# Central Lancashire Highways & Traffic Model Update

## Model Base Year Revalidation Methodology

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**Lancashire County Council**

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## Contents

# 1. Introduction

**Principles for agreement by DfT:**

Seeking approval of the proposed scope and methodology for present year validation of the Central Lancashire Highway Traffic Model

## 1.1 Model History

In 2015-2016 Jacobs built a WebTAG compliant RSI based highway traffic model in SATURN, the Central Lancashire Highways and Traffic Model (CLHTM), to support Central Lancashire's ambitious programme of economic growth and associated infrastructure improvements. Since then the model has been used to support:

- planning applications for three City Deal schemes (Preston Western Distributor (PWD), Penwortham Bypass and A582 dualling),
- the PWD Business Case,
- the A582 South Ribble Western Distributor SOBC,
- multiple local schemes and bus gate schemes in Preston.

The CLHTM was also used as a source model for the original and the extended versions of the North West Preston Aimsun Model, as well as for a number of LinSig models used to design and test impacts of junction improvements including M55 Junction 1.

The CLHTM network and demand matrices were originally calibrated and validated to Autumn 2013 data using 2015 WebTAG parameters (values of time and vehicle operating costs).

In 2018 the model was re-calibrated to 2018 WebTAG for the PWD Full Business Case but the Base Year remained 2013 in the absence of more recent traffic data.

## 1.2 Reasons for Revalidation

WebTAG requirements and recent DfT feedback on the TCF Appraisal Specification Report mean the CLHTM is due for present year validation to ensure that it remains WebTAG compliant (i.e. less than 6 years old).

The model will be updated and re-calibrated to Autumn 2019 traffic counts and journey times in accordance with current best practice contained within DfT WebTAG.

It is critical that the traffic surveys are undertaken prior to the starting of the PWD construction works in November 2019 (completion due in 2022) given that temporary traffic management arrangements may have a significant impact on routing of the traffic which will be difficult to model in the first place and may also create issues during the forecasting.

The survey program is designed to collect the data for neutral months and therefore all traffic data has been completed before the school term break in 22nd October.

A proportionate revalidation method to 2019 counts is proposed which will make use of the existing 2014 RSI surveys, demand methodology and network coding changes developed as part of the PWD Full Business Case model. This is cost and time efficient and anticipates the completion of the PWD by 2023, at which point local and strategic traffic distributions are expected to change significantly. Model revalidation with the PWD operational would likely require new observed trip distributions.

The existing 2014 RSI surveys will be adjusted based on the traffic counts undertaken at the RSI sites collected for the project. This exercise will ensure to capture any increase in trips that has taken place within the study area.

## 1.3 Future Applications

The future model applications will be confirmed by LCC but it is anticipated that the model, as a minimum, will be used to support the following schemes:

- A582 Dualling Outline Business Case and Full Business Case
- TCF schemes and particularly Ringway Improvements
- Testing various options for a New Ribble Crossing

# 2. Model Description and Specification

## 2.1 Model Description

The CLHTM covers Central Lancashire in detail and with future model applications expected between Preston and Leyland, the focus of the detailed network area will remain the same. The A582 dualling scheme is expected to have some wider area impacts and particularly reducing inappropriate use of the M6 between J27 and J32 by local traffic. Moreover, based on the previous feedback there are two SRN junctions of particular concern for Highways England where impacts of the scheme are anticipated (M65 J1 and M6 J29).

These SRN links and junctions are part of the simulation network in CLHTM. However, in view of the importance of the scheme impacts on the SRN, a TN has been produced to set out and agree additional steps to ensure strong calibration of the model around those junctions (Appendix A).

In line with latest WebTAG Unit M3.1 guidance, the modelled area makes use of a three-stage structure with levels of detail of network coding reducing away from the centre of the study area.

