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# M6 to A1(M) Corridor Study

## Combined Modelling and Appraisal (ComMA) Report

**FINAL DRAFT | CONFIDENTIAL**

**Report Number: SPaTS 1-878 M6 – A1(M) P04 S0**

March 2020

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# Document Control

| | |
|---|---|
| **Document Title** | M6 to A1(M) Corridor Study<br>**Combined Modelling and Appraisal (ComMA) Report**<br>M6 to A1(M) Corridor Study Scheme |
| **Author** | [redacted] (AECOM) |
| **Owner** | [redacted] - (Highways England – Project Manager) |
| **Distribution** | [redacted] - (Highways England – Project Manager)<br>[redacted] - (AECOM – Project Manager) |
| **Document Status** | FINAL Draft **CONFIDENTIAL** |

Record of Issue

| Revision | Status | Author | Date | Checker | Date | Approver | Date | Authorised for Issue | Date |
|---|---|---|---|---|---|---|---|---|---|
| V1 | Working Draft | IT | 03.04.20 | | | - | - | - | - |
| V2 | Working Draft | IT | 20.04.20 | SH | 22.04.20 | | | - | - |
| V3 | Draft Issue | IT | 24.04.20 | FM | 28.04.20 | LA | 29.04.20 | | |
| V4 | Final Draft | IT | 16.06.20 | FM | | LA | 18.06.20 | | |
| V5 | Final Draft – minor correction | IT | | FM | | LA | 25.06.20 | | |
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**Contents**



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# 1 INTRODUCTION

## 1.1 Background to the Scheme

Highways England have commissioned AECOM to examine the potential for a new strategic highway link across the Pennines, creating an additional link between the M6 and the A1(M). This commission follows on from an earlier strategy shaping study which reviewed the existing Central Pennines Corridor (CPC) conditions and examined the potential for Trans-Pennine highway improvements.

That study considered three strategic components:

- Skipton-Harrogate: Extending from the North-West of Blackburn to the West of York broadly following the A59, capturing Clitheroe, Skipton and Harrogate and the A1(M). This corridor serves the Lancashire and York, East Yorkshire and East Riding Strategic Economic Plans (SEPs).

- Leeds-Bradford: A central corridor that stems from the Eastern point of the M65, in Colne, to York, serving the conurbations of Leeds and Bradford, Leeds-Bradford International Airport, the M1 and the A1(M). This corridor also serves the Lancashire and York, East Yorkshire and East Riding SEPs.

- Bradford-Halifax: Runs South of the M65 and primarily serves Halifax, Bradford and the M62. This corridor includes parts of Lancashire and Leeds City Region SEPs.

An initial scoping study identified four possible Trans Pennine corridor concepts to provide additional East-West strategic highway capacity and alleviate congestion issues on existing routes identified within the baseline assessment. On the basis of high level assessment for this work two of those were identified for further testing. They are discussed in this report.

## 1.2 Study Area

The Study area is shown in **Figure 1**.

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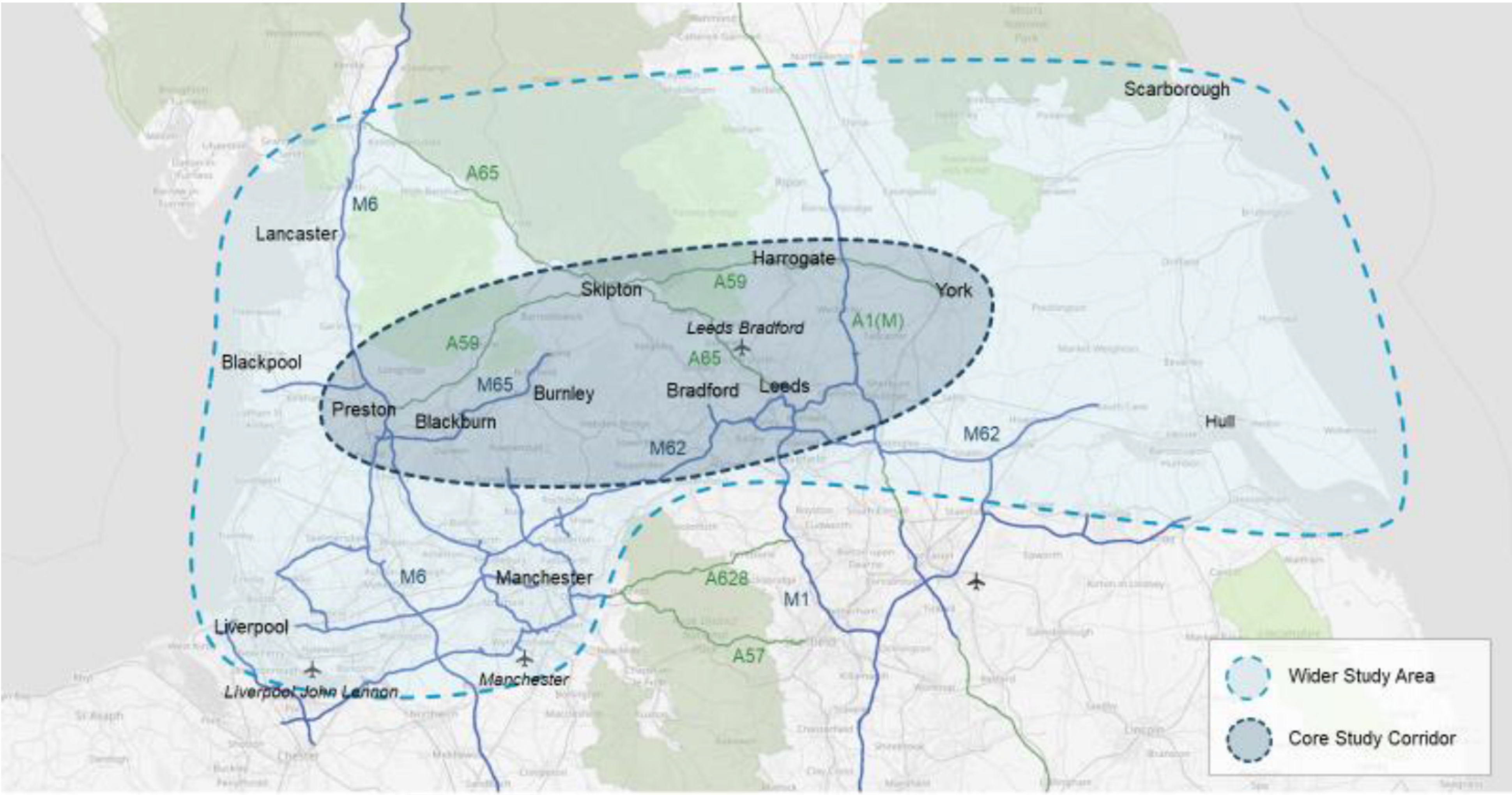
### Figure 1 Study Area



Four initial routes were identified and modelled as part of the initial testing phase within the study area. The four routes have now been refined and prioritised down to two main routes with an additional shorter variant for one route also considered. These are summarised as follows:

- Orange (long) – Colne (M65), Skipton, Leeds Bradford Airport (LBA), A1(M) and York (A64);
- Orange (short) – Colne (M65), Skipton, Leeds Bradford Airport (LBA), stopping at the A1(M); and
- Purple – Colne (M65), LBA and A64 east of Leeds.

Indicative routes for these options are shown in **Figure 2** to **Figure 4.**

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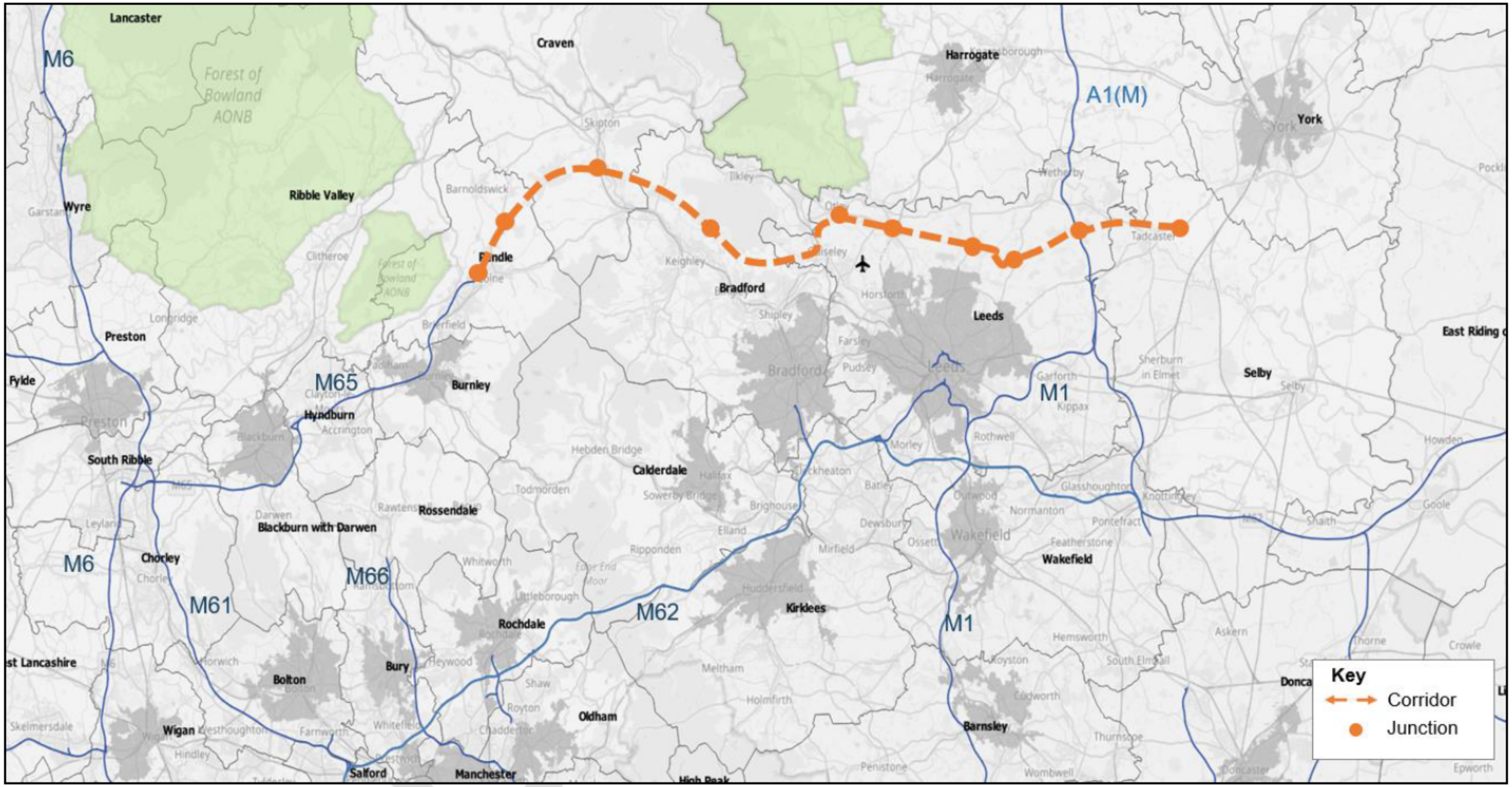
### Figure 2 Indicative Alignment for Orange (long) Route



### Figure 3 Indicative Alignment for Orange (short) Route

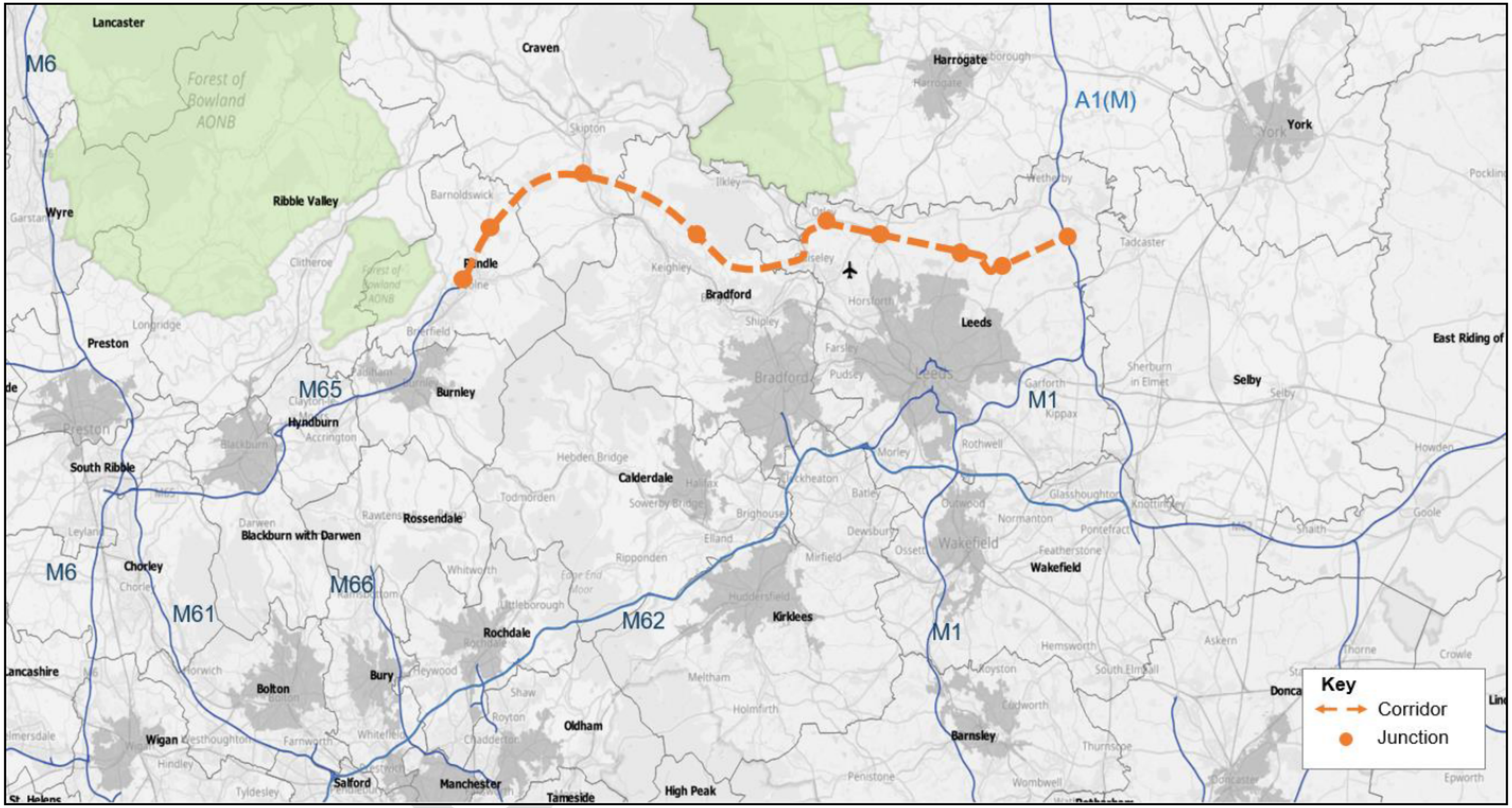
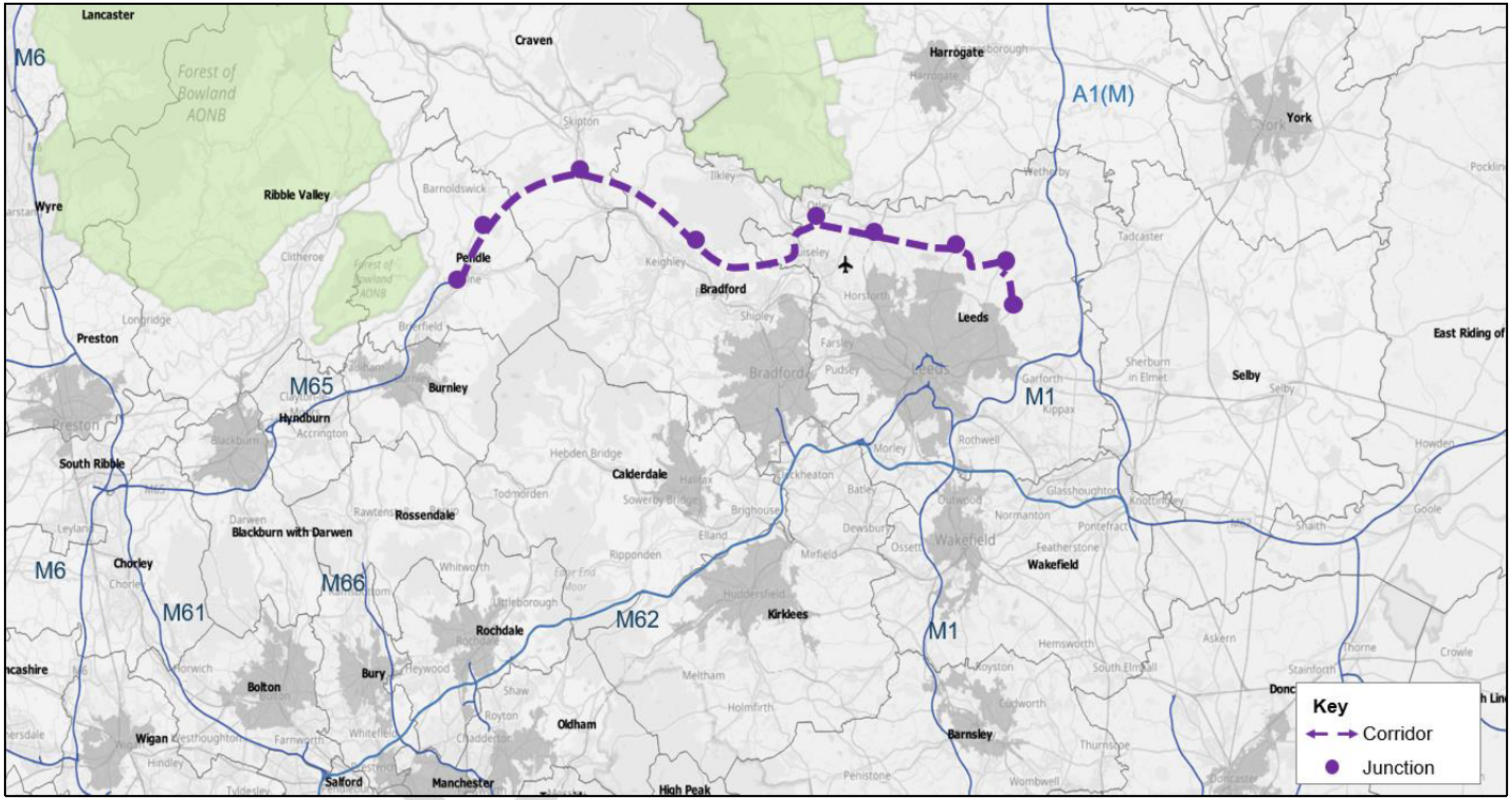


**Figure 4 Indicative Alignment for Purple Route**



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# 2 LOCAL TRANSPORT SITUATION

## 2.1 Local transport system and key travel demands

The total daily traffic demand crossing the north Pennines region as reflected in the Trans Pennine South Regional Traffic Model (TPS-RTM) is shown in **Table 1**.

**Table 1 Summary of Trans Pennine trips (Total PCUs)**

| | Origin | AM Peak | Inter Peak | PM Peak | 12 Hour Total |
|---|---|---|---|---|---|
| Eastbound | **Cumbria** | 735 | 567 | 868 | 8,206 |
| | **Lancashire** | 1,963 | 1,624 | 1,794 | 21,014 |
| | **Merseyside** | 597 | 782 | 627 | 8,367 |
| | **Gr Manchester** | 3,242 | 782 | 3,883 | 26,072 |
| | **Sub Total** | **6,537** | **3,755** | **7,172** | **63,659** |
| Westbound | **West Yorkshire** | 3,996 | 2,766 | 4,609 | 42,412 |
| | **East Yorkshire** | 428 | 3,731 | 311 | 24,604 |
| | **North Yorkshire** | 1,612 | 429 | 1,796 | 12,795 |
| | **North East** | 756 | 1,231 | 737 | 11,864 |
| | **Sub Total** | **6,792** | **8,156** | **7,454** | **91,675** |
| **Total** | **Total** | **13,329** | **11,911** | **14,626** | **155,333** |

*Source: Highways England TPS-RTM (2015)*

North of the M62 there are a number of A roads that serve cross Pennine movements.

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**Figure 5** shows a select link analysis from the do minimum traffic model showing the relative demand on the four links closest to the core area.  Across the four routes there are a total of 2,130 vehicles assigned in the eastbound direction in the morning peak period.

A further 6,400 vehicles use the M62 eastbound in the AM peak, **Figure 6** shows that a proportion of this traffic is drawn from the North Central Pennine region.

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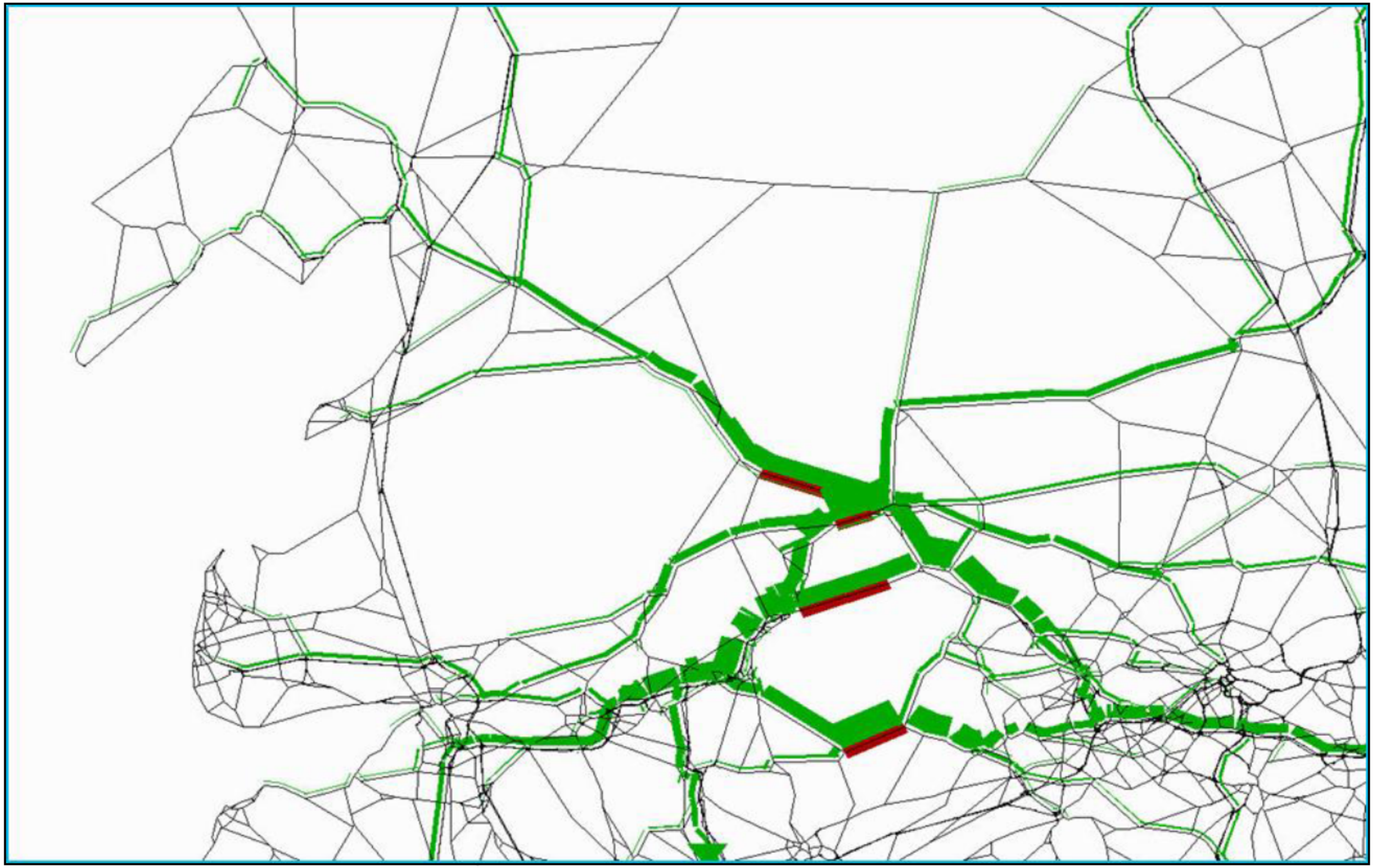
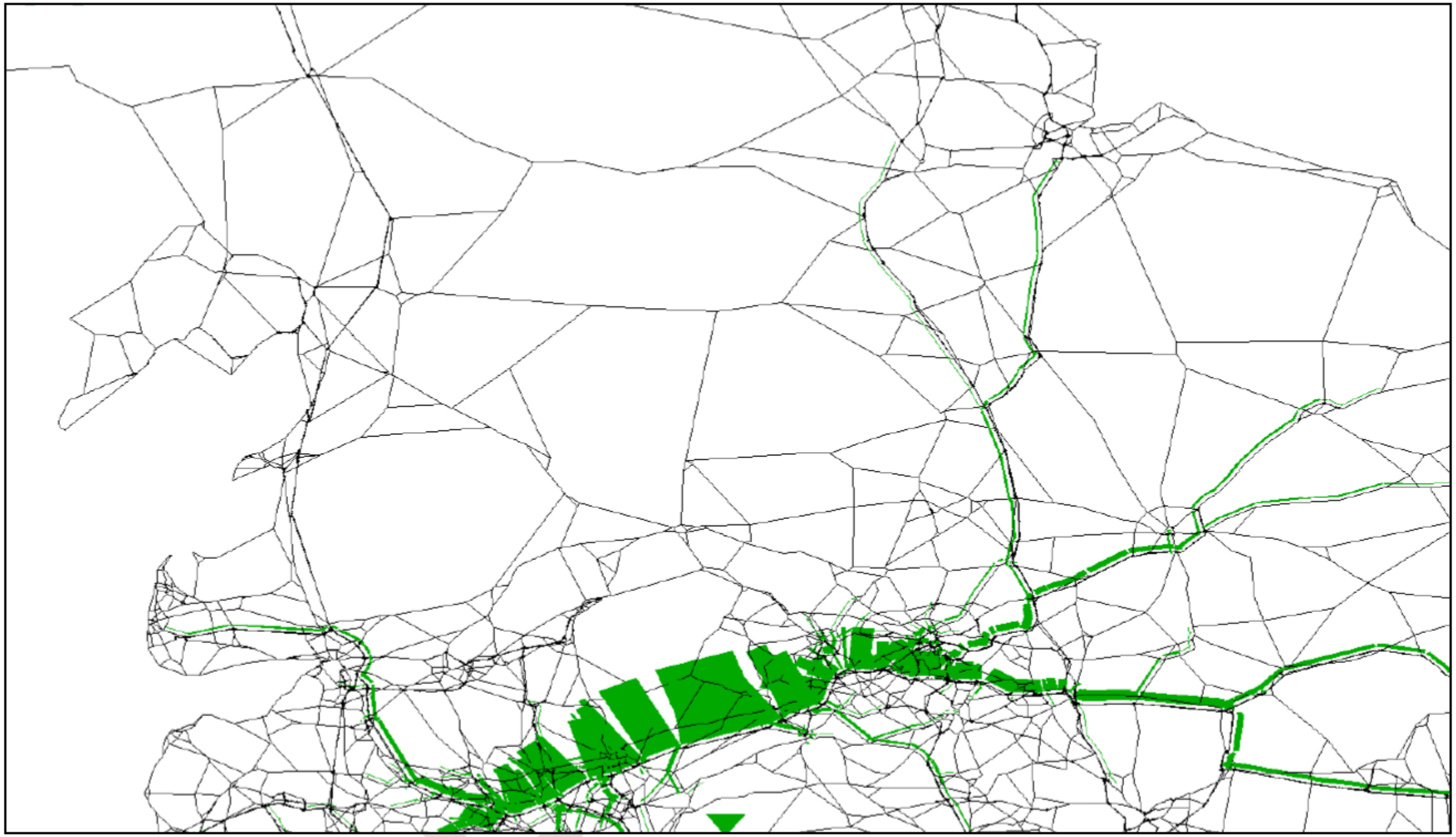
**Figure 5 Central North Pennines – AM Peak Eastbound Select Link**



*Source: Highways England TPS-RTM (2015)*

**Figure 6 M62 – AM Peak Eastbound Select Link**



*Source: Highways England TPS-RTM (2015)*

# 3 MODELLING AND APPRAISAL RESULTS

## 3.1 Traffic Model Results

Traffic model results have been compiled based upon a series of metrics which reflect the study objectives set out in the strategy shaping study. These are:

- Journey time differences between key economic centres east and west of the Pennines;
- The journey time and delay impact on the existing major Trans Pennine corridor, the M62 motorway;
- The level of flow in the new corridor by scenario; and
- Impact on flows on the existing M65 and M62 corridors.

