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A30 Carland to Chiverton Cross

Traffic Data Collection Report

August 2017
Highways England

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01	24/07/2017	Joe Payne/Martin Drapier	Holly Moon	Ian Beavis	First Draft
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The A30 Chiverton to Carland Cross Improvement scheme is part of the Department for Transport Road Investment Programme, being delivered by Highways England, and is receiving a funding contribution of up to £8m from the European Regional Development Fund to support the development phase of the scheme.

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Executive Summary

The section of the A30 in Cornwall between Chiverton Cross and Carland Cross, north of Truro experiences congestion and delays throughout the year, with poor journey time reliability. The route is in need of improvement to meet Highways England's objectives of maintaining the smooth flow of traffic, making the network safer and supporting economic growth.

The scope of the scheme is to upgrade 12.5km of single carriageway to dual carriageway on the A30 between Chiverton Cross Roundabout and Carland Cross roundabout.

The specific Transport Objectives are:

- to contribute to regeneration and sustainable economic growth
  - to support employment & residential development opportunities
- to improve the safety, operation & efficiency of the transport network
- improve network reliability and reduce journey times
  - to deliver capacity enhancements to the SRN
- supporting the use of sustainable modes of transport
- delivering better environmental outcomes, and;
- to improve local and strategic connectivity

This report details the development of the base year traffic model that has been used in the appraisal of the scheme for Highways England Project Control Framework (PCF) Stage 3 in support of the Development Consent Order.

Summary of Content

The report has been produced in accordance with the guidance set out in Highways England's Interim Advice Note 106/08 and the PCF product description for the Traffic Data Collection Report (version 9 dated 6/3/2014). The table below provides a checklist for the requirements.

Summary of Content

Traffic Data Collection Report Requirements	Related Chapter
1. Need for Traffic Data	1
a. Statement of Scheme objectives;	1.2
b. Statement of why data is required in context of the scheme design, PCF business case products and environmental appraisal;	1.3
c. Statement of how existing data and new survey data will be used in building appropriate transport models toprepare traffic forecasts and how those modelled period forecasts will be utilised in subsequent analyses;	1.4
d. Discussion of data collection in the context of model refinement over the course of the project PCF stages.	1.5
2. Summarise and Review Existing data	2.
a. Review data for detail, age, source quality and model risk (and annotate each data item appropriately);	2
b. Review existing volumetric data and indicate how it could be used in model calibration and validation and where further data is required;	2.1
c. Review existing trip data and how it could be used in trip matrix building and indicate where it is deficient;	2.2
d. Review existing journey time data and how it could be used in model building and validation and where further data is required;	2.3
e. Review existing mapping, geometric data, operational data (queue length, gap acceptance, etc) and accidental data, indicate how it could be used and where it needs to be supplemented.	2.4
3. Use of Available Processed Data and Models	3.
a. Existing traffic models are a useful source of data or a shortcut to developing a local traffic model for a project and can reduce development costs appreciably, but data and processing risks must be identified and responsibility accepted;	3.1
b. Where existing datasets, matrices or assignment models are to be used as inputs to the local traffic assignment model, review quality of data and modelled links and trips and overall validation;	3.2
c. Where existing demand (or mode choice) models are to be used, review quality of data used, model representation, model conversions adopted and the process structure and model validation;	3.3 – Demand or mode choice model not available
d. Use of data collected from GPS service providers, such as vehicle or mobile navigation equipment or mobile telephones, may provide useful trip data. This may be used to supplement traditional trip data sources, provided inherent biases and characteristics are taken into account.	3.4
4. Specification and Execution of Surveys	4.
a. Identify where additional data was obtained or surveys undertaken;	4.1
b. Indicate survey programme and durations and provide details of surveys;	4.2
c. Provide commentary on representative basis of surveys in relation to modelled time periods, year and month and neutral survey conditions;	4.3
d. Provide commentary on outcome of the surveys, operational issues (weather, incidents, maintenance and any non-representative aspects) and quality of data obtained.	4.4
5. Final Volumetric Dataset	5
a. Details of existing data, surveys and their locations (with mapping);	5.1
b. Classification by DfT vehicle class, length and modelled vehicle segment;	5.2
c. Details of adjustments or factoring made for expansion purposes and prior to for model building;	5.3
d. Tabular presentation of pertinent data as obtained, as adjusted (cleaned) and as output to the model building process with details of location, period, variability and quality (detailed datasets may be appended electronically);	Full datasets are available on request