The breakdown of the modelled area is outlined below:

- Fully modelled area:
  - Area of detailed modelling (Detailed) – highest detail
  - Rest of fully modelled area (ROFMA) – reduced network coverage but variable travel times enabled
- External Area – lowest network coverage and fixed speeds used

Figure 2-1 shows the extent of the fully modelled area (the rest of Great Britain is classed as the external area).


**Figure 2-1: CLHTM Fully Modelled Area**

## 2.2 Key Model Components

Central Lancashire is known to have morning and evening peak flows between urban areas and centred on the City of Preston. In addition, peak flows are also noted on the SRN including the M6, M55, M61 and M65. Therefore 2 peak hours plus an interpeak average hour will be developed.

The model peak hours are expected to remain the same as in the previous update, however, this will be reconfirmed using the traffic counts collected for the project.

User classes will be split by vehicle type and journey purpose to satisfy WebTAG Unit M3.1 guidance and so allow differing vehicle operating costs and values of time to be applied.

The current CLHTM has 579 zones covering Great Britain. This zone system will be adopted as a starting point and reviewed for suitability in the context of the proposed model applications and current planning data.

Table 2-1 provides a summary of the key model components.

| Characteristic | Model Approach |
|---|---|
| Model Type | Highway Assignment Model |
| Software package | SATURN (latest version at time of model build, currently 11.4.07H) |
| Base Year | 2019 |
| Time Periods | AM peak hour (0800-0900)<br>Interpeak (average hour 1000-1600)<br>PM peak hour (1700-1800) |

| Characteristic | Model Approach |
|---|---|
| User Classes | 5 user classes:<br>Car – Commute<br>Car – Business<br>Car – Other<br>LGV<br>HGV |
| Zone System | 579 zones |
| Assignment methodology | SATURN assignment – Wardrop Equilibrium |
| Capacity restraint mechanism | Capacity Index functions on links<br>Defined capacity at junctions<br>Fixed speed buffer networks |
| Variable Demand Model | Diadem (with public transport demand and costs) |
| Relevant guidance | WebTAG Unit M3.1 |

**Table 2-1: Key Model Components**

*Model approach subject to change upon data review*

# 3. Data Collection Methodology

The existing CHTLM model used 162 traffic counts across 17 calibration and validation screenlines as well as 29 individual counts as reported in the PWD FBC LMVR.

Based on the lessons learnt during calibration of that model it is proposed to adjust and redefine some of the screenlines to facilitate the model calibration process. Figure 3-1 shows the map of proposed counts and screenlines, which were refined following discussions with LCC.