These metrics have been assessed for the notional opening year of 2041. The metrics will form evidence to evaluate the level of benefit from each of the three route variations considered at this stage. The values have been rounded to the nearest thousand.

### *Route Corridor Flows*

Route corridor flows have been extracted based upon typical AADT flows in 2041. The range of traffic volume, based upon flows along each route, has been summarised in **Table 2** below.

**Table 2 AADT Corridor Flows (PCUs) Summary**

| Route | AADT Range |
|---|---|
| Orange (short) | 25,000 – 43,000 |
| Orange (long) | 11,000 – 43,000 |
| Purple | 26,000 – 44,000 |

The AADT corridor flow summary shows similar levels of heaviest flow with the Purple route experiencing the highest trafficked route with a 1,000 additional vehicles AADT when compared against the Orange routes. The Orange long route experiences significantly lower flows than the other two route variations. This can be attributed to the Orange long route extending east of the A1(m), the only route to do so, where there is lower demand and less strategic journeys. This is shown later in **Figure 8**.

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**Figure** 7 shows the Orange (short) route AADT eastbound and westbound per section. The results show that the highest flows are concentrated close to Leeds-Bradford Airport (LBA) with easy access to proposed route to commuters from Leeds and Bradford. The flows eastbound are typically heavier than westbound flows with an additional 3,000 vehicles AADT.

**Figure 8** shows the Orange (long) route AADT flows eastbound and westbound per section. The flow concentration around LBA is consistent with the Orange short route. As discussed in **Table 2**, flows are significantly lower East of the A1(M), less than half the average AADT flow experienced across the whole of the route.

**Figure 9** shows the Purple route AADT flows eastbound and westbound per section. All three route flows are relatively consistent given that there are no changes to the route under the three variations from the M65 until North of Leeds. The purple route has an AADT, averaging 35,000 eastbound and 32,000 westbound across the whole route, the highest of the three variations.

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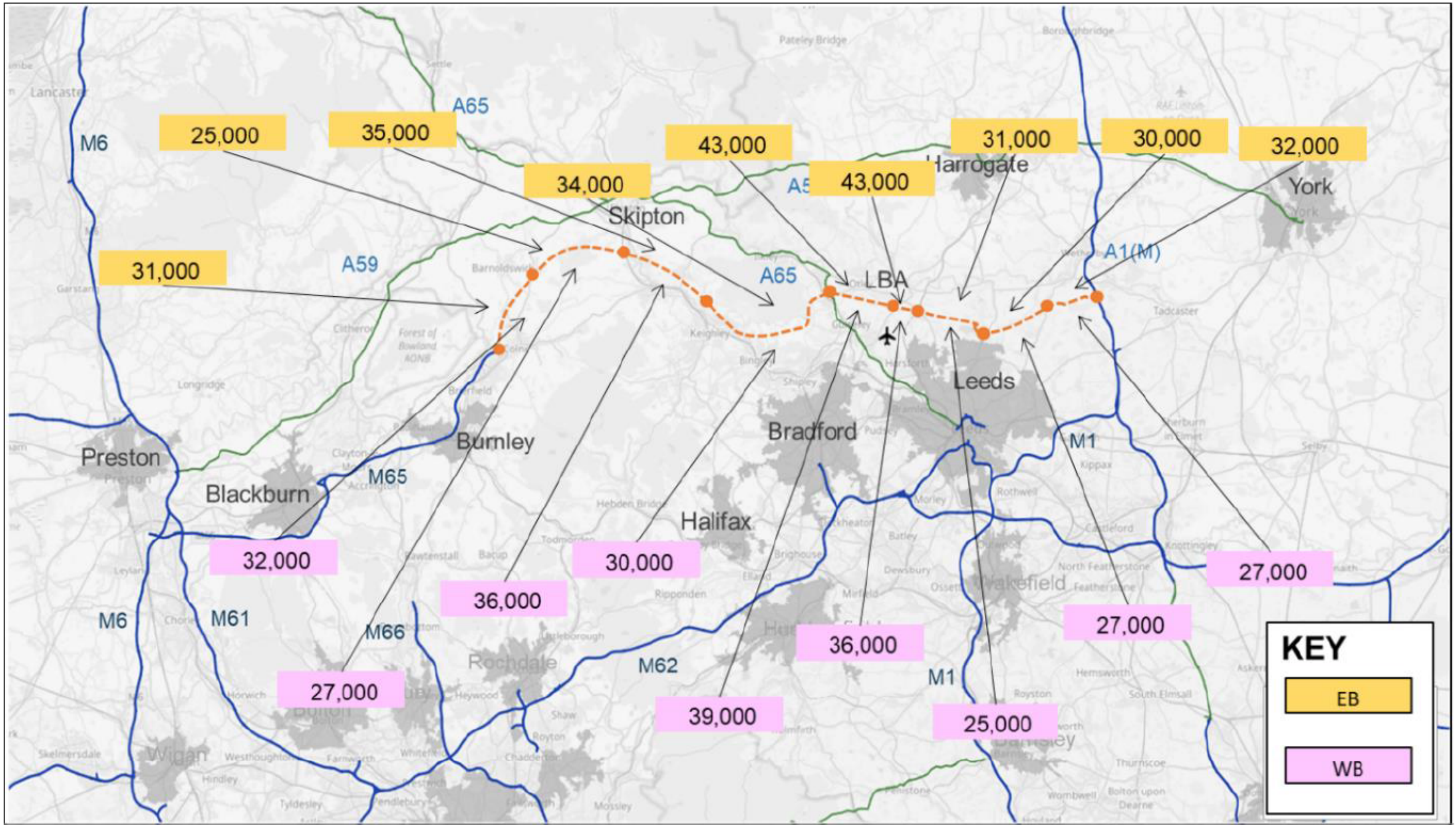
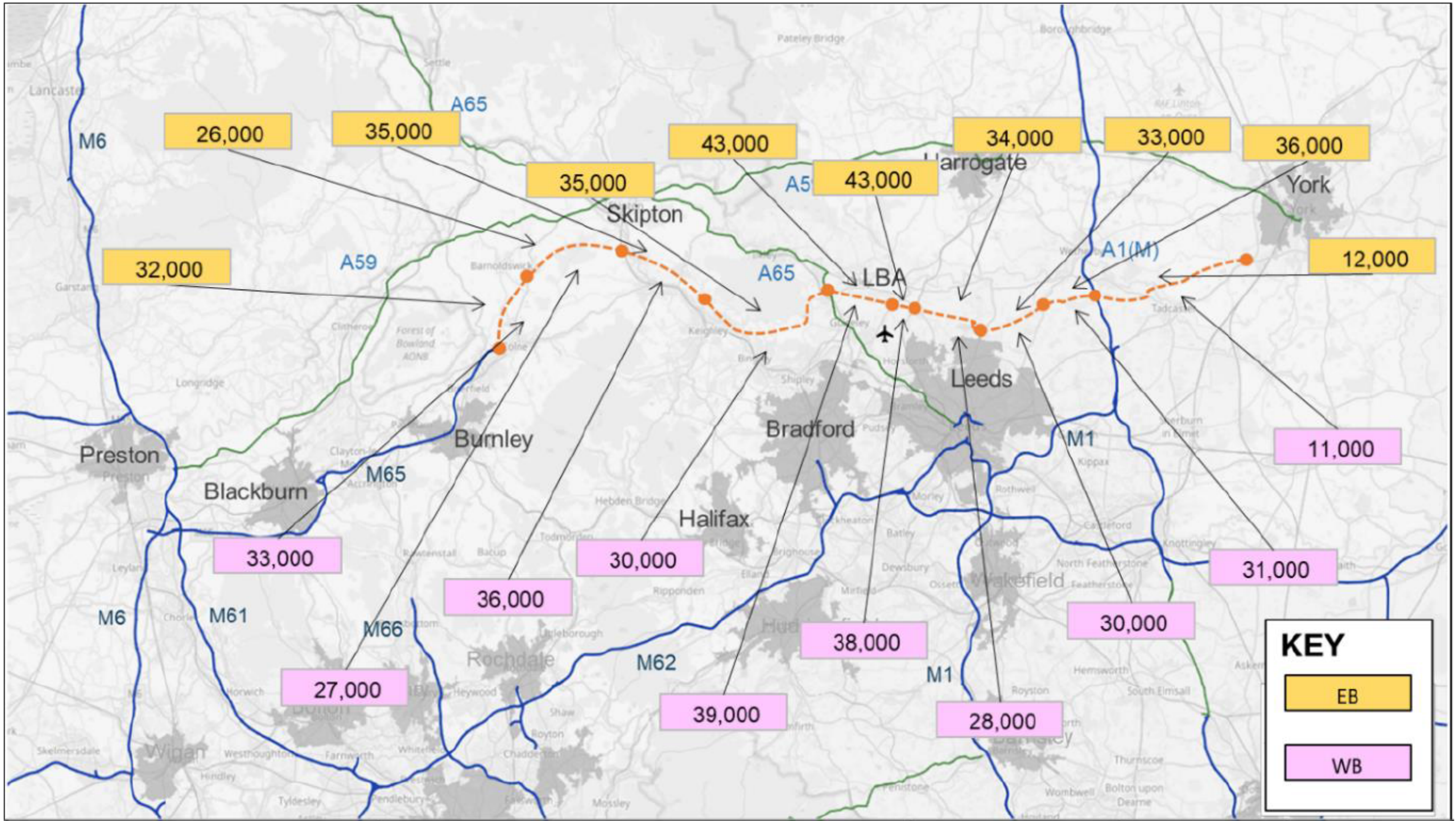
**Figure 7 Orange (Short) Scenario – 2041 AADT (PCUs) Corridor Flows**



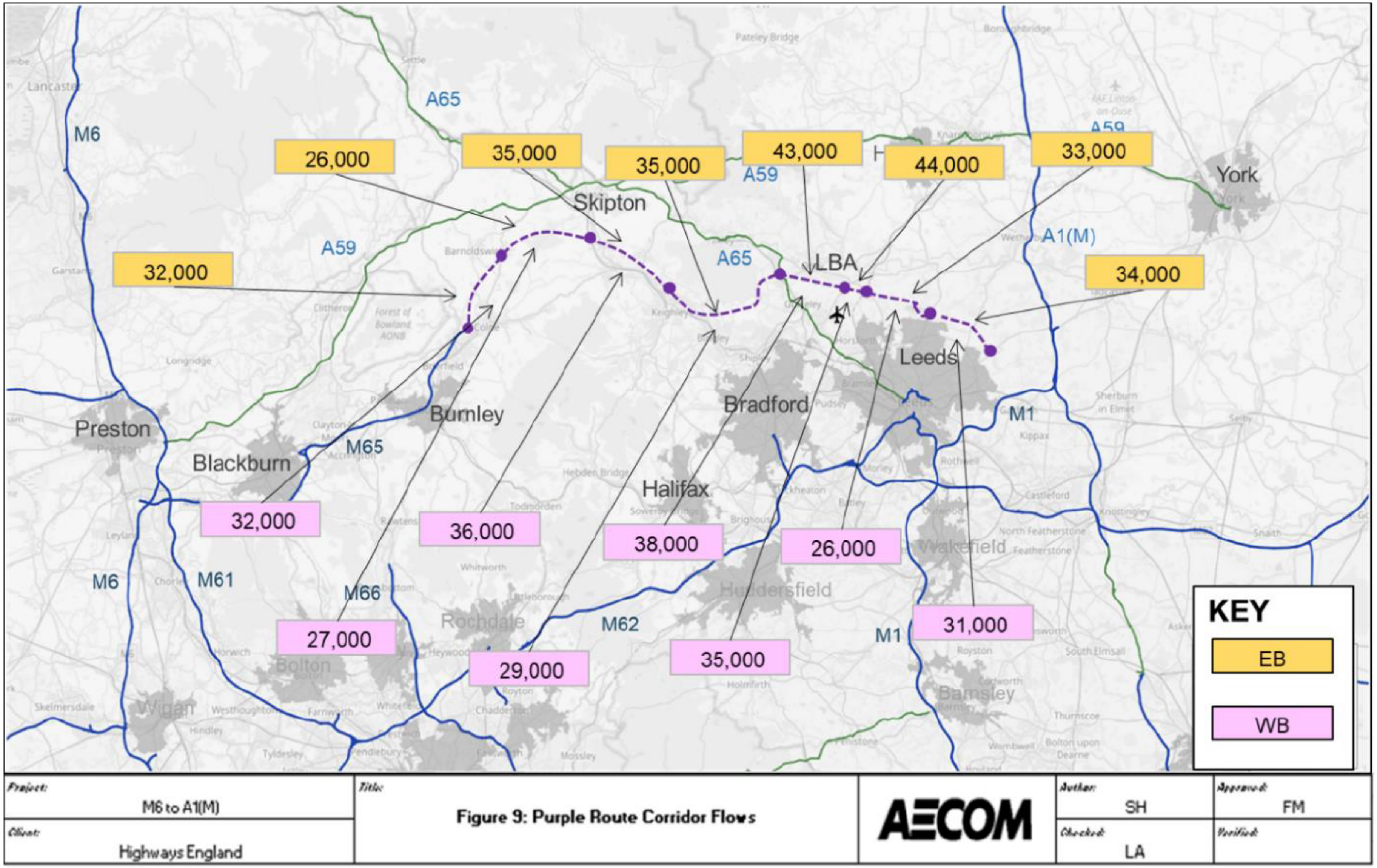

| Project | Title | | Drafted | Approved |
|---|---|---|---|---|
| M6 to A1(M) | Figure 7: Orange (short) Route Corridor Flows | AECOM | SH | FM |
| Client: Highways England | | | Checked: LA | Verified: |

### Figure 8 Orange (Long) Scenario – 2041 AADT (PCUs) Corridor Flows




| Project: M6 to A1(M) | Title: **Figure 8: Orange Route Corridor Flows** | AECOM | Author: SH | Approved: FM |
|---|---|---|---|---|
| Client: Highways England | | | Checked: LA | Verified: |

**Figure 9 Purple Scenario – 2041 AADT (PCUs) Corridor Flows**



### *Impact on Existing SRN Routes*

Traffic flows for each section of the M65 and M62 have been compiled to understand the impact of a new Trans-Pennine route on the existing Strategic Route Network. The two motorways have been chosen due to their proximity and existing function and will likely experience the biggest traffic flow variance as a result of the scheme.

**Table 3** shows two-way AADT flows for the three scenarios which result in broadly similar increases in flow on the M65 with additional volumes increasing closer to the start of the route. This can be attributed to vehicles joining the M65 from other areas of the SRN such as the A56/M66 and towns nearby such as Burnley and Nelson.

**Figure 10** shows the M65 AADT Do-Minimum scenario and each route under the 2041 forecast year. The route shows little variance between each of the proposed routes with the largest variance being a 1,000 additional vehicles AADT on the Purple route at sections across the motorway. **Figure 10** reiterates the findings in **Table 3** and indicates that the scheme will have the largest impact on the eastern section of the M65.

**Table 3 M65 Flow Changes (2041 two-way AADT PCUs)**

| M65 Section | | Do Minimum | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|---|---|
| M61 – Blackburn (J3-J4) | Flow | 87,000 | 94,000 | 94,000 | 94,000 |
| | Change | | 7,000 | 7,000 | 7,000 |
| Blackburn – A56 (J7-J8) | Flow | 91,000 | 106,000 | 107,000 | 108,000 |
| | Change | | 15,000 | 16,000 | 17,000 |
| A56 – Colne (J11-J12) | Flow | 74,000 | 97,000 | 97,000 | 97,000 |
| | Change | | 23,000 | 23,000 | 23,000 |

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## Figure 10 Impact on Existing Routes - M65 AADT (PCUs) flow

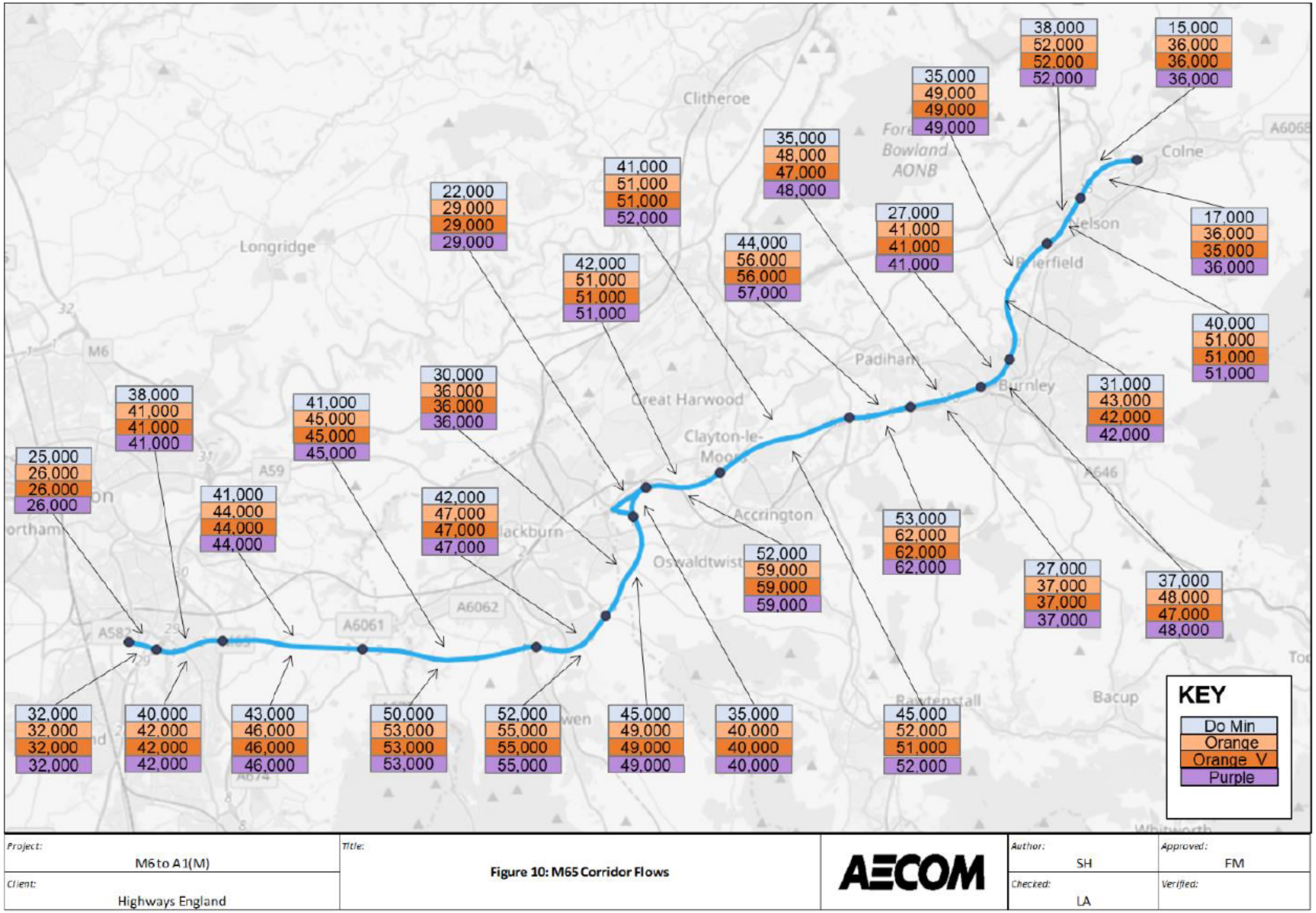

**Table 4** shows two-way AADT flows for the traffic flow impact on the M62. As each of the routes provide additional Trans Pennine road capacity and resilience, all three scenarios show a decrease in M62 traffic levels. There is minimal change between the three routes which is to be expected provided that the Trans Pennine sections of the proposed routes are consistent with one another.

**Table 4 M62 Traffic Flow Changes (2041 two-way AADT PCUs)**

| M62 Section | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| M60 to Halifax | Flow | 185,000 | 180,000 | 180,000 | 180,000 |
| | Change | | -5,000 | -5,000 | -5,000 |
| Halifax to A1(m) | Flow | 160,000 | 158,000 | 157,000 | 157,000 |
| | Change | | -3,000 | -3,000 | -3,000 |

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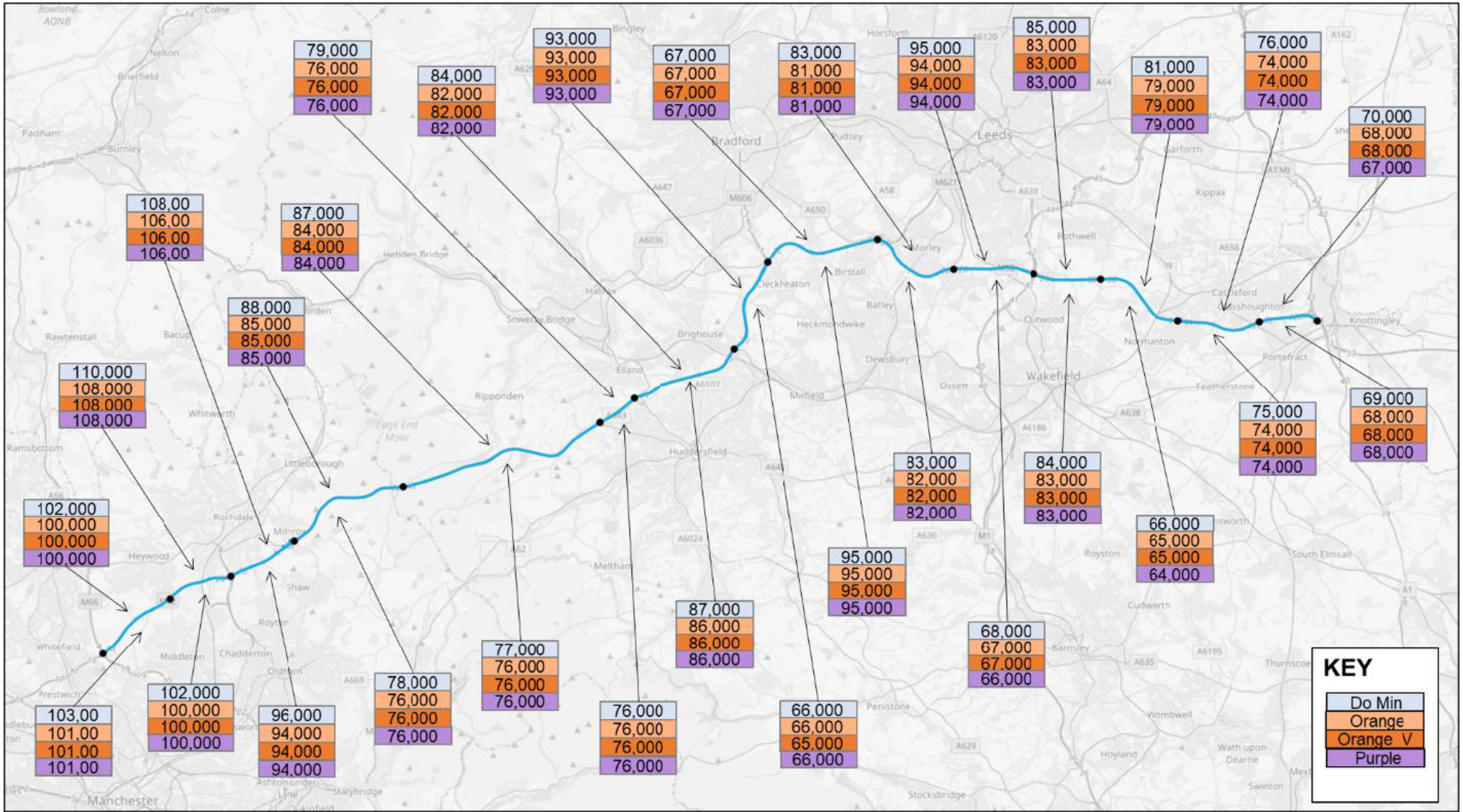
## Figure 11 Existing Routes - M62 AADT (PCUs) Flow




| | | | | |
|---|---|---|---|---|
| Project: M6 to A1(M) | Title: Figure 11: M62 Corridor Flows | AECOM | Author: SH | Approved: FM |
| Client: Highways England | | | Checked: LA | Verified: |

**Figure 11** shows the M62 AADT Do-Minimum scenario and each route under the 2041 forecast year. The results show that each of the proposed routes will result in a decrease in traffic levels. The decreases are concentrated at either end of the M62, averaging a 2,000 AADT decrease on eastbound and westbound traffic levels. However, there is minimal traffic flow change in the central section of the M62, with no noticeable change between Huddersfield and Bradford.

**Table 5** shows two-way AADT flows for the traffic flow impact on the A1(M). The Northern section (North of A59) of the A1(M) remains unchanged between Do-Minimum and the three routes. This can be attributed to the three routes locating further South on the A1(M) with the oranges routes intersecting the A1(M) South of Wetherby. This is shown through the increase in flows through the central section of the observed A1(M). Alternatively, the Purple route shows a decrease in volumes, which is the only route not to join the A1(M). The Purple route will provide greater benefit for longer journeys travelling South given the curvature of the Eastern section of the proposed route which may explain the scenario resulting in the largest traffic flow increases observed in the Southern section of the A1(M).

**Table 5 A1(M) Traffic Flow Changes (2041 2-way AADT PCUs)**

| M62 Section | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| North of A59 | Flow | 129,000 | 129,000 | 129,000 | 129,000 |
| | Change | | 0 | 0 | 0 |
| A59 to A64 (J44) | Flow | 132,000 | 136,000 | 137,000 | 127,000 |
| | Change | | 4,000 | 5,000 | -5,000 |
| A64 (J44) to A635 | Flow | 108,000 | 113,000 | 113,000 | 114,000 |
| | Change | | 5,000 | 5,000 | 6,000 |

*Source: Highways England TPS-RTM*

**Figure 12** shows the A1(M) AADT Do-Minimum scenario and each route under the 2041 forecast year. The figure shows flow variances attributed to the three scenarios, to the East of Leeds on the A1(M). The flow increases on the A1(M) based on the orange routes indicate that these routes could serve a greater level of benefit for strategic journeys due to the direct connectivity with the A1(M). Due to the proposed routing of the Purple, this has the least impact on the A1(M) and likely to support more commuter journeys around the Leeds City Region than the other two routes.

