VUC rate, all relevant journeys are recharged using the approved rate. In practice, during CP4 some vehicles have been operating on a default rate for several years. This is, clearly, far from ideal.

[24] Available at: http://www.rail-reg.gov.uk/upload/pdf/model-freight-contract.pdf

We consider that the inclusion of default rates in the track access contracts for both passenger and freight operators is necessary in order to ensure that Network Rail is compensated for wear and tear on the network in respect vehicles where a VUC rate has not been determined. Therefore, we proposed retaining a default rate for freight vehicles and introducing a default rate for passenger vehicles in CP5.

Network Rail position
We propose retaining a default rate for freight vehicles and introducing a default rate for passenger vehicles in CP5 where a bespoke VUC rate has not been determined.

Consultation question 13
What is your view on our proposal to retain a default rate for freight vehicles and introducing a default rate for passenger vehicles in CP5?

We also consider it important that default rates are set at a level that provides operators with an incentive to make all reasonable endeavours to provide the vehicle characteristic information necessary to estimate an appropriate VUC rate in a timely fashion. At present, because the freight default rate is an average across all vehicle types and commodities, we do not believe that the incentive for freight operators to provide the relevant information is very strong where there is a reasonable expectation that the bespoke VUC rate will be higher than the default one (e.g. for locomotives).

To improve the incentive properties of the existing freight default rate we propose introducing a more disaggregated approach in CP5. We also propose extending this disaggregated approach to include passenger vehicles. Specifically, we propose introducing default rate 'bands' for freight and passenger vehicles. For passenger vehicles we propose the following bands:

- locomotive;
- multiple unit (motor);
- multiple unit (trailer); and
- coach.

For freight vehicles we propose the following bands:

- locomotive;
- wagon (laden); and
- wagon (unladen).

We also propose that the respective default rate for each of these bands is based on the CP5 price list. In particular, the highest vehicle class rate on the price list for each of the bands. As noted above, we consider that this will ensure that we are compensated for wear and tear on the network in respect vehicles where a VUC rate has not been determined and provide a stronger incentive for operators to provide the necessary vehicle characteristic information such that a bespoke VUC rate can be calculated. Following the calculation of a bespoke rate, we propose that all journeys in the control period (including those already charged at the default rate) are re-charged at the ORR approved rate. Income already received at the default rate will be refunded (i.e. the net impact on operators will be the difference between the default and ORR approved rate).

Network Rail position
We propose introducing default rate ‘bands’ for passenger and freight vehicles and that the respective rate for each of these bands should be the highest relevant vehicle rate on the CP5 price list. We consider that this will ensure that we are compensated for wear and tear and introduce a strong incentive for operators to provide the necessary vehicle characteristic information.

Consultation question 14
What is your view on our proposed default rate ‘bands’ and that the respective rate for each of these bands should be the highest relevant vehicle rate on the CP5 price list?

5.4. Rates for modified vehicles

VUC rates are calibrated at the start of each control period based on the vehicle characteristics at the time. Based on our experience in CP4, it is not uncommon for individual vehicles, subclasses or entire fleets to undergo modification or re-fitment during the control period. Where such modification or re-fitment occurs the new vehicle characteristics may result in different VUC rates being appropriate. These rates could be higher or lower depending on the type of vehicle modification.

Network Rail is keen to encourage ‘track friendly’ vehicle modification that results in less wear and tear on the network. Consistent with this and to facilitate the accurate charging of individual vehicles that have been modified to be more ‘track friendly’ during CP4, we incorporated additional functionality into TABS. This functionality allows us to bill the VUC at an individual vehicle level in addition to vehicle class level. We propose that for CP5 that this functionality is utilised to charge operators an appropriate, ORR approved, VUC rate where vehicles are modified mid-control period resulting in a different VUC rate being appropriate. The amended charge rate would take the form of a bilaterally agreed amendment, subject to normal process including consultation and ORR approval.

Network Rail position
We propose that where an entire vehicle class or individual vehicle is modified mid-control period the VUC rate should be adjusted accordingly.

Consultation question 15
What is your view on our proposal to adjust VUC rates during the control period in light of vehicle modifications?

6. CONCLUSION AND NEXT STEPS

The VUC is an important source of income for Network Rail and a significant cost to train operators.

Consistent with our general approach for all existing track access charges, as part of PR13 we are reviewing whether the current VUC charging arrangements continue to be appropriate. As noted above, we have already carried out significant work to estimate total variable usage costs. The focus of this consultation is on the apportionment of these costs between individual vehicle classes. Re-calibrating the VUC should improve cost reflectivity and help to ensure that costs are recovered from those who cause them to be incurred.

We welcome stakeholders' views on the recalibration of the VUC for CP5. This consultation is the principal forum for stakeholders to express their views and sets out a number of specific consultation questions, which are summarised in Appendix 1. We would welcome responses to these questions, as well as comments on any other aspect of the VUC work programme.

We will continue to engage with stakeholders in relation to re-calibrating the VUC for CP5. We will be seeking stakeholders' views in respect of this consultation at the regular VTAC meeting on 11 January 2013. If you would like to attend this meeting please contact Ben Worley (Ben.Worley@networkrail.co.uk).

Following careful consideration of consultation responses we are aiming to conclude on this consultation by 31 March 2013. When we conclude to ORR we will publish a draft CP5 VUC price list. Ultimately, however, any decisions on VUC rates in CP5 will be a matter for ORR.

We understand that ORR will publish its decision on potentially capping freight VUC rates, in advance of its final determination, toward the end of December 2012. It will then issue its draft determination, which will cover access charges, in June 2013 before publishing its final determination in October 2013. In December 2013 ORR will audit and approve track access charge prices lists, including the VUC price list, before the revised charge rates are implemented on 1 April 2014.

The principal future milestones for this review are set out in the table, below:

Principal milestones	
December 2012	ORR decision on capping freight VUC rates
11 January 2013	Discuss this consultation at the VTAC meeting
1 February 2013	This consultation closes
By 31 March 2013	Conclude on consultation and publish draft price list
12 June 2013	ORR Draft Determination
31 October 2013	ORR Final Determination
By 31 December 2013	Final pricelists made available
1 April 2014	Implement new variable usage charge rates

APPENDIX 1 – CONSULTATION QUESTIONS

Vertical track variable usage costs

- **Question 1**: What is your view on the surface damage percentages estimated for each activity in Appendix 2 and our proposal that 78% and 22% of track variable usage costs should be attributed to vertical and horizontal rail forces respectively?

- **Question 2**: Do you have any comments on the analysis carried out by Serco in order to re-calibrate the existing equivalent track damage equation?

- **Question 3:** Do you consider that for CP5 we should use the revised 'hybrid' track damage formula derived by Serco, incorporating the existing Ct factor in its current format, to apportion vertical track variable usage costs between vehicle classes? Or

  Do you consider that the existing equivalent track damage formula should be retained for CP5, alongside a commitment from the industry to, as part of the wider charges review in early CP5, to better understand the Serco analysis for potential implementation in CP6?

  Ultimately any decisions on charges for CP5 will, however, be a matter for ORR.

  If it were to be concluded that the existing equivalent track damage equation should be retained for CP5, we would also propose using this equation to apportion the relevant non-track variable usage costs, rather than the revised 'hybrid' track damage formula recommended by Serco.

Horizontal track variable usage costs

- **Question 4**: Do you have any comments on the analysis in Appendix 3? What is your view on our proposal to update the existing methodology such that it incorporates a new damage calculation methodology (comprised of separate components for grinding, RCF and wear), a coefficient of friction on the flange of 0.1 (to reflect better lubrication), sample track alignment variations and values of $T\gamma$ for the trailing wheelset of a bogie?

- **Question 5**: Would you like to provide any tare and laden vehicle dynamics models in order to facilitate revising an existing, or creating a new, curving class for CP5?

Non-track (civils and signalling) variable usage costs

- **Question 6**: What is your view on our proposal to retain the existing equivalent structures damage equation for apportioning metallic underbridge variable usage costs but using a modified axle load exponent of 4 rather than 4.83?

- **Question 7**: What is your view on our proposal to use the revised equivalent track damage equation for apportioning embankments, culverts and brick and masonry underbridge variable usage costs?

- **Question 8**: What is your view on our proposal to apportion the 50% of signalling variable usage costs estimated to be load related using the equivalent track damage formula and the 50% of signalling variable usage costs estimated not be load related based on vehicle miles?

Vehicle characteristics that inform VUC rates

- **Question 9**: What is your view on the draft list of vehicle characteristics contained in the spreadsheet attached to the covering email accompanying this consultation? Do you consider that any of these should be amended (if so, please provide supporting evidence where possible)?

- **Question 10**: What is your view on our proposal that for existing vehicles, not subject to vehicle modification, VUC rates should 'locked down' for CP5?

- **Question 11**: What is your view on our revised freight operating speed estimates and the methodology used to derive them? Would you like to provide any further information in relation to freight operating speeds?

- **Question 12**: What is your view on our proposal that the default approach should be that passenger operating speeds are estimated using the existing CP4 formula unless evidence, based on the timetable, that an alternative operating speed is more appropriate is provided? Would you like to provide any evidence, based on the timetable, that an alternative operating speed is more appropriate?

Temporary default rates

- **Question 13**: What is your view on our proposal to retain a default rate for freight vehicles and introducing a default rate for passenger vehicles in CP5?

- **Question 14**: What is your view on our proposed default rate 'bands' and that the respective rate for each of these bands should be the highest relevant vehicle rate on the CP5 price list?

Rates for modified vehicles

- **Question 15**: What is your view on our proposal to adjust VUC rates during the control period in light of vehicle modifications?

APPENDIX 2 – RATIO OF VERTICAL AND HORIZONTAL TRACK COSTS

This appendix details each of the activities underlying our estimate of track variable usage costs. We have reviewed each activity and estimated the relevant proportion that we consider relates to remedying surface damage (horizontal track costs). We would welcome comments from stakeholders on our percentage estimates detailed, below, which will inform the split between vertical and horizontal track variable usage costs.

VTISM	**Estimated surface damage (%)**
Complete trax	0%
Complete trax with formation	0%
Complete HO	0%
Steel relay	0%
Heavy refurbishment (concrete)	0%
Heavy refurbishment (timber)	0%
Medium refurbishment (concrete)	0%
Medium refurbishment (timber)	0%
Rail renewal	33%
Single rail renewal	100%
S&C renewal	0%
S&C abandonment	0%
S&C heavy refurbishment	0%
S&C medium refurbishment	0%
Tamping	0%
Stoneblowing	0%
S&C tamping	0%
S&C stoneblowing	0%
Grinding	100%
SRSMM	
Maintenance delivery	0%
Weld Repair of Defective Rail	60%
Patrolling Track Inspection (Video) S&C	0%
Patrolling Track Inspection (Video) Plain Line	0%
Manual Ultrasonic Inspection - (S&C)	0%
Manual Ultrasonic Inspection - RCF	0%
Manual Ultrasonic Inspection - (Plain Line)	0%
Complete Treatment of S&C unit	0%
Track Inspection (Other)	0%
Train Grinding - S&C	100%
SandCTamping	0%
S&C Maintenance (Other)	0%
S&C Inspection (Other)	0%
S&C Renew Half Set of Switches	33%
Replacement of S&C Bearers	0%
S&C Arc Weld Repair	33%
Stoneblowing	0%
SandCStoneblowing	0%
Maintenance of Rail Lubricators	100%
Rail Changing - Jointed Rail - Renew Due to Wear	33%

Rail Changing - Jointed Rail - Renew (Defects)	33%
Rail Changing - CWR - Renew Due to Wear	33%
Rail Changing - CWR - Renew (Defects)	33%
Rail Changing - Al-Thermic Weld - Standard Gap	33%
PWAY Other	0%
Tamping	0%
Replacement of Pads & Insulators	0%
Manual Spot Re-sleepering (Wood / Steel)	0%
Manual Spot Re-sleepering (Concrete)	0%
Mechanical Wet Bed Removal	0%
Mechanical Spot Re-sleepering	0%
Mechanised Patrolling Track Inspection	0%
Mechanical Reprofiling of Ballast	0%
Manual Wet Bed Removal	0%
Transportation of Materials (To/From Site)	0%
Manual Rail Grinding	100%
Manual Reprofiling of Ballast	0%
Rail Lubricators Install / Remove	100%
Maintenance of Longitudinal Timber	0%
Lift & Replace Level Crossing for PWAY	0%
Level 1 Patrolling Track Inspection	0%
Installation of Pre-Fabricated IRJs	0%
Jointed Track Hot Weather Preparation	0%
Manual Correction of PL Track Geometry (CWR)	0%
CWR - Stressing	0%
S&C - renew crossing	0%
Replenishment of Ballast Train	0%
Replenishment of Ballast Manual	0%
NDS delivery	0%
SandCGrinding	100%
Grinding	0%
Offtrack	0%
Vegetation	0%
Level Crossings Management (Off Track)	0%
Inspections (Level Crossing - Access Points)	0%
Inspections (Fencing, Vegetation, Drainage)	0%
Fences and Boundary Walls	0%
Drainage	0%
Spoil & Debris Clearance Outside Station Area	0%

APPENDIX 3 – REVIEW OF SURFACE DAMAGE FORMULA

Review of surface damage VTAC formula

Mark Burstow
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19 December 2012

Introduction

A review of the surface damage component of the vehicle variable track access charge (VTAC) has been undertaken to propose how it can be revised for CP5. The methodology currently used was proposed by TTCI[1]. It is considered that this methodology is broadly sound, but particular aspects of the calculation process have been examined and considered for revision. The basic process to determine the surface damage component of the VTAC associates each vehicle with a 'curving class' which is a measure of the vehicle's 'track friendliness' with regard to tangential forces generated in the contact patch: these are the forces responsible for rail wear and rolling contact fatigue (RCF). In the current methodology these forces are determined for a range of curves representing those existing in the GB network (Appendix 1) and, for each curve radius, the forces are used to determine a measure of the wear and RCF damage generated by the vehicle. These measures of damage are then converted to a cost and weighted by the proportion of curves of that radius on the national network (Appendix 1). These costs are then summed to provide a national average cost per vehicle mile of operation of the vehicle.

