

# TECHNICAL NOTE

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| <b>DATE:</b>    | 14 May 2020                  | <b>CONFIDENTIALITY:</b> | Restricted |
| <b>SUBJECT:</b> | Tolling Sensitivity Analysis |                         |            |
| <b>PROJECT:</b> | TPTS+ 1-988                  | <b>AUTHOR:</b>          | NN         |
| <b>CHECKED:</b> | RM                           | <b>APPROVED:</b>        | RM         |

## TPTS+ TOLLING SENSITIVITY ANALYSIS – SUMMARY NOTE

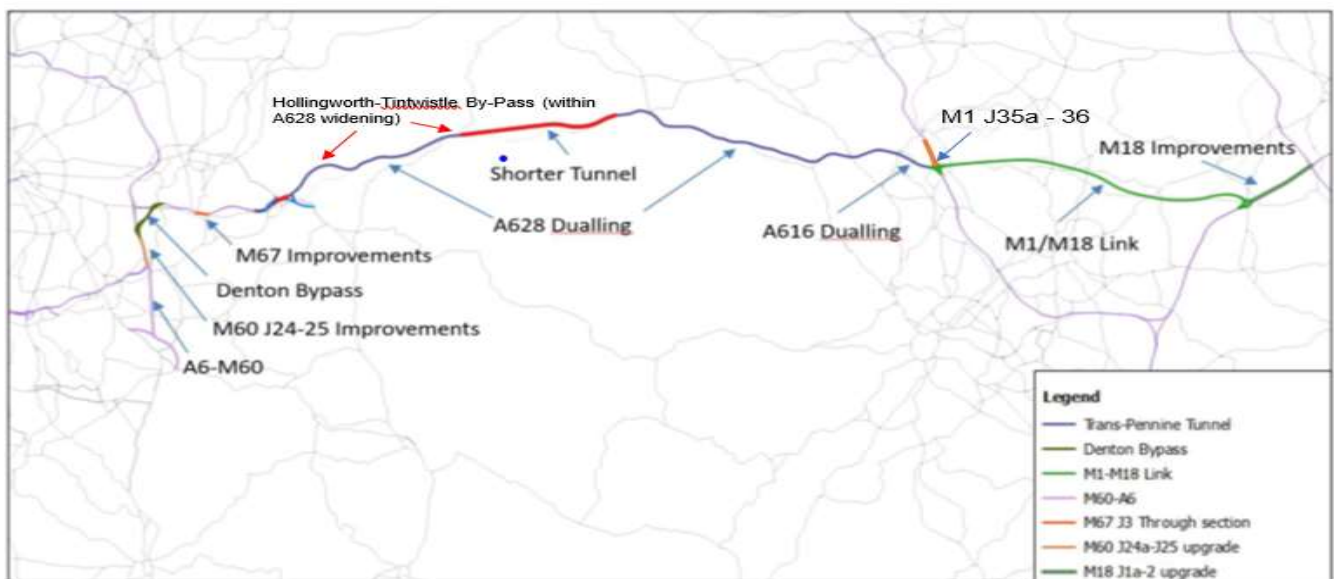
### 1.0 Introduction

The study work relating to the Trans-Pennine Tunnel has included the DfT/Highways England Trans-Pennine Tunnel Study (TPTS) and the TfN Wider Transport Connectivity Assessment (WTCA). Following these studies, the Trans-Pennine Tunnel Strategic Study Plus (TPTS+) produced a Strategic Outline Business Case (SOBC) for an Optimised Package in summer 2019.

The Optimised Package included a tunnel component and a series of additional schemes between the M60 in the west to the A1(M) in the east. Together, this is a very large intervention and following the SOBC the project team was asked to further disaggregate the component parts of the Optimised Package so that they could be appraised in more detail to inform the decision-making process for package development.

Three sub-packages were developed for three affordability bands, each incrementally increasing the number of interventions as incremental steps towards delivery of the full Optimised Package. The final component between sub-Package 3 and the Optimised Package contained the tunnelled section. The individual elements of the Optimised Package are shown in Figure 1.1

**Figure 1.1 – Optimised Package with individual scheme elements**



The three sub-packages were finalised, including further refinement of the component parts shown above, and are presented as a sensitivity test in the Economic Case of the revised SOBC.

In parallel to the SOBC the DfT is developing a paper to support the commercial case and funding options for the scheme. The modelling and appraisal tools used for the economic appraisal were available to undertake a tolling sensitivity test to inform this paper. In early 2020 the DfT requested a sensitivity test to

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provide an indication of the impact on the operational and economic performance, and the potential revenue of a tolled scenario for the Optimised Package.

This note sets out the approach taken for the analysis and a summary of the outputs. It also highlights the limitations of the analysis and any lessons that can be applied from the ongoing Lower Thames Crossing (LTC) study which is at a more advanced stage of analysis for the PCF Stage 3 tolled tunnel assessment.

The note comprises of the following sections:

- The configuration of the tolling sensitivity test
- Approach to transport modelling and appraisal
- Limitations of the modelling
- Limitations of the appraisal
- Assurance of the modelling and appraisal
- Reference to LTC study and lessons
- Reporting sensitivity test outputs
- Key model outputs
- Appraisal outputs (TUBA and WITA)
- Reporting Level 1 and Level 2 BCR compared to un-tolled Core Scenario
- Reporting Level 1 and Level 2 BCR as an incremental appraisal compared against Package 3
- Reporting the toll revenue stream
- Summary

## 2.0 Configuration of the Tolling Sensitivity Test

For the purpose of this note the sensitivity tests are referred to as tolling tests. The mechanism for administering these may be a toll or a user charge.