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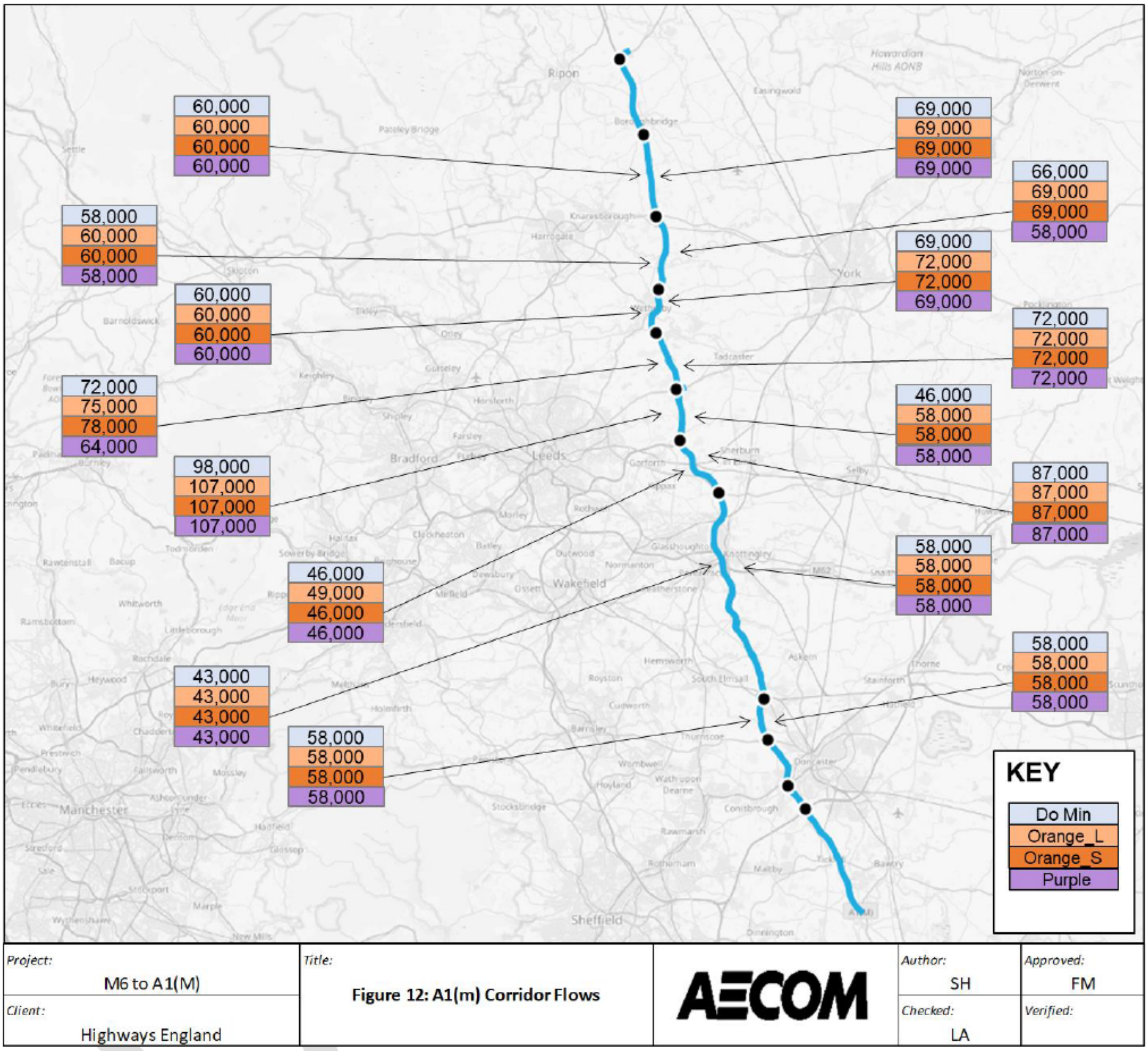
### Figure 12 Existing Routes – A1(M) AADT (PCUs) Flow




*Source: Highways England TPS-RTM*

### *Journey Times*

The objectives identify journey time differences between economic centres as an important metric to assess the connectivity impact of any chosen route. Journey time changes between three key economic centres have been reviewed to reflect Trans Pennine impacts.

**Table 6** shows point to point travel time differences between key economic centres in the AM peak between Do-Minimum and each of the three routes. The analysis shows significant time savings to cities such as Preston and York with both Orange routes saving at least 30 minutes on journey times. The Orange (long) route saves the most amount of time between Preston and York due to its direct link into the A64, East of Tadcaster. There are minor benefits experienced between Liverpool and Harrogate. This can be attributed to being located further away from the proposed routes and therefore the likelihood for traffic to continue travelling along the M62.

### Table 6 City Centre to City Centre Travel Times – 2041 AM Peak (h:mm)

| | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| Preston to York | Time | 2:20 | 1:50 | 1:45 | 1:49 |
| | Change from DM | | -0:30 | -0:35 | -0:31 |
| York to Preston | Time | 2:20 | 1:54 | 1:50 | 1:55 |
| | Change from DM | | -0:26 | -0:30 | -0:25 |
| Preston to Leeds | Time | 1:50 | 1:29 | 1:29 | 1:29 |
| | Change from DM | | -0:21 | -0:21 | -0:21 |
| Leeds to Preston | Time | 1:30 | 1:29 | 1:29 | 1:28 |
| | Change from DM | | -0:02 | -0:02 | -0:02 |
| Liverpool to Harrogate | Time | 2:38 | 2:29 | 2:29 | 2:35 |
| | Change from DM | | -0:09 | -0:09 | -0:03 |
| Harrogate to Liverpool | Time | 2:39 | 2:39 | 2:39 | 2:39 |
| | Change from DM | | 0:00 | 0:00 | 0:00 |

*Source: Highways England TPS-RTM*

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**Table 7** shows similar information for the PM peak. The results are consistent with those shown in the AM period. Both AM and PM periods show a directional imbalance in benefit between Leeds and Preston with the eastbound journey experiencing significantly more benefits than the westbound journey. This is attributed to use of the new route, with westbound journeys continuing to use the M62 in the modelling undertaken to date.

**Table 7 City Centre to City Centre Travel Times – 2041 PM Peak (h:mm)**

| | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| Preston to York | Time | 2:15 | 1:46 | 1:42 | 1:46 |
| | Change from DM | | -0:29 | -0:33 | -0:29 |
| York to Preston | Time | 2:23 | 1:59 | 1:56 | 2:0 |
| | Change from DM | | -0:23 | -0:27 | -0:22 |
| Preston to Leeds | Time | 1:40 | 1:27 | 1:27 | 1:27 |
| | Change from DM | | -0:13 | -0:13 | -0:13 |
| Leeds to Preston | Time | 1:40 | 1:35 | 1:36 | 1:35 |
| | Change from DM | | -0:05 | -0:04 | -0:05 |
| Liverpool to Harrogate | Time | 2:38 | 2:27 | 2:28 | 2:35 |
| | Change from DM | | -0:11 | -0:10 | -0:04 |
| Harrogate to Liverpool | Time | 2:37 | 2:36 | 2:36 | 2:36 |
| | Change from DM | | -0:01 | -0:01 | -0:01 |

*Source: Highways England TPS-RTM*

Additional Trans Pennine connectivity is important to provide resilience and capacity to the single existing strategic crossing, being the M62. Point to journey time savings were observed between Manchester and Leeds to evidence the likely impact to journey time savings on the M62. These two points were selected due to the likelihood of journeys remaining on the M62 regardless of the additional proposed routes. The analysis shows marginal benefit across all time periods. Noticeable time savings were observed in the PM period eastbound with Orange short and Purple saving 10 minutes or greater. These are shown in Table 8.

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**Table 8 M62 Time Savings (h:mm:ss)**

| | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| AM Westbound | Time | 1:08:35 | 1:09:30 | 1:09:17 | 1:08:47 |
| | Change from DM | | 0:00:55 | 0:00:42 | -0:00:12 |
| AM Eastbound | Time | 1:15:54 | 1:14:54 | 1:14:54 | 1:14:47 |
| | Change from DM | | -0:01:00 | -0:01:00 | -0:01:07 |
| IP Westbound | Time | 1:00:06 | 0:59:00 | 0:59:12 | 0:59:06 |
| | Change from DM | | -0:01:06 | -0:00:54 | -0:01:00 |
| IP Eastbound | Time | 1:11:47 | 1:10:00 | 1:09:47 | 1:10:00 |
| | Change from DM | | -0:01:47 | -0:02:00 | -0:01:47 |
| PM Westbound | Time | 1:08:30 | 1:08:35 | 1:07:54 | 1:08:47 |
| | Change from DM | | 0:00:05 | -0:00:36 | 0:00:17 |
| PM Eastbound | Time | 1:27:12 | 1:17:00 | 1:24:24 | 1:16:35 |
| | Change from DM | | -0:10:12 | -0:02:48 | -0:10:37 |

*Source: Highways England TPS-RTM*

## 3.2 Economic Appraisal Results

### *Overview*

The assumption made in calculating scheme costs was that the route would be split into four or five sections which would be constructed sequentially between 2029 and 2043. Route sections would be open to traffic when completed.

The effect of this would be that traffic benefits on completed sections would be realised prior to the assumed 2041 opening date. The benefits streams that would be generated from this construction profile could not be captured within the modelling and consequently a simplified process was necessary for the analysis.

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The economic appraisal has been carried out for two options regarding highway standards considering the scheme firstly as being built at a dual two lane motorway (D2M) standard and alternatively as a dual two lane all-purpose carriageway (D2AP) standard.

Since there is little difference in design between the two, for modelling at Stage 0 it has been considered proportionate to use the same model coding to represent both standards and thus it has been assumed that the benefits that would accrue would be broadly similar for both carriageway options. The prime difference for this analysis would be in cost.

**Table 9** presents an overview of the results for the motorway standard and **Table 10** for the all-purpose carriageway standard.

### Table 9 Overview of Costs and Benefits – D2M carriageway (£ millions)

| | Orange (short) | Orange (long) | Purple |
|---|---|---|---|
| Present Value of Benefits (PVB) | 2,949.6 | 3,084.6 | 2,976.2 |
| Present Value of Costs (PVC) | 3,205.7 | 3,532.5 | 3,270.9 |
| Initial Benefit to cost Ratio (BCR) | 0.92 | 0.87 | 0.91 |

All entries are present values discounted to 2010, in 2010 prices

### Table 10 Overview of Costs and Benefits – D2AP carriageway (£ millions)

| | Orange (short) | Orange (long) | Purple |
|---|---|---|---|
| Present Value of Benefits (PVB) | 2,949.6 | 3,084.6 | 2,976.2 |
| Present Value of Costs (PVC) | 2,931.3 | 3,230.0 | 2,986.4 |
| Initial Benefit to cost Ratio (BCR) | 1.01 | 0.95 | 1.00 |

All entries are present values discounted to 2010, in 2010 prices

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### *Costs*

Preliminary scheme costs have been produced by Highways England. A breakdown of the costs are shown in **Table 11** for D2M standard carriageway and **Table 12** for D2AP standard carriageway. The costs have been input to TUBA in order to calculate the PVC. Costs are assumed to be incurred over a 17 year construction period between 2028 and 2046.

**Table 11 Scheme Costs D2M Carriageway (£ millions)**

| | Orange (short) | Orange (long) | Purple |
|---|---|---|---|
| Cost (Q1 2016) | 5,908 | 6,502 | 6,019 |
| Inflation | 6,558 | 7,153 | 6,656 |
| Risk | 1,229 | 1,348 | 1,250 |
| Total | 13,696 | 15,004 | 13,925 |

All entries are in 2016 Quarter 1 prices.

*Source: Highways England Commercial Team*

**Table 12 Scheme Costs D2AP Carriageway (£ millions)**

| | Orange (short) | Orange (long) | Purple |
|---|---|---|---|
| Cost (Q1 2016) | 5,408 | 5,952 | 5,502 |
| Inflation | 6,006 | 6,550 | 6,088 |
| Risk | 1,119 | 1,227 | 1,137 |
| Total | 12,533 | 13,728 | 12,727 |

All entries are in 2016 Quarter 1 prices.

*Source: Highways England Commercial Team*

### *Benefits*

All of the options have been modelled using the TPS-RTM and have been assessed using TUBA and WITA. The same modelling was used to produce benefits for both carriageway standards.

A Transport Forecast Package has been prepared which describes the analytical material developed to create the transport forecasts that underpin the corridor option tests. The schemes were individually assessed using a fixed trip assignment using the TPS-RTM do minimum networks and matrices for 2041. An analysis of benefits was calculated for a 60-year period from an assumed scheme opening year of 2041. Since only a single model year was used it was assumed that there would be no further change in overall demand beyond 2041.

At this stage no assessment of accident and reliability benefits has been made. It might be expected that the scheme would have a small positive impact on both. Replacing existing trans Pennine routes with a higher standard carriageway would be expected to lead to a reduction in numbers of accidents and providing additional high standard route across the Pennines would be expected to reduce demand and hence improve the reliability on the existing routes.

In addition, no assessment of delays during construction and maintenance has been undertaken at this stage, which might be expected to produce a small negative impact. Further detailed analysis of the benefits would be conducted at later Project Control Framework (PCF) stages should the scheme continue.

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### *Monetised Costs and Benefits*

**Table 13** provides a summary of the monetised costs and benefits of the options considered.

**Table 13 Summary of Monetised Benefits & Costs D2M Standard (£ millions)**

| Category | Orange (short) | Orange (long) | Purple |
|---|---|---|---|
| **Business Users** | | | |
| Journey Time Savings | 1,383 | 1,471 | 1,407 |
| Vehicle Operating Costs | -5 | 1 | 22 |
| **Non-Business Users** | | | |
| Journey Time Savings | 476 | 515 | 475 |
| Vehicle Operating Costs | -118 | -126 | -109 |
| **Reliability** | n/a | n/a | n/a |
| **Safety** | n/a | n/a | n/a |
| **Environmental Impacts** | | | |
| Noise | n/a | n/a | n/a |
| Local Air Quality | n/a | n/a | n/a |
| Greenhouse Gases | n/a | n/a | n/a |
| Landscape | n/a | n/a | n/a |
| **Wider Economic Impacts** | | | |
| Agglomeration | 979 | 963 | 944 |
| Market Competition | 104 | 118 | 114 |
| Dependent Development | n/a | n/a | n/a |
| Labour Supply | 15 | 20 | 14 |
| **Indirect Tax Revenues** | 115 | 124 | 108 |
| Present Value of Benefits (PVB) | 2,949.6 | 3,084.6 | 2,976.2 |
| Present Value of Costs (PVC) | 3,205.7 | 3,532.5 | 3,270.9 |
| Net present Value (NPV) | -256.1 | -447.9 | -294.7 |
| Benefit to Cost Ration (BCR) | 0.92 | 0.87 | 0.91 |

All entries are present values discounted to 2010, in 2010 prices

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### Table 14 Summary of Monetised Benefits & Costs D2AP Standard (£ millions)

| Category | Orange (short) | Orange (long) | Purple |
|---|---|---|---|
| **Business Users** | | | |
| Journey Time Savings | 1,383 | 1,471 | 1,407 |
| Vehicle Operating Costs | -5 | 1 | 22 |
| **Non-Business Users** | | | |
| Journey Time Savings | 476 | 515 | 475 |
| Vehicle Operating Costs | -118 | -126 | -109 |
| **Reliability** | n/a | n/a | n/a |
| **Safety** | n/a | n/a | n/a |
| **Environmental Impacts** | | | |
| Noise | n/a | n/a | n/a |
| Local Air Quality | n/a | n/a | n/a |
| Greenhouse Gases | n/a | n/a | n/a |
| Landscape | n/a | n/a | n/a |
| **Wider Economic Impacts** | | | |
| Agglomeration | 979 | 963 | 944 |
| Market Competition | 104 | 118 | 114 |
| Dependent Development | n/a | n/a | n/a |
| Labour Supply | 15 | 20 | 14 |
| **Indirect Tax Revenues** | 115 | 124 | 108 |
| Present Value of Benefits (PVB) | 2,949.6 | 3,084.6 | 2,976.2 |
| Present Value of Costs (PVC) | 2,931.3 | 3,320.0 | 2,986.4 |
| Net present Value (NPV) | 18.3 | -145.4 | -10.2 |
| Benefit to Cost Ration (BCR) | 1.01 | 0.95 | 1.00 |

All entries are present values discounted to 2010, in 2010 prices

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# 4 TRANSPORT APPRAISAL EVIDENCE BASE

## 4.1 Transport Data Package

The Transport Data Package is included in Appendix A.

## 4.2 Summary

No new data has been collected for this stage of the study. The Transport Data package refers to data collected for the Trans Pennine South RTM development

## 4.3 Transport Model Package

The Transport Model Package is included in Appendix B.

## 4.4 Summary

The Transport Model Package references the Trans Pennine South RTM Validation Report to demonstrate the level of validation achieved in the area of focus for the current study.

## 4.5 Transport Forecast Package

The Transport Forecast Package is included in Appendix C.

## 4.6 Summary

Forecasting has been carried out for a single forecast year, 2041. This has been based on the Trans Pennine South RTM Forecasts developed for the Trans Pennine Tunnel Study.

Growth is based on NTEM factors for personal travel and Road Traffic Forecasts (2018) for freight vehicles.

## 4.7 Economic Appraisal Package

The Economic Appraisal Package is included in Appendix D.

## 4.8 Summary

Economic appraisal has been carried out using TUBA and WITA with standard WebTAG parameters. The EAP provides an analysis of the package outputs which produce the results presented in **Chapter 1**.

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# Appendix A  Transport Data Package

The Transport Data Package summarises the data used to underpin the development of the scheme's business case, design and operational and environmental assessments.

No new data has been collected for this stage of the study; the assessment is reliant on existing models.

The source model used was the TPS-RTM and the relevant data report for that model development was Trans Pennine South RTM Model Data Collection Report (March 2017).

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# Appendix B Transport Model Package

## Introduction

This Transport Model Package summarises the model used to underpin the development of the scheme's business case, design and operational and environmental assessments. In Stage 0 it is usual that an existing model is used, and the Transport Model Package Report sets out the reasons for model choice and the suitability of the model for use in assessing the scheme.

## Model Description / Specification

### Choice of Model

The model used for PCF Stage 0 for the M6 – A1(M) link is Highways England's Trans Pennine South Regional Transport Model (TPS-RTM).

The model is a strategic highway model covering the North of England, developed by Highways England specifically to test strategic road schemes in this area. The core focus of the schemes' impact would be in this area and thus this model the most appropriate tool for use in this study.

### Associated Documentation

The primary guide covering the development of the TPS-RTM is: *"Model Validation Report, Trans-Pennine South Regional Model, March 2017."*

### Model Summary

The TPS-RTM was one of five models developed together in 2015-16 to provide complete coverage of England. The Traffic Modelling Strategy developed by the Transport Planning Group (TPG) identified the creation of five 'regional' models as critical to the future delivery of schemes. The primary purpose of the regional model programme was to assess Road Investment Strategy (RIS) major highway schemes with a cost estimate greater than £10 million.

A series of Technical Control Groups (TCG) were instigated at the outset to the project to ensure quality and consistency of approach across the five models.

The regional model that covers the area of interest is the Trans-Pennine South RTM which has been used to support a series of RIS and other schemes in the region. It is this model that will form the basis of the PCF0 assessment.

## Structure of the Model

The TPS-RTM model is set up as a variable demand model with a highway assignment model feeding into a DIADEM based variable demand model using fixed public transport costs. For this stage of the assessment the variable demand element has not be used, and the tests were conducted using fixed matrix highways only assignments.

The TPS RTM highway model was developed using the SATURN modelling software package. The detailed area of the TPS RTM, shown in **Figure 13**, covers the area between

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the northern borders of Lancashire and North Yorkshire in the north to the southern border of Cheshire and South Yorkshire in the south. Outside this area the rest of Great Britain is represented by a buffer network.

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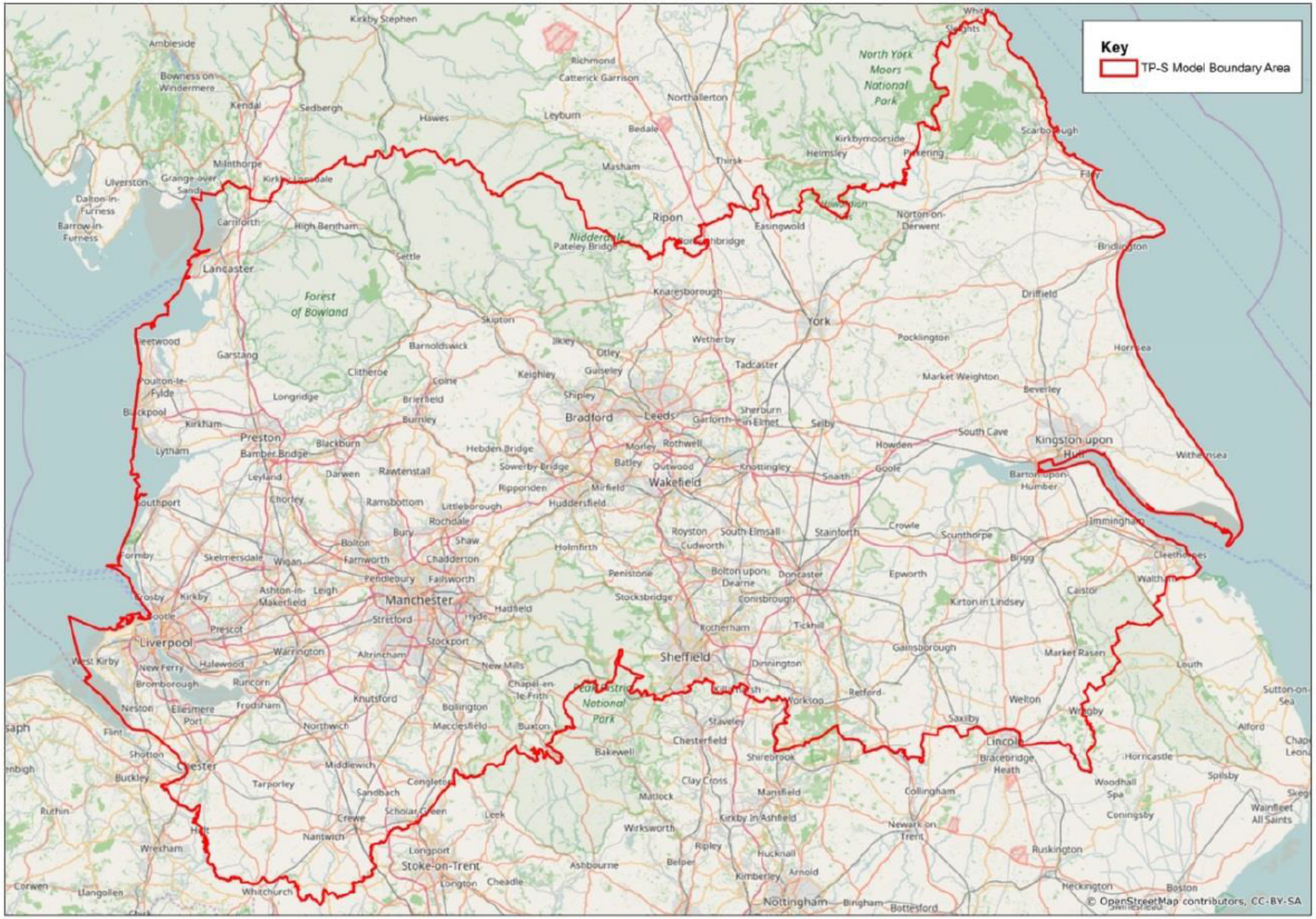
## Figure 13 TPS-RTM Model Area



In accordance with guidelines agreed by the Network Coding TCG, the network was considered in terms of four levels

- Level 1 – Strategic Road Network (SRN);
  - Roads connected to / parallel with SRN;
  - Roads considered important to RIS scheme appraisal;
- Level 2 – Rural roads that are not connected to SRN;
- Level 3 – Urban areas outside the influence area of RIS and SRN; and
- Level 4 – Roads outside the region of focus.

The coding standard to be applied to each of the four levels was then set out as follows:

- Level 1 – Detailed simulation coding;
- Level 2 – Simulation coding but less detail;
- Level 3 – Dummy nodes / fixed link speeds; and
- Level 4 – Buffer network.

The model covers an average hour for:

- AM Peak Period (0700 - 1000);
- Inter peak period (1000 - 1600); and
- PM Peak period (1600 - 1900).

It has five trip purposes / user classes as follows:

- Car – business trips;
- Car commuter trips;
- Car other trips;
- Light Goods Vehicles (LGVs); and
- Heavy Goods Vehicles (HGVs).

The model version used for this study was chosen to align with that used for the Trans Pennine Tunnel (TPT) study. This version of the model includes network coding revisions that have been included to correct for errors in the original coding which have been identified during a number of studies subsequent to the initial model validation. These are generally small localised changes to junction coding and no overall revalidation has followed these changes.

The extents of the model and the level of detail included in the coding ensure that the model would be able to represent the impacts of a potential scheme within the area under

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consideration. This ensures that the model can forecast the impact of the potential schemes which is expected to include a number of Trans Pennine routes to the north and south of the proposed corridor.

## Model Performance

### Model Flow Validation

A traffic count database was developed which provided traffic count data at 1054 sites which was aggregated to form 163 cordons and mini-screenlines as shown in **Figure 14.** A further 108 counts represented the strategic road network links at locations where the long screenlines crossed the SRN.

**Table 15** provides a comparison between the modelled and observed flows over the complete network.

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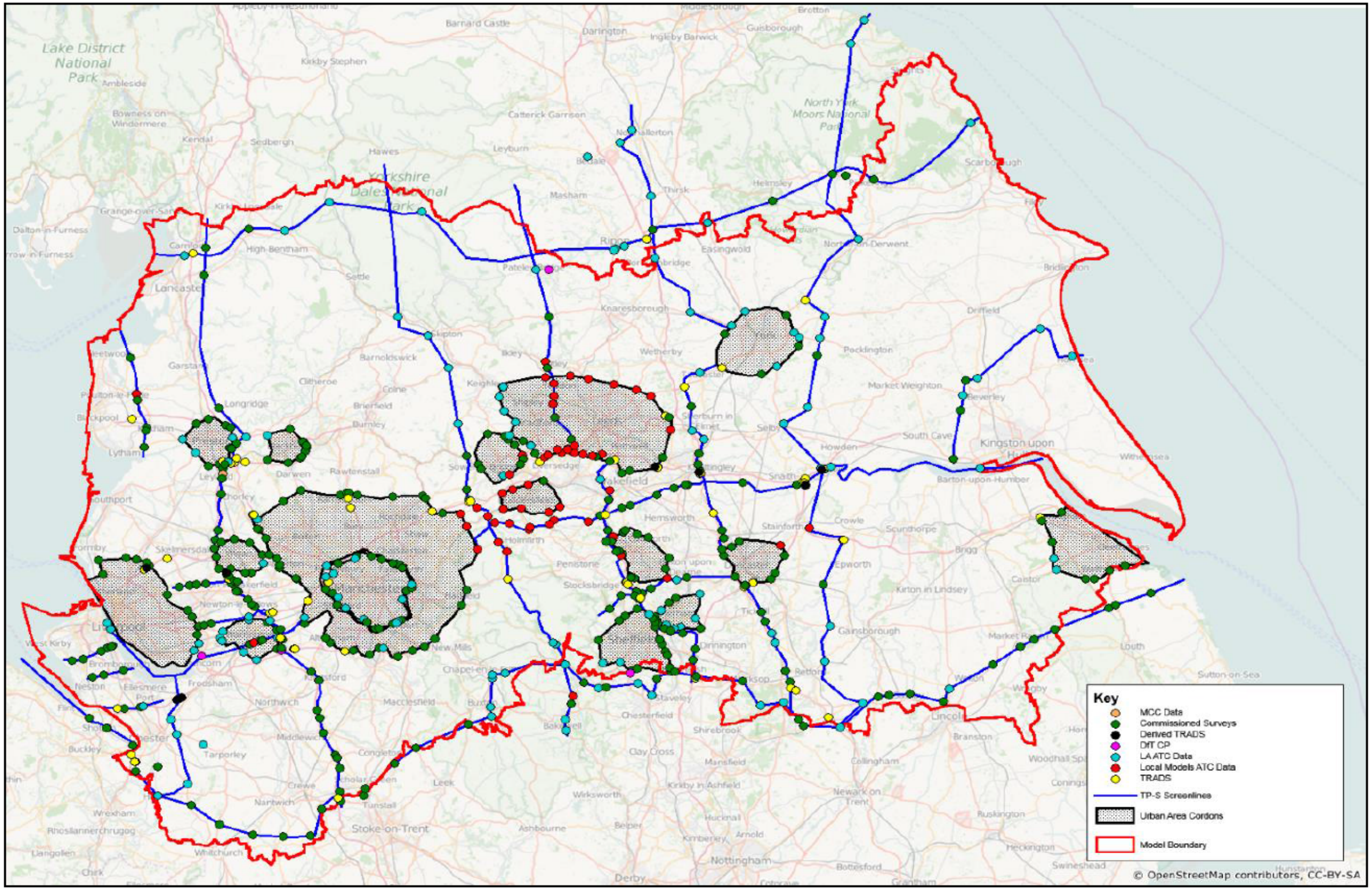
## Figure 14 Calibration Screenlines and Cordons



### Table 15 Summary of Comparison of Modelled and Observed Flows

| | | | AM Peak | | | Inter Peak | | | PM Peak | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No | Pass | Near | Fail | Pass | Near | Fail | Pass | Near | Fail |
| Links | GEH<5 | 1162 | 52% | 16% | 32% | 55% | 16% | 29% | 54% | 14% | 32% |
| | flow | | 84% | - | 16% | 89% | - | 11% | 84% | - | 16% |
| | GEH or flow | | 84% | - | 16% | 89% | - | 11% | 84% | - | 16% |
| Screen lines | Flow <5% | 69 | 97% | 3% | 0% | 96% | 3% | 1% | 96% | 4% | 0% |
| | GEH<4 | | 91% | 3% | 6% | 94% | 4% | 1% | 91% | 4% | 4% |
| Mini screen lines | Flow | 163 | 94% | - | 6% | 93% | - | 7% | 91% | - | 9% |
| | GEH<4 | | 90% | 7% | 3% | 93% | 4% | 4% | 88% | 7% | 5% |

Near is defined as:

- Having a GEH value between 5.0 and 7.5 for links;
- Having a flow difference between 5% and 10% for screenlines; and
- Having a GEH value between 4.0 and 7.5 for screenlines.