The wheel/rail forces used as a fundamental input to the calculations must be derived from vehicle dynamics simulations of the vehicle operating over each curve, and these can be obtained from either a full simulation of the actual vehicle or from a 'look-up' table of pre-calculated values for a range of vehicles: in that case the vehicle must be approximated by the vehicle with characteristics closest to it in the existing table (based on vehicle mass and primary yaw stiffness).

This review has considered three aspects of the surface damage charging methodology and the process that is used to derive the charges: 1) the damage cost calculation equations, 2) the friction coefficient assumed at the wheel/rail interface when determining the wheel/rail forces, and 3) the level of average track alignment 'quality' assumed when determining the wheel/rail forces.

Analysis

1. Damage cost calculations

Rail surface damage can be considered to contribute to two areas of cost: rail grinding and rail renewal. The main mechanisms contributing to these costs are wear and rolling contact fatigue (RCF). The current CP4 model was developed on the premise that rail wear triggered rail renewal and RCF triggered grinding. Rail grinding was considered to contribute to wear of the rail (through additional material removal from the rail), so RCF had an indirect impact on renewal costs. In practice this model can be considered deficient since a) rail grinding is programmed to be undertaken at fixed intervals, based on the traffic carried by a route, and b) rail renewal/replacement is undertaken due to RCF damage directly as well as rail wear.

This review of damage costs uses the main inputs as those used in the CP4 and a similar methodology: RCF and wear are driven by contact patch forces ($T\gamma$) derived from vehicle dynamics simulations and the damage calculations are weighted by the distribution of curves over the GB network, and this distribution is assumed to be the same as that used in CP4 (Appendix 1). The proposed methodology is divided into three sections: grinding costs, RCF costs and wear costs, and the total costs, *C*, per vehicle mile can be expressed as:

$$C = C_G + C_D + C_W \qquad (1)$$

a) Grinding costs, C_G

The frequency of rail grinding is specified in the Network Rail standard[1], and varies by location according to track curvature. These are summarised in Table 1.

Curve radius (m)	Grinding frequency (MGT)
≤2500	15
>2500	45

Table 1: Grinding frequencies according to curve radius

Appendix 1 gives the track curvature histogram, *H*(*R*), which is currently used in the VTAC calculator, and ∑*H*(*R*) is the total track mileage. Using this histogram an expression can be obtained for the proportionate contribution of a vehicle with mass, *M* (tonnes), to the total requirement for grinding per mile of the network:

$$G = \frac{M}{15\times10^6}\left[\frac{\sum H(R)_{R\le2500}}{\sum H(R)} + \frac{1}{3}\frac{\sum H(R)_{R>2500}}{\sum H(R)}\right] \qquad (2)$$

Knowing the cost of grinding, G_c, per mile of route then equation (1) can be used to determine the contribution to the grinding programme, C_G, for a vehicle with mass, *M,* per mile:

$$\begin{aligned} C_G &= G_c G \\ &= G_c \frac{M}{15\times10^6}\left[\frac{\sum H(R)_{R\le2500}}{\sum H(R)} + \frac{1}{3}\frac{\sum H(R)_{R>2500}}{\sum H(R)}\right] \end{aligned} \qquad (3)$$

b) RCF costs per curve, $C_D(R)$

Using the whole life rail model[2], which is the same model used to describe RCF crack formation in the CP4 charging model, it is possible to relate wheel/rail forces (parameterised by contact patch energy, $T\gamma$) to RCF damage by a function $D(T\gamma)$:

$$D(T\gamma) = \begin{cases} \left(\dfrac{T\gamma - 15}{50}\right)\times10^{-5} & 15 \le T\gamma < 65 \text{ J/m} \\ \left(\dfrac{175 - T\gamma}{110}\right)\times10^{-5} & 65 \le T\gamma < 175 \text{ J/m} \\ 0 & T\gamma < 15,\ T\gamma > 175 \text{ J/m} \end{cases} \qquad (4)$$

RCF damage is accumulated by summing the increments of $D(T\gamma)$ associated with each axle pass, and the rail requires replacement when $D(T\gamma)=D_{limit}$. At that point the depth of the crack below the surface is assumed to be 5mm. If it assumed that crack growth is linear throughout its life then it is possible to determine the incremental amount of crack growth from each axle pass, D_{inc}, from:

$$D_{inc} = 5\frac{D(T\gamma)}{D_{limit}} \text{ mm} \qquad (5)$$

The depth of RCF cracks can be reduced (or eliminated if the growth rate is slow enough) with grinding, so a vehicle's contribution to crack growth needs to be reduced by its contribution to the need for grinding (equation (2)). If it is assumed that grinding removes G_{depth} of material from the surface, then a vehicle's contribution to crack growth (mm) can be described by

$$D_{inc} = 5\frac{D(T\gamma)}{D_{limit}} - G_{depth} \times 10^{-6} \times \begin{cases} \frac{M}{15} & \text{for } R \leq 2500m \\ \frac{M}{45} & \text{for } R > 2500m \end{cases} \text{ mm} \qquad (6)$$

If rail is replaced when then total RCF depth reaches 5mm, then the proportion of cost of rail replacement, C_R, associated with each axle pass, using equation (6) can be found from

$$C_D(R) = R_c \times \frac{D_{inc}}{5}$$

$$= R_c \left[\frac{D(T\gamma)}{D_{\lim it}} - \left(\frac{G_{depth}}{5} \times 10^{-6} \times \begin{cases} \frac{M}{15} & \text{for } R \leq 2500m \\ \frac{M}{45} & \text{for } R > 2500m \end{cases} \right) \right] \qquad (7)$$

c) Wear costs per curve, $C_W(R)$

The wear function, which is also a function of contact patch energy ($T\gamma$), is assumed to increase linearly with contact patch force. The relationship between wear and contact patch force can be derived from the RCF relationship. The wear relationship increases linearly from Tg=65 as it then starts to reduce the effect of RCF, until at Tg=175 it is equal to the rate of RCF growth. Therefore, a wear function, $W(T\gamma)$, can be written as

$$W(T\gamma) = \begin{cases} 0 & T\gamma < 65 \\ T\gamma - 65 & 65 \leq 65 \end{cases} \qquad (8)$$

To convert equation (8) into a wear rate the wear function can be scaled from the RCF damage function at the location where wear is assumed to equal the crack growth rate.

$$W_{inc} = \frac{16}{550} W(T\gamma) \times 10^{-5} \text{ mm} \qquad (9)$$

The cases where the wear rate will be predicted to be the greatest will be those where the wheel flange is in contact with the rail. In this case the contact point should be lubricated (which is assumed in the simulations by reducing the coefficient of friction for flange contact). This has the effect of not only reducing the wheel/rail forces but also reducing the wear rate of the rail due to the presence of the lubricant. A wear rate factor, W_{fact}, is therefore introduced to recognise that the actual wear rate in flange contact should be lower than that predicted due to the presence of lubricant. Since it would be too complex to apply this to only flange contacts in equation (9) it is assumed that it is applied in all cases: the wear rate when not in flange contact is generally low so the error introduced is relatively small. This changes equation (9) to become

$$W_{inc} = \frac{16}{550}\frac{W(T\gamma)}{W_{fact}} \times 10^{-5} \text{ mm} \qquad (10)$$

The limit for rail headwear, W_{limit}, is the depth of material lost at which point the rail should be replaced. The cost of wear, C_W, can therefore be found from:

$$C_W(R) = \frac{R_C}{W_{limit}} W_{inc}$$
$$\frac{16}{550} R_C \frac{W(T\gamma)}{W_{limit} W_{fact}} \times 10^{-5} \qquad (11)$$

Total cost, *C*. Equations (3), (7) and (11) provide descriptions of the costs due to grinding, RCF and wear; but the equations (7) and (11) only provide the costs per mile of a curve. To determine the charges per mile of the GB network it is necessary to weight the charges for RCF and wear (equations (7) and (11)) according to the distribution of curves ($H(R)$) as used in equation (3). Equation (1) can therefore be re-written as

$$C = C_G + \frac{H(R)\left[C_D(R) + C_W(R)\right]}{\sum H(R)} \qquad (12)$$

where $C_D(R)$ and $C_W(R)$ are evaluated from equations (7) and (11) for each curve radius, R, in the histogram $H(R)$.

Vehicle dynamics simulations must be used to determine the $T\gamma$ values for each curve in the histogram (Appendix 1). Outputs should be obtained from both the leading and trailing wheelsets since both wheelsets cause wear and damage.

Example charges using the above methodology (equation (12)) are given in Table 2 compared to the surface damage charges from the existing methodology. However, these charges have been evaluated using the $T\gamma$ values in the existing charging spreadsheet: these values may change as a result of the improvements to the methodology which are a separate part of this review. These figures should therefore only be used as indicative and as a comparison to the existing methodology.

Curving class	CP4 surface damage (p/vehicle mile)	Proposed CP5 process (p/vehicle mile)			
		Grinding component	RCF component	Wear component	Total
Coach_12_40	1.46	0.49	0.58	0.23	1.29
Coach_48_50	3.60	0.61	1.65	1.27	3.54
Coach_128_50	4.15	0.61	1.96	1.52	4.08
Class 66	0.84	1.55	0.08	1.14	2.77
Loco2_50	10.92	0.61	1.60	8.84	11.05
3piece_empty	0.95	0.33	0.18	0.22	0.73
3piece_loaded	4.52	1.24	1.31	4.11	6.66
Y25_empty	0.54	0.33	0.22	0.06	0.61
Y25_loaded	0.90	1.24	0.31	0.35	1.91

Table 2: Comparison of current and proposed surface damage costs for a range of vehicles

2. Friction coefficients

The friction coefficient for the flange contact should be set to 0.1 and for the tread should be 0.4, for both the left and right wheels. The effect of the friction coefficient is shown in Figures 1 and 2 below, which compares the contact patch force predictions with this proposed friction coefficient with those used currently in the CP4 methodology for two passenger vehicles with different yaw stiffnesses. In both cases the friction coefficient only affects the forces on the tightest radius curves and reduces the maximum forces being generated. Within the charging model this will have the impact of reducing the costs associated with tighter radius curves because less wear will be generated.

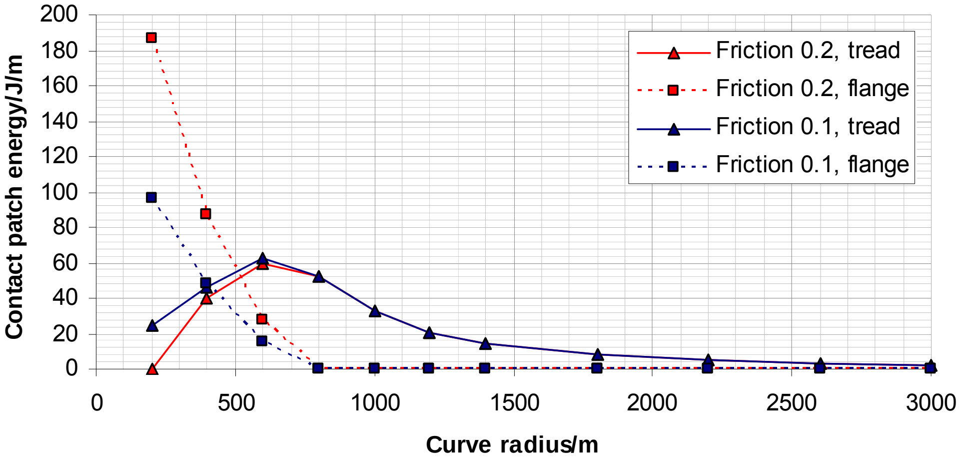

Figure 1: Variation in contact patch forces on a range of curves, for the tread and flange contact, for a passenger vehicle with a primary yaw stiffness of 16MNm/rad with the original and new proposed flange friction coefficient

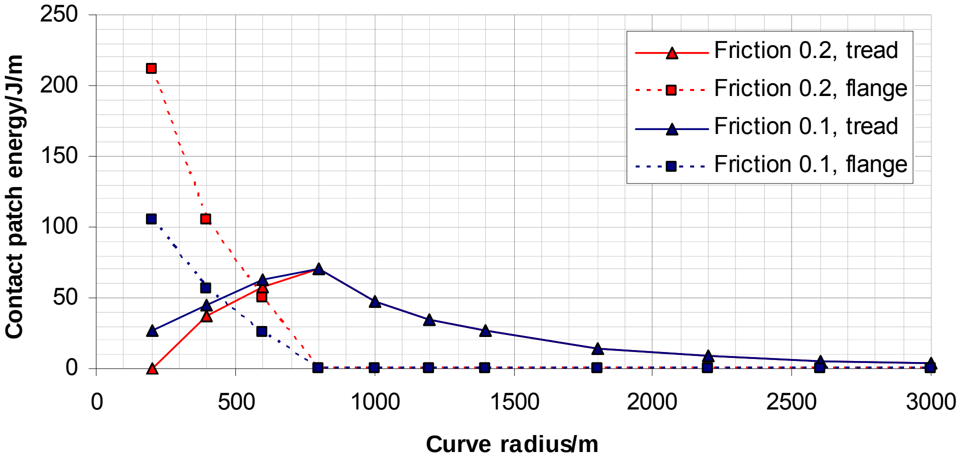

Figure 2: Variation in contact patch forces on a range of curves, for the tread and flange contact, for a passenger vehicle with a primary yaw stiffness of 48MNm/rad with the original and new proposed flange friction coefficient

However, it is considered that this change is appropriate to better reflect the conditions that should exist on curves which are lubricated.

3. Track quality

The methodology used in CP4 uses quasi-static vehicle behaviour to determine the wheel/rail forces. In other words, this assumes that each curve is perfectly circular. In reality all track contains some short wavelength variations in lateral and vertical alignment: track irregularities, of varying magnitudes. These can have the effect of slightly increasing the wheel/rail forces and can be the initiation sites if RCF defects of localised increases in wear. It is therefore considered appropriate to include some ‘real’ track geometry into the assessment. The use of real track irregularity also assists the vehicle dynamics simulation since, in some cases on perfectly aligned track, the friction components of the models can give unrealistic outputs. Using track alignment data helps to release ‘locked-in’ forces in some suspension designs in the modelling process.