The tolling structure was agreed based on the vehicle classifications in the transport model and the charging regime on the Dartford Crossings and the M6 Midland Expressway (M6 Toll) tolls. These charge different values for Car, LGV and HGV vehicles. The charge for the TPTS+ sensitivity was set at a value that could be understood in today's prices and directly compared with tolls at these assets.

An initial set of toll values were tested to review the model responses. A second set was later specified as a supplementary test. The toll values were assumed to apply across the whole day for expansion purposes (i.e. it differs to LTC where charges are suspended overnight and the M6 Toll where charges differ by time period).

The value of the tolls used in the tests is shown in Table 2.1. In sensitivity test 1, the toll charges are similar to the M6 Toll which is of a similar length (between the M1 and the M60). The value of the tolls in sensitivity

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test 2 is similar to the Dartford Crossing. This should help to provide context when discussing the impact on traffic volumes and revenue.

**Table 2.1 – Toll charges modelled (2020 prices)**

| Vehicle Class | Sensitivity Test 1 | Sensitivity Test 2 | Dartford <sup>1</sup> | M6 Toll <sup>2</sup> |
|---------------|--------------------|--------------------|-----------------------|----------------------|
| <b>Car</b>    | £5.00              | £2.50              | £2.50                 | £6.70                |
| <b>LGV</b>    | £7.50              | £3.75              | £3.00                 | £11.80               |
| <b>HGV</b>    | £10.00             | £5.00              | £6.00                 | £12.00               |

The toll values shown above are for a one-way trip. The same toll is applied in each direction of travel.

These toll values were not devised to optimise performance of the scheme. They do not represent a benefit, revenue or operational performance optimisation scenario nor do they represent a revenue maximisation scenario. Such analyses would require a different, more detailed modelling tool to provide an acceptable level of assurance.

## 3.0 Transport Modelling and Appraisal

The transport modelling and appraisal was undertaken using the analytical framework used to appraise the Optimised Package and the three sub-Packages.

Its main component is a variant of the Highways England TPS Regional Transport Model. This is a Variable Demand Model (VDM) developed to test the RIS programme and had adequate spatial coverage to assess a scheme of this scale. The VDM is configured using a bespoke DIADEM/HEIDI interface.

The network coding in urban areas, i.e. areas not designed to be modelled in the RIS, has coding that does not accurately capture the impacts of the scheme on urban traffic, particularly through Manchester and Sheffield, but also through smaller conurbations such as Rotherham. The project team has developed an Urban Delay Function (UDF) to apply an exogenous correction to the model assignments. This improves the model responses and the capture of scheme benefits.

The model has two forecast years of 2031 and 2041 with the latter representing the scheme opening year, thus only providing a single forecast year with which to assess the tolls.

The toll values stipulated in 2020 prices are adjusted to the equivalent value for the two modelled years to account for inflation (as toll values are typically indexed annually), and subsequently discounted to 2010

<sup>1</sup> <https://www.gov.uk/pay-dartford-crossing-charge/charges-fines>

<sup>2</sup> <https://www.m6toll.co.uk/pricing/>

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prices for the modelling and appraisal. The inflation has been applied using the growth in Value of Time (VoT) from the TAG Workbook. This approach is standard practice in the modelling of tolls and helps to maintain a consistent user response to the toll over the base year and forecast years.

The appraisal of the scheme for the Level 1 Initial BCR is undertaken using TUBA. This is a standard tool and the TUBA outputs are used directly (i.e. without masking) to report user impacts. The TUBA output is the largest single component of the Level 1 appraisal. A second component relates to accident impacts and has been calculated using a COBALT spreadsheet. The impacts are marginal and do not materially affect the Benefit Cost Ratio (BCR) calculation.

The appraisal of the scheme for the Level 2 Adjusted BCR is undertaken using WITA. This is also a standard tool where the WITA outputs are used directly (i.e. without masking), and the output is combined with a proportion of the TUBA Employers Business benefits to report wider economic impacts. The WITA is supplemented by reliability benefits which have been calculated to be 10% of user benefits. The final component of the Level 2 impacts is construction impacts. These impacts are marginal and do not materially affect the Adjusted BCR.

## 3.1 Limitations of the modelling

It is recognised that the approach undertaken to model the impact of tolls on the Optimised Package may not be robust due to number of limitations, including:

| Limitation of Modelling                                                                                                                         | Impact on Outputs                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Five RTM standard user classes (no willingness to pay income segmentation) in the demand and assignment models.                                 | Uncertainty in demand model and assignment model responses: Without the income distribution of the catchment the volumes from “commute” and “other” user classes cannot be appropriately modelled.                      |
| One user class for business trips independent of trip length.                                                                                   | Uncertainty in “business” user response to the toll: The longer distance / higher value of time trips may have a higher propensity to pay the toll but are not modelled separately in the demand and assignment models. |
| The response of freight users to tolls cannot be modelled in the demand model. Only a rerouting effect can be forecast in the assignment model. | Known limitation in the freight response likely to underestimate the freight users in the Optimised Package and overestimate freight users for the tolled scenarios.                                                    |