**Figure 15** to **Figure 17** illustrates the goodness of fit across the mini-screenlines and **Figure 18** to **Figure 20** for screenline links on the SRN. The results show a good level of fit across the north – south screenlines in the North Pennines area and on the cordons affected by the proposed scheme.

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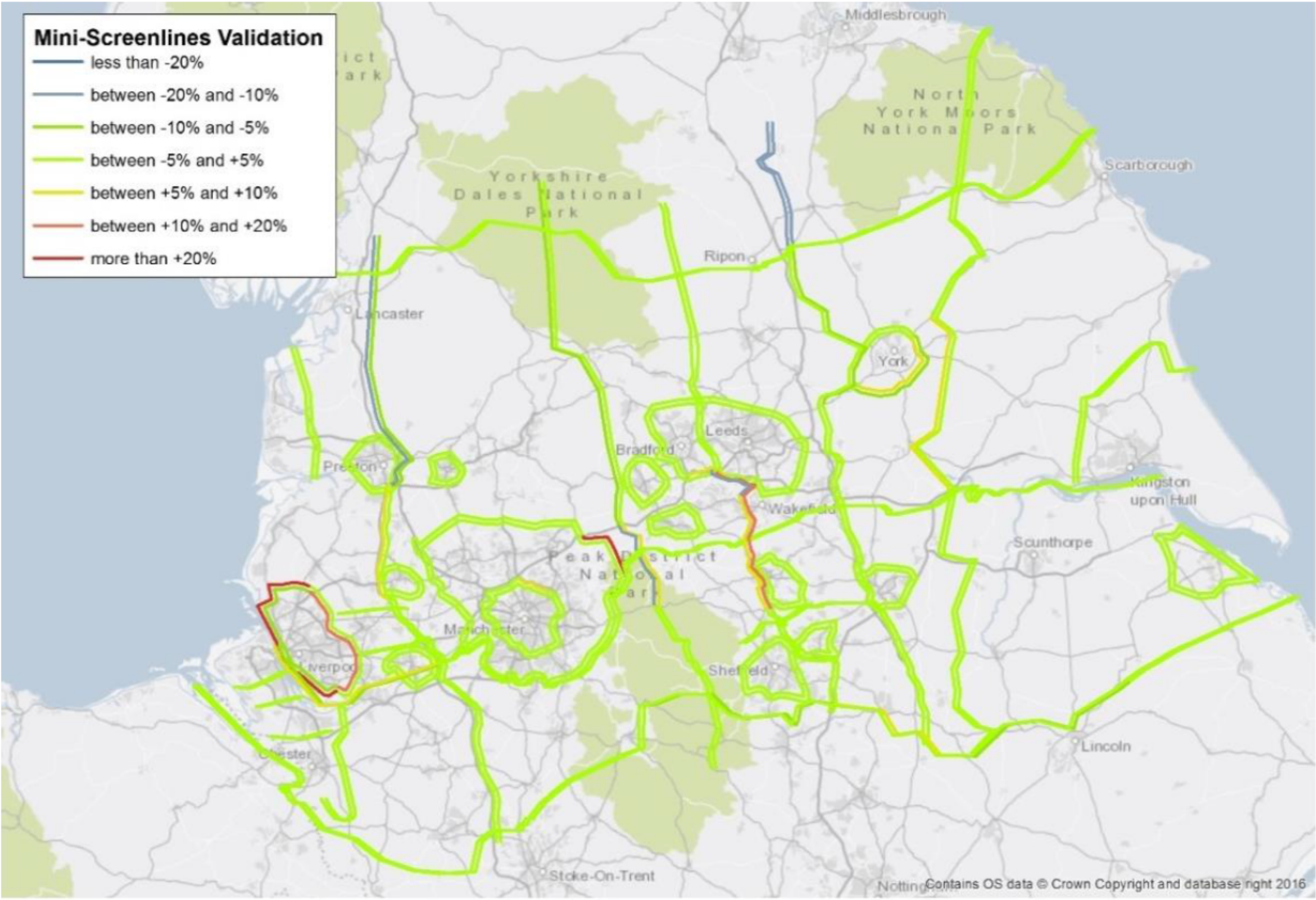
**Figure 15 Validation on Mini Screenlines (AM Peak)**



## Figure 16 Validation on Mini Screenlines (Inter Peak)

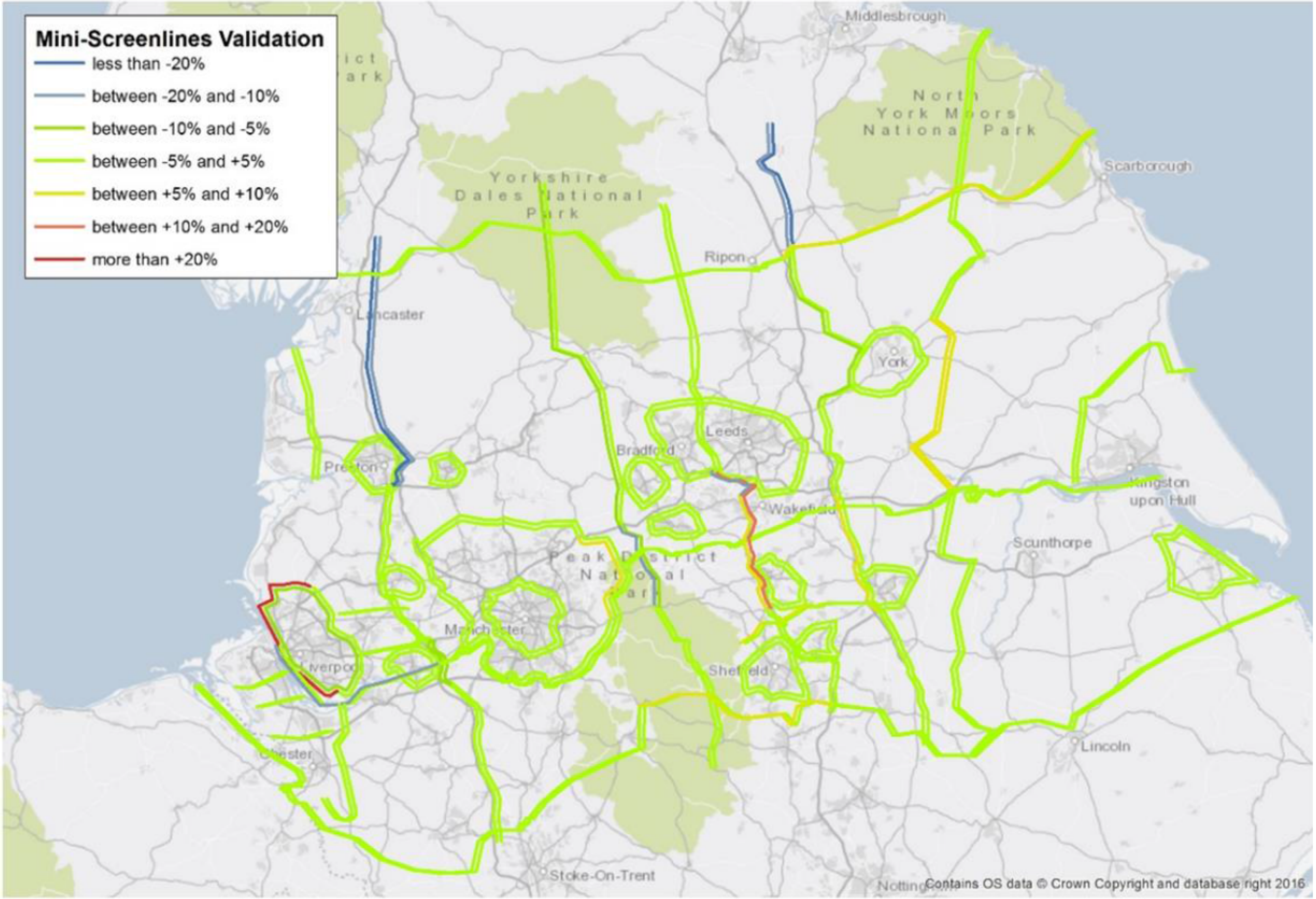
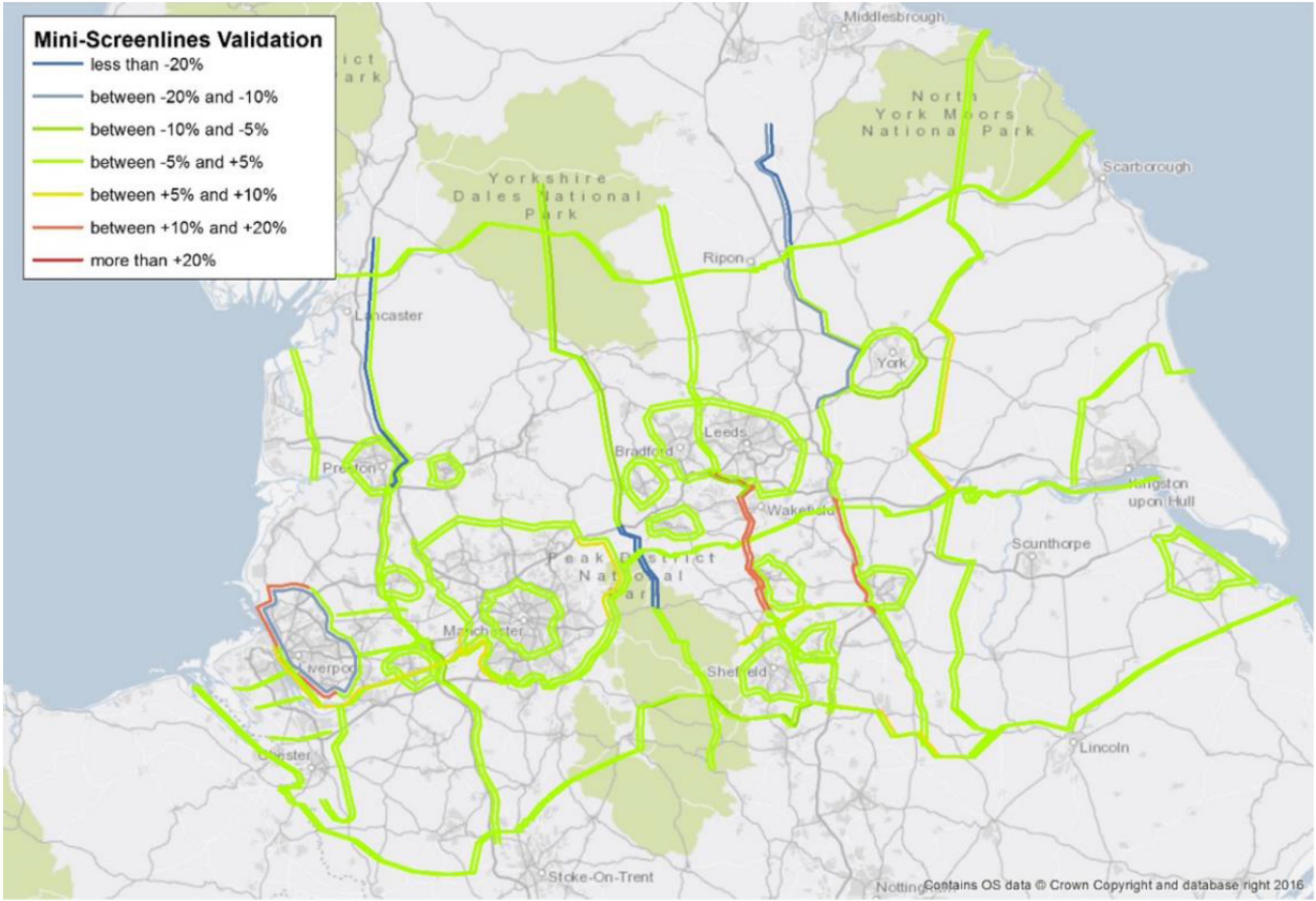
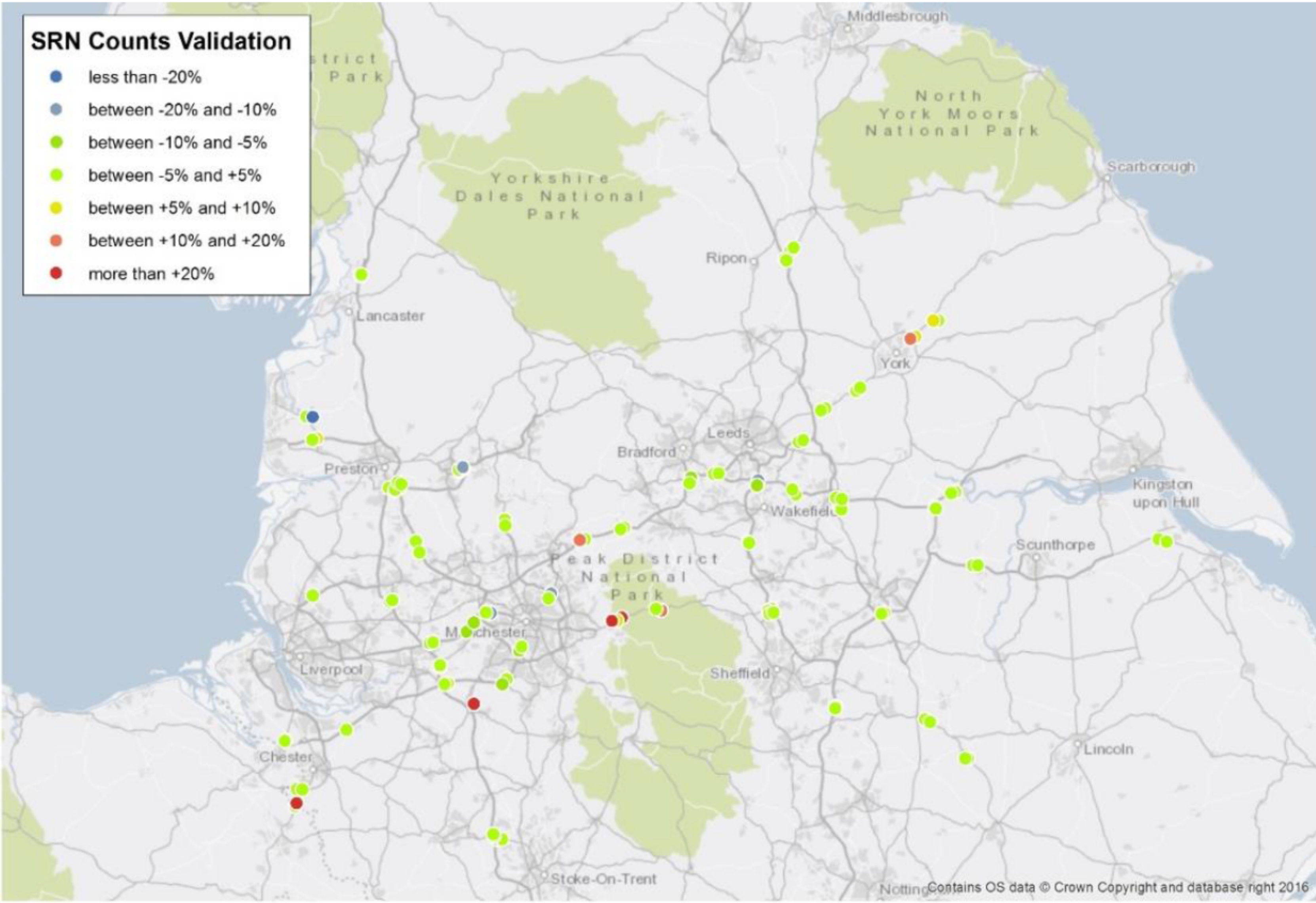


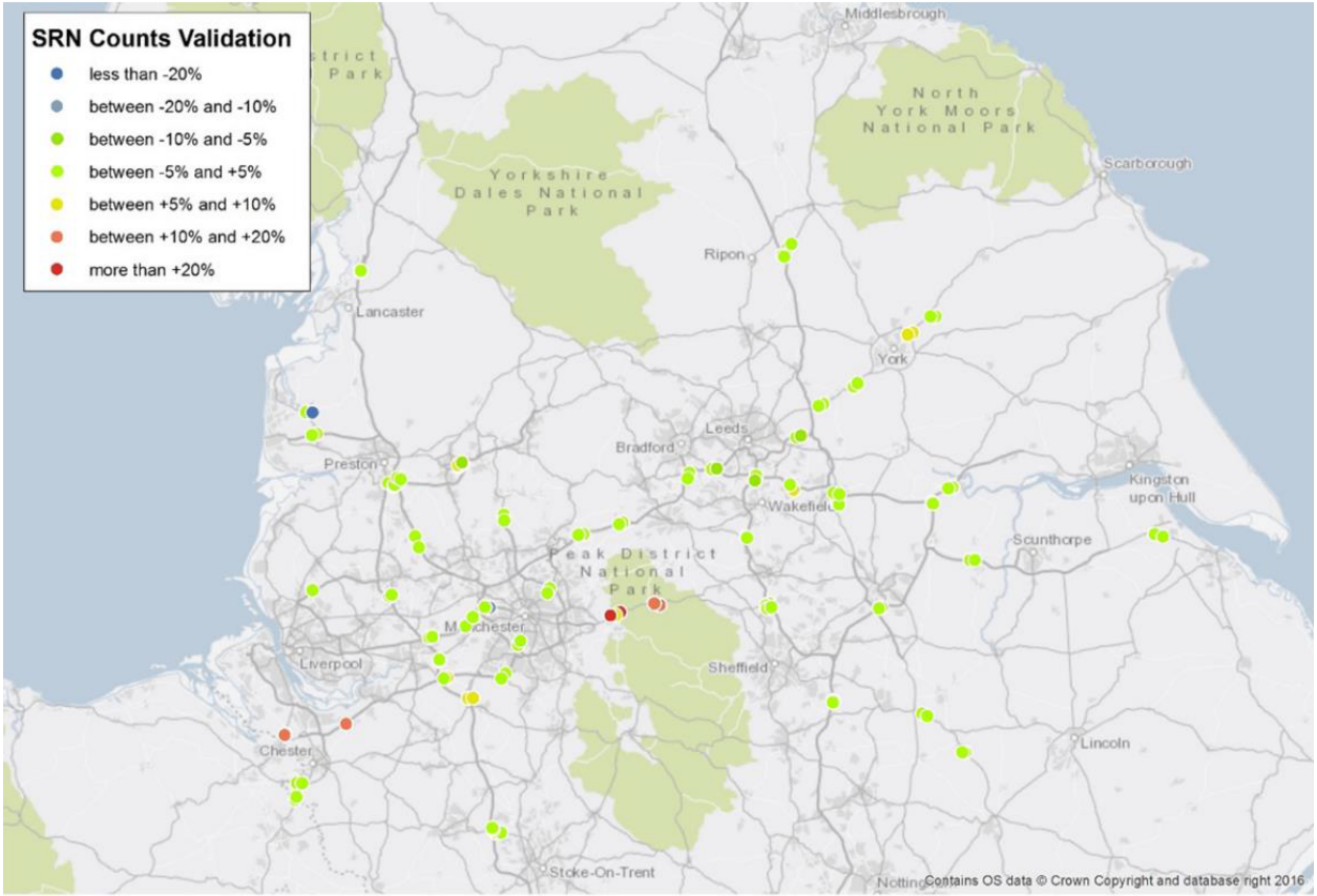
**Figure 17 Validation on Mini Screenlines (PM Peak)**



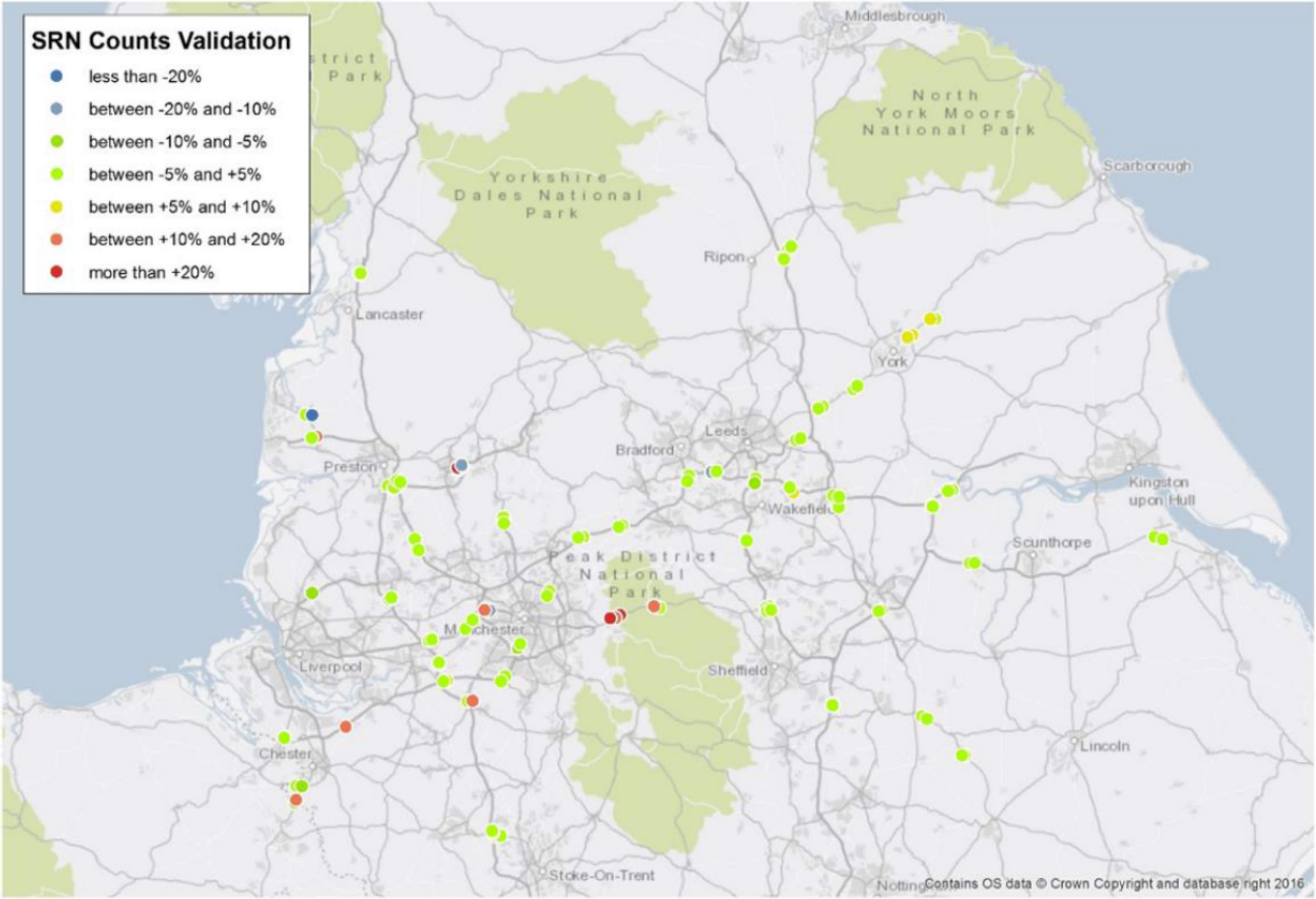
### Figure 18 Validation on SRN links on Screenlines AM Peak



### Figure 19 Validation on SRN links on Screenlines Inter Peak



### Figure 20 Validation on SRN links on Screenlines PM Peak



Of most relevance to the present study is the central Pennines screenline, shown in Error! Reference source not found., which runs north – south through Pennine crossing routes. Flow Validation for this screenline is shown in **Table 16** to **Table 18.**

The goodness of fit for each link comparison is assessed using the criteria set out in WebTAG Unit M3.1 paragraph 3.2.8. Links are assessed on the basis of the acceptability guidelines in Unit M3.1 Table 2 for:

- Flow differences; and
- GEH statistics.

A Pass is indicated if one or both criteria are satisfied.

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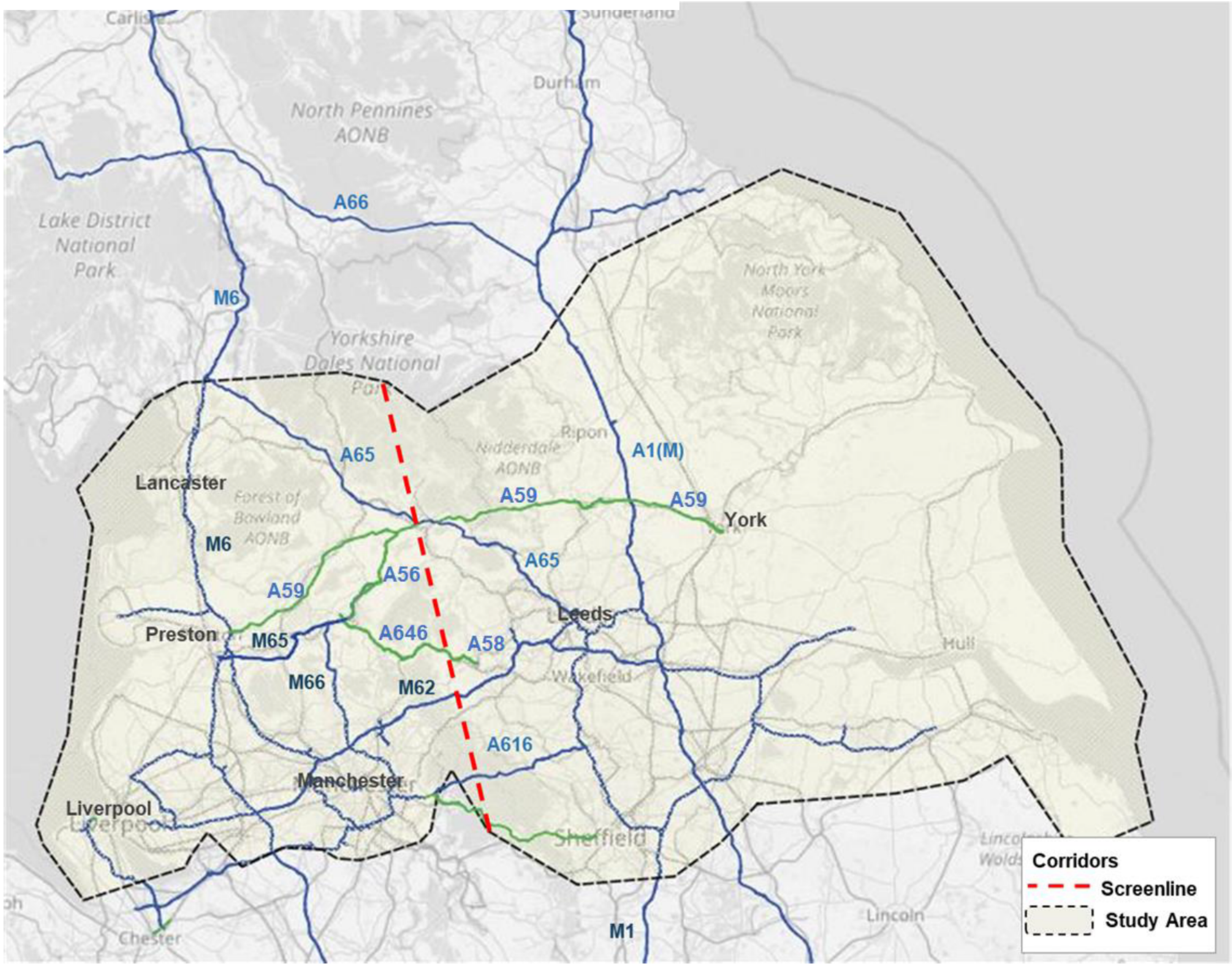
**Figure 21 Central Pennines Corridor Screenline**