The track alignment file that is proposed is a standard track alignment file provided with the Vampire vehicle dynamics package and is referred to as ‘track160.dat’. This file contains realistic track alignment data for ‘typical’ track for 100mph running. This file has been used in all simulations for all vehicles. The average value of $T\gamma$ is still obtained from the simulations (as used previously), and in many cases the results will be very similar to those obtained from the quasi-static analysis used previously.

Figures 3 and 4 show typical results from two passenger vehicles: one with a soft suspension and one with a stiff suspension. These show that, for both vehicles, the maximum average wheel/rail forces on the curves in the 500-600m range a slightly reduced. However, on shallow radius curves (2-3000m radius) the vehicle with the stiff suspension generates higher forces than soft suspension, the results for which are very similar to those from the quasi-static case. This reflects the higher propensity for generating clusters of RCF on shallow and straight track associated with stiff suspensions, and therefore better reflects the observed link between vehicle suspension characteristics and track damage. This is further illustrated in Figures 5 and 6 which compares the results from the same vehicle when the wheel/rail forces are converted to the RCF damage index and weighted according to the curve histogram for the network (Appendix 1).

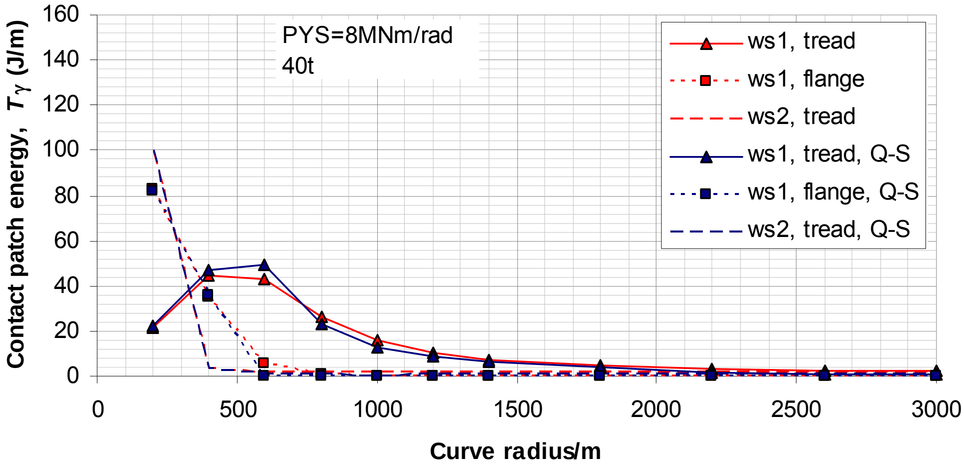

Figure 3: Variation in contact patch forces on a range of curves, for the tread and flange contact, for a passenger vehicle with a soft primary yaw stiffness comparing the effect of including or excluding (i.e. quasi-static, Q-S) the effect of track alignment irregularities

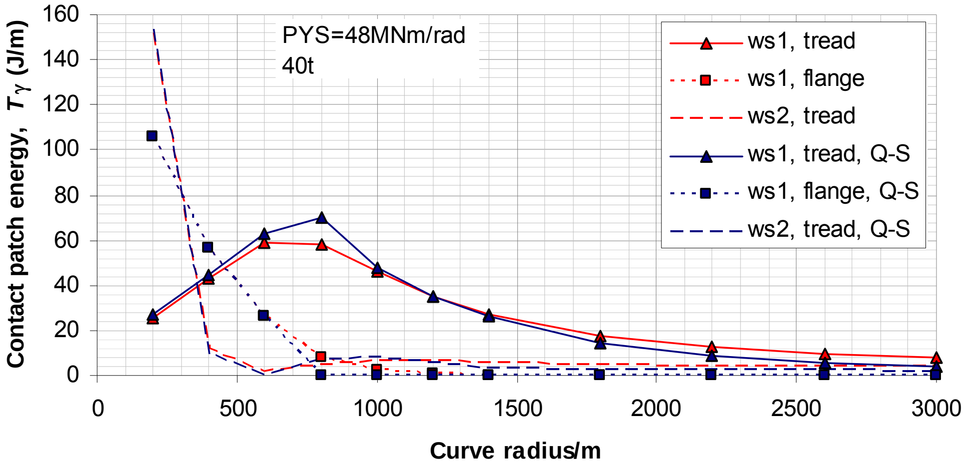

Figure 4: Variation in contact patch forces on a range of curves, for the tread and flange contact, for a passenger vehicle with a stiff primary yaw stiffness comparing the effect of including or excluding (i.e. quasi-static, Q-S) the effect of track alignment irregularities

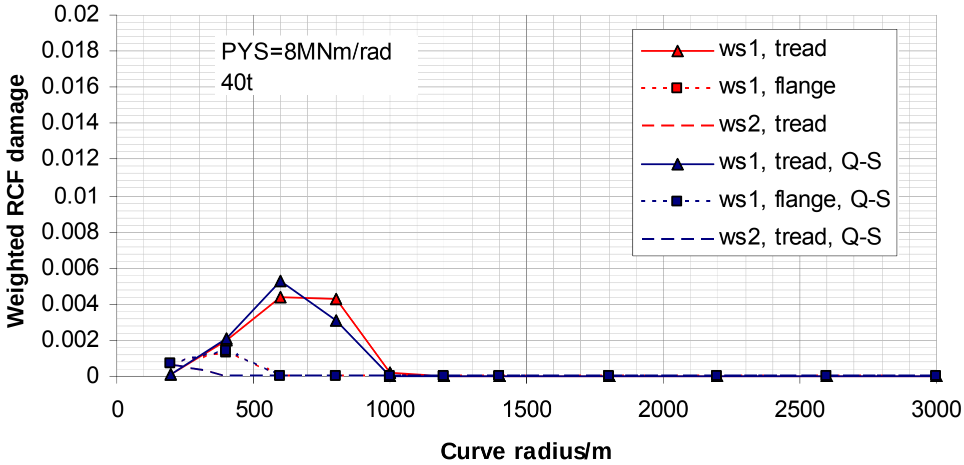

Figure 5: Weighted distribution of RCF damage index for a passenger vehicle with a soft primary yaw stiffness comparing the effect of including or excluding (i.e. quasi-static, Q-S) the effect of track alignment irregularities

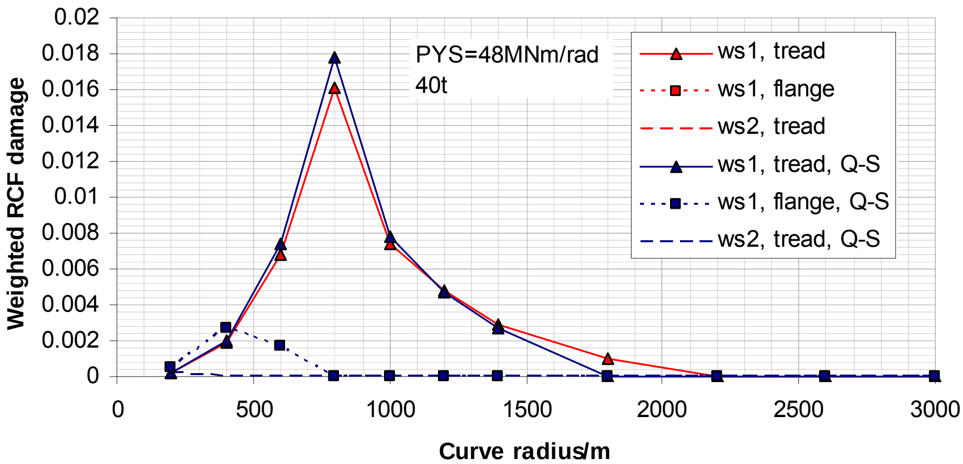

Figure 6: Weighted distribution of RCF damage index for a passenger vehicle with a stiff primary yaw stiffness comparing the effect of including or excluding (i.e. quasi-static, Q-S) the effect of track alignment irregularities

Examples

The methodology developed above has been applied to an initial selection of vehicles to indicate the effect that these changes may have on the surface damage component of the VTAC for these vehicles. However, these calculations cannot be directly compared with those from the CP4 VTAC calculator because the new damage function requires recalibration to the agreed total surface damage cost. This recalibration cannot be undertaken until vehicle dynamics simulations have been undertaken to recalculate the curving classes with data for the adjusted friction coefficients and the track alignment data.

The results of the calculations with the new methodology are shown in Table 5, with a breakdown of the charges into grinding, RCF and wear components so that the distribution of charges can be seen.

These calculations differ from the CP4 in a number of ways:

5. They use the new damage calculation methodology developed above which incorporates separate components for grinding, RCF and wear;
6. In the vehicle dynamics simulations the coefficient of friction on the flange is reduced to 0.1 to reflect better flange lubrication
7. Sample track alignment variations (typical of 100mph track) have been assumed in all cases to generate more realistic vehicle responses to track features
8. Values of $T\gamma$ for the trailing wheelset of a bogie have also been included since research has shown that, on tight radius curves, this wheelset can causes significant RCF damage to the low rail of curves[3].

Curving class	CP4 surface damage (p/vehicle mile)	Proposed CP5 process (p/vehicle mile)			
		Grinding component	RCF component	Wear component	Total
Coach_8_30	0.57	0.41	0.31	0.06	0.78
Coach_12_40	1.46	0.54	0.70	0.11	1.36
Coach_80_50	3.99	0.68	1.31	1.58	3.57
Pacer_10	0.94	0.42	0.16	0.49	1.07
Loco2_50	10.92	1.09	0.00	5.51	6.60
Y25_empty	0.54	0.29	0.71	0.05	1.04
Y25_loaded	0.90	1.12	0.00	1.28	2.40

Table 3: Comparison of current and proposed surface damage costs for a selection of passenger vehicles

Figure 7 shows how the new charging formula varies with primary yaw stiffness (PYS) for a selection of 40t passenger vehicles. The results for this sample of vehicles shows that there is a not a significant change in the surface damage costs for each vehicle. However, where the CP4 method shows the rate of increase in charges reducing at higher yaw stiffness (there is a small gap between Coach_48_40 and Coach_100_40 than between Coach_8_40 and Coach_16_40) the results for the new methodology are more linear.

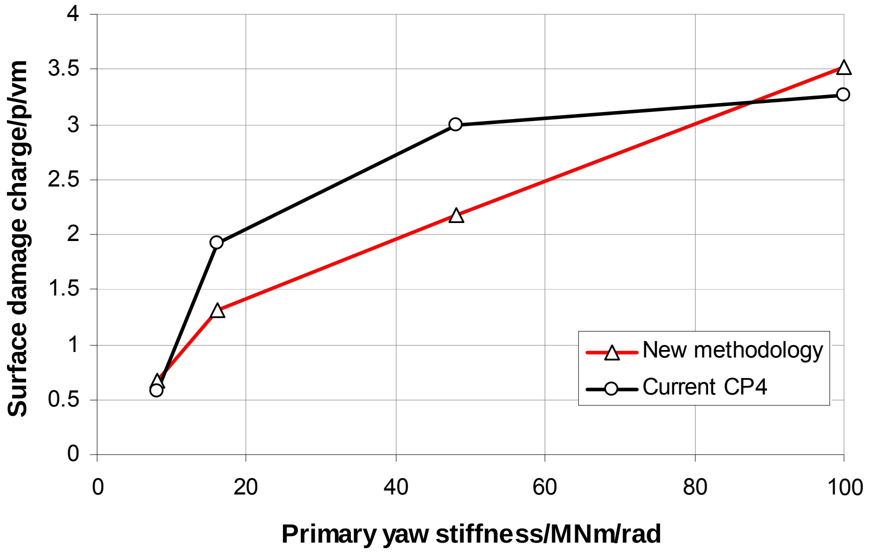

Figure 7: Comparison of surface damage charge for current and proposed methodology for different vehicle yaw stiffnesses

References

1. NR/L2/TRK/001/mod10, Inspection and maintenance of permanent way, Rail profile management, Issue 5, September 2012
2. M. C. Burstow (2003) *Whole life rail model application and development for RSSB- Development of an RCF damage parameter*, AEA Technology Rail report, October 2003
3. M. Burstow and S. Robinson (2007) *Management and understanding of rolling contact fatigue (RCF) damage on the low rail of curves*. Proceedings of Railway Engineering- 2007, London, 20th-21st June 2007

Appendix 1: Track curvature histogram for the GB network

Table showing track curvature histogram for GB network used in the CP4 VTAC calculator, from "*User guide for Network Rail variable usage charging model*, TTCI (UK) report NR 07-007, 5 October 2007"

Radius (m)	Track kilometres
0 – 300	83
301-500	334
501-700	778
701-900	1879
901-1100	1193
1101-1300	1193
1301-1600	1193
1601-2000	1885
2001-2400	1718
2401-2800	1718
2801-3500	1718
3501-5000	4294
5001-7000	0
7001-9000	0
9000-11000	0
11000 +	11110
Totals	29096

Appendix 2: Unit costs

Parameter	Symbol	Value	Description
Grinding cost	G_c	£2,000/km	Cost to grind 1 km of track
Renewal cost	R_c	£250,000/km	Cost to renew 1 km of track (one rail)
RCF damage limit	D_{limit}	20	Magnitude of RCF damage function at which rail replacement is required
Grinding depth	G_{depth}	0.5mm	Depth of material removed due to grinding
Wear limit	W_{limit}	10mm	Wear depth at which rail replacement is required
Lubricated wear rate	W_{fact}	5	Reduction in wear rate due to lubrication

APPENDIX 4 – VEHICLE CHARACTERISTICS

As discussed in Chapter 5 vehicle characteristics are important inputs into the CP5 VUC model. The more accurate the vehicle characteristics used in the VUC model the more accurate the allocation of variable usage costs to individual vehicles.

Attached to the email accompanying this consultation is a spreadsheet containing a draft list of vehicle characteristics which, following this consultation, we propose using as inputs into the CP5 VUC model. We are grateful for comments already received and would welcome any further comments on the vehicle characteristics set out in the attached spreadsheet and invite you to provide revised characteristics, with supporting evidence, where you consider that they should be refined. The freight and passenger vehicle characteristics are in the tabs labelled “freight” and “passenger” respectively.