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| Limitation of Modelling                                                                                                                                                                                  | Impact on Outputs                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Final modelled year of 2041 with no change in traffic volumes assumed beyond this point.                                                                                                                 | Expected underestimate in network congestion and demand for the scheme. However, impact on user benefits cannot be quantified (not known if the net effect over the whole network is positive or negative), and if tolling will improve network performance by reducing congestion. |
| The projection of toll value to 2031 and 2041 is an approximation based on VoT growth forecasts. This creates the desired model response to maintain user responses to the toll expected at 2020 prices. | The actual toll value applied in 2031 and 2041 may differ from the calculated value and lead to a different user response and different traffic volumes and revenues.                                                                                                               |

These model limitations are inherent in the modelling of the un-tolled Optimised Package. These are recognised limitations and form part of standard practice for use of the RTM. However, the introduction of a tolled scenario results in the model responses becoming increasingly uncertain. The net impact on scheme traffic forecasts and the transport user benefits is not quantifiable. This introduces a level of uncertainty into the BCR and revenue calculations. For this reason, the analysis carries a lower level of assurance.

Despite these caveats, the model outputs provide an insight into the potential responses to the application of a toll and the implications for traffic volumes and network impacts (i.e. generalised costs required for appraisal).

## 3.2 Limitations of the appraisal

It is also recognised that the approach undertaken to appraise the impact of tolls on the Optimised Package may not be robust due to number of limitations, including:

| Limitation of Appraisal                                                              | Impact on Outputs   |
|--------------------------------------------------------------------------------------|---------------------|
| Components of the Level 1 and Level 2 impacts are excluded: COBALT and Construction. | No material impact. |

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| Limitation of Appraisal                                                                                                                                                                                         | Impact on Outputs                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| No growth in traffic beyond 2041 resulting in the 60-year appraisal being based on 2041 forecasts.                                                                                                              | <p>The forecast is independent of traffic volume changes which will occur (user benefits, vehicle operating costs and toll revenues are based on 2041 traffic). The expectation is that growth would occur beyond 2041. This applies equally to the un-tolled and tolled scenarios.</p> <p>Note the economic parameters in TUBA are adjusted beyond 2041 using DfT forecasts. However, the toll value is not adjusted in TUBA (see below).</p> |
| Toll values after the last modelled year are not adjusted (constraint in TUBA).                                                                                                                                 | Underestimate in both user charges incurred and operator revenue collected. Uncertainty to the BCR calculation (a sensitivity test has been undertaken to estimate the impact of toll prices increasing with inflation beyond 2041).                                                                                                                                                                                                           |
| Sensitivity tests on all input variables are not considered, including willingness to pay values (which are excluded), costs, inflation, operating efficiencies (including synergies with other tolled assets). | Only a central value is presented for comparison and decision making.                                                                                                                                                                                                                                                                                                                                                                          |
| Costs of the implementation and administering the toll is excluded. This includes periodic restructuring the toll operating company.                                                                            | The cost of the toll scenario is underestimated (note this is addressed separately in the Study).                                                                                                                                                                                                                                                                                                                                              |
| Compliance is not considered in the appraisal.                                                                                                                                                                  | Impact of cost and revenue of enforcement and Penalty Charge Notices (PCN) is not allowed for. The cost of the scheme is underestimated (note PCN revenue cannot be included in an economic appraisal which assumes 100% compliance).                                                                                                                                                                                                          |

Despite these caveats, the appraisal provides an insight into the potential economic impacts and operational revenue generation to help compare with the un-tolled scenario.

The reporting of the appraisal assumes that the benefit accrued to the operator (toll revenues) can be removed from benefits (PVB) and subtracted from the costs (PVC) to present the BCR. This is standard

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practice with TUBA outputs. These costs include the changes in charges that occur on other tolled assets in the model (e.g. M6 Toll), but these effects are considered marginal.

### 3.3 Assurance of the modelling and appraisal

The tolling sensitivity tests have not been undertaken as part of the main scenario. They are designed to inform considerations for the scheme affordability and to provide an indication of the level of toll revenue that could be generated as a contribution towards the costs of the scheme.

The tests are only reported in the SOBC as a sensitivity.

The results should not be used for other purposes without revisiting the analysis.

The level of assurance required is therefore lower than for the main scenario forming the core of the SOBC. It is also appropriate for a PCF Stage 0 sensitivity test.

### 3.4 LTC study and lessons

The LTC study is currently working towards a DCO and therefore the modelling and appraisal has been developed to reflect PCF Stage 3.

The LTC analytical framework has been configured to model tolls and includes income segmentation to capture the impacts of charging at the existing Dartford Crossings and the proposed new link to the east. The LTC models developed for Statutory Consultation and DCO include 9 and 10 user classes respectively compared with the 5 user classes in the standard RTM from which they are derived.

**Table 3.1 – User Class Comparison between TPTS+ and LTC Models**

| TPTS+ vRTM                 | LTC DCO Model             |
|----------------------------|---------------------------|
| Car Business (all incomes) | Car Business all incomes  |
| Car Commute (all incomes)  | Car Commute low income    |
| Car Other (all incomes)    | Car Commute medium income |
| LGV                        | Car Commute high income   |
| HGV                        | Car Other low income      |
|                            | Car Other medium income   |
|                            | Car Other high income     |

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| TPTS+ vRTM | LTC DCO Model |
|------------|---------------|
|            | LGV           |
|            | HGV Non-Port  |
|            | HGV Port      |

The increased level of segmentation in the LTC model provides a more robust method for modelling tolls which is not included in the vRTM used for the Stage 0 TPTS+ analysis. The segmentation means that the user propensity to pay a toll or charge can be more accurately represented in the demand model and the assignment model. This improves the assurance of the forecast volumes and distribution of trip patterns and the associated calculation of impacts and revenues.