### Table 16 Link Flow Validation (PCUs) AM Peak

| Route | Location | Observed | Modelled | Diff | % Diff | GEH | Pass / Fail |
|---|---|---|---|---|---|---|---|
| **Eastbound** | | | | | | | |
| A65 | West of Coniston | 333 | 367 | 34 | 10.3% | 1.84 | PASS |
| A59 | A59 Broughton (East) | 810 | 732 | -78 | -9.6% | 2.81 | PASS |
| A6068 | A6068 West of Guisburn | 461 | 415 | -46 | -10.0% | 2.21 | PASS |
| A6033 | A6033 | 88 | 393 | 305 | 346.1% | 19.65 | FAIL |
| A646 | Burnley Road West of Junction with Timmey Lane | 877 | 727 | -150 | -17.1% | 5.29 | FAIL |
| A58 | A58 Rochdale Rd W of junction A672 Oldham Rd | 156 | 54 | -102 | -65.2% | 9.92 | FAIL |
| A672 | A672 Oldham Rd North East of junction with Moselden Ln | 200 | 122 | -78 | -39.0% | 6.14 | PASS |
| M62 | M62 westbound between J23 and J22(E403618, N416324) | 3,466 | 3,490 | 24 | 0.7% | 0.41 | PASS |
| **Total** | **north of M62 only** | **2,925** | **2,811** | **-115** | **-3.9%** | **2.15** | **PASS** |
| | **including M62** | **6,391** | **6,300** | **-91** | **-1.4%** | **1.14** | **PASS** |
| **Westbound** | | | | | | | |
| A65 | West of Coniston | 274 | 293 | 19 | 6.8% | 1.11 | PASS |
| A59 | A59 Broughton (East) | 568 | 511 | -57 | -10.0% | 2.44 | PASS |
| A6068 | A6068 West of Guisburn | 336 | 445 | 109 | 32.5% | 5.53 | FAIL |
| A6033 | A6033 | 70 | 157 | 87 | 124.0% | 8.15 | PASS |
| A646 | Burnley Road West of Junction with Timmey Lane | 571 | 442 | -130 | -22.7% | 5.76 | FAIL |
| A58 | A58 Rochdale Rd W of junction A672 Oldham Rd | 124 | 63 | -61 | -49.1% | 6.28 | PASS |
| A672 | A672 Oldham Rd North East of junction with Moselden Ln | 226 | 142 | -84 | -37.3% | 6.22 | PASS |
| M62 | M62 westbound between J23 and J22(E403618, N416324) | 3,704 | 3,655 | -49 | -1.3% | 0.81 | PASS |
| **Total** | **north of M62 only** | **2,170** | **2,053** | **-117** | **-5.4%** | **2.54** | **PASS** |
| | **including M62** | **5,874** | **5,708** | **-166** | **-2.8%** | **2.18** | **PASS** |

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**Table 17 Link Flow Validation (PCUs) Inter Peak**

| Route | Location | Observed | Modelled | Diff | % Diff | GEH | Pass/ Fail |
|---|---|---|---|---|---|---|---|
| **Eastbound** | | | | | | | |
| A65 | West of Coniston | 320 | 284 | -36 | -11.2% | 2.06 | PASS |
| A59 | A59 Broughton (East) | 540 | 436 | -104 | -19.3% | 4.71 | PASS |
| A6068 | A6068 West of Guisburn | 333 | 246 | -87 | -26.1% | 5.11 | PASS |
| A6033 | A6033 | 78 | 416 | 338 | 435.4% | 21.52 | FAIL |
| A646 | Burnley Road West of Junction with Timmey Lane | 670 | 569 | -101 | -15.0% | 4.04 | PASS |
| A58 | A58 Rochdale Rd W of junction A672 Oldham Rd | 89 | 26 | -63 | -70.9% | 8.35 | PASS |
| A672 | A672 Oldham Rd North East of junction with Moselden Ln | 136 | 91 | -45 | -32.9% | 4.20 | PASS |
| M62 | M62 westbound between J23 and J22(E403618, N416324) | 3225 | 3224 | -1 | 0.0% | 0.03 | PASS |
| **Total** | **north of M62 only** | **2166** | **2068** | **-98** | **-4.5%** | **2.12** | **PASS** |
| | **including M62** | **5391** | **5292** | **-99** | **-1.8%** | **1.36** | **PASS** |
| **Westbound** | | | | | | | |
| A65 | West of Coniston | 307 | 309 | 2 | -0.6% | 0.10 | PASS |
| A59 | A59 Broughton (East) | 563 | 511 | -52 | 9.3% | 2.26 | PASS |
| A6068 | A6068 West of Guisburn | 340 | 394 | 54 | -15.8% | 2.81 | PASS |
| A6033 | A6033 | 78 | 147 | 69 | -88.8% | 6.51 | PASS |
| A646 | Burnley Road West of Junction with Timmey Lane | 615 | 502 | -113 | 18.4% | 4.78 | PASS |
| A58 | A58 Rochdale Rd W of junction A672 Oldham Rd | 92 | 38 | -55 | 59.1% | 6.77 | PASS |
| A672 | A672 Oldham Rd North East of junction with Moselden Ln | 136 | 118 | -18 | 13.3% | 1.60 | PASS |
| M62 | M62 westbound between J23 and J22(E403618, N416324) | 3292 | 3300 | 8 | -0.2% | 0.13 | PASS |
| **Total** | **north of M62** | **2131** | **2017** | **-114** | **-5.3%** | **2.49** | **PASS** |
| | **including M62** | **5423** | **5317** | **-106** | **-2.0%** | **1.45** | **PASS** |

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**Table 18 Link Flow Validation (PCUs) PM Peak**

| Route | Location | Observed | Modelled | Diff | % Diff | GEH | Pass/ Fail |
|---|---|---|---|---|---|---|---|
| **Eastbound** | | | | | | | |
| A65 | West of Coniston | 299 | 243 | -56 | -18.6% | 3.38 | PASS |
| A59 | A59 Broughton (East) | 588 | 511 | -77 | -13.1% | 3.29 | PASS |
| A6068 | A6068 West of Guisburn | 387 | 371 | -16 | -4.2% | 0.83 | PASS |
| A6033 | A6033 | 91 | 455 | 365 | 401.3% | 22.06 | FAIL |
| A646 | Burnley Road West of Junction with Timmey Lane | 646 | 448 | -198 | -30.7% | 8.48 | FAIL |
| A58 | A58 Rochdale Rd W of junction A672 Oldham Rd | 115 | 40 | -75 | -65.1% | 8.49 | PASS |
| A672 | A672 Oldham Rd North East of junction with Moselden Ln | 282 | 175 | -107 | -38.0% | 7.09 | FAIL |
| M62 | M62 westbound between J23 and J22(E403618, N416324) | 3363 | 3358 | -5 | -0.1% | 0.08 | PASS |
| **Total** | **north of M62** | **2408** | **2243** | **-165** | **-6.8%** | **3.41** | **PASS** |
| | **including M62** | **5771** | **5601** | **-169** | **-2.9%** | **2.25** | **PASS** |
| **Westbound** | | | | | | | |
| A65 | West of Coniston | 367 | 414 | 47 | 12.8% | 2.37 | PASS |
| A59 | A59 Broughton (East) | 837 | 800 | -37 | -4.4% | 1.29 | PASS |
| A6068 | A6068 West of Guisburn | 483 | 487 | 4 | 0.9% | 0.20 | PASS |
| A6033 | A6033 | 115 | 188 | 74 | 64.6% | 6.01 | PASS |
| A646 | Burnley Road West of Junction with Timmey Lane | 775 | 662 | -112 | -14.5% | 4.18 | PASS |
| A58 | A58 Rochdale Rd W of junction A672 Oldham Rd | 165 | 103 | -62 | -37.5% | 5.36 | PASS |
| A672 | A672 Oldham Rd North East of junction with Moselden Ln | 189 | 181 | -7 | -3.9% | 0.54 | PASS |
| M62 | M62 westbound between J23 and J22(E403618, N416324) | 3704 | 3671 | -33 | -0.9% | 0.54 | PASS |
| **Total** | **north of M62** | **2930** | **2837** | **-93** | **-3.2%** | **1.73** | **PASS** |
| | **including M62** | **6634** | **6508** | **-126** | **-1.9%** | **1.55** | **PASS** |

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The proportion of link flows passing the criteria in each peak is shown in **Table 19**. Overall 81% of links fit the validation criteria.

**Table 19 Summary of Link Flow Comparisons**

| Period | No of Links Passing flow or GEH criteria | Proportion of all links |
|---|---|---|
| AM | 11 | 69% |
| IP | 15 | 93% |
| PM | 13 | 81% |
| Total | **38** | **81%** |

WebTAG Module M3.1 states that the total assigned flow across the screenline should fall within 5% of the observed.

For the entire screenline, including M62, this criterion is achieved in each peak and in each direction. For the screenline excluding the M62 the criterion is exceeded in three of the six comparisons, although the exceedance is small, the maximum error being 6.8% in the PM peak eastbound. In each case the GEH statistic for the screenline is less than 4.

### Journey Time Validation

Journey time data was collected from Trafficmaster and used to form a series of journey time routes to cover the model. The coverage of the journey time routes is shown in **Figure 22**.

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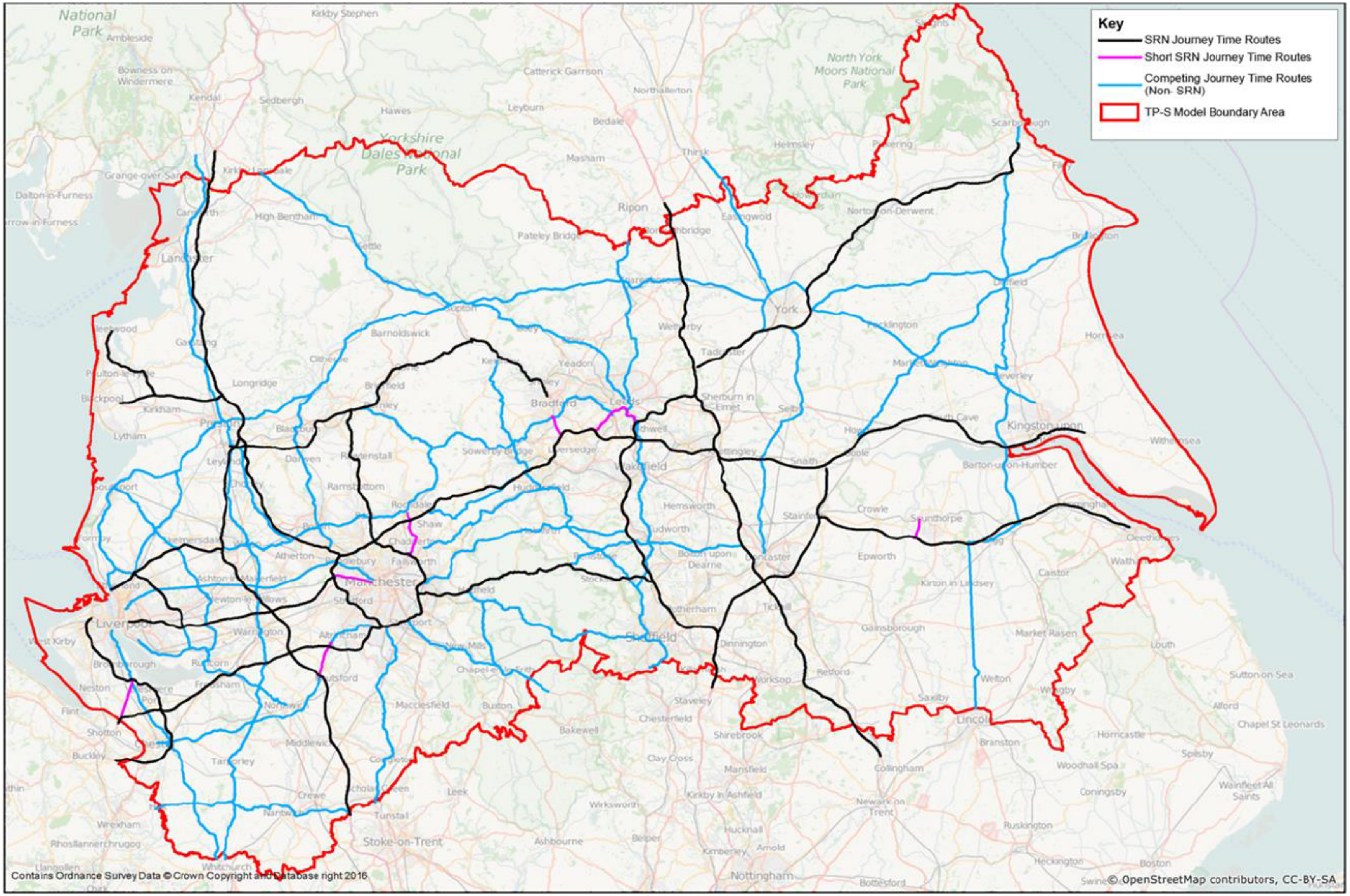
## Figure 22 Journey Time Routes



Over the whole network the level of fit between observed and modelled times was very good, a summary of route comparisons is shown in **Table 20**.

Overall for each route in each period 75% or more the modelled journey times are within ±15% of the observed times, in each case fewer than 10% of comparisons are outside the ±25% bound. When considering individual route sections over 65% are within ±15% of the observed times and fewer than 15% are more than ±25% from the observed times.

### Table 20 Journey Time Comparison Summary

| | | **No of Routes or Route Sections** | **Pass (within +/-15%)** | **Near (+/- 15% to +/- 25%)** | **Fail** |
|---|---|---|---|---|---|
| AM | Routes | 112 | 77% | 13% | 10% |
| | Route Sections | 302 | 65% | 22% | 13% |
| IP | Routes | 112 | 76% | 19% | 5% |
| | Route Sections | 302 | 71% | 18% | 11% |
| PM | Routes | 112 | 80% | 11% | 9% |
| | Route Sections | 302 | 67% | 20% | 14% |

The results for the routes with most relevance to the present study are given in **Table 21** to **Table 23**. The routes identified to assess journey time comparisons are shown in **Figure 23**. The results show that, with the exception of Route 1 Northbound in the PM Peak the modelled journey times on these routes are within ±15% of the observed times in each comparison.

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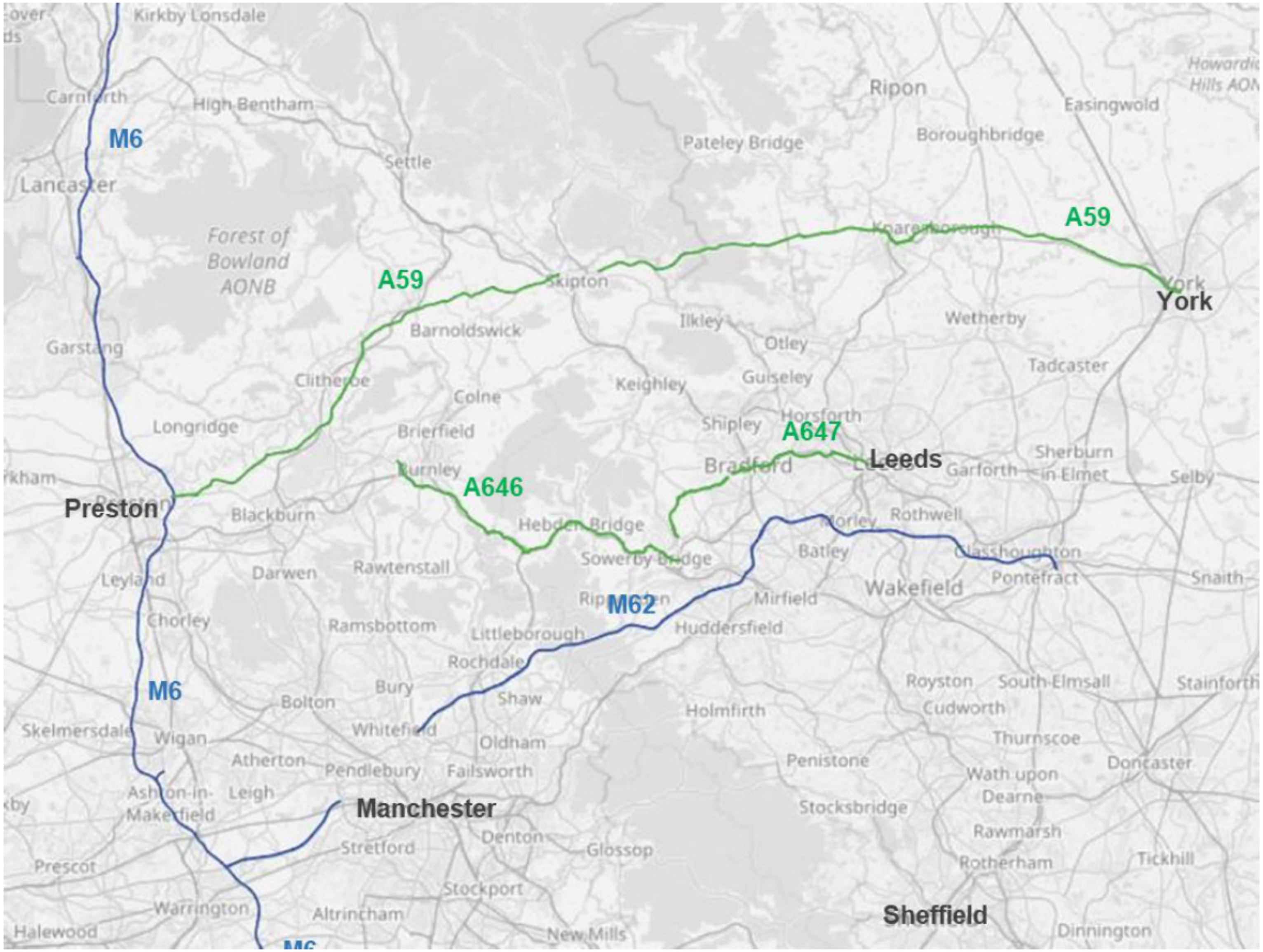
### Figure 23 Journey Time Comparison Routes



### Table 21 AM Peak Journey Time Comparisons (h:mm:ss)

| Route Name | Route Description | Observed JT (h:mm:ss) | Modelled JT (h:mm:ss) | %Diff |
|---|---|---|---|---|
| C6 (EB) | A646 / A647 Eastbound | 1:31:10 | 1:25:28 | -6.8% |
| C6 (WB) | A646 / A647 Westbound | 1:24:02 | 1:19:32 | -5.9% |
| C19 (NB) | A59 Northbound | 1:34:00 | 1:34:30 | 0.3% |
| C19 (SB) | A59 Southbound | 1:34:41 | 1:37:49 | 3.2% |
| 2 (EB) | M62 Eastbound | 3:07:58 | 3:05:10 | -1.3% |
| 2 (WB) | M62 Westbound | 3:12:59 | 2:50:04 | -13.3% |
| 1 (NB) | M6 Northbound | 1:41:58 | 1:43:17 | 1.5% |
| 1 (SB) | M6 Southbound | 1:44:57 | 1:42:45 | -2.1% |

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### Table 22 Inter Peak Journey Time Comparisons

| Route Name | Route Description | Observed JT (h:mm:ss) | Modelled JT (h:mm:ss) | %Diff |
|---|---|---|---|---|
| C6EB | A646 / A647 Eastbound | 1:25:58 | 1:20:15 | -6.8% |
| C6WB | A646 / A647 Westbound | 1:24:53 | 1:17:46 | -9.1% |
| C19NB | A59 Northbound | 1:34:32 | 1:29:21 | -5.7% |
| C19SB | A59 Southbound | 1:36:13 | 1:32:22 | -4.2% |
| 2EB | M62 Eastbound | 2:56:46 | 2:44:2 | -7.6% |
| 2WB | M62 Westbound | 2:52:24 | 2:33:01 | -12.6% |
| 1Nb | M6 Northbound | 1:41:27 | 1:34:14 | -7.6% |
| 1SB | M6 Southbound | 1:41:49 | 1:36:38 | -5.3% |

### Table 23 PM Peak Journey Time Comparisons

| Route Name | Route Description | Observed JT (h:mm:ss) | Modelled JT (h:mm:ss) | %Diff |
|---|---|---|---|---|
| C6EB | A646 / A647 Eastbound | 1:28:47 | 1:24:40 | -4.82% |
| C6WB | A646 / A647 Westbound | 1:36:29 | 1:23:46 | -4.8% |
| C19NB | A59 Northbound | 1:35:0 | 1:33:22 | -15.4% |
| C19SB | A59 Southbound | 1:37:11 | 1:35:19 | -1.9% |
| 2EB | M62 Eastbound | 3:04:18 | 2:49:01 | -2.0% |
| 2WB | M62 Westbound | 3:01:8 | 2:46:40 | -9.0% |
| 1Nb | M6 Northbound | 1:55:49 | 1:34:40 | -8.8% |
| 1SB | M6 Southbound | 1:41:42 | 1:42:03 | -22.3% |

## Model Convergence

Highway Assignment Model

The convergence of the highway assignment model is monitored by a series of stability and proximity indicators. **Table 24** to **Table 26.**

provide the final convergence statistics for each time period for the base year model. As can be seen the % Flow, Delta and %Gap targets have been achieved in each time period and it is therefore considered to be acceptable.

### Table 24 – Assignment Convergence Statistics – AM Peak

| Iteration | Delta | %Gap | %Flows | %Delays |
|---|---|---|---|---|
| 63 | 0.0101 | 0.017% | 98.2 | 98.8 |
| 64 | 0.0084 | 0.021% | 97.7 | 98.5 |
| 65 | 0.0080 | 0.022% | 98.0 | 98.7 |
| 66 | 0.0083 | 0.016% | 97.9 | 98.6 |

Table 25 – Assignment Convergence Statistics – Inter Peak

| Iteration | Delta | %Gap | %Flows | %Delays |
|---|---|---|---|---|
| 57 | 0.0049 | 0.006% | 98.6 | 99.4 |
| 58 | 0.003 | 0.006% | 99.1 | 99.4 |
| 59 | 0.0026 | 0.008% | 99.3 | 99.5 |
| 60 | 0.0033 | 0.007% | 98.9 | 99.4 |

Table 26 – Assignment Convergence Statistics – PM Peak

| Iteration | Delta | %Gap | %Flows | %Delays |
|---|---|---|---|---|
| 114 | 0.0093 | 0.019% | 97.7 | 98.5 |
| 115 | 0.0089 | 0.018% | 97.9 | 98.8 |
| 116 | 0.0082 | 0.016% | 98.6 | 98.7 |
| 117 | 0.0077 | 0.020% | 98.8 | 98.8 |

### Summary of Model Performance

In terms of both flow and journey time validation, the model is considered suitable satisfying the criteria set by the TCG tasked by Highways England with determining appropriate standards for the Regional Models.

The model performance is tested across a number of cordons and screenlines across the RoF demonstrating acceptable performance against these standards. It should be noted that these are commensurate with the scale of the model and more local and spatially detained data may be required to refine the model for specific schemes.

### Summary

The model adopted for this study is the Trans Pennine South Regional Transport Model. The model has a base year of 2015 and covers a morning and evening peak and an average inter peak hour. Demand is segmented into five user classes, three car classes, LGV and HGV.

The network detail and zone structure have been investigated and characterised as detailed enough for this study

Traffic flow calibration and validation are shown to be good both across the model as a whole and within the area of focus for the present study.

Journey time validation is shown to be good both as a whole and within the area if focus for the present study.

It is therefore deemed suitable for the TPS-RTM to be used as the basis for this PCF0 study.

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# Appendix C Transport Forecast Package

## Introduction

The Transport Forecast Package describes the analytical material developed to create the transport forecasts that will be used for assessing the M6 – A1M Stage 0 business case, design and operational and environmental assessments

## Future Year Schemes

### Introduction

The following schemes have been assessed:

- Orange (long) – Colne (M65), Skipton, Leeds Bradford Airport (LBA), A1(M) and York (A64);
- Orange (short) – Colne (M65), Skipton, Leeds Bradford Airport (LBA), stopping at the A1(M); and
- Purple – Colne (M65), LBA and A64 east of Leeds.

A location plan for the schemes is provided in **Figure 24**.

## Methodology

### Introduction

The Transport model package describes the performance of the 2015 base year model. Each scheme has been assessed for 2041 as a proxy scheme opening year

Note that the actual opening year of any scheme is yet to be determined, the model year chosen was defined by the availability of existing forecasts within the model.

### Modelling

The TPS RTM Post VDM models for 2041 was used for forecasting for this scheme. The models, which include all RIS1 schemes will become the do minimum model which will provide a benchmark against which the schemes included in this assessment will be compared.

The forecasting process has been to:

- Run the do minimum models for each time period and forecast year;
- Code the do something networks; and
- Run the do something models using the same matrices as for the do minimum.

The four options were coded into the do-minimum model using the same coding manual as used for development of the original RTM model to ensure consistency in the representation of highway standards.

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The routes were coded as a D2M standard. Junctions between the new route and the existing SRN were coded as grade separated junctions.

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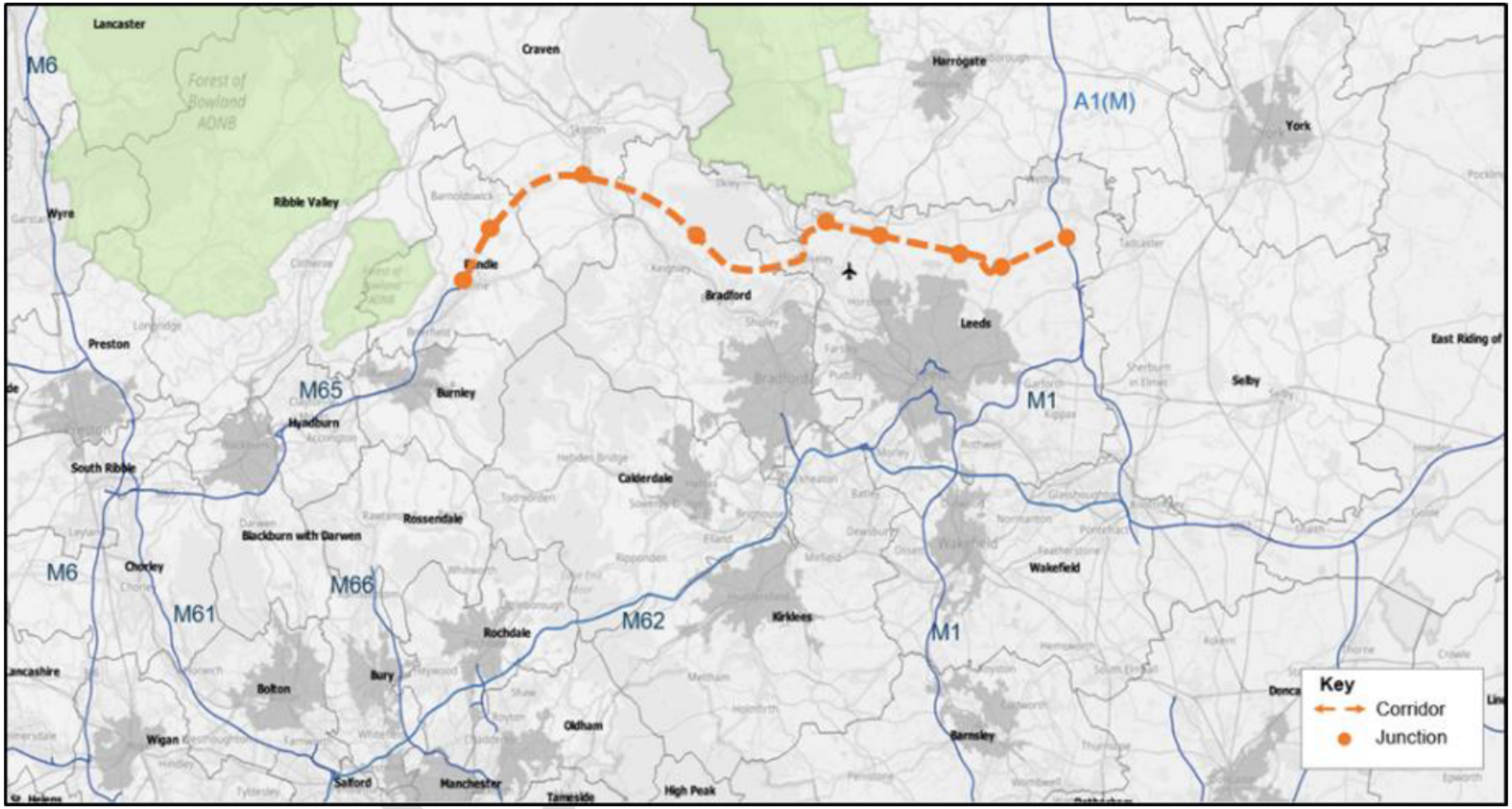
## Figure 24 Overview of the Orange (Short) Scenario