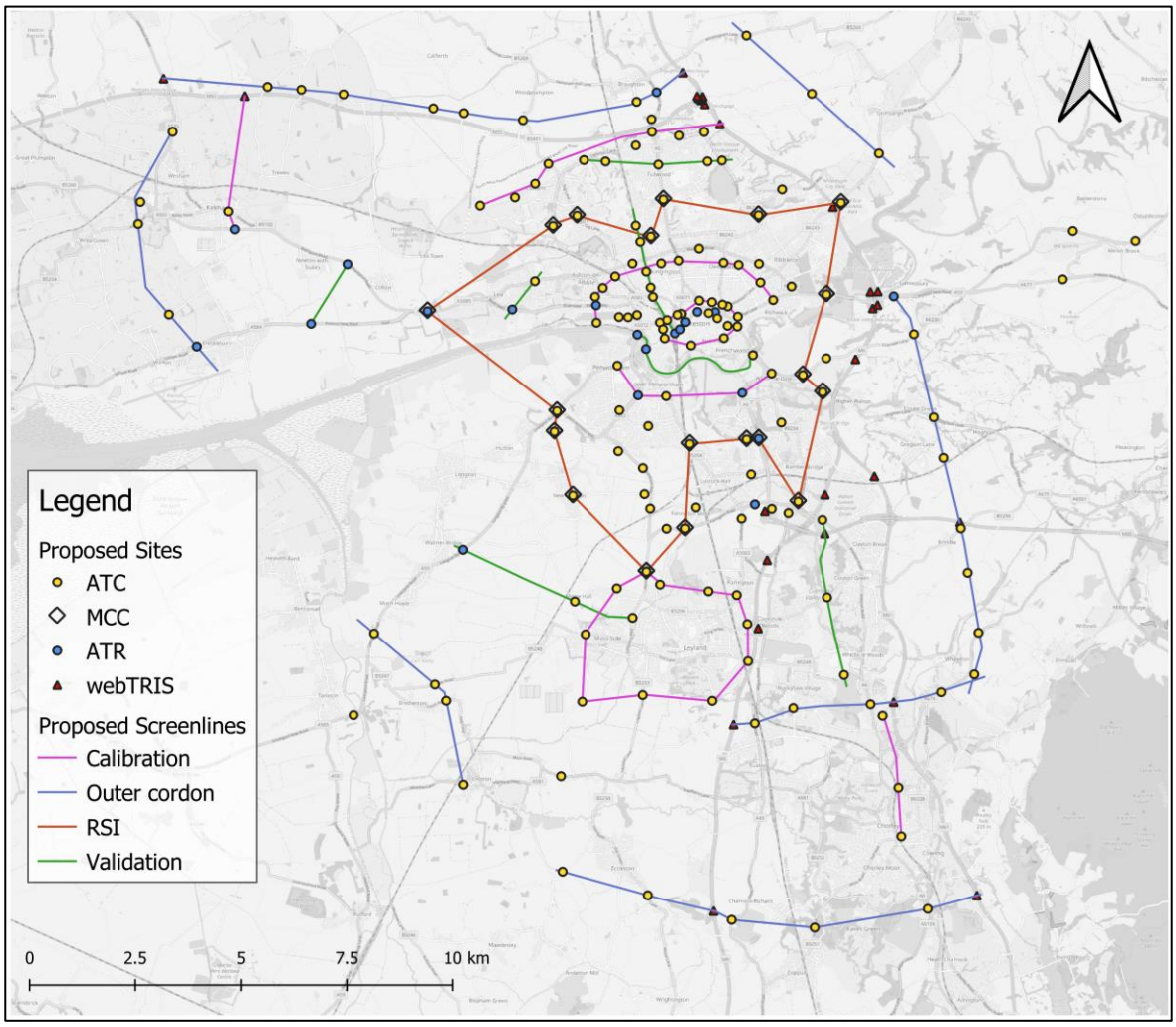


**Figure 3-1: Proposed Screenline Locations**

It is proposed that Automatic Traffic Counts (ATCs) will be undertaken for 2 weeks during a non-school holiday period. ATC data will be screened for incomplete data before calculating weekday averages for use in the model build, calibration or validation and to verify the model time periods and expansion factors.

Radar counts (ATR) are proposed for high-speed dual carriageway roads where ATC counts is not recommended due to safety concerns. ATR counts will be undertaken for 2 weeks during typical weekday.

Manually Classified Count (MCC) data will be used for vehicle class proportions and will only be undertaken for 1 day.

LCC would need to review and confirm if any of the identified survey locations have permanent ATCs installed. In addition, it is expected that some of the sites will be surveyed as part of Baseline Traffic Data Collection for monitoring and evaluation of the PWD scheme.

Strategic Road Network (SRN) traffic flows will be extracted from Highway's England WebTRIS information. Only neutral months school terms dates in 2019 will be used.

2019 Journey Time Data will be obtained from the TrafficMaster dataset and processed for journey time calibration using the same approach as previously applied on the PWD and A582 Business Case projects. Any observations that lie outside confidence intervals will be removed from the calculation of average journey times.

The data processing methodology is consistent with the original CLHTM model process. A Traffic Survey Report will be produced in line with TAG to support the model update.

# 4. Network Refinement Methodology

The starting point for the network coding will be the PWD FBC update to the CLHTM model.

The PWD FBC update included a review of the 2013 base year network coding and made minor corrections and lane configuration updates in the simulation and buffer areas. These changes will be incorporated in full to avoid duplication and provide a time saving. Full details of the network update are available in the PWD FBC LMVR (2019).