The LTC team has also shared TUBA outputs with the TPTS+ team so that the profiling of tolls beyond the final modelled year can be considered.

The output files show that LTC has four modelled years compared to two for TPTS+. The final model year for LTC extends to 2051 (24 years after scheme opening) compared to 2041 for TPTS+ being the scheme opening year. However, the treatment of tolls for the LTC appraisal seems to be the same as for TPTS+, i.e. the toll values are not adjusted to allow for inflation beyond the final modelled year and the revenue calculation is based on the 2051 value for the remainder of the 60-year appraisal period.

The project team has looked at making the toll price path consistent with other appraisal metrics, e.g. the value of time which continues to increase for the remainder of the appraisal period. This adjustment is applied exogenously to TUBA and introduces an unacceptable level of uncertainty into the assurance. However, the analysis is presented for comparison purposes.

## 4.0 Reporting Sensitivity Test Outputs

### 4.1 Key Model Outputs

The key model outputs are reported in the Combined Modelling and Appraisal (ComMA) Report. These include daily traffic volumes on the scheme and the traffic impacts across the wider network.

The traffic volumes on the tunnel section of the scheme (or A628 in the Do Minimum) are shown in Table 4.1.

**Table 4.1 – Forecast 2041 AADT Flows**

| Do Minimum | Optimised Package | Toll Sensitivity 1 | Toll Sensitivity 2 |
|------------|-------------------|--------------------|--------------------|
| 23,000     | 80,000            | 40,000             | 60,000             |

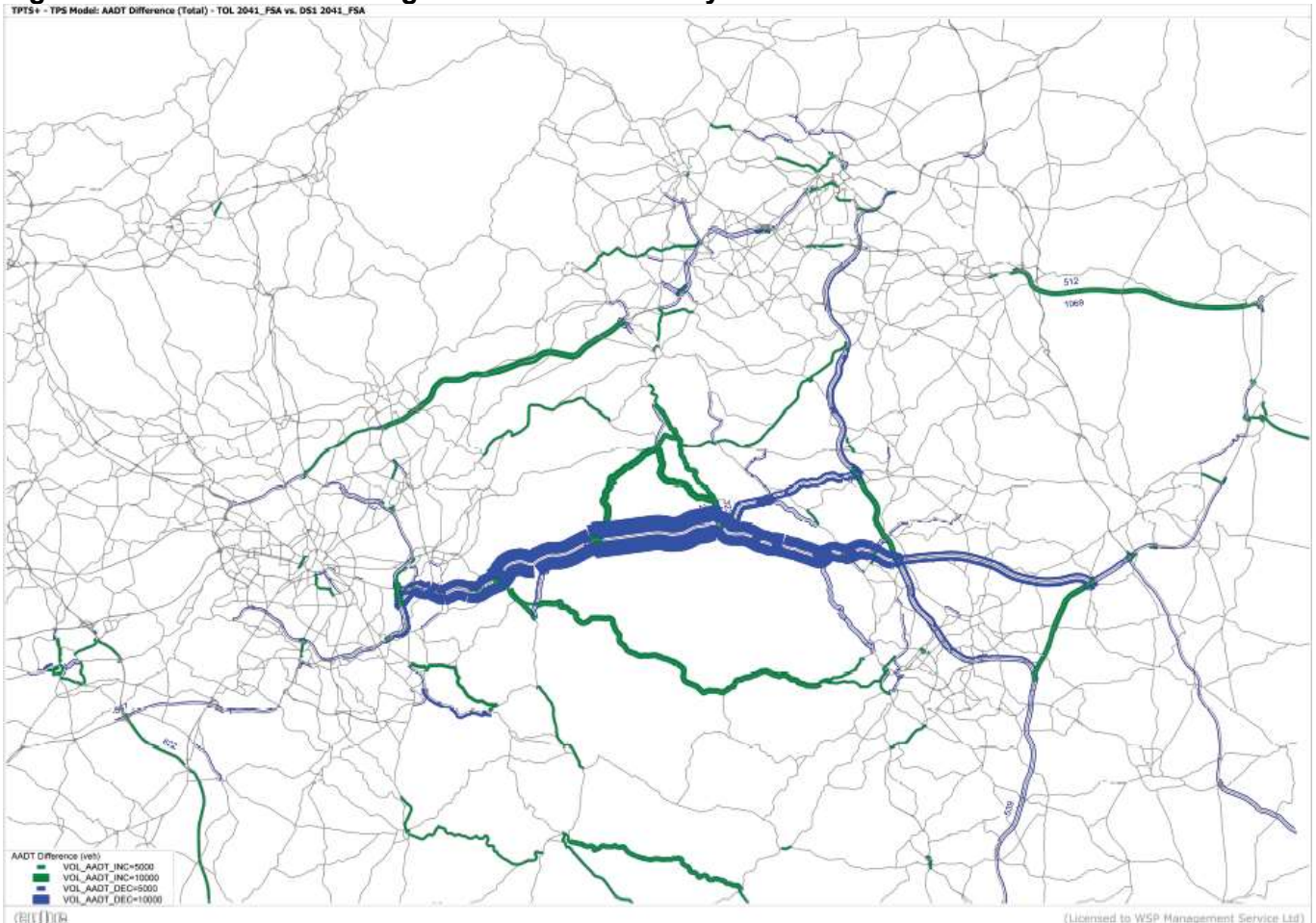
Figures 4.1 and 4.2, show the impact of the two sensitivity tests on AADT (i.e. daily flows) in 2041.