## Figure 25 Overview of the Orange (Long) Scenario

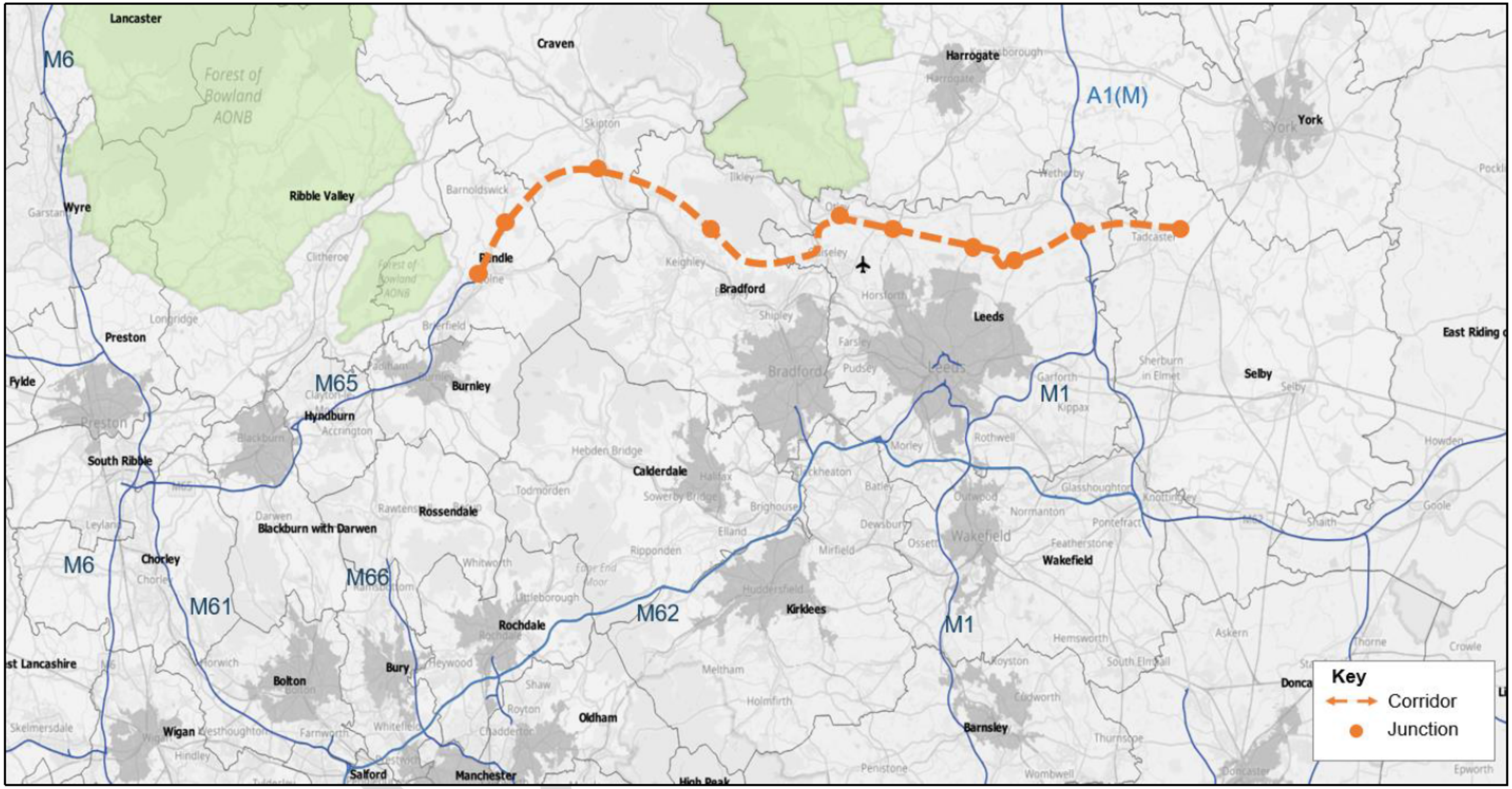
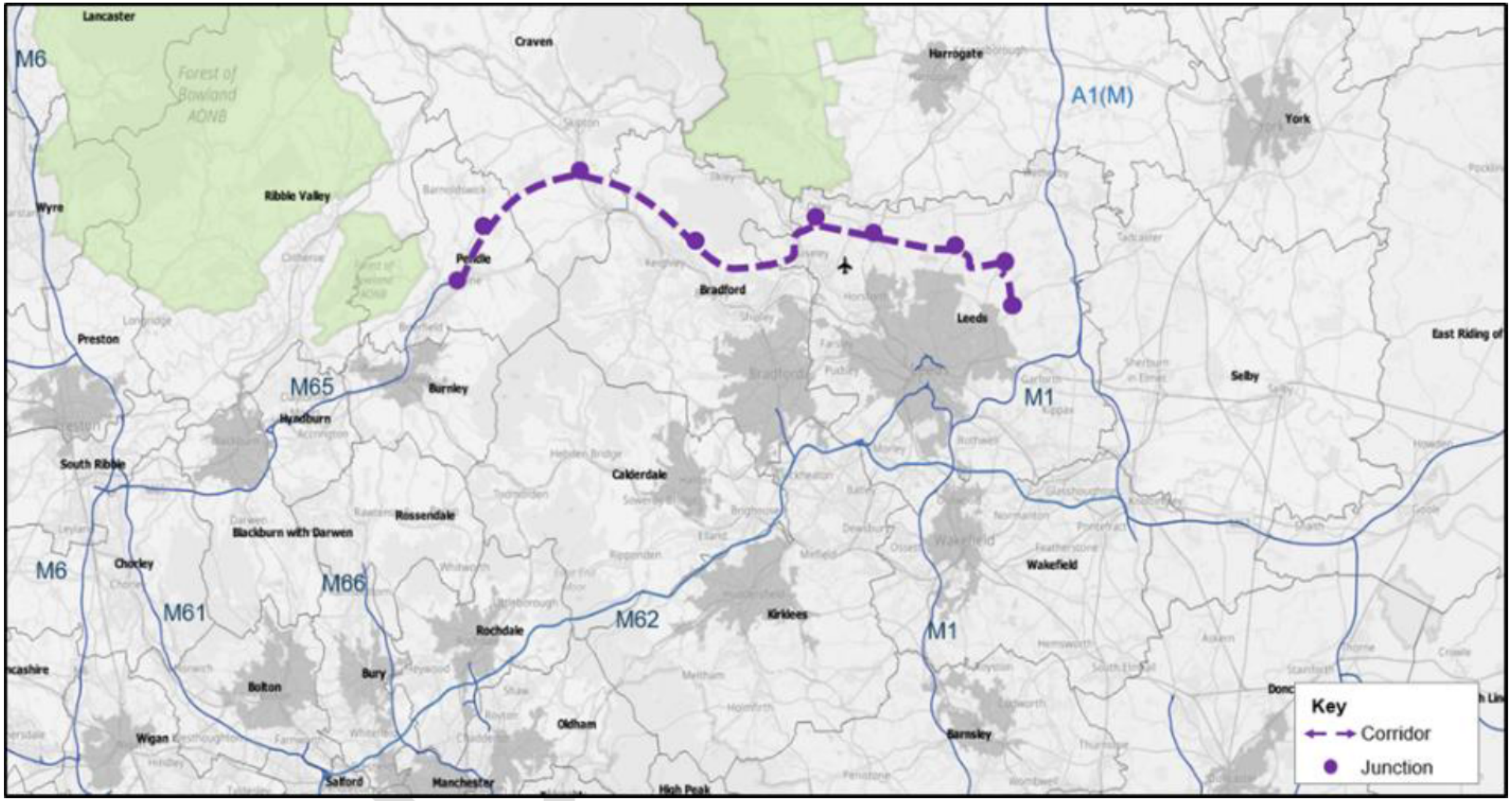


**Figure 26 Overview of the Purple Scenario**



The existing forecast highway matrices were used with no additional growth assumed or model years developed. The DIADEM Variable Demand Model was not used for the initial part of this study.

## Forecast Assumptions

### Traffic Growth

Traffic growth between the base and forecast years was derived from NTEM Version 7.0 (July 2016). Growth rates were applied at a zonal level using the correspondence between NTEM zones and model zones both of which are built on units of Middle layer Super Output Area (MSOA).

Growth rates were derived for car (car available) and rail (car available) segments for each modelled trip purpose.

Growth rates for major airports were obtained independently from forecasts generated by the Civil Aviation Authority (CAA) and applied to airport passengers.

Growth rates for LGV and HGV traffic were derived from the National Transport Model (NTM) Regional Traffic Forecasts (2018).

### Highway Model Matrices

The core matrices input to the VDM process and effective growth rates are shown in **Table 27** to **Table 29**.

Also included is a comparison against TEMPRO outputs. These are taken from TEMPRO v7.2 and represent an average growth over the North West and Yorkshire and Humberside regions. They have not been adjusted for fuel cost and income. The comparisons show that the observed growth in the pre VDM matrices from the Regional Model is similar to the equivalent NTEM growth rate.

### Uncertainty Log

No additional specific developments were included as part of the forecasts.

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### Table 27 AM Peak Matrix (PCUs) Totals

| Purpose / Vehicle Type | Scheme Model | | | |
|---|---|---|---|---|
| | Base (2015) | 2041 | | |
| | | Value | Growth | NTEM Growth |
| Business | 323,830 | 387,709 | 19.7% | 21.3% |
| Commute | 2,379,780 | 2,667,214 | 12.1% | 17.9% |
| Other | 2,138,047 | 2,636,345 | 23.3% | 22.5% |
| LGV | 607,023 | 856,045 | 41.0% | |
| HGV | 325,584 | 341,975 | 5.0% | |
| Total | 5,774,263 | 6,889,289 | 19.3% | |

### Table 28 Inter Peak Matrix (PCUs) Totals

| | Base (2015) | 2041 | | |
|---|---|---|---|---|
| | | Value | Growth | NTEM |
| Business | | Value | Growth | Average NTEM |
| Commute | 345,909 | 409,661 | 18.4% | 20.0% |
| Other | 912,453 | 1,020,209 | 11.8% | 14.9% |
| LGV | 2,722,870 | 3,356,144 | 23.3% | 22.8% |
| HGV | 556,666 | 785,257 | 41.1% | |
| Total | 336,565 | 353,746 | 5.1% | |

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### Table 29 PM Peak Matrix (PCUs) Totals

| | Base (2015) | 2041 | | |
|---|---|---|---|---|
| | | Value | Growth | NTEM |
| Business | 343,179 | 407,295 | 18.7% | 20.7% |
| Commute | 2,238,295 | 2,507,264 | 12.0% | 16.0% |
| Other | 3,052,078 | 3,769,582 | 23.5% | 21.1% |
| LGV | 589,780 | 831,476 | 41.0% | |
| HGV | 237,279 | 249,026 | 5.0% | |
| Total | 6,460,611 | 7,764,643 | 20.2% | |

## Do Minimum Highway Schemes

The following schemes are included in the 2041 Do Minimum networks.

### RIS Schemes

- M62 junction 18 Improvement
- M621 / A623 Roundabout Update
- M56 Junction 11a
- M1 Junction 45
- M1 Junctions 32 – 35A
- M1 Smart Motorway
- A180 Immingham Improvement
- M6 Junction 22 Upgrade
- M6 Junction 21A – 26 Smart Motorway
- A556 and M6 Junction 19
- M62 Junctions 10-12
- M56 Junctions 6 to 8 and M60 Junctions 24-27 and 1-4

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- M6 Junctions 16-19
- M1 Junctions 28-32 Smart Motorway
- M62 to M606 Chain Bar
- M621 Junctions 1-7
- M62 Junctions 20-25
- A61 Dualling
- Windy Harbour to Skippool
- A63 Castle Street
- M56 Junction 11A
- M53 Smart Motorway

### Local Authority Schemes

- P WB and EW Link Road
- MMM M62 J18-J20 ALR
- East Leeds Orbital Route (ELOR)
- M62 junction 19 Improvement
- FARRRS
- Hatfield Link Road
- Waverley Link Road
- A630 Parkway Widening
- Harrogate Road / New Line junction
- A650 Hard Ings Road
- Wakefield Eastern Relief Road
- Mersey Gateway
- A6 MARR
- Poynton Relief Road
- Congleton Link Road
- Middlewich Eastern Bypass
- A59 Penwortham Bypass
- Broughton Bypass

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- Heysham to M6 Link
- A582 South Ribble Widening
- M58 Pemberton Link Road
- Westward Park A49 Link road and Marus bridge roundabout
- Phoenix Way to Seaman Way Link
- Knowsley Expressway and Speke Road Junction
- Denton Link Road
- A565 North Liverpool Dualling
- Etruria Valley Highway and Connectivity Improvement
- A575 Brooms Cross Road
- M58 Junction 1 Improvement
- A580/A570 Windle island Improvement
- A570 Corridor Improvements
- M181
- A18/A180 Link Road
- Glasshoughton Southern Link Road
- A6110 Leeds Outer Ring Road
- Barnet by Top
- M18 Junctions 2-3 Mainline Widening
- A650 Tong Street
- M62 Junction 24A
- Western Gateway Infrastructure
- Leeds Bradford Airport Access
- M58 Junction 1 Slip
- Windle island Improvements
- Outer ring Road Leeds

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### Traffic Flow Results

Route Corridor Flows

The 2041 flow ranges on each corridor are summarised in **Table 30**. Flows on the central corridor are broadly the same for each option. The low values for the orange(long) option occur to the east of the A1(M), this is the only route that extends to the east of the A1(M)

**Table 30 Corridor Flow Summary (AADT PCUs)**

| Route | AADT Range |
|---|---|
| Orange (short) | 25,000 – 43,000 |
| Orange (long) | 11,000 – 43,000 |
| Purple | 26,000 – 44,000 |

Flows by section for each route option are shown in **Figure 27** to **Figure 29**. The highest flow levels for each option are experienced towards the east of the route where it passes to the north of Bradford and Leeds.

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**Figure 27 Orange (Short) Scenario – Corridor Flows (AADT, 2041 PCUs)**

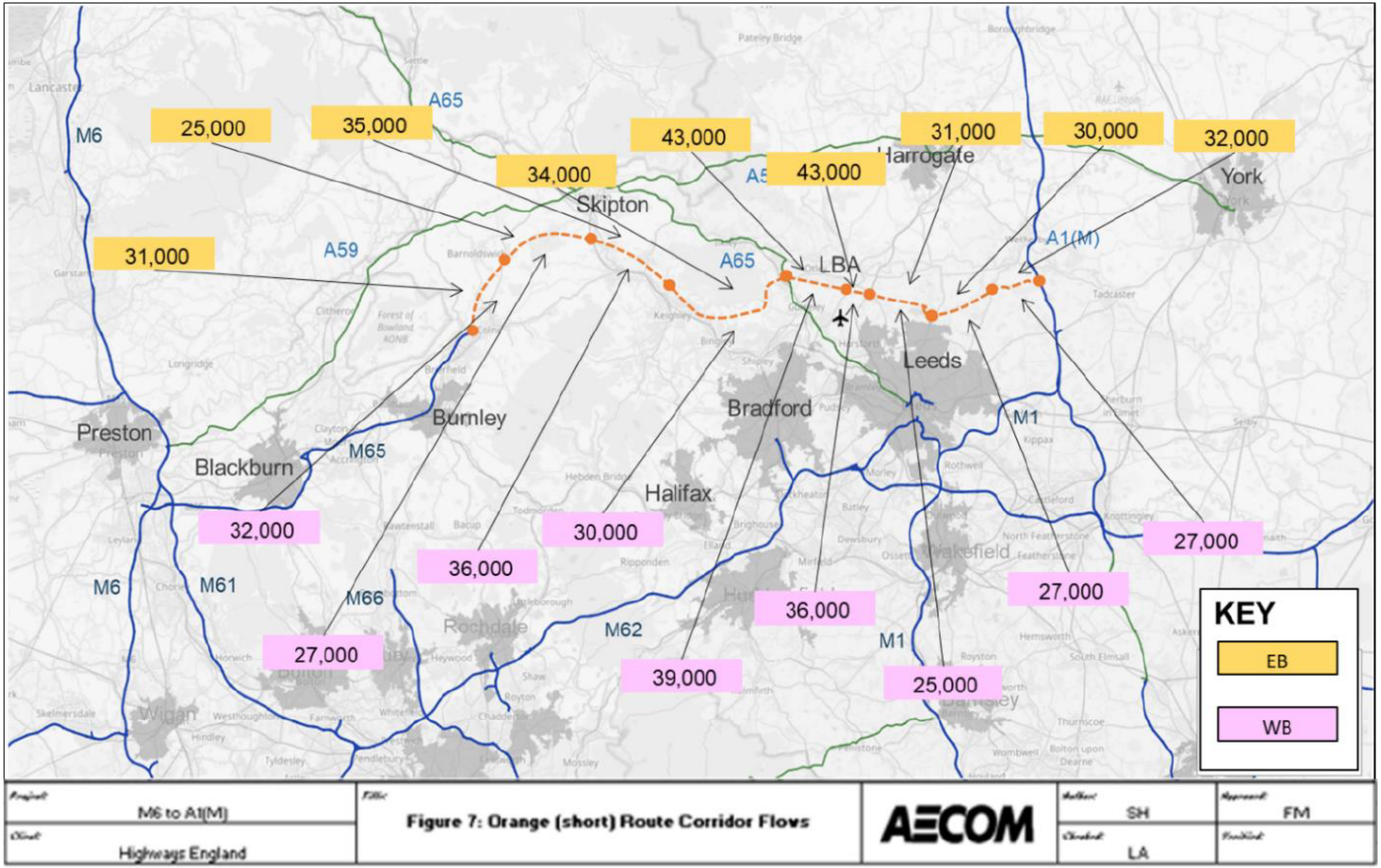


**Figure 28 Orange (Long) Scenario – Corridor Flows (AADT, 2041 PCUs)**

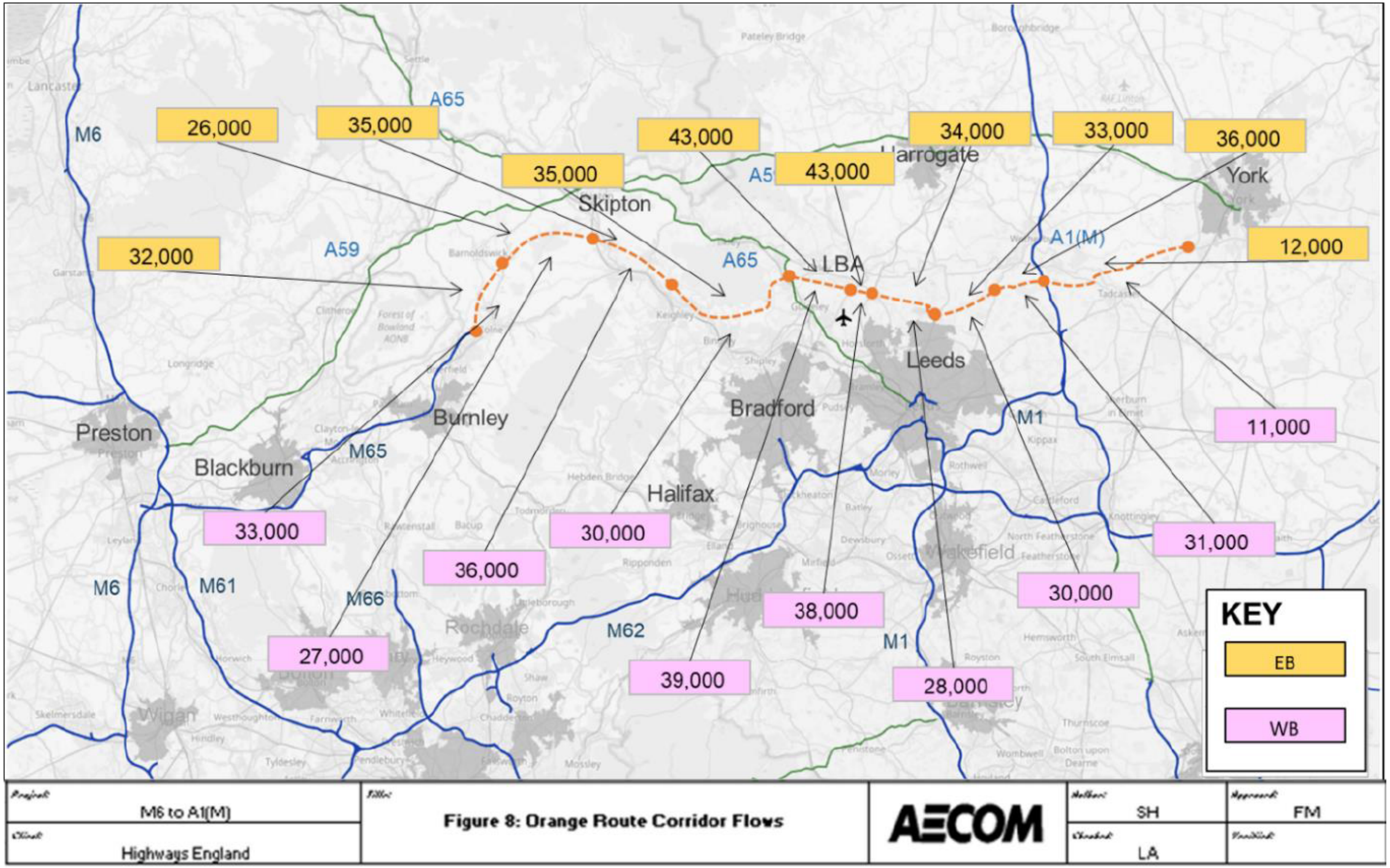
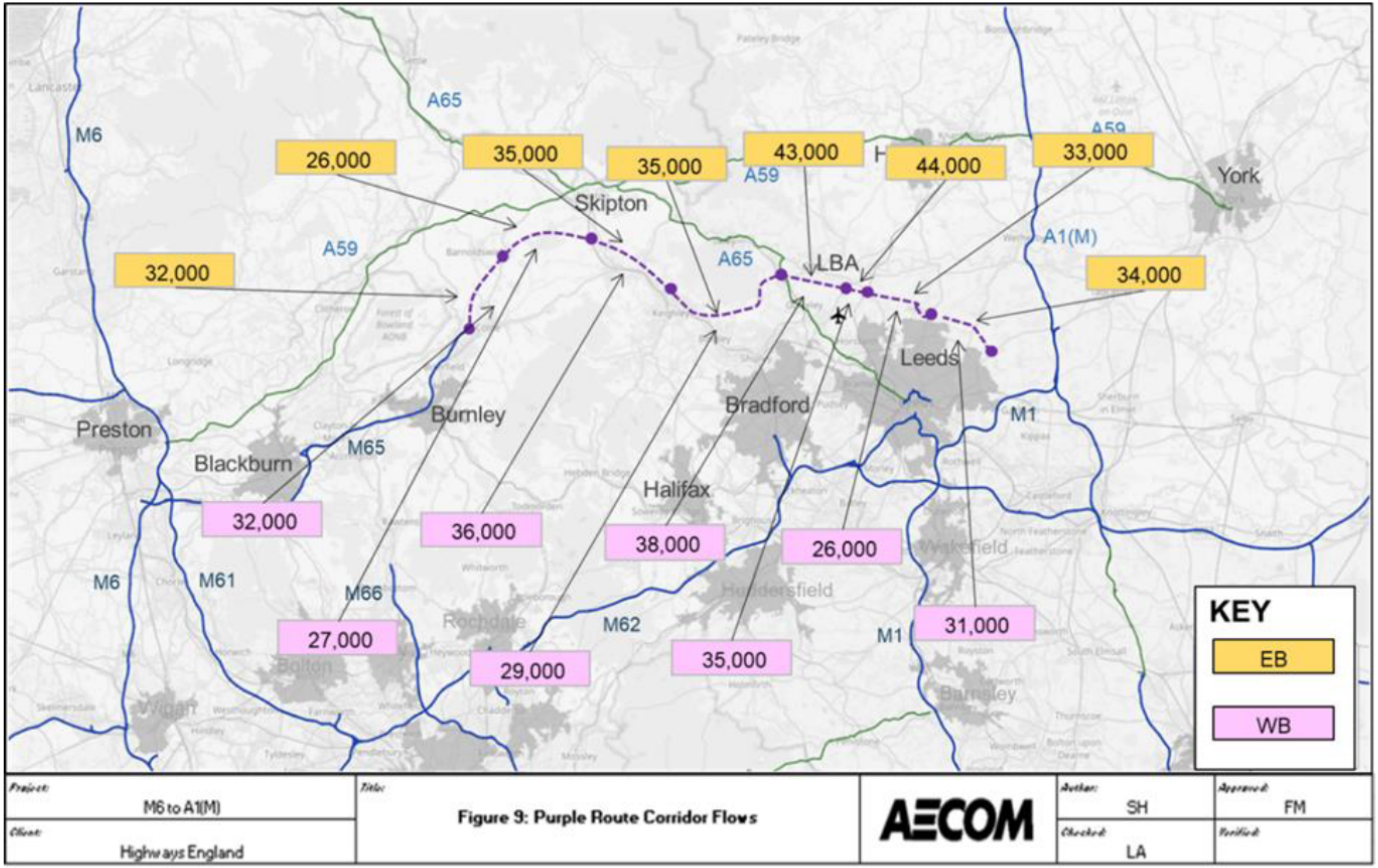


**Figure 29 Purple Scenario – Corridor Flows (AADT, 2041 PCUs)**



Flow on M62

**Table 31** shows the flow changes on the sections of the M62 to the east and west of Halifax. The results show that each option would result in a flow reduction on the M62 of the order of 2%. The changes are very similar across all options.

**Table 31 M62 Traffic Flow Changes (AADT, 2041 2-way PCUs)**

| M62 Section | | Do Minimum | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|---|---|
| M60 to Halifax | Flow | 185,000 | 180,000 | 180,000 | 180,000 |
| | Change | | -5,000 | -5,000 | -5,000 |
| Halifax to A1(m) | Flow | 160,000 | 158,000 | 157,000 | 157,000 |
| | Change | | -3,000 | -3,000 | -3,000 |

Flow on M65

**Table 32** summarises flow changes on the M65 to the west of the route. Each option would lead to a significant increase in demand on the M65, increasing flow by around 30% immediately before the new scheme junction.

**Table 32 M65 Traffic Flow Changes (AADT, 2041 2-way PCUs)**

| M65 Section | | Do Minimum | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|---|---|
| M61 – Blackburn (J3-J4) | Flow | 87,000 | 94,000 | 94,000 | 94,000 |
| | Change | | 7,000 | 7,000 | 7,000 |
| Blackburn – A56 (J7-J8) | Flow | 91,000 | 106,000 | 107,000 | 108,000 |
| | Change | | 15,000 | 16,000 | 17,000 |
| A56 – Colne (J11-J12) | Flow | 74,000 | 97,000 | 97,000 | 97,000 |
| | Change | | 23,000 | 23,000 | 23,000 |

Flow on A1M

**Table 33** summarises flow changes on the A1M at the eastern end of the scheme. The two orange route options join the A1(M) between A59 and A64 and hence lead to an increase in demand on that section of the order 3-4%. The purple option terminates on the A64 to west of the A1(M0 having a lesser impact on this section. All options lead to an increase in traffic on the A1(M0 to the south of the A64 by around 4%.

**Table 33 A1(M) Traffic Flow Changes (AADT, 2041 2-way PCUs)**

| M62 Section | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| North of A59 | Flow | 129,000 | 129,000 | 129,000 | 129,000 |
| | Change | | 0 | 0 | 0 |
| A59 to A64 (J44) | Flow | 132,000 | 136,000 | 137,000 | 127,000 |
| | Change | | 4,000 | 5,000 | -5,000 |
| A64 (J44) to A635 | Flow | 108,000 | 113,000 | 113,000 | 114,000 |
| | Change | | 5,000 | 5,000 | 6,000 |

East and West Pennine Screenlines

Flows and Volume / Capacity Ratios for sites on two screenlines to the east of the M6 and to the east of the A1(M) are presented in two spreadsheets appended to this report.