We would also welcome comments on the draft mapping of the relevant vehicle types to mark 1, 2, 3 and 4 coaches. In CP4, an average rate was derived for each of the classes of coach (1, 2, 3 and 4) and this rate was charged to the different variants of coach within each class. We propose retaining this approach for CP5 and, therefore, would welcome comments on the draft mapping set out in the spreadsheet attached to the cover email accompanying this consultation. The draft mappings are shown in the tabs “freight mapping” and “passenger mapping” for freight and passenger vehicles, respectively.

To help facilitate the review of the vehicle characteristic information we have defined, below, each of the column headings in the attached vehicle characteristics spreadsheet. For the avoidance of doubt, the vehicle characteristics which we propose using in the CP5 VUC model, and which we would welcome comments on, are:

- Vehicle operating weight (freight only);
- Tare weight including passengers (passenger only);
- Maximum speed (passenger only);
- Operating speed;
- Axles;
- Un-sprung mass;
- Suspension band (freight only); and
- Curving Class.

We have included additional information in the attached spreadsheet (e.g. vehicle mileage and whether it was included on the CP4 price list) for context but this information is not relevant to VUC rates in CP5. As noted above, we would also welcome comments on the draft mapping of the relevant vehicle types to mark 1, 2, 3 and 4 coaches.

On CP4 price list

This indicates if the vehicle is on the CP4 price list[25].

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[25] Available at: http://www.networkrail.co.uk

Laden

This indicates if the vehicle is laden or tare and is only applicable to freight vehicles.

NR Reporting Commodity Name

This indicates what commodity the vehicle is transporting and is only applicable to freight vehicles.

Vehicle Actual Mileage SUM

This is the total vehicle mileage based on actual data from TABS for the 2011/12 financial year. This provides some context in relation to the extent to which the vehicle has been used on the network. Materiality would suggest that effort should be directed towards validating the characteristics of the vehicles currently with material mileages or that are forecast to travel material mileages in CP5.

Vehicle KGTM SUM

Vehicle KGTM is the total number of thousand gross tonne miles travelled based on actual data from TABS for the 2011/12 financial year. Unlike vehicle mileage, these values take account of the weight of the load being transported.

Customer Type

This confirms whether the vehicle movement is associated with a franchised passenger operator (TOC) or an open access operator (OAO).

Vehicle operating weight (calculated)

This is the estimated ‘operating weight’ of the vehicle (i.e. the typical weight at which it usually operates on the network, rather than the gross laden weight) and is only applicable to freight vehicles. This has been calculated based on the actual vehicle mileage and actual vehicle KGTM from TABS in 2011/12 using the following formula:

$$operatingweight = \frac{VehicleKGTMSUM}{VehicleActualMileageSUM} \times 1000$$

Tare weight (tonne) including passengers

This is the tare weight of the vehicle plus a nominal value to reflect the weight of passengers. The assumption is the same as in PR08 and assumes 70kg per passenger seat for non-intercity services and 80kg per passenger seat for intercity services (reflecting the increased likelihood of luggage also being transported). Intercity services are defined as those with dedicated luggage space. This is only applicable to passenger vehicles.

Speed (m/hr)

Freight

The sets out the estimated operating speed for each vehicle class. In CP4 a freight vehicles operating speed was estimated based on the commodity being transported.

The speeds used for the different commodity types in CP4 are set out in the table, below.

Commodity	Average laden operating speed (mph)	Average unladen operating speed (mph)	Average locomotive operating speed (mph)
Domestic Automotive	46	47	46.5
Domestic Intermodal	46	47	46.5
European Automotive	46	47	46.5
European Intermodal	46	47	46.5
Coal ESI	32	41	36.5
Iron Ore	32	41	36.5
Mail and Premium Logistics	67	67	67
Royal Mail	67	67	67
Chemicals	35	41	38
Coal Other	35	41	38
Construction Materials	35	41	38
Domestic Waste	40	50	45
Engineering Haulage	35	41	38
Enterprise	40	50	45
European Conventional	40	50	45
General Merchandise	40	50	45
Industrial Minerals	35	41	38
Non Reportable	35	41	38
Other	35	41	38
Petroleum	35	41	38
Steel	35	41	38
Biomass	35	41	38

As set out in Chapter 5, based on information from the Working Timetable, we have reviewed the continued appropriateness of these speeds. For CP5, we propose basing freight VUC rates on updated operating speed information derived from the Working Timetable and adjusted such that it excludes 'stopping time'. The revised values are set out in the table, below:

Commodity	CP5 Average Speed (mph)	CP5 Average Speed excluding 'stopping time' (mph)	CP4 speed (mph)	
			Laden	Empty
Coal (other)	22	25	35	41
Iron Ore	22	25	32	41
Steel	22	25	35	41
Domestic Waste	21	24	40	50
Construction Materials	26	29	35	41
Petroleum	20	23	35	41
Coal (ESI)	21	24	32	41
European Intermodal	33	38	46	47
Domestic Automotive	22	25	46	47
European Automotive	27	31	46	47
Industrial Minerals	16	18	35	41
General Merchandise	26	30	40	50
Royal Mail	69	78	67	67
Mail and Premium Logistics	69	78	67	67
Domestic Intermodal*	33	38	46	47
Engineering haulage*	16	18	35	41
Enterprise*	26	30	40	50
European Conventional*	26	30	40	50
Other*	21	24	38	41
Biomass*	21	24	35	41
Chemicals	14	16	35	41

* Operating speed estimated based on commodity mapping

Passenger

For passenger vehicles, a 'maximum speed (m/hr)' and an 'operating speed (m/hr)' are included in the vehicle characteristic spreadsheet attached to the cover email accompanying this consultation. The maximum speed is the maximum unconstrained speed that the vehicle is capable of operating at. This information can be obtained from TOPS.

However, it is the 'operating speed (m/hr)' value that is used as an input for charging purposes (i.e. we do not assume that vehicles operate continuously at their maximum speed). The operating speed is designed to reflect the typical speed at which each vehicle class operates at. In CP4 these values were estimated formulaically based on maximum speed using the, below, formula or input manually as distance based averages.

$$S_{Op} = 0.021 * S_{Max}^{1.71}$$

where,
S_{Op} is the operating speed (miles/hour)
S_{Max} is the maximum speed (miles/hour)

As noted in Chapter 5, above, for CP5, we propose that the default approach should be that passenger operating speeds are estimated using the existing CP4 formula. However, if based on timetable information as described, above, an operator is able to demonstrate than an alternative operating speed would be more appropriate, we would accept this for charging purposes. If an operator wishes to provide analysis of the timetable and propose an alterative operating speed, they should do so in response to this consultation. This should provide us with sufficient time to review the information and incorporate it, where appropriate, into the proposed CP5 VUC price list that we will publish at the end of March 2013.

Axles

This sets out the number of axles that the vehicle has. The information can be obtained from TOPS.

Un-sprung mass

Un-sprung mass (USM) reflects the weight of the axle and any attachments to it which are below the vehicle's suspension. We are not able to access this information and thus it has previously been provided by the train operator, vehicle manufacturer or rolling stock leasing company.

Suspension band

This is only applicable to freight vehicles and indicates the 'suspension band' that the freight vehicle has been allocated to. The bands are designed to reflect the relative 'track friendliness' of the different suspension types and thus there is a discount / premium associated with each band. In CP4 freight vehicles were allocated to suspension bands based on the description in the table, below:

Suspension band	Wagon types	Suspension factor
1	4-wheel wagon with pedestal type suspension	1.098
2	4-wheel wagon having leaf springs, friction damped	1.058
3	Bogie wagon with three piece bogie	1.018
4	Bogie wagon with enhanced three piece bogie e.g. "swing motion", and parabolic 4-wheel wagon	0.978
5	Basic bogie wagon with primary spring e.g. Y25	0.938
6	Bogie wagon with enhanced primary springs – low track force bogies, TF25, "axle motion" (like HV primary sprung bogies)	0.898
7	Bogie wagon with enhanced primary springs and steering	0.858

However, following a request from ORR, for CP5, we have developed a revised quantitative methodology for allocating vehicles to suspension bands based on their 'Ride Force Count'. More information in relation to this methodology is available on our website[26].

This methodology will be applied to all new vehicles in CP5. However, it is also available for existing freight vehicles if operators choose to 'opt in'. As set out in our proposal letter, and confirmed in ORR's decision letter, operators have until 28 February 2013 to 'opt in' and calculate revised suspension factors using the new approach.

[26] Available at: Periodic review 2013

Curving Class

Curving class is an artificial classification that has been developed as a measure of relative horizontal track damage for each vehicle class. A freight vehicle's curving class is based on its suspension band. Curving class is calculated separately for laden and tare vehicles. The existing mapping between suspension band and curving class is set out below:

Suspension band	Curving class
1	2axle
2	2axle
3	3piece
4	NACO
5	Y25
6	Y25

Passenger vehicles are allocated to a curving class based on primary yaw stiffness (PYS) and weight. For example, the curving class "Coach_50_60" indicates that the vehicle has a primary yaw stiffness of approximately 50 MNm/rad and a weight of approximately 60 tonnes.

As noted above, this review affords the industry the opportunity to revise existing and introduce new curving classes in order to make the surface damage component of the VUC more cost reflective in CP5. However, in order to do this we would require access to the relevant tare and laden vehicle dynamics models. We request that freight vehicle owners/operators assist us by providing access to better models of freight vehicles so that more reliable definitions of the curving classes can be generated for CP5.

APPENDIX 5 – FREIGHT OPERATING SPEED DATA

B0 - Coal (Other) And Nuclear

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	3	036G26	349.85	25.17	116.62	75.51
DB Schenker	3	086G25	347.00	25.33	115.67	75.99
DB Schenker	1	086R25	25.73	18.82	25.73	18.82
DB Schenker	1	096F42	118.35	14.40	118.35	14.40
DB Schenker	5	356C40	589.26	18.51	117.85	92.55
DB Schenker	2	356F40	12.03	6.33	6.01	12.66
DB Schenker	6	796B05	152.55	14.96	25.43	89.74
DB Schenker	2	796B15	23.20	29.00	11.60	58.01
DB Schenker	1	796B54	13.36	27.65	13.36	27.65
DB Schenker	7	796G05	196.00	15.70	28.00	109.91
DB Schenker	5	796O70	74.56	14.43	14.91	72.16
DB Schenker	3	796O71	44.74	22.94	14.91	68.83
DRS	1	046M50	145.50	31.07	145.50	31.07
DRS	2	096C22	107.29	24.76	53.65	49.52
DRS	2	096S43	262.23	34.96	131.12	69.93
DRS	1	106C42	53.65	26.82	53.65	26.82
DRS	4	106C46	214.59	27.05	53.65	108.20
DRS	2	106C51	129.82	30.43	64.91	60.85
DRS	2	106K73	275.25	32.77	137.62	65.54
DRS	2	107C20	11.50	20.29	5.75	40.59
DRS	3	107C21	17.25	17.25	5.75	51.75
DRS	3	116C52	202.01	20.30	67.34	60.91
DRS	2	426C53	271.90	39.22	135.95	78.43
DRS	1	426C53	143.23	35.08	143.23	35.08
DRS	1	426O62	234.26	29.65	234.26	29.65
DRS	1	726K51	155.10	33.47	155.10	33.47

DRS	2	816M67	368.20	24.49	184.10	48.98
DRS	1	896M95	86.00	25.54	86.00	25.54
Totals	69					1532.56

Average weighted speed
22.21

B1 - Metals

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	1	076E30	194.89	22.66	194.89	22.66
DB Schenker	2	076E30	389.79	22.49	194.89	44.98
DB Schenker	8	146N27	89.21	21.58	11.15	172.67
DB Schenker	1	146N27	11.15	20.91	11.15	20.91
DB Schenker	1	156D11	104.87	23.39	104.87	23.39
DB Schenker	2	156D97	209.74	24.02	104.87	48.03
DB Schenker	1	156D97	120.55	21.03	120.55	21.03
DB Schenker	2	156J71	184.69	26.14	92.34	52.27
DB Schenker	1	156J72	90.66	21.33	90.66	21.33
DB Schenker	4	156N52	7.20	9.00	1.80	36.01
DB Schenker	4	156N93	7.20	7.72	1.80	30.87
DB Schenker	1	156S58	42.45	16.59	42.45	16.59
DB Schenker	1	156S58	192.08	25.50	192.08	25.50
DB Schenker	1	156S58	192.08	25.44	192.08	25.44
DB Schenker	1	156V02	306.02	31.44	306.02	31.44
DB Schenker	1	156V49	305.02	24.78	305.02	24.78
DB Schenker	1	206J27	32.66	19.03	32.66	19.03
DB Schenker	2	216J03	115.76	26.21	57.88	52.42
DB Schenker	2	216M99	295.31	17.93	147.65	35.87
DB Schenker	4	216T18	76.75	18.57	19.19	74.28

DB Schenker	5	216T19	95.94	19.85	19.19	99.25
DB Schenker	5	216T20	95.94	20.93	19.19	104.66
DB Schenker	5	216T21	95.94	20.93	19.19	104.66
DB Schenker	2	216T22	38.38	19.85	19.19	39.70
DB Schenker	6	216T23	115.13	19.51	19.19	117.08
DB Schenker	7	216T24	134.32	21.72	19.19	152.06
DB Schenker	5	216T25	95.94	19.51	19.19	97.57
DB Schenker	8	216T27	153.51	22.14	19.19	177.13
DB Schenker	4	216T28	76.75	21.72	19.19	86.89
DB Schenker	4	216T29	76.75	21.72	19.19	86.89
DB Schenker	4	216T30	76.75	19.85	19.19	79.40
DB Schenker	1	216T30	19.19	16.93	19.19	16.93
DB Schenker	4	216T31	76.75	19.19	19.19	76.75
DB Schenker	7	226K18	137.90	22.30	19.70	156.12
DB Schenker	6	226K19	118.20	22.73	19.70	136.39
DB Schenker	2	226K19	39.40	21.89	19.70	43.78
DB Schenker	3	226K20	59.10	22.30	19.70	66.91
DB Schenker	5	226K21	98.50	22.73	19.70	113.66
DB Schenker	4	226K22	78.80	21.89	19.70	87.56
DB Schenker	8	226K23	157.60	21.49	19.70	171.93
DB Schenker	8	226K24	157.60	21.49	19.70	171.93
DB Schenker	6	226K25	118.20	20.74	19.70	124.42
DB Schenker	5	226K26	98.50	22.73	19.70	113.66
DB Schenker	8	226K27	157.60	20.03	19.70	160.28
DB Schenker	6	226K28	118.20	18.76	19.70	112.57
DB Schenker	3	226K29	59.10	20.38	19.70	61.14
DB Schenker	2	226K30	39.40	21.89	19.70	43.78
DB Schenker	2	226K30	39.40	21.49	19.70	42.98
DB Schenker	4	226K31	78.80	22.73	19.70	90.93
DB Schenker	1	226N31	105.89	22.29	105.89	22.29
DB Schenker	1	226N38	105.89	23.27	105.89	23.27