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As shown in Table 4.1, with the higher toll charges, the traffic flow along the tunnel section of the scheme is about half the level without any tolls and this is represented by the broad blue band in Figure 4.1. The green bands show traffic increases relative to the un-tolled scheme. The implementation of the toll results in the reduction of traffic on the scheme and an increase in traffic on parallel routes including the M62 and A57. It has a regional impact with longer distance traffic rerouting from the scheme corridor including the M1 and A1(M) to the M62 towards the North-East.

**Figure 4.1 – Traffic Flow changes with Toll Sensitivity 1**



With the lower level of tolls, traffic across the tunnel section of the scheme is roughly 75% of that with an un-tolled scheme. The impacts in the scheme corridor are similar to the higher toll with traffic rerouting to the M62 and A57. However, the regional impact is less pronounced.

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**Figure 4.2 – Traffic Flow changes with Toll Sensitivity 2**

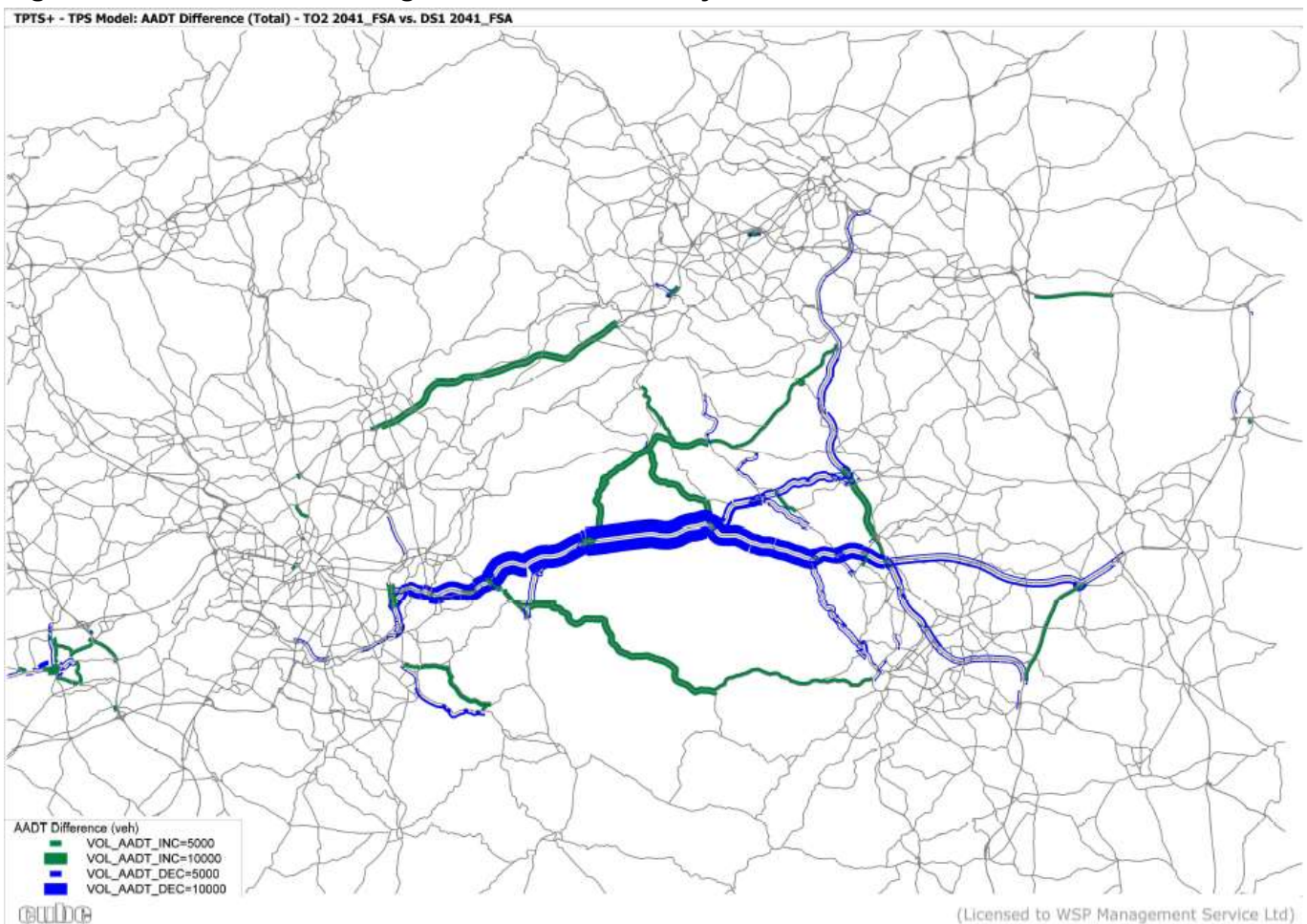
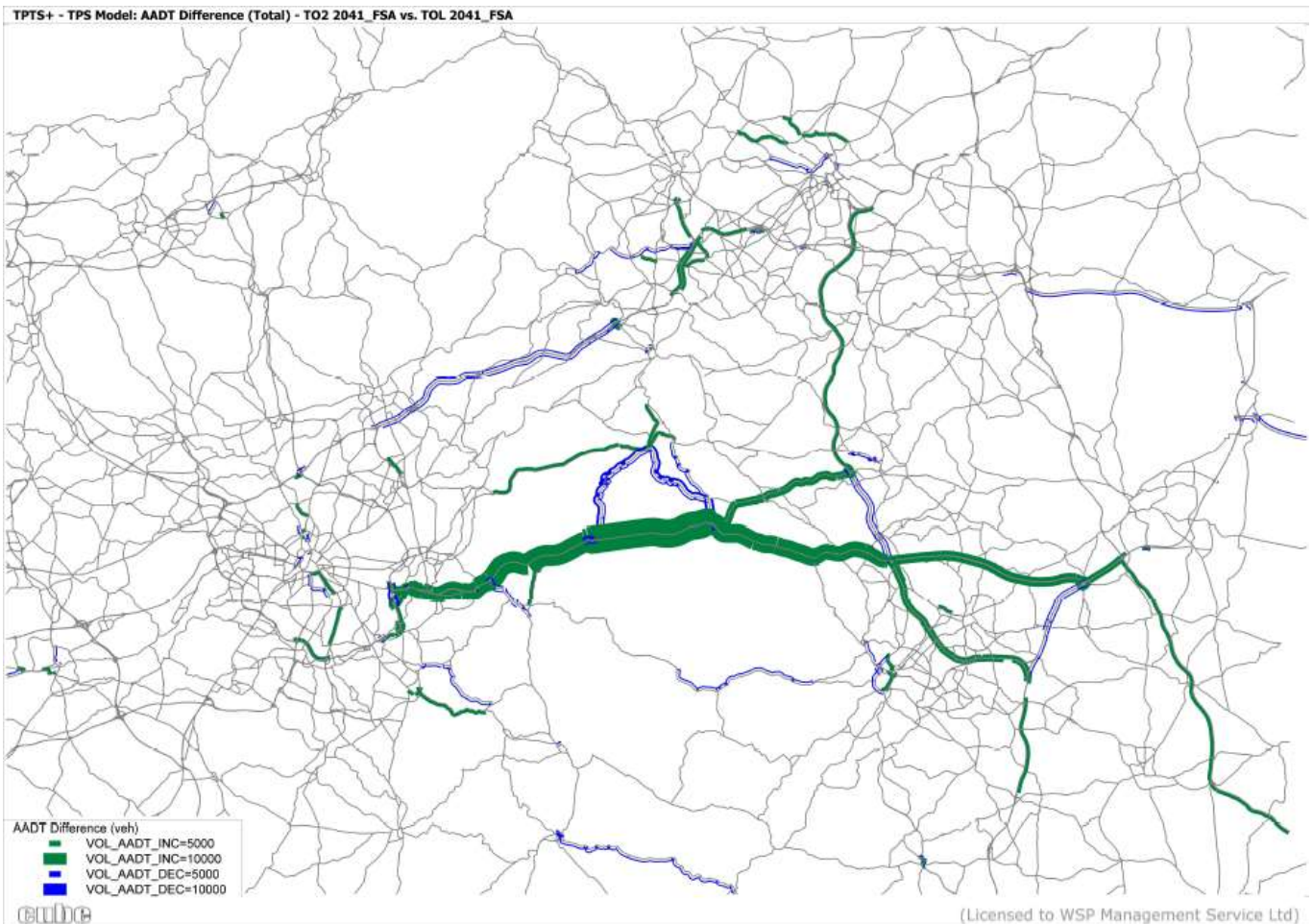


Figure 4.3 shows the change in traffic flow between the two toll scenarios. This highlights difference in the regional impact, with the green bands showing where the lower toll has less impact on reduction in flows, particularly on the M62 and M1.

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**Figure 4.3 – Traffic Flow changes between the two Toll scenarios**



Please refer to the ComMA for detailed reporting of impacts.