There are a number of critical network changes in the modelled area which have been implemented since 2013 including:

- D'Urton Link Road – connecting D'Urton Lane and B6241 Eastway
- M6/M55 - M6 J32 and M55 Jn1 junction improvements
- M55 - J1 improvements, approach and circulatory widening
- A6 Broughton Bypass - Broughton Congestion relief and public realm
- Lightfoot lane – Eastway junction improvements, signalisation
- New Hall Lane Local Centre
- A582 junction improvements
- Bamber Bridge Local Centre - Brownedge Lane/ Collins Road junction improvements - Public Realm
- Penwortham – Liverpool and Leyland Road junction improvements (under construction, expected to be completed by December 2019)
- Penwortham Bypass and Public Realm – from Goldenway roundabout to A59 Liverpool Road (under construction, opening by December 2019)
- Golden Way dualling
- Preston City Centre bus gate schemes

These schemes are available from the PWD Traffic Forecasting Uncertainty Log. The list was reviewed and refined in collaboration with LCC and further verified using latest satellite/street view images where relevant.

The coding will be undertaken in line with the CLHTM coding manual. Network pre-calibration checks will be undertaken in line with the steps described in the PWD FBC LMVR.

Signal staging and timings will be coded to LCC data for 2019 where available. If appropriate data is not available, then the existing model signals (based on typical LCC timings and SATURN optimisation) will be used. Alterations to signal timings will be undertaken as part of the calibration/validation process.

A 2019 bus service map and frequency information will be sourced through LCC and coded as fixed routes through the model.

Generalised cost parameters (value of time and vehicle operating costs) are used for assignment. The generalised costs per user class will be updated based on the latest TAG databook release (currently May 2019, v1.12).

# 5. Demand Matrix Methodology

The demand building methodology utilises Roadside Interview (RSI) responses expanded to 2019 count data as an observed trip matrix and will be merged with a synthetic matrix to infill unobserved movements.

Synthetic matrices will be recreated using latest TEMPRO 7.2 model to develop PA trip ends per journey purpose in line with DfT comments on the PWD FBC LMVR and to ensure consistency with WebTAG. The new synthetic matrix trip ends will be compared with the synthetic trip ends, which were developed for the PWD project using NTEM and Car Ownership models.

Journey purposes for PA demand building will have additional segmentation over the assignment journey purposes. Trips will be split by home based and non-home based with further breakdown of 'other' trips to make use of detail within NTEM, NTS and RSI responses. Trip purposes for demand building are shown in Table 5-1.

| Demand Trip Purpose | Aggregation for Assignment |
|---|---|
| Home based Work | Commute |
| Home based Employer's Business | Business |
| Home based Education | Other |
| Home based Other | Other |
| Home based Shopping | Other |
| Non-Home based Employer's Business | Business |
| Non-Home based Other | Other |

**Table 5-1: PA Demand Trip Purposes**

Trip ends will be distributed by a log-normal gravity model utilising tri-proportional fitting between zonal productions and attractions and NTS distance bands for Lancashire.

This synthetic demand methodology is consistent with the existing CLHTM and is subject to confirmation with the DfT.

2013 RSI matrices will remain the basis for the Observed Matrices since no major schemes likely to significantly alter distribution patterns has been completed between 2013 and 2019. The 2014 RSI responses have the advantage of having undergone extensive checks for logical OD movements and the sample trip length distribution and purpose splits compared to NTS and NTEM. The 26 RSI survey locations are shown in Figure 5-1.