DB Schenker	2	226N73	206.49	25.49	103.24	50.98
DB Schenker	8	246D61	62.31	7.92	7.79	63.37
DB Schenker	8	246J57	125.00	20.38	15.63	163.05
DB Schenker	2	246N75	197.54	20.87	98.77	41.73
DB Schenker	1	256D03	58.13	21.66	58.13	21.66
DB Schenker	1	256D03	58.13	21.53	58.13	21.53
DB Schenker	5	256D62	38.94	8.65	7.79	43.27
DB Schenker	1	256D94	34.78	18.14	34.78	18.14
DB Schenker	7	256J58	126.00	22.98	18.00	160.86
DB Schenker	1	256M87	96.30	24.48	96.30	24.48
DB Schenker	3	256V81	561.37	28.42	187.12	85.27
DB Schenker	1	256V81	187.12	28.35	187.12	28.35
DB Schenker	3	344V01	660.05	37.50	220.02	112.51
DB Schenker	1	366G72	114.04	18.39	114.04	18.39
DB Schenker	1	366G72	114.04	15.91	114.04	15.91
DB Schenker	1	396V75	187.02	24.29	187.02	24.29
DB Schenker	8	396V80	1,496.13	27.04	187.02	216.31
DB Schenker	2	516V47	477.82	10.13	238.91	20.26
DB Schenker	5	606V92	1,100.08	27.05	220.02	135.26
DB Schenker	1	656B07	16.91	23.59	16.91	23.59
DB Schenker	5	656E08	827.73	19.21	165.55	96.06
DB Schenker	8	656V05	1,120.13	21.21	140.02	169.72
DB Schenker	7	656V07	973.08	16.39	139.01	114.71
DB Schenker	2	656V61	280.03	23.34	140.02	46.67
DB Schenker	1	756B50	52.59	24.46	52.59	24.46
DB Schenker	1	756M73	214.61	30.95	214.61	30.95
DB Schenker	3	766B04	135.05	33.35	45.02	100.04
DB Schenker	1	766B04	45.02	32.54	45.02	32.54
DB Schenker	1	766B04	45.02	31.78	45.02	31.78
DB Schenker	4	766B49	209.65	19.41	52.41	77.65
DB Schenker	1	766B66	45.02	29.68	45.02	29.68

DB Schenker	1	766B90	8.91	17.25	8.91	17.25
DB Schenker	1	766F03	7.13	7.25	7.13	7.25
DB Schenker	1	766F04	6.13	4.72	6.13	4.72
DB Schenker	1	766H30	45.02	30.01	45.02	30.01
DB Schenker	1	766H32	45.02	32.94	45.02	32.94
DB Schenker	1	766H32	45.02	32.54	45.02	32.54
DB Schenker	1	766H32	45.02	31.05	45.02	31.05
DB Schenker	1	776B44	14.04	8.14	14.04	8.14
DB Schenker	1	776B91	8.91	18.44	8.91	18.44
DB Schenker	6	796B03	149.18	26.64	24.86	159.83
DB Schenker	1	796B11	21.91	23.48	21.91	23.48
DB Schenker	2	796B12	43.82	23.90	21.91	47.80
DB Schenker	2	796B16	49.73	27.63	24.86	55.25
DB Schenker	5	796B20	124.31	26.17	24.86	130.86
DB Schenker	8	796B26	175.28	24.80	21.91	198.43
DB Schenker	1	796B41	21.91	24.80	21.91	24.80
DB Schenker	4	796B48	87.64	25.28	21.91	101.12
DB Schenker	1	796B61	24.86	22.27	24.86	22.27
DB Schenker	1	796B64	24.86	24.06	24.86	24.06
DB Schenker	4	796E30	1,302.98	24.93	325.74	99.72
DB Schenker	1	796E47	319.22	27.44	319.22	27.44
DB Schenker	1	796H25	44.02	28.71	44.02	28.71
DB Schenker	1	796H29	44.02	29.67	44.02	29.67
DB Schenker	2	796H29	88.03	29.34	44.02	58.69
DB Schenker	1	796H31	44.02	29.34	44.02	29.34
DB Schenker	3	796H31	132.05	27.80	44.02	83.40
DB Schenker	1	796L42	218.66	12.21	218.66	12.21
DB Schenker	1	796M11	137.97	24.49	137.97	24.49
DB Schenker	5	796M11	692.01	24.21	138.40	121.05
DB Schenker	4	796M76	739.07	25.60	184.77	102.41
DB Schenker	5	796M81	690.44	23.88	138.09	119.39

DB Schenker	7	796M86	1,293.37	19.80	184.77	138.57
DB Schenker	1	796M94	221.03	24.33	221.03	24.33
DB Schenker	1	796M96	241.12	24.44	241.12	24.44
Freightliner HH	1	776L33	154.45	27.02	154.45	27.02
GB Railfreight	7	066E45	2,037.00	21.74	291.00	152.20
GB Railfreight	2	126S45	584.00	24.33	292.00	48.67
GB Railfreight	5	126S45	1,460.00	20.44	292.00	102.22
GB Railfreight	1	156M58	135.00	28.22	135.00	28.22
GB Railfreight	1	556V88	167.00	20.04	167.00	20.04
Totals	373					8098.02

Average weighted speed
21.71

B5 - Refuse

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	2	046B41	59.30	25.42	29.65	50.83
DB Schenker	2	046B44	54.20	28.78	27.10	57.56
DB Schenker	10	046B45	267.02	29.67	26.70	296.68
DB Schenker	9	046B46	243.91	28.04	27.10	252.32
DB Schenker	5	706A58	218.03	28.44	43.61	142.19
DB Schenker	1	736A54	46.65	25.45	46.65	25.45
DB Schenker	1	736A54	46.65	25.22	46.65	25.22
DB Schenker	2	736A56	86.97	29.65	43.48	59.29
DB Schenker	1	736A56	44.98	9.24	44.98	9.24
DB Schenker	5	746A55	232.64	21.90	46.53	109.48
DB Schenker	2	746A55	93.06	18.19	46.53	36.37
Freightliner HH	10	226M05	840.00	16.74	84.00	167.44
Freightliner HH	3	226M06	246.00	16.35	82.00	49.04

Freightliner HH	1	226M06	82.00	14.60	82.00	14.60
Freightliner HH	4	226M07	327.00	21.14	81.75	84.57
Freightliner HH	4	226M07	332.00	20.58	83.00	82.31
Freightliner HH	4	316E07	312.16	21.68	78.04	86.71
Freightliner HH	3	316E07	240.55	19.72	80.18	59.15
Freightliner HH	2	316H07	18.00	13.50	9.00	27.00
Freightliner HH	1	326E01	83.04	21.48	83.04	21.48
Freightliner HH	10	326E06	849.08	18.46	84.91	184.58
Freightliner HH	1	326E07	89.71	26.00	89.71	26.00
Freightliner HH	10	636M22	563.20	11.61	56.32	116.12
Freightliner HH	11	706M23	616.07	18.77	56.01	206.50
Totals	104					2190.16

Average weighted speed
21.06

B6 - Building Materials

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	4	074M00	716.39	32.86	179.10	131.45
DB Schenker	6	168D06	107.94	19.63	17.99	117.75
DB Schenker	2	296S00	369.28	23.32	184.64	46.65
DB Schenker	6	316H60	146.87	13.73	24.48	82.35
DB Schenker	1	346M19	106.09	28.42	106.09	28.42
DB Schenker	1	456M85	52.20	37.29	52.20	37.29
DB Schenker	1	456M85	67.20	26.18	67.20	26.18
DB Schenker	1	456M85	165.96	26.73	165.96	26.73
DB Schenker	1	516V34	18.43	6.28	18.43	6.28
DB Schenker	1	524E25	125.15	20.60	125.15	20.60
DB Schenker	2	524E25	346.30	18.69	173.15	37.37

DB Schenker	1	546M34	131.55	38.88	131.55	38.88
DB Schenker	2	596E25	208.00	27.37	104.00	54.74
DB Schenker	2	596E25	206.00	23.23	103.00	46.47
DB Schenker	3	596M85	296.89	31.58	98.96	94.75
DB Schenker	3	636F93	417.82	25.95	139.27	77.85
DB Schenker	2	636F93	278.55	25.87	139.27	51.74
DB Schenker	2	656M82	209.65	27.47	104.83	54.93
DB Schenker	1	736L26	18.43	11.64	18.43	11.64
DB Schenker	6	736L26	110.60	11.58	18.43	69.49
DB Schenker	1	737A40	9.60	12.26	9.60	12.26
DRS	1	024N83	138.18	36.20	138.18	36.20
Freightliner HH	3	016B31	644.14	30.89	214.71	92.68
Freightliner HH	2	026B32	311.40	38.29	155.70	76.57
Freightliner HH	1	046A65	192.94	30.99	192.94	30.99
Freightliner HH	1	046A65	192.94	29.57	192.94	29.57
Freightliner HH	1	046A65	192.94	29.53	192.94	29.53
Freightliner HH	1	046D62	78.70	25.52	78.70	25.52
Freightliner HH	7	046E90	804.13	26.41	114.88	184.86
Freightliner HH	4	046H51	856.80	29.75	214.20	119.00
Freightliner HH	1	046M01	129.31	23.44	129.31	23.44
Freightliner HH	1	146S25	113.00	31.24	113.00	31.24
Freightliner HH	6	146S26	678.00	31.24	113.00	187.47
Freightliner HH	3	186M45	175.73	18.31	58.58	54.92
Freightliner HH	1	186M89	49.81	23.72	49.81	23.72
Freightliner HH	1	346E91	49.34	24.26	49.34	24.26
Freightliner HH	1	346L45	197.10	30.48	197.10	30.48
Freightliner HH	1	346L86	191.88	28.93	191.88	28.93
Freightliner HH	2	346L86	382.44	27.06	191.22	54.12
Freightliner HH	4	346L87	788.98	20.84	197.24	83.34
Freightliner HH	1	346V20	198.29	26.98	198.29	26.98
Freightliner HH	1	346V91	203.47	33.04	203.47	33.04

Freightliner HH	5	516M90	980.76	31.14	196.15	155.68
Freightliner HH	2	516M90	392.31	23.97	196.15	47.94
Freightliner HH	3	516M92	555.46	23.14	185.15	69.43
Freightliner HH	1	516M97	185.15	31.74	185.15	31.74
Freightliner HH	2	746M91	402.31	33.62	201.15	67.24
Freightliner HH	2	826C17	302.85	29.89	151.43	59.77
Freightliner HH	2	846C66	304.00	28.95	152.00	57.90
GB Railfreight	2	894E19	432.95	30.78	216.48	61.56
GB Railfreight	1	894E19	234.59	32.39	234.59	32.39
Totals	113					2884.36

Average weighted speed
25.53

B7 - Petroleum Products

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	2	016H03	137.93	15.56	68.96	31.11
DB Schenker	2	016H66	497.37	33.46	248.68	66.91
DB Schenker	2	056D17	44.42	18.77	22.21	37.54
DB Schenker	1	056D17	22.21	18.01	22.21	18.01
DB Schenker	2	056D18	44.42	18.13	22.21	36.26
DB Schenker	3	056M34	256.43	28.73	85.48	86.19
DB Schenker	3	056M34	328.43	19.26	109.48	57.79
DB Schenker	3	056M34	328.43	16.44	109.48	49.33
DB Schenker	2	066D16	233.99	17.12	116.99	34.24
DB Schenker	1	076B01	38.31	24.45	38.31	24.45
DB Schenker	1	076Y15	131.00	19.80	131.00	19.80
DB Schenker	1	086D61	60.12	13.61	60.12	13.61
DB Schenker	2	096C31	12.20	8.51	6.10	17.03

DB Schenker	6	096C31	36.61	8.32	6.10	49.92
DB Schenker	8	096C32	48.81	6.31	6.10	50.49
DB Schenker	2	096C33	12.20	13.07	6.10	26.15
DB Schenker	7	096C33	42.71	11.44	6.10	80.08
DB Schenker	7	096C34	42.71	6.78	6.10	47.45
DB Schenker	1	096C34	6.10	6.31	6.10	6.31
DB Schenker	7	096C35	42.71	11.44	6.10	80.08
DB Schenker	6	096S36	713.11	22.42	118.85	134.55
DB Schenker	1	096S36	118.85	16.90	118.85	16.90
DB Schenker	2	166D49	137.48	26.78	68.74	53.56
DB Schenker	2	176D80	143.86	25.54	71.93	51.07
DB Schenker	2	216D31	112.45	29.08	56.23	58.17
DB Schenker	4	216D39	274.96	25.78	68.74	103.11
DB Schenker	1	216D79	72.23	17.98	72.23	17.98
DB Schenker	6	216M00	694.13	17.78	115.69	106.65
DB Schenker	1	216M11	78.49	21.80	78.49	21.80
DB Schenker	1	216M11	78.49	21.51	78.49	21.51
DB Schenker	6	216M24	692.93	20.59	115.49	123.55
DB Schenker	1	216M35	115.84	24.65	115.84	24.65
DB Schenker	5	216M35	579.20	24.56	115.84	122.80
DB Schenker	1	216M35	115.84	23.88	115.84	23.88
DB Schenker	2	216M57	231.28	19.54	115.64	39.09
DB Schenker	2	216M57	230.98	19.46	115.49	38.93
DB Schenker	3	216N03	459.95	26.32	153.32	78.96
DB Schenker	1	216N03	153.32	26.21	153.32	26.21
DB Schenker	1	216V11	237.00	27.77	237.00	27.77
DB Schenker	1	216V98	208.01	32.42	208.01	32.42
DB Schenker	1	266D34	27.78	24.15	27.78	24.15
DB Schenker	2	496R34	134.72	19.91	67.36	39.82
DB Schenker	1	516Y35	67.99	24.87	67.99	24.87
DB Schenker	2	556E82	175.18	26.95	87.59	53.90