## 4.2 Appraisal outputs

The appraisal of the toll sensitivity has been simplified to include only the main components of the impacts.

**Table 4.2 – Impacts Included and Excluded in Assessment**

| Impact  | Included           | Excluded                |
|---------|--------------------|-------------------------|
| Level 1 | TUBA User Impacts  | COBALT Accident Impacts |
| Level 2 | WITA Wider Impacts | Construction Impacts    |

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| Impact | Included                                                      | Excluded |
|--------|---------------------------------------------------------------|----------|
|        | TUBA Wider Impacts component (10% of TUBA Employers Business) |          |
|        | Reliability (10% of TUBA benefits)                            |          |

The impact on the BCR of excluding the accident and construction is negligible (see Table 4.3) and therefore comparing the toll sensitivity analysis without these elements has no material effect on the conclusions.

**Table 4.3 – Change in Optimised Package BCR with removal of excluded components**

| Optimised Package BCR | SOBC - All components | Sensitivity – Main components |
|-----------------------|-----------------------|-------------------------------|
| Level 1               | 1.11                  | 1.09                          |
| Level 2               | 1.87                  | 1.85                          |

The outputs based on TUBA and WITA assessments for a 60-year appraisal are presented in two alternative ways for the two sensitivity tests:

- Tolled Optimised Package against the Do-Minimum; and
- Tolled Optimised Package against Package 3 (i.e. an incremental test).