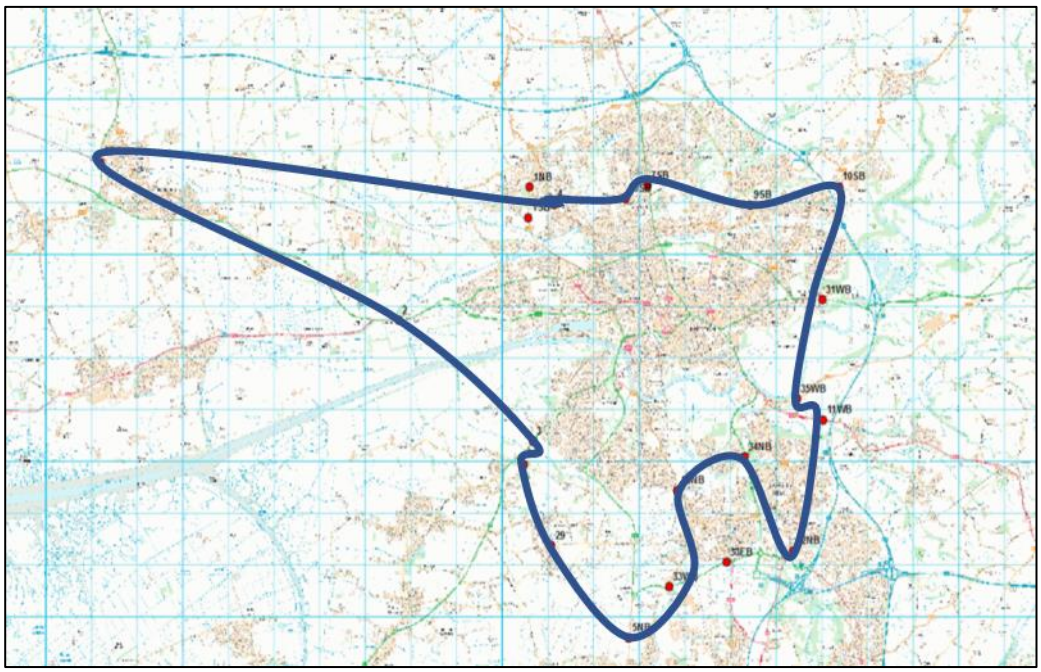

**Figure 5-1: RSI 2013 - Survey Locations**

The process for smoothing 'lumpy' RSI trips (where model zone pairs observed in the survey contain the majority of trips with zero flows on non-observed pairs) is also established. This process portions out demand from non-zero observed OD zone pairs using small groupings of zones within 2km of the original observed pairings.

The RSI observed trips will be expanded to 2019 ATC counts at RSI locations and merged with the synthetic demand using the same approach as adopted and tested during re-calibration of the CLHTM in 2017-2018. Merging will be undertaken according to the DfT's approved approach used in ERICA to account for double counting across screenlines and response, survey and postcard biases.

~~Subject to discussion with DfT, it is proposed that the LGV and HGV prior matrices as used in the PWD FBC model will not be updated. As part of Highways England's assurance on the CLHTM development, LGV trips were compared to the TransPennine South Regional Transport Model (TPSRTM) at sector level and found to show an acceptable match, particularly for internal sectors.~~

HGV and LGV matrices were built from the TransPennine South Regional Transport Model (TPSRTM) base year (2015) prior matrices. TPSRTM LGV and HGV matrices were originally created from Trafficmaster Origin Destination data and 2006 Base Year Freight Matrix (BYFM), respectively. The TPSRTM LGV matrices were then uplifted to 2015 using the traffic count at various location and the HGV demand was uplifted using the factors from the DfT's Continuing Survey of Road Goods Transport. This approach is considered more robust than the one previously used for 2013 CLHTM where the freight demand had been factored by RTF13 growth factors.

Given the difference in the zoning systems, where the CLHTM model zones were smaller, the TPSRTM demand was disaggregated using the proportions calculated from CLHTM 2013 GV trips per zone. In the buffer areas, however, the TPSRTM zones were smaller, and therefore, they were aggregated into one CLHTM zone.

The 2015 matrices were then uplifted to 2019 using two sets of growth factors. The first growth factor was calculated from DfT's Road Traffic Statistics (RTS) using counts for a number of sites at motorways and major roads to scale up the trips from 2015 to 2018. A second growth factor was calculated from Road Traffic Forecast 2018 (RTF18) to uplift trips from 2018 to 2019. The RTF18 factor was calculated from Table 1 for North West all roads.