DB Schenker	5	556E82	437.95	21.90	87.59	109.49
DB Schenker	1	666E46	115.49	22.50	115.49	22.50
DB Schenker	9	666E46	1,040.75	22.20	115.64	199.82
DB Schenker	8	666E54	926.71	25.74	115.84	205.94
DB Schenker	1	666E54	115.84	25.27	115.84	25.27
DB Schenker	1	666E59	115.49	23.10	115.49	23.10
DB Schenker	1	666E59	115.49	22.87	115.49	22.87
DB Schenker	1	666E68	115.84	27.58	115.84	27.58
DB Schenker	2	696V55	511.31	22.51	255.65	45.02
DB Schenker	1	736E38	211.05	30.01	211.05	30.01
DB Schenker	4	736E38	848.71	26.14	212.18	104.56
DB Schenker	1	746A70	51.74	22.02	51.74	22.02
DB Schenker	1	746B33	141.01	26.19	141.01	26.19
DB Schenker	1	746B33	225.65	28.15	225.65	28.15
DB Schenker	2	746E55	449.17	29.36	224.59	58.72
DB Schenker	1	796B10	83.65	38.61	83.65	38.61
DB Schenker	1	806A11	236.12	31.21	236.12	31.21
DB Schenker	7	806B13	1,401.15	27.48	200.16	192.38
DB Schenker	2	806B13	402.93	25.88	201.46	51.77
DB Schenker	1	806M03	247.25	27.94	247.25	27.94
DB Schenker	2	816B47	226.03	37.67	113.02	75.34
DB Schenker	2	816C62	242.87	31.68	121.43	63.36
DB Schenker	2	816E41	413.96	30.03	206.98	60.07
DB Schenker	2	846C12	1.56	5.20	0.78	10.41
DB Schenker	2	846C14	1.56	5.20	0.78	10.41
DB Schenker	4	846C15	3.12	4.26	0.78	17.03
DB Schenker	2	856C11	92.01	18.16	46.00	36.32
DB Schenker	2	856C21	91.51	26.40	45.75	52.79
DB Schenker	2	866B41	36.80	22.53	18.40	45.07
DB Schenker	2	866B41	36.80	21.65	18.40	43.30
DB Schenker	1	866B94	18.40	20.45	18.40	20.45

DB Schenker	1	866V62	102.53	19.22	102.53	19.22
DB Schenker	2	866Y32	191.08	24.29	95.54	48.58
DB Schenker	2	876Y34	152.48	29.14	76.24	58.27
GB Railfreight	2	136Y11	220.00	25.19	110.00	50.38
GB Railfreight	8	136Y11	872.00	24.04	109.00	192.35
GB Railfreight	3	486A33	249.00	25.94	83.00	77.81
GB Railfreight	2	496P41	162.00	28.42	81.00	56.84
Totals	212					4330.20

Average weighted speed
20.43

E0 - Coal (Electricity) Merry Go Round

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	5	034J01	419.33	31.45	83.87	157.25
DB Schenker	10	034J03	821.53	29.52	82.15	295.16
DB Schenker	1	034J04	48.83	34.47	48.83	34.47
DB Schenker	5	034J04	419.33	32.46	83.87	162.32
DB Schenker	9	034J06	754.79	31.85	83.87	286.63
DB Schenker	9	034J08	754.79	27.05	83.87	243.48
DB Schenker	8	034J09	670.92	32.26	83.87	258.05
DB Schenker	1	034J10	83.87	28.92	83.87	28.92
DB Schenker	11	034J11	922.52	30.13	83.87	331.44
DB Schenker	2	034R72	171.28	31.92	85.64	63.83
DB Schenker	1	036J09	83.87	32.26	83.87	32.26
DB Schenker	5	044J69	458.69	22.84	91.74	114.20
DB Schenker	4	044J72	366.95	22.65	91.74	90.61
DB Schenker	4	044J79	366.95	20.02	91.74	80.06
DB Schenker	2	044J79	183.48	17.93	91.74	35.86

DB Schenker	4	086B70	403.83	14.96	100.96	59.83
DB Schenker	2	086B79	177.62	26.91	88.81	53.83
DB Schenker	1	086B79	94.86	8.56	94.86	8.56
DB Schenker	3	086E68	646.80	21.10	215.60	63.31
DB Schenker	1	086G02	86.00	31.85	86.00	31.85
DB Schenker	5	086G02	430.00	27.30	86.00	136.51
DB Schenker	7	086G04	603.00	30.40	86.14	212.82
DB Schenker	11	086G06	946.00	29.49	86.00	324.34
DB Schenker	6	086G07	516.00	30.71	86.00	184.29
DB Schenker	5	086G11	431.00	28.03	86.20	140.16
DB Schenker	3	086G12	258.00	30.53	86.00	91.60
DB Schenker	3	086G12	258.00	29.83	86.00	89.48
DB Schenker	1	094S58	110.00	31.88	110.00	31.88
DB Schenker	2	164M58	258.90	28.87	129.45	57.75
DB Schenker	1	164R07	71.55	30.67	71.55	30.67
DB Schenker	1	164R27	69.00	26.04	69.00	26.04
DB Schenker	1	164R32	70.94	28.00	70.94	28.00
DB Schenker	3	164S62	350.40	27.16	116.80	81.49
DB Schenker	5	164S62	1,232.59	26.46	246.52	132.30
DB Schenker	1	164S78	110.00	30.99	110.00	30.99
DB Schenker	2	164S78	486.00	32.76	243.00	65.53
DB Schenker	1	164S84	116.80	30.21	116.80	30.21
DB Schenker	5	164S84	1,231.34	23.31	246.27	116.53
DB Schenker	1	166H68	23.10	23.10	23.10	23.10
DB Schenker	1	184A35	16.78	24.55	16.78	24.55
DB Schenker	1	184A64	16.78	18.99	16.78	18.99
DB Schenker	1	184A66	16.78	20.13	16.78	20.13
DB Schenker	1	184A85	16.91	11.27	16.91	11.27
DB Schenker	1	184A97	16.78	22.37	16.78	22.37
DB Schenker	1	184A97	16.78	21.88	16.78	21.88
DB Schenker	2	184R26	152.21	18.27	76.11	36.53

DB Schenker	6	196H25	308.78	11.44	51.46	68.62
DB Schenker	10	196H28	514.63	12.76	51.46	127.59
DB Schenker	4	216B06	227.36	20.30	56.84	81.20
DB Schenker	3	216F11	237.64	22.21	79.21	66.63
DB Schenker	1	216F15	78.32	10.54	78.32	10.54
DB Schenker	2	216F23	122.65	11.15	61.33	22.30
DB Schenker	1	216F23	79.21	13.98	79.21	13.98
DB Schenker	2	216H15	162.19	17.69	81.10	35.39
DB Schenker	7	216H22	528.22	20.12	75.46	140.86
DB Schenker	6	216M03	492.95	20.04	82.16	120.23
DB Schenker	3	226V66	802.02	28.39	267.34	85.17
DB Schenker	1	264R05	79.89	16.59	79.89	16.59
DB Schenker	1	264R11	79.89	26.63	79.89	26.63
DB Schenker	1	264R15	57.45	31.92	57.45	31.92
DB Schenker	1	264R17	61.33	12.64	61.33	12.64
DB Schenker	1	264R27	62.00	20.11	62.00	20.11
DB Schenker	1	354F70	24.61	23.07	24.61	23.07
DB Schenker	6	356F07	200.67	8.14	33.45	48.85
DB Schenker	2	356F09	50.22	19.32	25.11	38.63
DB Schenker	6	356F09	199.68	12.80	33.28	76.80
DB Schenker	1	356F16	26.61	19.35	26.61	19.35
DB Schenker	7	356F16	233.29	9.59	33.33	67.13
DB Schenker	2	356F29	53.23	21.87	26.61	43.75
DB Schenker	1	356F78	30.38	9.39	30.38	9.39
DB Schenker	6	356F78	182.25	8.03	30.38	48.17
DB Schenker	5	356F88	151.88	11.46	30.38	57.31
DB Schenker	2	366F37	60.85	11.55	30.43	23.11
DB Schenker	1	366F37	30.43	11.27	30.43	11.27
DB Schenker	1	366F37	30.43	11.20	30.43	11.20
DB Schenker	8	366F74	291.72	11.96	36.46	95.64
DB Schenker	9	366F77	328.18	13.02	36.46	117.21

DB Schenker	2	366F79	60.85	9.76	30.43	19.52
DB Schenker	6	366F81	218.79	13.02	36.46	78.14
DB Schenker	1	366F84	36.46	13.02	36.46	13.02
DB Schenker	5	366F85	183.90	6.25	36.78	31.26
DB Schenker	2	366F86	72.93	13.59	36.46	27.18
DB Schenker	2	366F89	72.93	15.19	36.46	30.39
DB Schenker	6	564E04	492.96	27.69	82.16	166.17
DB Schenker	2	744D02	131.47	35.22	65.73	70.43
DB Schenker	1	744D04	65.73	36.52	65.73	36.52
DB Schenker	3	744D04	197.20	30.34	65.73	91.02
DB Schenker	1	744D06	65.73	27.58	65.73	27.58
DB Schenker	3	744D06	197.20	23.76	65.73	71.28
DB Schenker	2	744D08	131.47	28.07	65.73	56.14
DB Schenker	2	744D10	135.98	24.28	67.99	48.56
DB Schenker	1	744D10	67.99	19.90	67.99	19.90
DB Schenker	3	744D12	197.20	27.58	65.73	82.74
DB Schenker	4	744D16	262.94	28.37	65.73	113.50
DB Schenker	4	744D18	271.95	29.35	67.99	117.39
DB Schenker	5	744D20	328.67	34.90	65.73	174.52
DB Schenker	3	744D22	197.20	34.60	65.73	103.79
DB Schenker	1	744D24	65.73	35.86	65.73	35.86
DB Schenker	3	744D24	197.20	29.88	65.73	89.64
DB Schenker	1	764C42	39.30	16.38	39.30	16.38
DB Schenker	2	764C68	52.04	21.99	26.02	43.98
DB Schenker	1	784C42	42.30	11.70	42.30	11.70
DB Schenker	3	784C53	155.96	21.51	51.99	64.53
DB Schenker	2	784C60	103.97	20.79	51.99	41.59
DB Schenker	1	784C91	35.21	14.27	35.21	14.27
DB Schenker	3	784C93	105.63	16.13	35.21	48.38
DB Schenker	1	784O11	66.95	17.93	66.95	17.93
DB Schenker	5	786C45	195.74	12.70	39.15	63.48

DB Schenker	4	786C47	156.59	12.70	39.15	50.79
DB Schenker	8	786C93	281.68	6.29	35.21	50.30
DB Schenker	3	786C94	105.63	5.49	35.21	16.46
DB Schenker	1	786C95	35.21	8.45	35.21	8.45
DB Schenker	3	786C96	105.63	8.48	35.21	25.45
DB Schenker	2	796C32	135.93	13.24	67.96	26.48
DB Schenker	4	796O11	274.85	16.69	68.71	66.77
DB Schenker	1	814D09	13.24	27.39	13.24	27.39
DB Schenker	1	814F23	23.40	19.50	23.40	19.50
DB Schenker	1	816B66	53.15	15.18	53.15	15.18
DB Schenker	3	816B68	159.44	20.71	53.15	62.12
DB Schenker	1	816B72	53.15	12.55	53.15	12.55
DB Schenker	2	816B81	106.29	21.12	53.15	42.24
DB Schenker	1	816D01	65.73	26.65	65.73	26.65
DB Schenker	1	816D03	65.73	28.37	65.73	28.37
DB Schenker	1	816D05	76.97	27.65	76.97	27.65
DB Schenker	1	816D07	65.74	25.28	65.74	25.28
DB Schenker	2	816D09	131.62	21.82	65.81	43.63
DB Schenker	1	816D09	65.81	17.17	65.81	17.17
DB Schenker	3	816D11	197.43	20.78	65.81	62.35
DB Schenker	2	816D13	131.62	18.03	65.81	36.06
DB Schenker	3	816D15	197.43	25.15	65.81	75.45
DB Schenker	3	816D17	197.43	18.98	65.81	56.95
DB Schenker	5	816D19	329.05	21.58	65.81	107.89
DB Schenker	5	816D21	328.67	25.12	65.73	125.61
DB Schenker	4	816D23	262.94	24.81	65.73	99.22
Freightliner HH	4	034D12	160.00	34.29	40.00	137.14
Freightliner HH	1	034D12	40.00	32.00	40.00	32.00
Freightliner HH	4	074C31	62.50	27.57	15.63	110.30
Freightliner HH	3	076B34	194.62	30.89	64.87	92.68
Freightliner HH	2	076E87	476.71	21.31	238.36	42.63

Freightliner HH	5	076G05	280.00	30.83	56.00	154.13
Freightliner HH	2	076G05	112.00	30.55	56.00	61.09
Freightliner HH	7	076G20	392.00	19.65	56.00	137.54
Freightliner HH	1	086E21	261.39	20.91	261.39	20.91
Freightliner HH	4	086E74	1,051.63	24.19	262.91	96.78
Freightliner HH	8	086E80	2,555.84	19.82	319.48	158.58
Freightliner HH	2	086E80	651.74	20.16	325.87	40.31
Freightliner HH	8	086M61	2,112.00	23.68	264.00	189.42
Freightliner HH	2	086M71	235.62	27.08	117.81	54.17
Freightliner HH	3	094S34	412.59	29.68	137.53	89.05
Freightliner HH	1	096E69	115.00	24.47	115.00	24.47
Freightliner HH	1	096F73	129.00	19.95	129.00	19.95
Freightliner HH	1	096F75	130.00	20.05	130.00	20.05
Freightliner HH	3	164S22	650.79	33.90	216.93	101.69
Freightliner HH	1	174M75	116.18	29.54	116.18	29.54
Freightliner HH	1	174R08	73.71	20.57	73.71	20.57
Freightliner HH	1	184A68	11.00	9.71	11.00	9.71
Freightliner HH	1	184A74	11.00	12.00	11.00	12.00
Freightliner HH	1	184K18	39.00	20.35	39.00	20.35
Freightliner HH	1	184R08	78.82	35.83	78.82	35.83
Freightliner HH	3	184S11	789.00	31.00	263.00	93.01
Freightliner HH	1	186H19	9.27	20.60	9.27	20.60
Freightliner HH	1	186H19	9.27	17.38	9.27	17.38
Freightliner HH	3	186H66	27.81	20.60	9.27	61.80
Freightliner HH	1	186H67	9.27	21.39	9.27	21.39
Freightliner HH	1	186H74	9.27	19.18	9.27	19.18
Freightliner HH	1	186H74	9.27	18.54	9.27	18.54
Freightliner HH	1	196M51	93.41	23.35	93.41	23.35
Freightliner HH	1	196M51	169.41	22.54	169.41	22.54
Freightliner HH	1	216R02	69.96	23.99	69.96	23.99
Freightliner HH	1	216R02	80.00	20.25	80.00	20.25