## 5.0 Benefit Cost Ratio (BCR)

The appraisal for the Optimised Package excluding the accident and construction impacts is shown in Table 5.1. The BCR differs marginally from the full appraisal included in the SOBC. This test is based on comparing the impacts against the Do Minimum scenario.

For sensitivity test 1, the toll revenues calculated by TUBA are around £0.59bn at 2010 prices discounted to 2010. The user charges incurred are of a similar order and this is reflected in the reduction in benefits (PVB). The Level 1 BCR is marginally higher than for the Optimised Package. However, the WITA benefits are significantly lower and therefore the Level 2 BCR is lower compared with the un-tolled scenario.

For sensitivity test 2, the toll revenues are around £0.42bn at 2010 prices discounted to 2010 (the user charges are of a similar magnitude). The user benefits (excluding the impact of charges) are higher compared with the un-tolled scenario. The net impact is a small further improvement in the Level 1 BCR. The WITA benefits are lower compared with the un-tolled scenario, however, the Level 2 BCR is still marginally better.

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Part of the reduction in WITA benefits can be attributed to the increase in generalised costs created between origins and destinations by the addition of the toll. For example, if the value of time of a user is £10/hour, the £5 toll will equate to 30 minutes being offset from the journey time savings created by the Optimised Package. This results in a large reduction in WITA benefits for sensitivity test 2 and a proportionate reduction, i.e. about twice the value, for sensitivity test 1.

**Table 5.1 – Summary of Economic Assessment**

|                           | Optimised Package | Toll Sensitivity 1 | Toll Sensitivity 2 |
|---------------------------|-------------------|--------------------|--------------------|
| Outturn Costs (£m)        | 15,408.55         | 15,408.55          | 15,408.55          |
| CAPEX                     | 3,629.57          | 3,629.57           | 3,629.57           |
| OPEX                      | 483.42            | 483.42             | 483.42             |
| Toll Revenues             |                   | -588.72            | -426.48            |
| PVC (£m) (EO Most Likely) | 4,113.00          | 3,524.28           | 3686.52            |
| Level 1 PVB (£m)          | 4,489.99          | 3,930.88           | 4307.72            |
| <b>Level 1 BCR</b>        | <b>1.09</b>       | <b>1.12</b>        | <b>1.17</b>        |
| Reliability               | 441.21            | 421.90             | 444.68             |
| WITA                      | 2,684.18          | 1,770.35           | 2,182.20           |
| Total Level 2 PVB         | 7,615.38          | 6,123.14           | 6934.61            |
| <b>Level 2 BCR</b>        | <b>1.85</b>       | <b>1.74</b>        | <b>1.88</b>        |

The cost for the tolling sensitivity tests excludes the capital and operational cost of implementing and operating toll collection. This has been taken into account separately as part of DfT's work in developing its paper.

## 6.0 Incremental Benefit Cost Ratio (BCR)

Table 6.1 shows the incremental BCR of the Optimised Package, with and without tolls, when compared against sub-Package 3.

The completion of the un-tolled Optimised Package provides an incremental adjusted (Level 2) BCR of 1.5 when compared against Package 3. This indicates that the final component of the Optimised Package could provide an acceptable VfM.

For sensitivity test 1, the adjusted (Level 2) BCR is significantly lower and could result in a lower VfM Category to that of the un-tolled Optimised Package.

For sensitivity test 2, the adjusted BCR is similar to the un-tolled scenario.

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**Table 6.1 – Summary of Incremental BCR against sub-Package 3**

|                                | Optimised Package | Toll Sensitivity 1 | Toll Sensitivity 2 |
|--------------------------------|-------------------|--------------------|--------------------|
| Incremental PVC (£m)           | 2,450.67          | 1,861.95           | 2,024.19           |
| Incremental Level 1 PVB (£m)   | 1,969.79          | 1,410.68           | 1,787.52           |
| <b>Incremental Level 1 BCR</b> | <b>0.80</b>       | <b>0.76</b>        | <b>0.88</b>        |
| Incremental Level 2 PVB (£m)   | <b>3,740.63</b>   | <b>2,248.39</b>    | <b>3059.85</b>     |
| <b>Incremental Level 2 BCR</b> | <b>1.53</b>       | <b>1.21</b>        | <b>1.51</b>        |

## 7.0 Estimate of Revenue from Tolls

The main purpose of this analysis was to understand the potential revenue that could be generated from tolling, as well as the impact of tolling on the value for money of the Optimised Package. The TUBA assessment of toll revenue excludes any increase in toll from the toll values set in 2041. Without the ability to index link these values, the toll charge used by TUBA is diminishing in real-terms. This in turn leads to a significant under-estimate in both the likely revenue generated from the tolls and the user charges incurred by users paying the toll. An adjustment to this underestimate would change the gearing of the BCR relationship by reducing the benefits and the costs in the calculation.

Given the limitations of the TUBA analysis to estimate the index-linked toll revenue, we have undertaken an external calculation of the likely toll revenue from the two toll tests. This is based on recalculating both the operator revenue (tolls collected) to offset costs in the BCR calculation and user charges (tolls paid by users) to reduce the benefits in the BCR.