Since the RTM matrices are based on average hour matrix, the variation between the peak hour and average hour will be investigated using the current traffic counts and necessary factors will be applied to convert matrices into peak hour.

The final merged matrices will serve as Initial Prior Matrices as part of the model calibration exercise.

# 6. Calibration/Validation Methodology

Demand calibration will be a staged process as discussed in the PWD FBC LMVR.

As a first step, a sector factoring exercise will be undertaken where unobserved and partially observed trips in matrices will be adjusted at a sector level to match calibration screenline counts (fully observed movements from RSI will be held constant during this process).

Once sufficiently robust results are achieved in line with WebTAG screenline and link-based criteria the matrices will undergo matrix estimation (ME) process to ensure WebTAG compliant calibration statistics and then validated against an independent set of counts not used in the calibration process. The calibration and validation screenlines are shown in Figure 3-1. Again, fully observed trips will be held constant during ME.

Route choice calibration will be undertaken using engineering judgement and Google Maps and confirmed with LCC against local knowledge of the area. The model network will be adjusted where the route used is contrary to expectations.

14 Journey time routes for modelling the PWD FBC were agreed in conjunction with LCC and Highways England TAME to give strong coverage of Central Lancashire. These routes, shown in Figure 6-1, will be reviewed for suitability before being used to calibrate model journey times against average Trafficmaster journey times along each route.