Freightliner HH	2	216R04	151.00	25.03	75.50	50.06
Freightliner HH	3	216R08	226.50	23.00	75.50	68.99
Freightliner HH	1	216R08	80.00	14.41	80.00	14.41
Freightliner HH	4	216R12	302.01	18.88	75.50	75.50
Freightliner HH	1	216R14	75.50	24.36	75.50	24.36
Freightliner HH	1	216R16	69.96	21.98	69.96	21.98
Freightliner HH	2	216R22	139.93	23.39	69.96	46.77
Freightliner HH	1	216R22	65.43	20.03	65.43	20.03
Freightliner HH	1	216Y13	69.96	22.57	69.96	22.57
Freightliner HH	2	216Y13	139.93	19.43	69.96	38.87
Freightliner HH	2	216Y17	139.93	21.09	69.96	42.19
Freightliner HH	5	236H38	191.26	19.96	38.25	99.79
Freightliner HH	4	264K02	287.00	23.27	71.75	93.08
Freightliner HH	1	264N75	70.14	22.15	70.14	22.15
Freightliner HH	1	276M62	93.41	24.80	93.41	24.80
Freightliner HH	7	354F03	157.60	10.89	22.51	76.26
Freightliner HH	1	354F04	18.00	14.40	18.00	14.40
Freightliner HH	7	354F04	126.00	12.13	18.00	84.94
Freightliner HH	1	354S41	264.07	27.51	264.07	27.51
Freightliner HH	5	354S42	1,312.03	26.07	262.41	130.33
Freightliner HH	7	364F02	210.36	14.66	30.05	102.62
Freightliner HH	1	386F02	23.00	14.08	23.00	14.08
Freightliner HH	7	386F02	161.00	13.40	23.00	93.79
Freightliner HH	8	386F03	184.00	10.78	23.00	86.25
Freightliner HH	2	564E23	168.77	20.50	84.39	41.00
Freightliner HH	1	654V46	121.43	25.75	121.43	25.75
Freightliner HH	1	654V57	119.56	23.99	119.56	23.99
Freightliner HH	9	654V61	1,076.56	21.55	119.62	193.97
Freightliner HH	2	666A45	114.00	25.33	57.00	50.67
Freightliner HH	2	666A45	114.00	24.60	57.00	49.21
Freightliner HH	1	666A61	55.00	20.69	55.00	20.69

Freightliner HH	1	666A89	55.00	22.76	55.00	22.76
Freightliner HH	9	764F57	345.69	15.26	38.41	137.36
Freightliner HH	6	766F53	42.00	4.67	7.00	28.00
Freightliner HH	2	814C04	30.00	18.75	15.00	37.50
Freightliner HH	8	814C05	120.00	17.31	15.00	138.46
Freightliner HH	6	814C07	90.00	13.43	15.00	80.60
Freightliner HH	2	814C56	30.00	17.31	15.00	34.62
Freightliner HH	2	814C56	30.00	16.98	15.00	33.96
Freightliner HH	2	814C59	30.00	11.84	15.00	23.68
Freightliner HH	1	814C66	15.00	16.98	15.00	16.98
Freightliner HH	5	816F65	185.00	15.97	37.00	79.86
Freightliner HH	1	816F65	37.00	11.16	37.00	11.16
Freightliner HH	1	816M07	199.32	30.98	199.32	30.98
Freightliner HH	3	816M55	539.59	26.00	179.86	78.01
Freightliner HH	10	816M61	1,798.63	27.67	179.86	276.71
GB Railfreight	1	124N85	30.40	19.30	30.40	19.30
GB Railfreight	2	124N89	60.80	13.51	30.40	27.02
GB Railfreight	2	136H36	226.46	28.31	113.23	56.62
GB Railfreight	2	136H36	226.46	27.62	113.23	55.24
GB Railfreight	2	136H81	236.76	22.91	118.38	45.82
GB Railfreight	1	136H90	110.12	27.53	110.12	27.53
GB Railfreight	3	136H90	329.98	26.94	109.99	80.81
GB Railfreight	8	136H92	905.36	28.77	113.17	230.18
GB Railfreight	3	136H92	337.26	25.55	112.42	76.65
GB Railfreight	5	136H93	560.28	32.32	112.06	161.62
GB Railfreight	1	136H93	112.12	25.39	112.12	25.39
GB Railfreight	1	136H94	117.49	21.62	117.49	21.62
GB Railfreight	3	136H97	355.71	25.87	118.57	77.61
GB Railfreight	1	136H97	111.17	20.84	111.17	20.84
GB Railfreight	1	136H98	119.49	29.75	119.49	29.75
GB Railfreight	1	136H99	111.17	31.61	111.17	31.61

GB Railfreight	4	136N66	102.81	12.85	25.70	51.40
GB Railfreight	6	136N78	319.84	17.29	53.31	103.73
GB Railfreight	4	154N73	224.67	20.30	56.17	81.20
GB Railfreight	1	164D06	17.00	20.40	17.00	20.40
GB Railfreight	6	164D18	210.00	18.92	35.00	113.51
GB Railfreight	3	164N33	330.00	33.67	110.00	101.02
GB Railfreight	3	174A56	27.00	9.31	9.00	27.93
GB Railfreight	1	174A56	9.00	9.00	9.00	9.00
GB Railfreight	2	174D04	56.00	24.35	28.00	48.70
GB Railfreight	1	174D04	28.00	19.09	28.00	19.09
GB Railfreight	6	174D21	126.00	17.75	21.00	106.48
GB Railfreight	1	174D66	21.00	20.66	21.00	20.66
GB Railfreight	1	174N36	115.00	33.33	115.00	33.33
GB Railfreight	5	174N36	604.00	31.79	120.80	158.95
GB Railfreight	2	174N90	232.86	32.42	116.43	64.83
GB Railfreight	2	174N90	234.86	32.03	117.43	64.05
GB Railfreight	1	174N90	124.75	30.68	124.75	30.68
GB Railfreight	1	174N91	117.37	36.87	117.37	36.87
GB Railfreight	2	174N92	232.86	36.57	116.43	73.15
GB Railfreight	1	174N92	115.00	30.26	115.00	30.26
GB Railfreight	1	174N93	117.68	31.81	117.68	31.81
GB Railfreight	5	174N93	583.21	27.45	116.64	137.23
GB Railfreight	1	174N94	115.00	28.63	115.00	28.63
GB Railfreight	3	174N94	371.26	30.31	123.75	90.92
GB Railfreight	2	174N98	251.51	33.68	125.75	67.37
GB Railfreight	1	174R09	46.00	22.81	46.00	22.81
GB Railfreight	2	174R09	133.00	12.47	66.50	24.94
GB Railfreight	3	174R09	201.00	12.22	67.00	36.66
GB Railfreight	3	176H02	23.40	15.60	7.80	46.80
GB Railfreight	2	176H02	15.60	15.10	7.80	30.19
GB Railfreight	2	176H56	15.60	19.50	7.80	39.00

GB Railfreight	3	176H56	23.40	15.60	7.80	46.80
GB Railfreight	1	214R51				0.00
GB Railfreight	4	216C09	280.92	19.15	70.23	76.62
GB Railfreight	3	216C21	204.36	22.21	68.12	66.64
GB Railfreight	1	216C52	68.78	20.43	68.78	20.43
GB Railfreight	9	216Y09	639.00	22.54	71.00	202.86
GB Railfreight	5	216Y21	355.00	24.48	71.00	122.41
GB Railfreight	4	234K38	32.00	22.86	8.00	91.43
GB Railfreight	1	234R06	47.00	35.70	47.00	35.70
GB Railfreight	6	234R06	282.00	30.00	47.00	180.00
GB Railfreight	2	234R18	104.00	32.50	52.00	65.00
GB Railfreight	1	234R72	52.00	26.90	52.00	26.90
GB Railfreight	9	264K55	279.05	14.76	31.01	132.88
GB Railfreight	4	264K56	128.32	19.15	32.08	76.61
GB Railfreight	4	264K57	127.25	8.05	31.81	32.21
GB Railfreight	3	266H80	105.16	14.02	35.05	42.06
GB Railfreight	3	286B56	96.24	22.12	32.08	66.37
GB Railfreight	7	286B57	224.57	23.76	32.08	166.34
GB Railfreight	8	286B58	258.55	18.47	32.32	147.74
GB Railfreight	1	286B58	32.00	8.08	32.00	8.08
Totals	844					18106.18

Average weighted speed
21.45

H1 - Channel Tunnel Intermodal

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	1	334O59	263.88	36.31	263.88	36.31
DB Schenker	1	514Q20	47.19	39.33	47.19	39.33

DB Schenker	4	664O57	717.50	33.42	179.38	133.70
DB Schenker	1	664O57	179.88	30.53	179.88	30.53
DB Schenker	1	664O68	208.88	18.46	208.88	18.46
DB Schenker	1	894M31	189.46	34.34	189.46	34.34
DB Schenker	1	894Q21	54.00	37.24	54.00	37.24
Totals	10					329.91

Average weighted speed
32.99

H2 - Automotive (Vehicles)

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	2	366F55	28.93	13.15	14.46	26.30
DB Schenker	6	366L48	1,197.63	30.02	199.60	180.09
DB Schenker	5	366O38	1,322.26	34.49	264.45	172.47
DB Schenker	6	366O42	1,334.81	25.00	222.47	149.98
DB Schenker	1	366O46	228.45	36.95	228.45	36.95
DB Schenker	5	514V40	416.46	23.03	83.29	115.15
DB Schenker	2	514V40	168.49	21.79	84.25	43.58
DB Schenker	2	514V40	166.75	21.20	83.38	42.39
DB Schenker	3	516X41	595.24	27.69	198.41	83.06
DB Schenker	1	516X41	200.41	26.49	200.41	26.49
DB Schenker	7	516X44	462.27	21.65	66.04	151.56
DB Schenker	1	516X48	66.04	23.31	66.04	23.31
DB Schenker	1	744A38	10.41	9.47	10.41	9.47
DB Schenker	6	744A38	62.48	8.93	10.41	53.55
DB Schenker	7	744L40	579.47	15.87	82.78	111.08
DB Schenker	6	744O40	441.62	12.30	73.60	73.81
DB Schenker	5	766B30	182.92	20.32	36.58	101.62

DB Schenker	2	796B31	81.02	19.29	40.51	38.58
DB Schenker	4	796B31	162.04	18.84	40.51	75.37
DB Schenker	5	864B01	34.44	15.90	6.89	79.48
DB Schenker	3	864M52	422.54	26.33	140.85	78.98
DB Schenker	9	864V42	652.42	16.79	72.49	151.14
DB Schenker	2	866M38	466.00	30.59	233.00	61.18
DB Schenker	5	866M38	1,135.00	29.10	227.00	145.51
DB Schenker	5	866M44	1,135.00	32.35	227.00	161.76
DB Schenker	2	866M44	454.00	31.60	227.00	63.20
DB Schenker	5	866M48	1,140.00	27.64	228.00	138.18
Totals	108					2394.23

Average weighted speed
22.17

H3 - Channel Tunnel Automotive

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	3	517O81	281.63	26.57	93.88	79.71
DB Schenker	1	896B52	78.02	32.97	78.02	32.97
DB Schenker	1	897L22	92.21	24.37	92.21	24.37
Totals	5					137.04

Average weighted speed
27.41

J4 - Industrial Minerals (UK Contracts)

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed

DB Schenker	5	156N90	87.89	20.68	17.58	103.40
DB Schenker	6	156N91	105.46	17.01	17.58	102.06
DB Schenker	1	186H31	30.54	22.08	30.54	22.08
DB Schenker	1	186M94	73.71	26.80	73.71	26.80
DB Schenker	5	206H93	94.75	13.22	18.95	66.11
DB Schenker	2	206H93	37.90	12.92	18.95	25.84
DB Schenker	2	216C73	44.55	17.36	22.28	34.72
DB Schenker	8	216C73	179.21	16.00	22.40	128.01
DB Schenker	1	216C76	22.28	13.64	22.28	13.64
DB Schenker	10	216C76	223.77	9.73	22.38	97.29
DB Schenker	6	216C77	135.66	17.39	22.61	104.35
DB Schenker	2	216C80	45.05	17.33	22.53	34.66
DB Schenker	6	216C80	135.16	16.69	22.53	100.12
DB Schenker	1	224C71	21.31	26.37	21.31	26.37
DB Schenker	1	224C73	21.31	17.52	21.31	17.52
DB Schenker	5	224C73	105.99	15.51	21.20	77.55
DB Schenker	8	224C76	169.93	24.51	21.24	196.08
DB Schenker	4	224C77	84.68	25.92	21.17	103.69
DB Schenker	1	224C77	21.31	14.05	21.31	14.05
DB Schenker	2	224C79	42.63	21.67	21.31	43.35
DB Schenker	2	224C80	2.75	13.76	1.38	27.51
DB Schenker	8	224C80	170.51	15.60	21.31	124.76
DB Schenker	1	236D20	5.50	12.69	5.50	12.69
DB Schenker	4	236L31	539.68	28.11	134.92	112.43
DB Schenker	3	236L31	404.76	17.91	134.92	53.73
DB Schenker	2	236L98	274.63	29.74	137.32	59.49
DB Schenker	4	236L98	548.37	23.84	137.09	95.37
DB Schenker	3	346E56	224.72	22.14	74.91	66.42
DB Schenker	3	346E60	224.72	25.54	74.91	76.61
DB Schenker	5	346H22	61.13	7.97	12.23	39.87
DB Schenker	8	346H23	87.11	7.60	10.89	60.77