## Journey Time Results

An objective of the scheme is to improve centre to centre journey times across the North Pennine area. Journey times for selected movements have been extracted from the model runs and are reported in **Table 34** to **Table 35.**

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### Table 34 City Centre to City Centre Travel Times – 2041 AM Peak (h:mm)

| | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| Preston to York | Time | 2:20 | 1:50 | 1:45 | 1:49 |
| | Change from DM | | -0:30 | -0:35 | -0:31 |
| York to Preston | Time | 2:20 | 1:54 | 1:50 | 1:55 |
| | Change from DM | | -0:26 | -0:30 | -0:25 |
| Preston to Leeds | Time | 1:50 | 1:29 | 1:29 | 1:29 |
| | Change from DM | | -0:21 | -0:21 | -0:21 |
| Leeds to Preston | Time | 1:30 | 1:29 | 1:29 | 1:28 |
| | Change from DM | | -0:02 | -0:02 | -0:02 |
| Liverpool to Harrogate | Time | 2:38 | 2:29 | 2:29 | 2:35 |
| | Change from DM | | -0:09 | -0:09 | -0:03 |
| Harrogate to Liverpool | Time | 2:39 | 2:39 | 2:39 | 2:39 |
| | Change from DM | | 0:0 | 0:0 | 0:0 |

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**Table 35 City Centre to City Centre Travel Times – 2041 PM Peak (h:mm)**

| | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| Preston to York | Time | 2:15 | 1:46 | 1:42 | 1:46 |
| | Change from DM | | -0:29 | -0:33 | -0:29 |
| York to Preston | Time | 2:23 | 1:59 | 1:56 | 2:0 |
| | Change from DM | | -0:23 | -0:27 | -0:22 |
| Preston to Leeds | Time | 1:40 | 1:27 | 1:27 | 1:27 |
| | Change from DM | | -0:13 | -0:13 | -0:13 |
| Leeds to Preston | Time | 1:40 | 1:35 | 1:36 | 1:35 |
| | Change from DM | | -0:05 | -0:04 | -0:05 |
| Liverpool to Harrogate | Time | 2:38 | 2:27 | 2:28 | 2:35 |
| | Change from DM | | -0:11 | -0:10 | -0:04 |
| Harrogate to Liverpool | Time | 2:37 | 2:36 | 2:36 | 2:36 |
| | Change from DM | | -0:01 | -0:01 | -0:01 |

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The analysis shows significant (25-35 minutes) time savings on the Preston to York route for all routes with the orange long route saving the most due to its direct link into the A64, East of Tadcaster.

There are notable time savings also for Preston to Leeds and Liverpool to Harrogate though a directional imbalance is prevalent in both cases. This is likely to be due to impacts arising from patterns associated with the M62 and would merit further investigation should the study proceed further.

**Table 36 M62 Time Savings (minutes: seconds)**

| | | Do Minimum | Orange Short | Orange Long | Purple |
|---|---|---|---|---|---|
| AM Westbound | Time | 68:35 | 69:30 | 69:17 | 68:47 |
| | Change from DM | | 0:55 | 0:42 | -0:12 |
| AM Eastbound | Time | 75:54 | 74:54 | 74:54 | 74:47 |
| | Change from DM | | -1:00 | -1:00 | -1:07 |
| IP Westbound | Time | 60:06 | 59:00 | 59:12 | 59:06 |
| | Change from DM | | -1:06 | -0:54 | -1:00 |
| IP Eastbound | Time | 71:47 | 70:00 | 69:47 | 70:00 |
| | Change from DM | | -1:47 | -2:00 | -1:47 |
| PM Westbound | Time | 68:30 | 68:35 | 67:54 | 68:47 |
| | Change from DM | | 0:05 | -0:36 | 0:17 |
| PM Eastbound | Time | 87:12 | 77:00 | 84:24 | 76:35 |
| | Change from DM | | -10:12 | -2:48 | -10:37 |

The analysis conducted to calculate the time saving impact from the three route variations is based on a fixed trip across the M62 from Central Manchester to Central Leeds (no routing change between Do-Minimum and Do-Something).

**Table 37** shows total delay changes on the M65 during AM, IP and PM periods for 2041. As a result of the proposals, there will be an increase in the total average delay experienced on the M65, rising by approximately 3 and a half minutes in all time periods.

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### Table 37 M65 Delay Changes (minutes)

| Period | Direction | Orange (long) | Orange (short) | Purple |
|---|---|---|---|---|
| AM | Eastbound | +3.3 | +3.1 | +3.2 |
| | Westbound | +2.5 | 2.4 | +2.4 |
| IP | Eastbound | +1.4 | +1.3 | +1.5 |
| | Westbound | +2.3 | +2.2 | +2.4 |
| PM | Eastbound | +2.2 | +2.1 | +2.2 |
| | Westbound | +3.7 | +3.6 | +3.5 |

**Table 38** shows the total delay changes on the M62 during AM, IP and PM periods for 2041. An additional Trans Pennine link would reduce the total average delay experienced on the M62 in all time periods, averaging just under 2 minutes in the AM, IP and PM periods.

### Table 38 M62 Delay Changes (minutes)

| Period | Direction | Orange (long) | Orange (short) | Purple |
|---|---|---|---|---|
| AM | Eastbound | -2.0 | -1.9 | -1.9 |
| | Westbound | -1.7 | -1.7 | -1.7 |
| IP | Eastbound | -2.4 | -2.3 | -2.5 |
| | Westbound | -1.5 | -1.5 | -1.7 |
| PM | Eastbound | -1.5 | -1.6 | -1.6 |
| | Westbound | -1.7 | -1.6 | -1.6 |

## Model Convergence

Highway assignment model convergence statistics for the Do Minimum and foe each route scenarios for each time period are shown in **Table 39** to **Table 42**. From the tables it may be seen that the assignments have achieved reasonably good stability.

### Table 39 Convergence Statistics - 2041 - Do Minimum - Last Four Loops

| AM Peak | | | | Inter Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap |
| 61 | 0.007 | 98.0 | 0.01 | 88 | 0.005 | 98.8 | 0.005 | 117 | 0.009 | 97.6 | 0.023 |
| 62 | 0.007 | 98.4 | 0.008 | 89 | 0.005 | 98.9 | 0.006 | 118 | 0.009 | 96.9 | 0.019 |
| 63 | 0.006 | 98.1 | 0.007 | 90 | 0.004 | 98.7 | 0.007 | 119 | 0.011 | 97.2 | 0.018 |
| 64 | 0.006 | 98.7 | 0.007 | 91 | 0.004 | 98.6 | 0.007 | 120 | 0.010 | 97.1 | 0.018 |

### Table 40 Convergence Statistics - 2041 - Orange (Short) - Last Four Loops

| AM Peak | | | | Inter Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap |
| 51 | 0.010 | 97.7 | 0.011 | 100 | 0.004 | 98.7 | 0.005 | 113 | 0.007 | 97.7 | 0.014 |
| 52 | 0.006 | 97.6 | 0.01 | 101 | 0.004 | 98.9 | 0.006 | 114 | 0.007 | 97.8 | 0.011 |
| 53 | 0.007 | 97.6 | 0.008 | 102 | 0.003 | 98.8 | 0.005 | 115 | 0.006 | 97.7 | 0.009 |
| 54 | 0.005 | 97.8 | 0.008 | 103 | 0.003 | 98.9 | 0.005 | 116 | 0.007 | 98.1 | 0.018 |

### Table 41 Convergence Statistics - 2041 - Orange (Long) - Last Four Loops

| AM Peak | | | | Inter Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap |
| 40 | 0.009 | 97.9 | 0.012 | 101 | 0.004 | 98.6 | 0.006 | 77 | 0.009 | 97.9 | 0.013 |
| 41 | 0.007 | 97.9 | 0.009 | 102 | 0.003 | 98.9 | 0.006 | 78 | 0.008 | 97.7 | 0.016 |
| 42 | 0.008 | 98.4 | 0.011 | 103 | 0.003 | 98.8 | 0.006 | 79 | 0.009 | 97.9 | 0.017 |
| 43 | 0.008 | 97.9 | 0.008 | 104 | 0.003 | 98.7 | 0.007 | 80 | 0.010 | 97.5 | 0.013 |

### Table 42 Convergence Statistics - 2041 - Purple - Last Four Loops

| AM Peak | | | | Inter Peak | | | | PM Peak | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap | Loop no | % Delta | % Flows | %Gap |
| 43 | 0.007 | 98.2 | 0.014 | 71 | 0.005 | 98.7 | 0.007 | 111 | 0.008 | 98.1 | 0.018 |
| 44 | 0.009 | 97.6 | 0.01 | 72 | 0.004 | 98.6 | 0.008 | 112 | 0.008 | 97.6 | 0.011 |
| 45 | 0.008 | 98.2 | 0.012 | 73 | 0.004 | 98.5 | 0.006 | 113 | 0.008 | 97.8 | 0.011 |
| 46 | 0.007 | 97.7 | 0.009 | 74 | 0.004 | 98.9 | 0.008 | 114 | 0.007 | 97.9 | 0.02 |

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# Appendix D Economic Appraisal Package

## Introduction

All the options have been modelled using the Trans Pennine South (TPS) Regional Transport Model (RTM) and have been assessed using the Department for Transport's Transport User Benefit Appraisal (TUBA) and Wider Impacts in Transport Appraisal (WITA) programs.

The assessment has been undertaken for two carriageway standards, dual two lane motorway and dual two lane dual carriageway. Given that this is a Stage 0 assessment it was considered that it would not be proportionate to carry out full model runs for each standard and the D2M has been assumed to be broadly similar to the D2AP and results from a single model run taken to represent the benefits for both scenarios.

## TUBA Assessment

TUBA 1.9.13 (July 2019) has been used for this assessment. The current year has been taken as 2017 as this is the base year from which the forecasts have been developed.

For the purposes of this assessment the assumed opening year is 2041 and the assessment has been made over the 60-year period from this year until 2100.

## TUBA Inputs

### Annualisation

The model has been run for the two peak periods and for the inter peak period. The annualisation factors are values used for previous analysis using the TPS RTM:

- AM Peak - 783 hours;
- Inter Peak- 1566 hours; and
- PM Peak - 783 hours;

### Model Years

Model data has been input for 2041 the opening year. To enable the TUBA program to calculate a 60-year analysis a second year is required. For this study the 2041 inputs were repeated and entered to represent 2051 model outputs.

This effectively creates a 60-year TUBA assessment with no change from the opening year in terms of traffic volumes and travel times.

### Skimmed Costs

Skimmed travel distance, travel time and toll charges were extracted on a zone to zone basis for each time period and for each vehicle class in the model.

## TUBA Output

### Errors and Warnings

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In line with the guidance given by the TUBA User Manual and associated guidance notes, the warnings produced by TUBA were investigated. The number of warnings produced for each scenario are reported in **Table 43**.

### Table 43 TUBA Error Message Totals

| | Orange Short | Orange Long | Purple |
|---|---|---|---|
| Total warnings | 253,647 | 258,275 | 253,073 |
| Serious warnings | 17,188 | 17,258 | 16,710 |
| % of warnings serious | 6.8% | 6.7% | 6.6% |

The main messages produced and the proportion of the total for each test are shown in **Table 44**.

### Table 44 Error Message Breakdown

| Message | Orange Short | Orange Long | Purple |
|---|---|---|---|
| Ratio of DM to DS travel time lower than limit | 9.8% | 8.4% | 10.2% |
| Ratio of DM to DS travel time higher than limit | 14.8% | 17.4% | 14.6% |
| Ratio of DM to DS distance lower than limit | 6.2% | 6.5% | 4.8% |
| DM speeds lower than limit | 29.6% | 29.1% | 29.7% |
| DS speeds lower than limit | 29.9% | 29.1% | 29.7% |
| One of DM or DS time is 0 but not both | 4.7% | 4.4% | 4.9% |

It should be noted that if a warning is generated by a given OD pair then it generally will be replicated for each user class, time period and modelled year, thus a warning for a single OD pair can, in this case, generate 30 warnings. There are 2012 zones in the matrix, representing some 4 million zone pairs, thus although the absolute number of warnings in each case is high, it reflects a small proportion (<1%) of the overall number of zone pairs assessed by TUBA

Ratio of DM to DS travel times lower than limit – this message is generated when a movement is slower in the scheme scenario than in the do minimum (DM) scenario such that the do-something (DS) time is as least 50% greater than the do-minimum time. In these tests this error was generated when both DM time and DS time were 0 such that the ratio could not be calculated. In such cases these movements have no impact on scheme benefits. This accounted for around 10% of the overall warnings.

Ratio of DM to DS travel times greater than limit – this message is generated when a movement is faster in the do something scenario than in the do minimum scenario such that the do minimum time is at least 50% greater than the do something time. These are instances

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where the scheme is improving journey times. Since the intention of the scheme is to create quicker journeys for some movements and also to relieve congestion then journey time improvements should be expected.

The maximum ratio for any OD pair was 4.5 from 2.6 minutes in the DM to 0.6 minutes in the DS which is not unreasonable. This accounted for 15-17% of warnings.

Ratio of DM to DS distance lower than limit– this message is generated when the distance for a movement is at least 50% greater in the DS scenario than in the DM scenario. In this instance it is seen that some movements are able to travel a longer distance in the do something scenario to achieve a travel time saving. This accounted for about 7% of warnings in each scenario.

DM speeds DS speeds lower than limit – this message is generated when either speed is lower than 5 km/h. The numbers of warnings are broadly similar for DM and DS and in general are at the same locations for trips between neighbouring zones in the congested areas of the model where OD distances are small but travel times can be high due to localised junction delays. Thus, these warnings broadly cancel each other out between DM and DS scenarios. The account for around 60% of warnings in each scenario.

One of DM or DS time is 0 but not both– this message is generated when travel distances are 0 in one but not both scenarios. In this case this is due to the relocation of centroid loading points for some zones in coding the scheme. These represent only around 5% of the warnings.

### Benefits

Total time benefits by time period and trip purpose for each option are shown in **Table 45** and **Table 46**.

**Table 45 Benefits Split by Time Period (£m)**

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| AM | 514.4 | 668.1 | 478.1 |
| IP | 859.9 | 845.1 | 904.8 |
| PM | 476.5 | 471.6 | 520.5 |
| Total | 1,850.8 | 1,984.8 | 1,903.4 |

*All entries are present values discounted to 2010, in 2010 prices*

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### Table 46 Benefit Split by Trip Purpose (£m)

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| Business | 1435.6 | 1532.2 | 1481.1 |
| Commute | 208.4 | 259.3 | 206.6 |
| Other | 206.6 | 193.1 | 215.5 |
| Total | 1850.6 | 1984.6 | 1903.2 |

*All entries are present values discounted to 2010, in 2010 prices*

## Benefits by Year

Discounted benefits by year for each scheme are shown in **Figure 30**. For each route option the results show a similar profile with benefits rising between 2031 and 2041 with traffic growth. Beyond 2041 no further growth is assumed and although values of time and operating costs continue to increase the discounting process leads to a steady decline in benefits in subsequent years.

The equivalent without the discounting is shown in **Figure 31**. In this instance benefits continue to grow in future years as a result of the modelled growth in values of time and vehicle operating costs.

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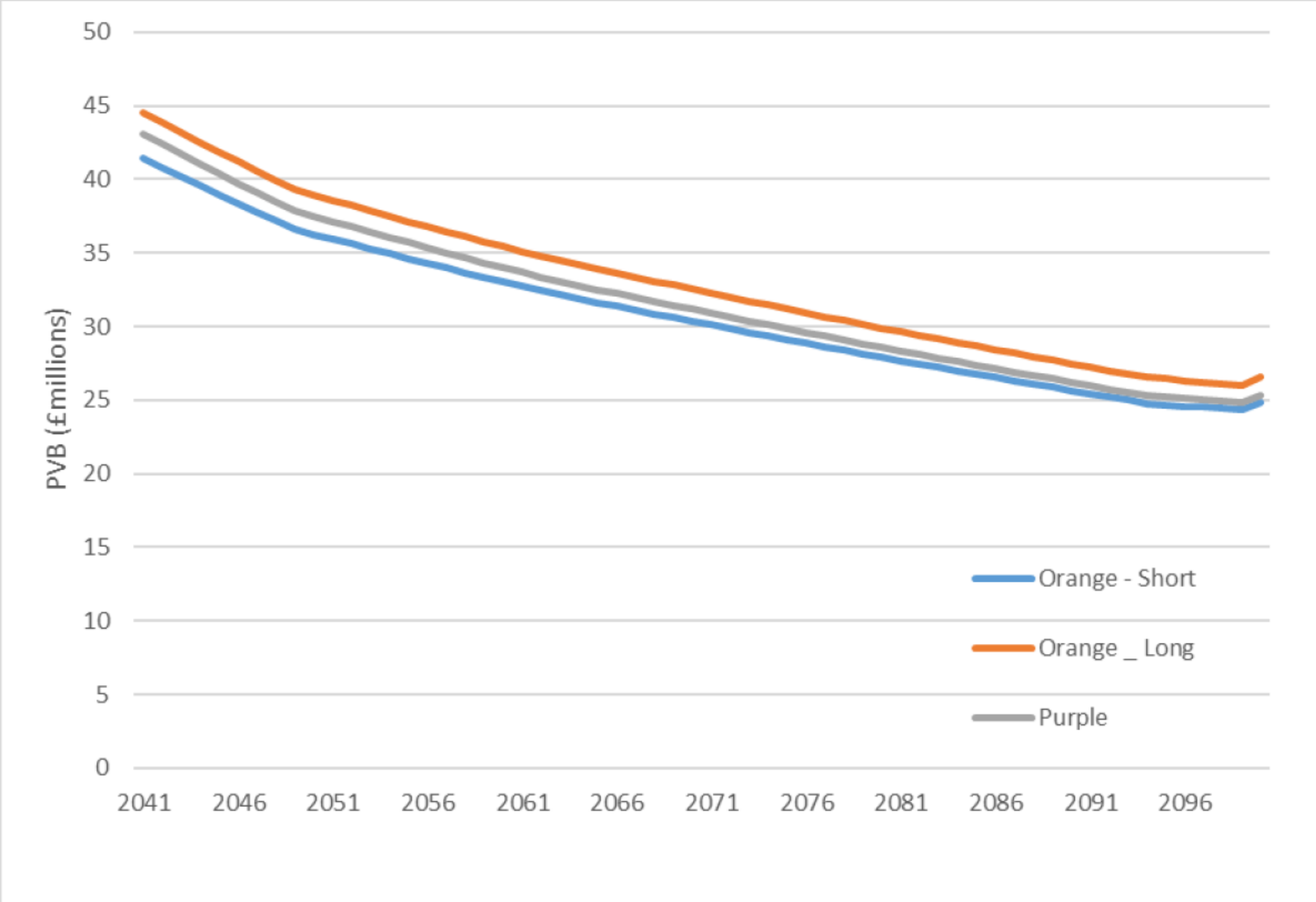
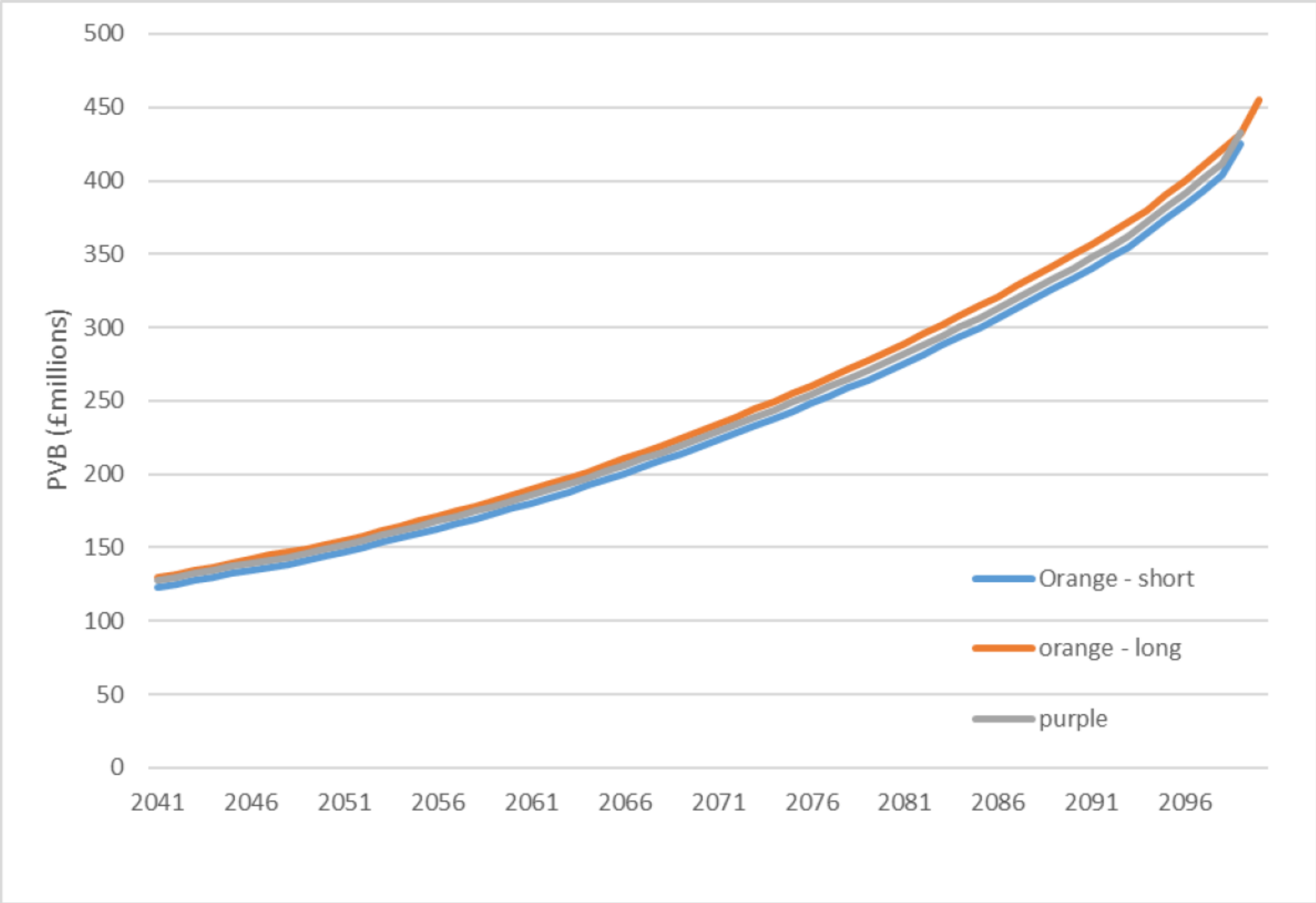
**Figure 30 Discounted PVB per year**




*All entries are present values discounted to 2010, in 2010 prices*

**Figure 31 Undiscounted benefits**



### Benefits by Sector

Benefits have been considered at a county to county level across the area covered by the model. The PVB for each county to county movement is shown in **Table 47** to **Table 49** for the three scenarios.

In each case the greatest level of benefits is consistent with the nature of the route. Largest benefits are obtained by:

- Internal West Yorkshire – where additional capacity is provided in the congested road network around Leeds and Bradford; and
- Lancashire to West Yorkshire – where an improved route standard is provided.

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### Table 47 Sector to Sector Benefits Orange (Short) (£m)

| | Ches. | Derb. | GM | Mersey | Lancs. | Cumb. | S Yrk. | W Yrk. | N Yrk. | Humb. | Lincs | North | South | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cheshire** | 7.6 | 0.9 | 11.4 | 0.7 | -7.7 | -0.2 | 1.9 | 25.5 | 10.4 | 4.0 | -0.1 | 2.4 | 1.2 | **58.1** |
| **Derbyshire** | 0.0 | 0.3 | 2.5 | 0.1 | 0.7 | 0.0 | 0.9 | 2.1 | -0.8 | -0.2 | -2.0 | -0.1 | 0.4 | **4.0** |
| **GM** | -7.3 | 3.8 | 118.2 | 0.0 | 2.4 | 0.9 | 8.2 | 74.4 | 37.8 | 16.2 | 5.0 | 11.5 | 7.2 | **278.1** |
| **Merseyside** | 2.0 | 0.2 | 9.7 | 1.7 | -19.8 | -0.3 | 4.0 | 53.8 | 23.6 | 12.0 | -0.3 | 3.3 | 2.3 | **92.2** |
| **Lancashire** | -2.7 | 1.2 | 6.4 | -10.3 | -110.0 | -1.3 | 58.2 | 181.2 | 79.7 | 67.6 | 2.6 | 21.4 | 24.8 | **318.9** |
| **Cumbria** | 0.2 | 0.2 | 2.4 | 0.0 | 0.0 | 0.0 | 2.6 | 5.7 | 2.6 | 1.6 | 0.0 | 1.3 | 7.9 | **24.5** |
| **S Yorkshire** | 0.7 | 0.4 | 3.3 | 1.3 | 22.3 | 1.2 | -8.6 | 16.0 | -2.9 | -3.4 | -2.3 | -1.8 | -0.3 | **25.8** |
| **W Yorkshire** | 8.6 | 0.9 | 44.8 | 31.1 | 188.7 | 11.6 | 13.6 | 337.2 | 118.7 | 24.2 | 12.0 | 11.5 | 15.7 | **818.7** |
| **N Yorkshire** | 3.2 | -1.1 | 21.4 | 16.5 | 105.4 | 3.5 | -7.4 | 50.2 | 3.3 | -5.8 | 0.1 | -2.0 | -8.8 | **178.3** |
| **Humberside** | 1.4 | -0.1 | 8.5 | 3.7 | 48.3 | 1.7 | -3.0 | 21.4 | -6.8 | -49.9 | -0.6 | -1.7 | -1.7 | **21.2** |
| **Lincolnshire** | 0.1 | -1.5 | 4.1 | 0.0 | 8.2 | 0.0 | -3.4 | 8.0 | 0.4 | -0.5 | 0.0 | -1.7 | -11.3 | **2.4** |
| **Nth - External** | 1.5 | -0.4 | 6.2 | 1.9 | 10.8 | 0.7 | -2.3 | 7.4 | -1.4 | -11.5 | -0.9 | 4.5 | -9.1 | **7.3** |
| **Sth - External** | 1.6 | 0.8 | 6.6 | 0.4 | 5.0 | 4.7 | 1.3 | 22.0 | -5.4 | -2.0 | -9.1 | -5.1 | 0.2 | **21.2** |
| **Total** | **17.0** | **5.7** | **245.5** | **47.0** | **254.2** | **22.6** | **65.9** | **804.9** | **259.1** | **52.3** | **4.5** | **43.5** | **28.5** | **1850.6** |

*All entries are present values discounted to 2010, in 2010 prices*

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## Table 48 Sector to Sector Benefits Orange (Long) (£M)

| | Ches. | Derb. | GM | Mersey | Lancs. | Cumb. | S Yrk. | W Yrk. | N Yrk. | Humb. | Lincs | North | South | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cheshire** | -33.0 | 0.5 | 2.4 | -1.8 | -8.9 | -0.2 | 1.5 | 23.7 | 10.1 | 4.0 | -0.2 | 2.2 | -2.5 | **-2.1** |
| **Derbyshire** | 0.1 | 2.1 | 2.8 | 0.2 | 0.7 | 0.1 | 6.1 | 2.5 | -0.2 | 0.1 | -1.4 | 0.0 | 1.7 | **14.7** |
| **GM** | -8.1 | 3.8 | 95.4 | -1.8 | -0.4 | 0.7 | 8.3 | 74.2 | 41.1 | 18.2 | 5.7 | 11.4 | 6.5 | **255.0** |
| **Merseyside** | -2.3 | 0.2 | 8.9 | -2.9 | -20.2 | -0.4 | 4.0 | 54.1 | 28.4 | 15.2 | -0.3 | 3.3 | 2.7 | **90.7** |
| **Lancashire** | -3.8 | 1.3 | 6.9 | -11.0 | -108.9 | -1.2 | 57.3 | 177.3 | 89.0 | 76.4 | 2.6 | 21.1 | 24.9 | **331.9** |
| **Cumbria** | 0.1 | 0.2 | 2.6 | -0.1 | 0.0 | 0.0 | 2.6 | 5.6 | 3.3 | 1.9 | 0.0 | 1.3 | 8.0 | **25.6** |
| **S Yorkshire** | 0.5 | 0.6 | 3.2 | 1.2 | 22.2 | 1.4 | -7.1 | 16.4 | -1.1 | -1.8 | -1.2 | -1.0 | -0.5 | **32.8** |
| **W Yorkshire** | 8.3 | 1.0 | 44.9 | 30.2 | 186.1 | 11.5 | 13.5 | 338.9 | 146.7 | 38.0 | 13.6 | 12.8 | 14.9 | **860.4** |
| **N Yorkshire** | 3.3 | -1.0 | 23.7 | 18.9 | 119.2 | 4.6 | -6.2 | 71.8 | 37.6 | -5.6 | 0.6 | -1.9 | -8.0 | **256.9** |
| **Humberside** | 1.5 | -0.1 | 9.3 | 4.1 | 55.8 | 2.3 | -3.0 | 31.7 | -7.3 | -16.1 | -0.5 | -1.0 | -1.5 | **75.1** |
| **Lincolnshire** | 0.1 | -1.4 | 4.5 | 0.0 | 8.1 | 0.0 | -3.2 | 7.4 | 0.4 | -0.5 | 0.0 | -1.6 | -11.0 | **2.9** |
| **Nth - External** | 1.4 | -0.3 | 6.5 | 1.8 | 10.8 | 0.7 | -2.0 | 7.8 | -0.7 | -0.1 | -0.6 | -8.5 | -8.5 | **8.4** |
| **Sth - External** | -1.3 | 0.7 | 6.3 | 1.5 | 5.7 | 5.2 | 1.4 | 21.9 | -1.9 | -1.1 | -6.6 | -3.6 | 4.1 | **32.3** |
| **Total** | **-33.2** | **7.3** | **217.2** | **40.3** | **270.4** | **24.8** | **73.2** | **833.2** | **345.6** | **128.7** | **11.7** | **34.4** | **31.0** | **1984.6** |

*All entries are present values discounted to 2010, in 2010 prices*

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### Table 49 Sector to Sector Benefits Purple Route, (£M)

| | Ches. | Derb. | GM | Mersey | Lancs. | Cumb. | S Yrk. | W Yrk. | N Yrk. | Humb. | Lincs | North | South | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cheshire** | 15.4 | 0.9 | 8.4 | -5.1 | -7.2 | -0.1 | 1.9 | 23.8 | 8.5 | 4.2 | 0.0 | 2.7 | 1.8 | **55.2** |
| **Derbyshire** | 0.3 | -0.8 | 1.4 | 0.1 | 0.7 | 0.3 | 0.5 | 1.7 | 0.8 | -0.1 | -0.3 | 0.3 | 0.4 | **5.0** |
| **GM** | 6.9 | 3.7 | 80.8 | -0.6 | 4.6 | 1.0 | 8.6 | 73.1 | 36.0 | 17.5 | 5.9 | 12.4 | 8.3 | **258.4** |
| **Merseyside** | -0.6 | 0.2 | 6.8 | -13.1 | -23.3 | -0.3 | 4.1 | 52.9 | 24.1 | 14.1 | -0.2 | 3.7 | 2.5 | **70.8** |
| **Lancashire** | -0.7 | 1.4 | 9.9 | -10.1 | -101.0 | -1.1 | 63.1 | 187.6 | 83.2 | 75.4 | 2.2 | 24.4 | 29.3 | **363.4** |
| **Cumbria** | 0.4 | 0.3 | 2.9 | 0.1 | 0.1 | 0.0 | 2.9 | 5.8 | 2.8 | 1.8 | 0.0 | 1.4 | 9.0 | **27.5** |
| **S Yorkshire** | 0.8 | 0.0 | 3.4 | 1.3 | 21.7 | 1.8 | -5.2 | 11.0 | -0.1 | -2.6 | 0.0 | 0.4 | -0.3 | **32.2** |
| **W Yorkshire** | 9.8 | 1.3 | 46.1 | 31.7 | 193.2 | 12.2 | 15.2 | 336.3 | 104.0 | 27.1 | 3.1 | 13.2 | 18.8 | **811.8** |
| **N Yorkshire** | 3.0 | -1.1 | 18.5 | 15.6 | 105.8 | 3.5 | -7.8 | 22.3 | 24.1 | -2.4 | 0.2 | -1.8 | -8.2 | **171.7** |
| **Humberside** | 1.6 | -0.1 | 9.0 | 3.9 | 49.2 | 1.9 | -2.8 | 15.8 | -4.6 | -22.0 | -0.1 | 1.0 | -1.2 | **51.6** |
| **Lincolnshire** | 0.3 | -1.4 | 3.6 | 0.0 | 6.0 | 0.0 | -3.1 | -0.6 | 0.2 | -0.5 | 0.0 | -1.6 | -10.7 | **-7.6** |
| **Nth - External** | 1.8 | -0.3 | 6.9 | 2.1 | 10.4 | 0.7 | -1.4 | -0.2 | -0.1 | -1.1 | -0.2 | 22.7 | -7.6 | **34.0** |
| **Sth - External** | -1.1 | -0.1 | 6.2 | -0.3 | 5.3 | 5.0 | -0.6 | 14.9 | 2.6 | -1.8 | -2.5 | -1.9 | 3.9 | **29.3** |
| **Total** | **37.7** | **4.0** | **203.8** | **25.7** | **265.6** | **24.8** | **75.3** | **744.3** | **281.4** | **109.6** | **8.0** | **76.9** | **46.0** | **1903.2** |

*All entries are present values discounted to 2010, in 2010 prices*

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### Assessment of Benefits by Trip Distance

An analysis was undertaken of the level of benefits by trip length. Since the schemes are developed with the objective of providing alternative routes for strategic movements it should be expected that longer journeys should benefit most from the scheme.