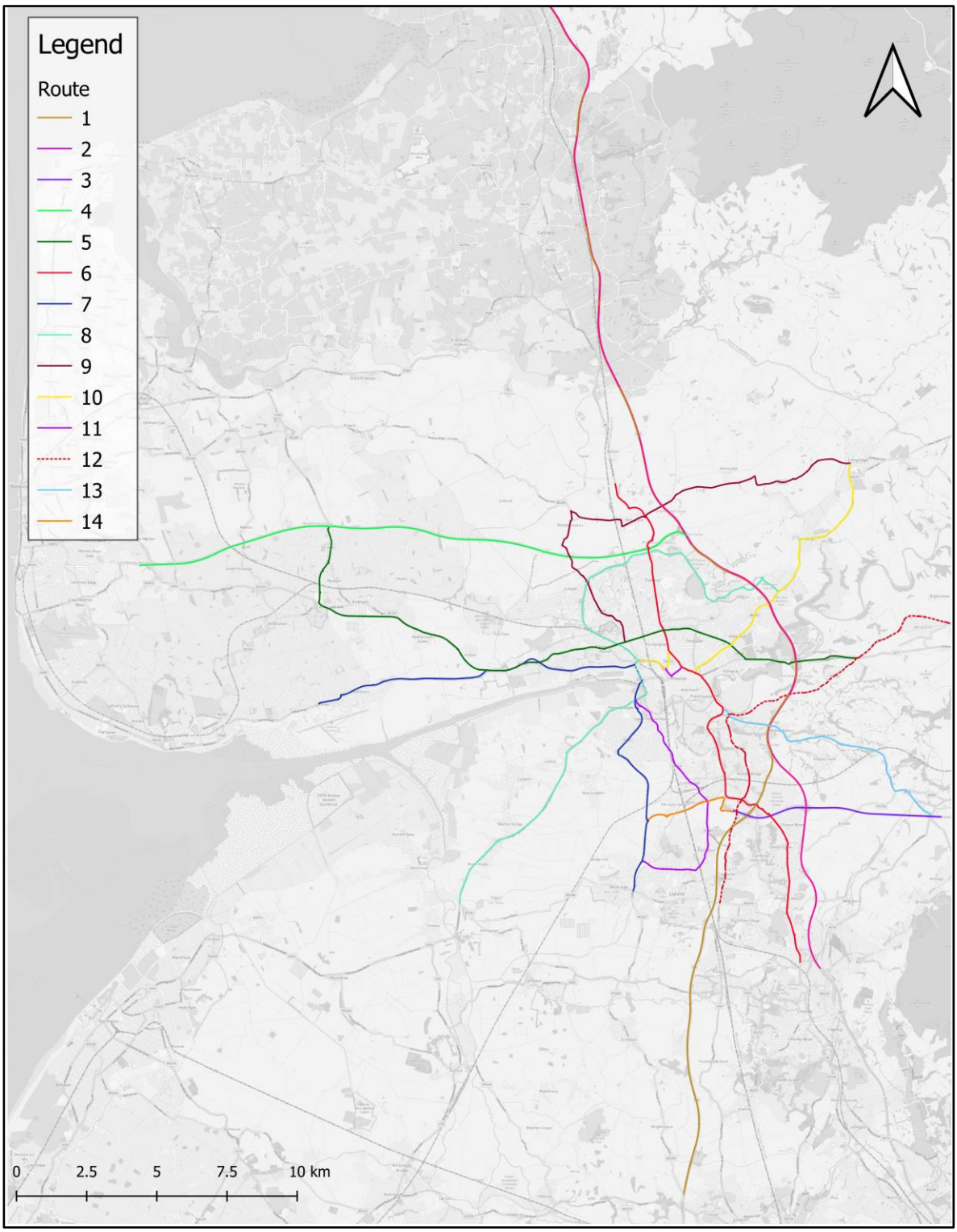


**Figure 6-1: Journey Time Validation Routes**

*Journey time routes shown are subject to review*

Model assignment of trips to the network will be consistent with the original model. The latest WebTAG values of time and vehicle operating costs will be used for generalised cost calculations. Model convergence will be checked against WebTAG requirements.

# 7. Variable Demand

Any change to transport conditions will, in principle, cause a change in demand. The purpose of Variable Demand Modelling (VDM) is to predict and quantify these changes and to ensure that the model can be used for testing potential future schemes in Central Lancashire.

The Department for Transport (DfT) maintain comprehensive Transport Appraisal Guidance (TAG). TAG Unit M2 was published in May 2019 and covers Variable Demand Modelling.

Our recommendation is to build an O/D based variable demand model for highway mode only using DIADEM5 software. The setup and the testing of the variable demand model will be in compliance with the WebTAG guidance. The realism test will be undertaken. The car fuel cost elasticity with the assumption of 10% fuel cost increase will be required. The car fuel cost elasticities will be calculated as both matrix-based and network-based. The car journey time elasticity tests will also be carried out in line with the car fuel cost elasticity test. Public transport fare elasticity tests will not be required, given that the mode choice is not included. Table 7-1 describes the responses that will be set up for the VDM modelling.

It is anticipated that a mode choice will not be required as part of the A582 dualling scheme appraisal. This is based on a high level analysis of scheme impacts on travel time (i.e. predominantly small changes less than 2 minutes) and the existing modal split in the study area (over 90% of trips by car based on Census 2011 JTW data). However, a formal modal shift significance test will be undertaken to confirm this assumption and reported in model revalidation report.

| Modelled | Not Modelled |
|---|---|
| Trip Frequency<br>(for optional trip purposes) | Mode choice |
| Trip Distribution | Time of day choice |
| Cost damping | Micro time choice |

**Table 7-1: Scope of VDM**

Trip distribution model is likely to be the key response and will therefore be incorporated along with trip frequency and cost damping.

The demand input for the VDM will be based on highway assignment OD matrices for peak hours. The car user classes will be comprised of commute, business and other. ~~The car user classes will be disaggregated into 6 demand segments for each peak hour. including 3 non-External to External demand matrices and 3 External to External demand matrices.~~

The external to external trips which do not pass through the fully modelled area will be treated as fixed, and will be excluded from the demand model calculations. Freight is also excluded from variable demand calculations.

The VOT and VOC parameter setups for DIADEM will be consistent with the setups for the corresponding highway assignment models.