DB Schenker	6	466E84	841.13	20.03	140.19	120.16
DB Schenker	2	466E84	331.65	20.22	165.83	40.45
DB Schenker	4	466E88	601.75	18.84	150.44	75.38
DB Schenker	1	856C39	190.13	28.24	190.13	28.24
DB Schenker	1	856C40	9.08	11.12	9.08	11.12
DB Schenker	3	856G05	45.75	11.73	15.25	35.19
DB Schenker	3	856G05	45.75	11.30	15.25	33.89
DB Schenker	3	856G05	45.75	9.84	15.25	29.52
DB Schenker	5	856G06	76.25	11.16	15.25	55.80
DB Schenker	3	856G06	45.75	10.77	15.25	32.30
DB Schenker	2	856G06	30.50	10.28	15.25	20.56
DB Schenker	4	856G07	61.00	11.02	15.25	44.10
DB Schenker	4	856G08	61.00	10.89	15.25	43.57
DB Schenker	2	856G09	30.50	9.95	15.25	19.89
DB Schenker	3	856G10	45.75	11.02	15.25	33.07
DB Schenker	3	856P07	60.93	10.07	20.31	30.22
DB Schenker	1	856P07	20.31	9.99	20.31	9.99
DB Schenker	3	856P24	67.08	12.31	22.36	36.93
DB Schenker	1	856P24	20.31	10.98	20.31	10.98
Totals	174					2778.69

Average weighted speed
15.97

J5 - Chemicals (UK Contracts)

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	2	664S25	592.10	37.79	296.05	75.59
Freightliner HH	9	156F23	185.52	13.59	20.61	122.32
Freightliner HH	8	156F24	164.91	13.44	20.61	107.55

Freightliner HH	3	156F25	83.97	14.99	27.99	44.98
Freightliner HH	8	156F26	164.91	12.49	20.61	99.94
Freightliner HH	2	156F30	41.23	13.16	20.61	26.31
Freightliner HH	7	156F30	203.00	15.40	29.00	107.79
Freightliner HH	7	156F31	144.29	12.37	20.61	86.58
Freightliner HH	1	156F31	27.99	13.44	27.99	13.44
Freightliner HH	7	156F32	182.00	14.72	26.00	103.02
Freightliner HH	2	156F33	41.23	13.90	20.61	27.79
Freightliner HH	5	156F33	139.95	13.44	27.99	67.18
Freightliner HH	7	156F34	144.29	12.01	20.61	84.05
Freightliner HH	8	156F35	164.91	11.56	20.61	92.47
Freightliner HH	6	156F36	123.68	12.88	20.61	77.30
Freightliner HH	5	156F37	103.07	13.90	20.61	69.48
Totals	87					1205.80

Average weighted speed
13.86

J8 - General Merchandise (UK Contracts)

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	2	026D84	302.88	28.22	151.44	56.44
DB Schenker	2	026D84	302.88	27.87	151.44	55.74
DB Schenker	2	076A32	309.55	34.52	154.77	69.04
DB Schenker	2	076A32	309.72	31.82	154.86	63.64
DB Schenker	2	076H44	353.44	39.27	176.72	78.54
DB Schenker	3	076M76	634.01	36.65	211.34	109.94
DB Schenker	4	076O15	1,680.55	28.23	420.14	112.91
DB Schenker	3	076R52	133.53	18.17	44.51	54.50
DB Schenker	1	076V15	365.02	27.83	365.02	27.83

DB Schenker	2	086D80	115.22	27.22	57.61	54.44
DB Schenker	1	094E62	106.94	22.51	106.94	22.51
DB Schenker	3	096C17	111.49	12.32	37.16	36.96
DB Schenker	5	096C78	55.88	19.16	11.18	95.79
DB Schenker	4	096C78	44.70	18.63	11.18	74.51
DB Schenker	5	096C79	39.63	12.85	7.93	64.26
DB Schenker	6	096C79	47.55	12.51	7.93	75.08
DB Schenker	1	096E62	116.32	27.26	116.32	27.26
DB Schenker	1	096E62	106.94	22.51	106.94	22.51
DB Schenker	1	106C48	34.13	24.67	34.13	24.67
DB Schenker	3	106C49	102.38	25.59	34.13	76.78
DB Schenker	1	156M57	107.44	28.15	107.44	28.15
DB Schenker	1	156M57	107.44	28.03	107.44	28.03
DB Schenker	1	164M02	82.49	27.05	82.49	27.05
DB Schenker	1	174D53	24.30	27.00	24.30	27.00
DB Schenker	4	174L05	778.99	22.09	194.75	88.35
DB Schenker	6	174L45	1,171.18	20.23	195.20	121.37
DB Schenker	1	174O53	236.14	34.56	236.14	34.56
DB Schenker	3	174O53	723.72	29.54	241.24	88.62
DB Schenker	1	196J94	62.98	20.65	62.98	20.65
DB Schenker	1	216M33	91.62	24.01	91.62	24.01
DB Schenker	3	234L45	512.01	19.51	170.67	58.52
DB Schenker	4	236M30	353.44	20.01	88.36	80.02
DB Schenker	2	326E72	208.00	24.09	104.00	48.19
DB Schenker	5	334O30	1,156.19	25.93	231.24	129.67
DB Schenker	2	356F47	29.45	27.61	14.73	55.22
DB Schenker	2	356F60	57.33	15.36	28.67	30.71
DB Schenker	3	356G76	209.52	31.51	69.84	94.52
DB Schenker	1	366F62	28.67	16.46	28.67	16.46
DB Schenker	1	366F62	28.67	16.30	28.67	16.30
DB Schenker	1	436G71	37.44	39.76	37.44	39.76

DB Schenker	1	494B15	17.19	23.44	17.19	23.44
DB Schenker	1	494E05	197.90	26.50	197.90	26.50
DB Schenker	5	494E05	984.90	26.15	196.98	130.74
DB Schenker	2	494E45	392.48	27.57	196.24	55.15
DB Schenker	2	494M00	362.18	19.51	181.09	39.01
DB Schenker	2	494M00	416.05	21.73	208.02	43.45
DB Schenker	5	494M00	1,045.12	21.29	209.02	106.46
DB Schenker	2	494M85	310.05	25.84	155.03	51.68
DB Schenker	6	516R04	75.13	24.24	12.52	145.42
DB Schenker	8	516R81	100.17	25.04	12.52	200.35
DB Schenker	3	516R98	105.85	14.35	35.28	43.06
DB Schenker	1	654B70	35.25	27.47	35.25	27.47
DB Schenker	1	656F25	70.25	37.63	70.25	37.63
DB Schenker	1	656K72	37.44	33.53	37.44	33.53
DB Schenker	1	656V69	118.13	31.50	118.13	31.50
DB Schenker	6	664L74	1,221.32	22.35	203.55	134.09
DB Schenker	8	664O23	1,177.91	24.54	147.24	196.32
DB Schenker	1	664O63	154.24	21.27	154.24	21.27
DB Schenker	1	664O63	154.24	9.96	154.24	9.96
DB Schenker	1	666G53	20.06	14.00	20.06	14.00
DB Schenker	1	694V03	45.22	28.27	45.22	28.27
DB Schenker	2	696V03	90.45	28.27	45.22	56.53
DB Schenker	1	704B85	0.05	0.06	0.05	0.06
DB Schenker	7	704L70	1,066.17	16.02	152.31	112.13
DB Schenker	2	706A42	146.78	42.34	73.39	84.68
DB Schenker	5	706A42	366.01	32.06	73.20	160.29
DB Schenker	9	746A48	194.97	23.63	21.66	212.69
DB Schenker	7	746A49	151.64	25.49	21.66	178.40
DB Schenker	2	746B14	166.26	41.57	83.13	83.13
DB Schenker	1	746L31	66.09	26.26	66.09	26.26
DB Schenker	6	746L31	392.63	24.24	65.44	145.42

DB Schenker	1	746L35	65.11	22.45	65.11	22.45
DB Schenker	8	746L35	526.94	19.00	65.87	152.00
DB Schenker	2	746L98	196.13	18.44	98.06	36.89
DB Schenker	3	746O15	165.41	34.46	55.14	103.38
DB Schenker	8	746X65	2,949.12	27.21	368.64	217.65
DB Schenker	1	746X65	368.39	27.02	368.39	27.02
DB Schenker	1	766A29	79.55	26.37	79.55	26.37
DB Schenker	4	766B06	68.00	14.78	17.00	59.13
DB Schenker	4	766B24	20.14	23.24	5.04	92.96
DB Schenker	2	766B98	21.13	21.85	10.56	43.71
DB Schenker	1	766C99	186.45	21.76	186.45	21.76
DB Schenker	3	776A29	238.65	26.37	79.55	79.11
DB Schenker	3	776A29	253.76	20.89	84.59	62.66
DB Schenker	6	786B39	121.78	16.24	20.30	97.42
DB Schenker	2	786B99	20.25	21.70	10.13	43.40
DB Schenker	1	846B39	39.00	5.53	39.00	5.53
DB Schenker	1	846C44	46.00	37.30	46.00	37.30
DB Schenker	1	864B43	8.10	15.68	8.10	15.68
DB Schenker	1	864B53	8.10	15.68	8.10	15.68
DB Schenker	1	864M15	158.20	24.28	158.20	24.28
DB Schenker	1	864M66	152.05	24.72	152.05	24.72
DB Schenker	3	864M66	457.16	23.81	152.39	71.43
DB Schenker	3	864M78	691.48	29.49	230.49	88.46
DB Schenker	1	864V38	67.67	14.30	67.67	14.30
DB Schenker	3	866B43	24.30	15.68	8.10	47.04
DB Schenker	5	866B44	40.50	16.20	8.10	81.01
DB Schenker	2	866B93	36.80	19.37	18.40	38.74
DB Schenker	6	866V38	331.15	29.05	55.19	174.29
DB Schenker	2	866V38	135.34	14.30	67.67	28.59
DRS	7	014D47	1,236.27	38.67	176.61	270.72
DRS	3	014D47	529.83	38.39	176.61	115.18

DRS	2	014D47	353.22	38.32	176.61	76.65
DRS	1	054A13	140.00	37.84	140.00	37.84
DRS	10	054A13	1,400.00	36.52	140.00	365.22
DRS	2	054M30	668.00	42.64	334.00	85.28
DRS	9	054R75	349.00	18.76	38.78	168.87
DRS	3	074H47	537.00	38.63	179.00	115.90
DRS	2	074H47	358.00	38.36	179.00	76.71
DRS	9	074H47	1,611.00	31.50	179.00	283.46
DRS	2	074M34	628.00	41.59	314.00	83.18
DRS	4	074M34	1,256.00	41.23	314.00	164.90
DRS	5	074M44	1,567.00	37.91	313.40	189.56
DRS	1	074N68	23.65	17.31	23.65	17.31
DRS	9	074N76	344.27	17.19	38.25	154.73
DRS	5	514M71	515.00	23.15	103.00	115.73
DRS	1	514M77	108.00	24.45	108.00	24.45
DRS	1	514M77	108.00	24.13	108.00	24.13
DRS	1	704L38	97.37	23.37	97.37	23.37
DRS	1	704L38	100.66	22.66	100.66	22.66
DRS	2	704L48	212.00	29.04	106.00	58.08
DRS	3	704L48	318.00	24.94	106.00	74.82
DRS	12	704S44	3,778.61	36.83	314.88	441.94
DRS	6	704S45	1,872.00	38.13	312.00	228.76
DRS	3	704S47	945.61	39.57	315.20	118.70
DRS	5	704S47	1,567.77	37.18	313.55	185.90
DRS	1	704S49	332.71	40.25	332.71	40.25
DRS	1	704S49	332.58	34.23	332.58	34.23
DRS	2	704S49	664.95	30.78	332.48	61.57
DRS	3	704V38	429.74	39.07	143.25	117.20
DRS	1	704V38	144.25	37.63	144.25	37.63
DRS	3	774M36	450.00	38.14	150.00	114.41
GB Railfreight	4	164L78	828.34	24.75	207.08	99.00

GB Railfreight	2	234L35	344.19	24.04	172.09	48.08
GB Railfreight	4	234L35	688.37	23.20	172.09	92.81
GB Railfreight	3	334L18	804.24	25.82	268.08	77.45
GB Railfreight	1	494E78	191.97	34.38	191.97	34.38
GB Railfreight	6	494M02	1,184.78	33.00	197.46	198.01
GB Railfreight	1	494M21	177.19	29.78	177.19	29.78
GB Railfreight	6	494M23	1,172.78	35.01	195.46	210.05
GB Railfreight	2	494M23	392.93	34.07	196.46	68.14
GB Railfreight	2	494M23	356.38	27.03	178.19	54.06
GB Railfreight	1	494M29	267.00	24.53	267.00	24.53
GB Railfreight	4	494M29	1,068.00	21.56	267.00	86.24
GB Railfreight	4	664G23	28.00	8.75	7.00	35.00
GB Railfreight	7	664G77	45.42	13.42	6.49	93.97
GB Railfreight	2	664L02	354.93	20.96	177.47	41.92
GB Railfreight	2	664L20	358.51	30.51	179.25	61.02
GB Railfreight	2	664L22	381.68	25.39	190.84	50.78
GB Railfreight	1	664L23	177.47	24.71	177.47	24.71
Totals	452					11731.67

Average weighted speed
25.96

PM - Parcels Post Office Controlled

Operator Name	Train Count	Headcode	Planned Total Distance Miles	planned velocity	planned distance per train	frequency * speed
DB Schenker	9	071M03	1,827.00	71.65	203.00	644.82
DB Schenker	12	071M44	2,436.00	77.09	203.00	925.06
DB Schenker	10	351A97	1,809.51	56.25	180.95	562.54
DB Schenker	6	351S55	1,192.66	75.49	198.78	452.91
DB Schenker	10	721S96	3,784.27	63.78	378.43	637.80

Totals	47	3223.14

Average weighted speed
68.58