There is no recognised method for selecting the values for the indexation of the toll values. We have used two alternative parameters to test the sensitivity of the BCR to alternative assumptions for the indexation of the toll values beyond 2041:

- General inflation at 2.5% per annum; and
- GDP inflation based on the TAG workbook.

A third benchmarking test was also undertaken to replicate the TUBA method and compare the level of error in the output. This variance (as a proportion) can be used reflect the level of uncertainty in the two sensitivity tests.

TUBA reports a value for the user revenues which are presented as a user disbenefit, and operator revenue which is applied as a reduction in cost. This is effectively the transfer of revenue from the user (paying tolls) to HM Treasury (collecting tolls). However, due to internal calculations in TUBA, including the treatment of tax, the values are similar, but not exactly the same. We have used the externally

## TECHNICAL NOTE

|                 |                              |                         |            |
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| <b>DATE:</b>    | 14 May 2020                  | <b>CONFIDENTIALITY:</b> | Restricted |
| <b>SUBJECT:</b> | Tolling Sensitivity Analysis |                         |            |
| <b>PROJECT:</b> | TPTS+ 1-988                  | <b>AUTHOR:</b>          | NN         |
| <b>CHECKED:</b> | RM                           | <b>APPROVED:</b>        | RM         |

calculated operator revenue to replace the TUBA value in the GDP and Inflation sensitivity tests. This is applied as a reduction in cost. We have no means of directly calculating the user impacts. Therefore, we have applied the same proportionate change to the user charges. This has enabled us to calculate a revised BCR for the inflation and GDP based external calculation.

|                                 | Toll Sensitivity 1 | Toll Sensitivity 2 |
|---------------------------------|--------------------|--------------------|
| TUBA Operator Revenue           | £589m              | £426m              |
| TUBA Adjusted BCR               | 1.74               | 1.88               |
| Inflation test Operator Revenue | £2,080m            | £1,503m            |
| Inflation test Adjusted BCR     | 2.33               | 2.28               |
| GDP test Operator Revenue       | £2,226m            | £1,608m            |
| GDP test Adjusted BCR           | 2.44               | 2.34               |

The sensitivity test shows that modelling the revenue stream by projecting an increase in toll values beyond 2041 could increase the BCR from 1.74 to 2.44 in Toll Sensitivity 1 and from 1.88 to 2.34 in Toll Sensitivity 2. However, this result must be considered together with the uncertainty related to this analysis, in particular the core analysis using TUBA outputs directly is consistent with industry practice for reporting tolling and charging analysis (e.g. for the ongoing LTC analysis). These tests are merely indicative and of low assurance and therefore it is not appropriate or proportionate to place reliance on the outputs without further work.

The external calculation of revenue carries a level of uncertainty. The level of error associated with this was calculated by benchmarking. The TUBA output of £589m for Toll Sensitivity 1 was calculated using the external method and gave a value of £679m. This variance can be attributed to the treatment of VAT (business users recover this at the prevailing rate of 20% in TUBA) and the difference between using weekday annualization in TUBA compared with AADT flows in the external analysis. Based on this comparison, the results of the revenue calculated in the two sensitivity tests could be overestimated by around 15%.

A financial analysis was not undertaken as part of these sensitivity tests. However, a calculation was undertaken to estimate the revenue that would be collected in the first year of operation. The toll values for 2041 adjusted for inflation were multiplied through by the AADT traffic forecasts. The revenue that these tolls would generate for a single year in 2041 is shown below. These are undiscounted values presented in 2041 prices and cannot be compared with the TUBA outputs.

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|                          | Toll Sensitivity 1 | Toll Sensitivity 2 |
|--------------------------|--------------------|--------------------|
| 2041 Car Toll            | £8.40              | £4.20              |
| 2041 LGV Toll            | £12.60             | £6.30              |
| 2041 HGV Toll            | £16.80             | £8.40              |
| 2041 Daily Toll Revenue  | £391k              | £283k              |
| 2041 Annual Toll Revenue | £143m              | £103m              |

## 8.0 Summary

Based on the TUBA analysis, the tolling sensitivity tests show that the Level 1 and Level 2 BCR can be maintained under a scenario where the Optimised Package is tolled. This improves the affordability of the scheme but the toll revenue under any scenario will not cover the scheme costs. The tests indicate that high volumes of additional traffic across the Pennines can be achieved under a tolled scenario which is set at the lower toll values tested (toll sensitivity 2).

The analysis has limitations that need to be caveated in presenting the results. The main caveats relating to the modelling are the lack of income segmentation in the model and the fixed demand for LGVs and HGVs.

The analysis is also limited by the constraints in TUBA of dealing with toll revenues. The exogenous adjustment to account for these would introduce a level of uncertainty that would lower the assurance of the output to an unacceptable level. This work has therefore been presented as a sensitivity analysis.

The externally calculated estimate of toll revenues indicate that a higher VfM category could be achieved if a fuller analysis is undertaken to project increases in toll values beyond 2041.

These toll sensitivity tests have been developed to look at a potential upside relating to revenue streams due to a known limitation in the appraisal tools. There are likely to be other limitations in the tools but as all schemes are compared on an equal basis there is an understanding that these effects are assumed neutral in the decision-making process. Therefore, this particular upside should be considered within this context, noting that other limitation could result in either upsides or downsides if they were also considered.