- The benefits by trip length band for each scheme are shown in **Figure 32** to **Figure 34**.

The results show that the larger proportion of benefits accrue to the trips in the 50-200km trip length bands suggesting that the scheme is benefiting longer distance movements as would be expected for a route of this nature.

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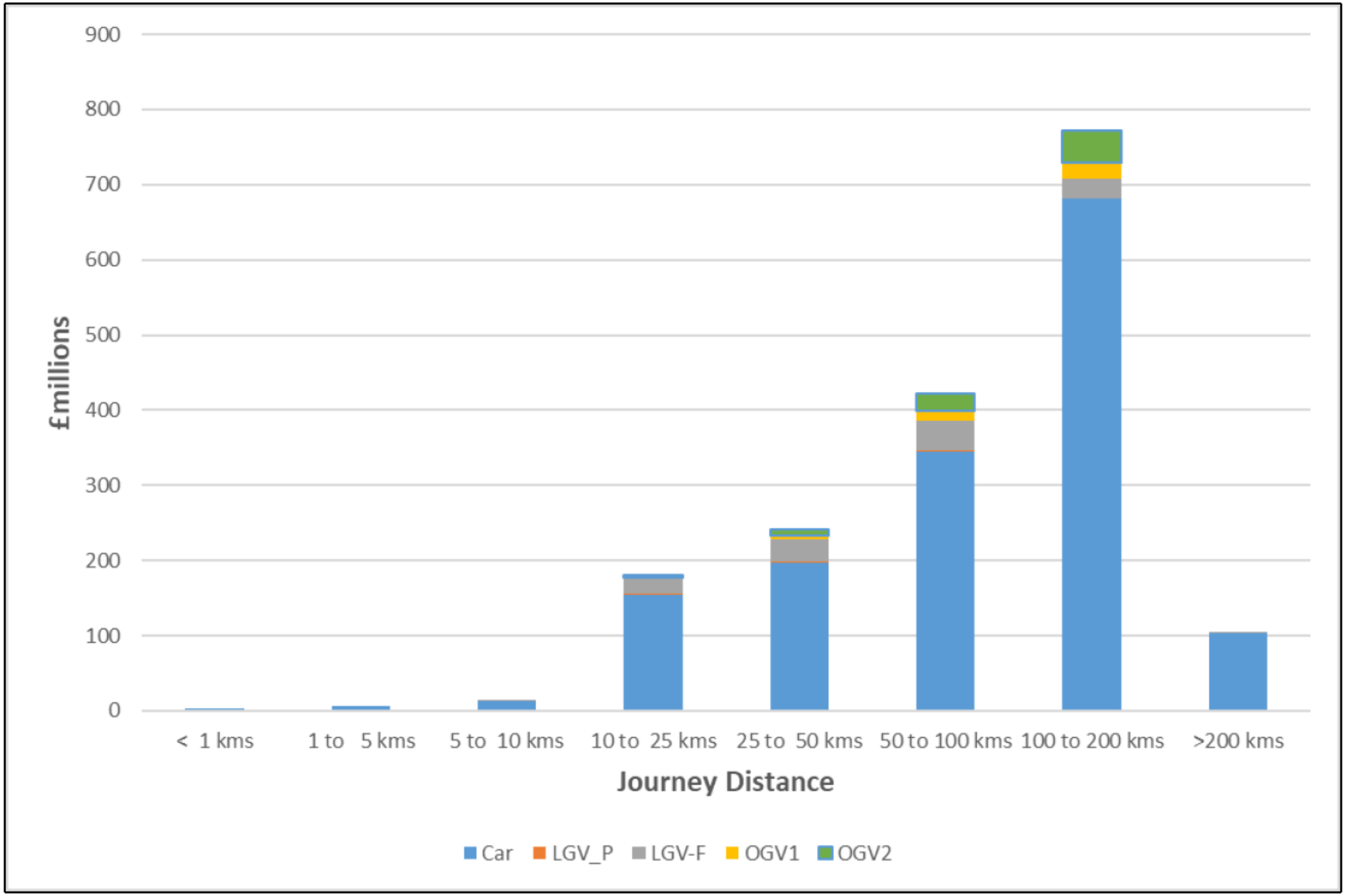
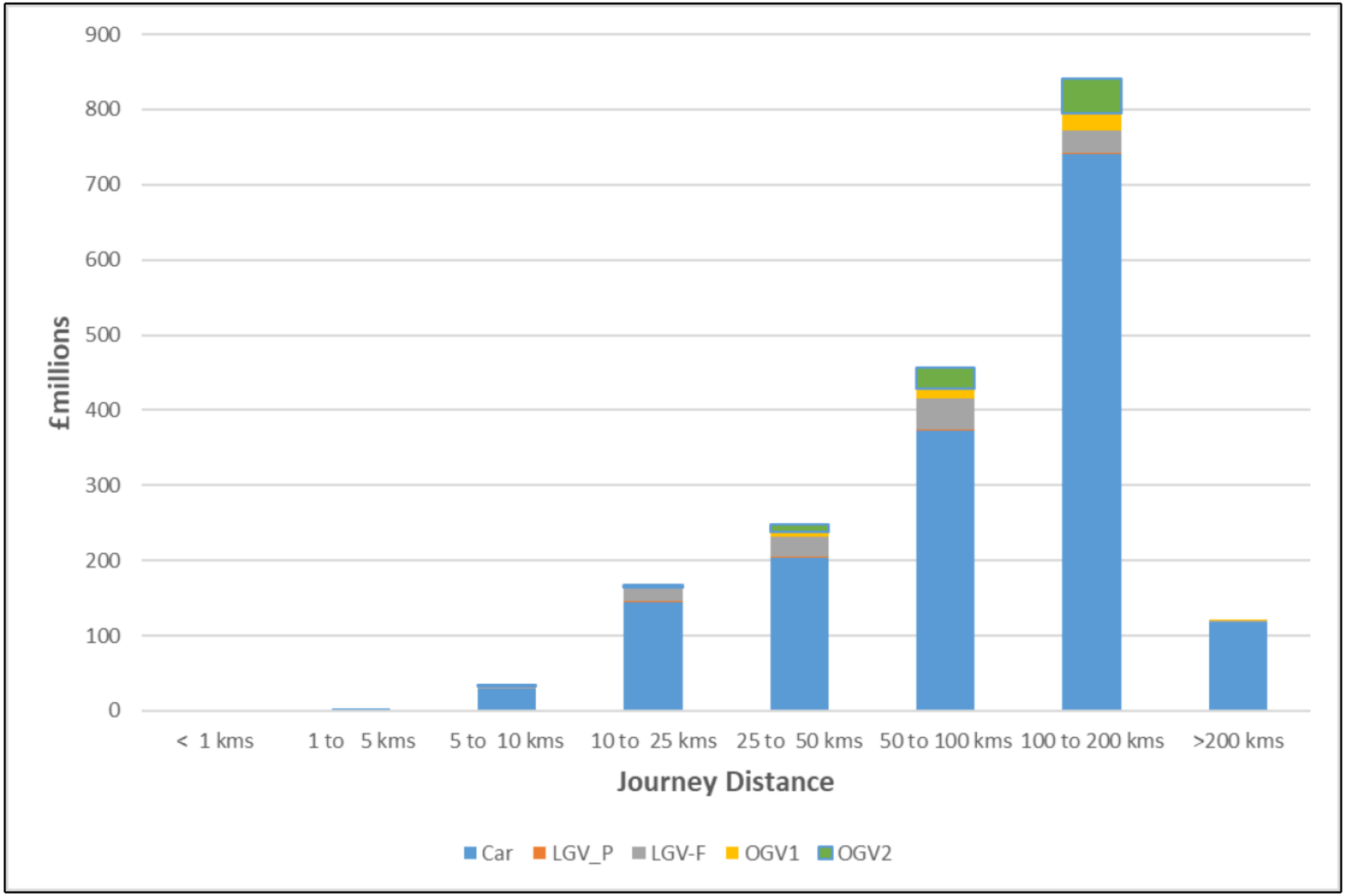
**Figure 32 Monetised Benefits by Journey Distance – Orange (Short) Route**



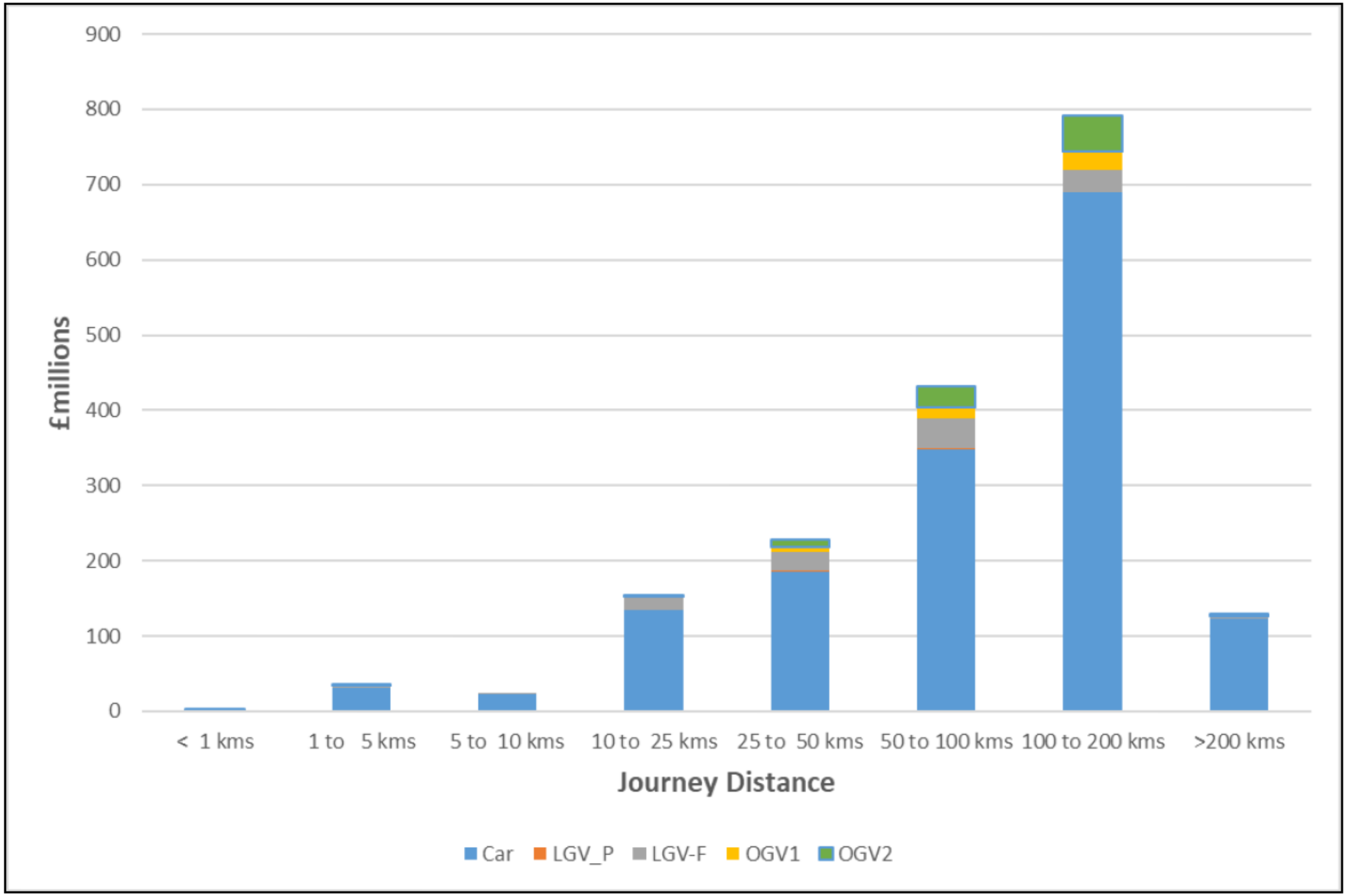

*All entries are present values discounted to 2010, in 2010 prices*

**Figure 33 Monetised Benefits by Journey Distance – Orange (Long) Route**




*All entries are present values discounted to 2010, in 2010 prices*

**Figure 34 Monetised Benefits by Journey Distance – Purple Route**




*All entries are present values discounted to 2010, in 2010 price*

## WITA

WITA 2.0 (July 2019) has been used for this assessment. The current year has been taken as 2017 as this is the base year from which the forecasts have been developed.

For the purposes of this assessment the assumed opening year is 2041 and the assessment has been made over the 60-year period from this year until 2100.

### WITA Inputs

*Zones*

WITA zones were created at a LAD level within the modelled area. Outside the modelled area two WITA zones were used to represent external areas to the north and to the south of the modelled area.

*TUBA Defined Inputs*

The demand matrices and cost skims input to WITA were the same files input to the TUBA assessment.

*Economic Data*

District economic data and employment data were extracted from the July 2019 WebTAG databook and formatted for WITA input.

The commuting PA matrix was sourced from the demand model.

### WITA Outputs

The version of WITA available appeared to be unable to forecast benefits up to the year 2100. To work around this and to remain consistent with the TUBA outputs WITA was run for 60 years between 2031 and 2090.

A spreadsheet process was then used to remove the benefits for the years 2031 to 2040 from the total, and to extrapolate the benefit stream from 2090 to 2100. Thus the final outputs represent benefits for the years 2041 to 2100 in line with the TUBA output.

### WITA Benefits

The WITA process requires inputs for all modes. Since the current model represents highway modes only then the WITA calculations do not include a representation of demand and travel times for public transport and slow modes. As such it is considered that WITA would overstate the economic benefits of the highway improvement. To compensate for this all benefits are reduced by 20%.

Total benefits split by benefit type are shown in **Table 50**.

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### Table 50 WITA Benefit Total (£ millions)

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| agglomeration | 979 | 963 | 944 |
| labour supply | 15 | 20 | 14 |
| Imperfect markets | 104 | 118 | 114 |
| Total | 1,099 | 1,100 | 1,073 |

*All entries are present values discounted to 2010, in 2010 prices*

**Table 51** shows the ten districts with the highest level of benefit for each scenario. The results show that in general the West Yorkshire districts obtain the highest level of benefits.

### Table 51 Top 10 Benefitting Local Authorities

| Rank | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| 1 | Leeds | Leeds | Bradford |
| 2 | Bradford | Bradford | Leeds |
| 3 | Manchester | Calderdale | Pendle |
| 4 | Calderdale | Pendle | Calderdale |
| 5 | Pendle | Burnley | Craven |
| 6 | Craven | Craven | Burnley |
| 7 | Burnley | Manchester | Manchester |
| 8 | Warrington | Harrogate | Warrington |
| 9 | Harrogate | Warrington | Kirklees |
| 10 | Preston | Salford | Preston |

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## Scheme Costs

### Cost Inputs

Scheme costs have been produced by Highways England's Commercial Team. Scheme costs have been calculated for two different carriageway standards:

- Dual two lane motorway (D2M); and
- Dual two lane all purpose carriageway (D2AP).

Scheme costs were produced on the assumption that the route would be built in a number of sequential stages over a period from around 2029 through to 2043.

The total cost provided for each scheme for each carriageway standard are shown in **Table 52** and Table 53

**Table 52 Scheme Costs D2M Standard (£ Millions)**

| | Orange Short | Orange Long | Purple |
|---|---|---|---|
| Cost (Q1 2016) | 5,908 | 6,502 | 6,019 |
| Inflation | 6,558 | 7,153 | 6,656 |
| Risk | 1,229 | 1,348 | 1,250 |
| Total | 13,696 | 15,004 | 13,925 |

*All entries are in 2016 Quarter 1 prices*

**Table 53 Scheme Costs D2AP Standard (£ Millions)**

| | Orange Short | Orange Long | Purple |
|---|---|---|---|
| Cost (Q1 2016) | 5,408 | 5,962 | 5,502 |
| Inflation | 6,006 | 6,550 | 6,088 |
| Risk | 1,119 | 1,227 | 1,137 |
| Total | 12,533 | 13,728 | 12,727 |

*All entries are in 2016 Quarter 1 prices.*

For input to TUBA a taxation factor of 1.19 was applied to convert the costs from factor to market prices.

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### Present Value of Cost Calculations

The assumption made in calculating scheme costs was the route split into four or five sections which would be constructed sequentially between 2029 and 2043. Route sections would be open to traffic when completed.

The commercial team have provided cost spend profiles in units of 2010 factor prices using the GDP deflator from the forecast year of spend.

To calculate PVC these costs have been converted to Market Prices in accordance with WebTAG using an adjustment factor of 1.19, and then discounted to 2010 values using a discount rate of 3.5% per year.

The values of PVC calculated for each route option by each method are shown in **Table 54**.

**Table 54 Present value of Costs (PVC) (£ millions)**

| Standard | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| PVC D2M | 3,205.7 | 3,532.5 | 3,270.9 |
| PVC D2AP | 2,931.3 | 3,230.0 | 2,986.4 |

*All entries are present values discounted to 2010, in 2010 prices*

### Other Costs and Benefits

Other costs and benefits have not been assessed at this stage. These would include:

- Collision impacts;
- Reliability impacts;
- Maintenance costs;
- Maintenance delay changes; and
- Delays during construction.

## Summary

### Overview

An initial cost benefit assessment using TUBA and WITA has been undertaken for the M6 – A1(M) scheme for two main options with an additional shorter variant for one corridor. Due to the complexity of the scheme certain simplifications have been made to enable existing models to be used for the assessment.

The total benefit for each route option is drawn from the TUBA benefits representing time and operating cost savings to users and from WITA benefits representing growth in the economic activity within the region. The TUBA benefits account for about 60% of the total.

The overall summary results below show that the BCR values range from around 0.87 to 0.92. The orange short and purple route options providing the highest values.

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### Results

Overall calculated PVB for the three route options are shown in **Table 55** and **Table 56.**

**Table 55 Total Present Value of benefits (PVB) D2M Standard (£ millions)**

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| TUBA | 1,850.6 | 1,984.6 | 1,903.2 |
| WITA | 1,099.0 | 1,100.0 | 1,073.0 |
| **Total PVB** | **2,949.6** | **3,084.6** | **2,976.2** |
| PVC | 3,205.7 | 3,532.5 | 3,270.9 |
| NPV | -256.1 | -447.9 | -294.7 |
| **BCR** | **0.92** | **0.87** | **0.91** |

*All entries are present values discounted to 2010, in 2010 prices*

**Table 56 Total Present Value of benefits (PVB) D2AP Standard (£ millions)**

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| TUBA | 1,850.6 | 1,984.6 | 1,903.2 |
| WITA | 1,099.0 | 1,100.0 | 1,073.0 |
| **Total PVB** | **2,949.6** | **3,084.6** | **2,976.2** |
| PVC | 2,931.3 | 3,230.0 | 2,986.4 |
| NPV | 18.3 | -145.4 | -10.2 |
| **BCR** | **1.01** | **0.95** | **1.00** |

*All entries are present values discounted to 2010, in 2010 prices*

## Summary Reports

### Public Accounts

Table 57 shows the Public Accounts Table for the three schemes.

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### Table 57 Public Accounts Table (£ millions)

| | Standard | Orange Short | Orange Long | Purple |
|---|---|---|---|---|
| Central Government Investment Cost | D2M | 3,205.7 | 3,532.5 | 3,270.9 |
| | D2AP | 2,991.3 | 3,230.0 | 2,986.4 |
| Indirect Tax Revenue | All | -115.1 | -123.8 | -107.9 |
| Broad Transport Budget | D2M | 3,205.7 | 3,532.5 | 3,270.9 |
| | D2AP | 2,991.3 | 3,230.0 | 2,986.4 |
| Wider Public Finances | All | -115.1 | -123.8 | -107.9 |

*All entries are present values discounted to 2010, in 2010 prices*

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## Transport Economic Efficiency

### Table 58 TEE Table (£ million)

| | | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|---|
| Consumer - Commuting | Time | 225.5 | 276.2 | 220.7 |
| | Op Costs | -30.2 | -30.4 | -25.7 |
| | Total | 195.3 | 245.8 | 195.0 |
| Consumer - Other | Time | 250.2 | 239.2 | 254.4 |
| | Op Costs | -88.1 | -95.5 | -83.3 |
| | Total | 162.1 | 143.7 | 171.1 |
| Business - Personal | Time | 1,159.8 | 1,227.8 | 1,163.8 |
| | Op Costs | -6.0 | -2.5 | 11.4 |
| | Total | 1,153.9 | 1,225.3 | 1,175.2 |
| Business - Freight | Time | 223.2 | 242.7 | 242.9 |
| | Op Costs | 1.1 | 3.2 | 11.0 |
| | Total | 224.3 | 246.0 | 253.9 |
| Total | PV of TEE | 1,735.5 | 1,860.8 | 1,795.3 |

*All entries are present values discounted to 2010, in 2010 prices*

### Analysis of Monetised Costs and Benefits

**Table 59** and **Table 60** present the Analysis of Monetary Costs and Benefits based on the TUBA output

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**Table 59 Analysis of Monetary Costs and Benefits – Initial BCR. D2M Standard**

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| Economic Efficiency: Consumer Users (Commuting) | 195.3 | 245.8 | 195.0 |
| Economic Efficiency: Consumer Users (Other) | 162.1 | 143.7 | 171.1 |
| Economic Efficiency: Business Users and Providers | 1,378.2 | 1,471.3 | 1,429.1 |
| Wider Public Finances (Indirect Taxation Revenues) | 115.1 | 123.8 | 107.9 |
| **Present Value of Benefits (PVB)** | **1,850.6** | **1,984.6** | **1,903.2** |
| Broad Transport Budget | 3,205.7 | 3,532.5 | 3,270.9 |
| **Present Value of Costs (PVC)** | **3,205.7** | **3,532.5** | **3,270.9** |
| **OVERALL IMPACTS** | | | |
| **Net Present Value (NPV)** | -1,355.1 | -1,547.9 | -1,367.7 |
| **Benefit to Cost Ratio (BCR)** | **0.58** | **0.56** | **0.58** |

*All entries are present values discounted to 2010, in 2010 prices*

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## Table 60 Analysis of Monetary Costs and Benefits – Initial BCR. D2AP Standard

| | **Orange (Short)** | **Orange (Long)** | **Purple** |
|---|---|---|---|
| Economic Efficiency: Consumer Users (Commuting) | 195.3 | 245.8 | 195.0 |
| Economic Efficiency: Consumer Users (Other) | 162.1 | 143.7 | 171.1 |
| Economic Efficiency: Business Users and Providers | 1,378.2 | 1,471.3 | 1,429.1 |
| Wider Public Finances (Indirect Taxation Revenues) | 115.1 | 123.8 | 107.9 |
| **Present Value of Benefits (PVB)** | **1,850.6** | **1,984.6** | **1,903.2** |
| Broad Transport Budget | 2,931.3 | 3,532.5 | 3,270.9 |
| **Present Value of Costs (PVC)** | **2,931.3** | 3,532.5 | **3,270.9** |
| **OVERALL IMPACTS** | | | |
| **Net Present Value (NPV)** | -1,080.7 | -1,547.9 | -1,367.7 |
| **Benefit to Cost Ratio (BCR)** | **0.63** | **0.56** | **0.58** |

*All entries are present values discounted to 2010, in 2010 prices*

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Table 61 and **Table 62** represent the Adjusted BCR for the two carriageway standards taking into account the Wider Economic Impacts of the schemes.

### Table 61 Adjusted BCR D2M Standard (£ million)

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| PVB (TUBA) | 1,850.6 | 1,984.6 | 1,903.2 |
| PVB (WITA) | 1,099.0 | 1,100.0 | 1,073.0 |
| PVB Total | 2,949.6 | 3,084.6 | 2,976.2 |
| PVC | 3,205.7 | 3,532.5 | 3,270.9 |
| **BCR** | **0.92** | **0.87** | **0.91** |

*All entries are present values discounted to 2010, in 2010 prices*

### Table 62 Adjusted BCR D2AP Standard (£ million)

| | Orange (Short) | Orange (Long) | Purple |
|---|---|---|---|
| PVB (TUBA) | 1,850.6 | 1,984.6 | 1,903.2 |
| PVB (WITA) | 1,099.0 | 1,100.0 | 1,073.0 |
| PVB Total | 2,949.6 | 3,084.6 | 2,976.2 |
| PVC | 2,931.3 | 3,230.0 | 2,986.4 |
| **BCR** | **1.01** | **0.95** | **1.00** |

*All entries are present values discounted to 2010, in 2010 prices*

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