Traffic Data Collection Report Requirements	Related Chapter
e. Note reasons for decisions, e.g. where multiple data sources occur and merging is required or where data is to be discarded for modelling purposes;	Not applicable
f. Interpretation of data to comment on existing traffic conditions and other pertinent observations (flow vs capacity, etc).	5.4
6. Final Trip Dataset	6
a. Details of existing roadside interview (RSI) data, new survey data, locations (with mapping), occupancy, purpose and tour responses, etc;	6.1
b. Details of other interview surveys (e.g. home based, car-park, travel diary) of actual travel or stated preference, including public transport, active (non-motorised) modes and freight;	6.2
c. Details of tracked vehicle trip or partial trip data and data from other sources;	6.3
d. Details of adjustments or factoring made for expansion of trip data samples to survey site population and modelled day with commentary on sample sizes and expansion applied by class;	6.4
e. Details of dataset merging undertaken. Also where synthesis of data required to fill in matrices using journey-to-work surveys, gravity modelling or other processes;	Not undertaken at this stage
f. Details of postcode or other processing applied (cleaning, logic tests, etc) to assign zones to trip data with zone and sector plans (matrix building and subsequent processing to be addressed in LMVR);	6.4
g. Details of segmentation by vehicle type, purpose, income, etc;	6.4
h. Tabulate key data as obtained, as adjusted and as exported to the model building process with quality qualification (detailed datasets may be appended electronically);	6.4
i. Interpretation of data to comment on existing travel patterns, sector - sector movements by time of day and other pertinent findings.	6.5
7. Journey Time Data	7
a. Details of existing journey time routes and data and new surveys undertaken (with mapping);	7.1
b. Details of traffic conditions and any factors potentially affecting quality;	7.1
c. Details of checks on variability and numbers of journey time runs undertaken and data cleaning;	7.2
d. Details of journey time or link speed data obtained from other sources, e.g. tracked data or HATRIS, with comments on quality;	7.3
e. Interpretation of data to comment on existing travel times, travel time variability, confidence intervals, relative route travel times, traffic congestion, quality of service and other pertinent observations.	7.4
8. Operational Data	8
a. Identify mapping data used for base year model building with issue dates (with verification against model base year) and illustrate network mapping (differentiating between buffer areas, simulation areas and areas with complete or partial matrix data;	8.1
b. Tabulated geometric data and operational data (queue length or queuing delay, gap acceptance, etc) for junction and link details;	8.2
c. Checks undertaken of geometric data - including where electronically transferred into model files;	Not undertaken at this stage
d. Area and period of local accident data obtained and comparison of data with expected (default) accident rates (with mapping plots) and incident data (where applicable);	8.2.1
e. Data quality and risk mitigation (particularly relating to third party data).	8.3
9. Suitability of Accumulated Database	
a. Data organisation, documentation with file formats, data format, file identifiers for each data type;	9.1 - Not covered at this stage
b. Accompanying electronic files of raw data, data as exported to the model building process and as used for subsequent processing of model outputs;	9.1 - Not covered at this stage
c. Summary of adequacy of data collected for modelling at current and future PCF Stages and approach to mitigating data shortfalls and quality issues.	9.2

1. Need for Traffic Data

1.1 Background

The section of the A30 in Cornwall between Carland Cross and Chiverton Cross, north of Truro, is currently a winding single carriageway route. Once dualling of the single carriageway section of the A30 between Temple and Higher Carblake near Bodmin is completed in 2017, the A30 Chiverton to Carland Cross will remain as the only single carriageway section of the A30 route between the M5 at Exeter and Camborne.

Due to the low standard of the route, this section of the A30 experiences congestion and delays throughout the year, with poor journey time reliability. These problems are exacerbated in summer months, when traffic flows increase due to tourist traffic. The route is in need of improvement to meet Highways England's objectives of maintaining the smooth flow of traffic, making the network safer and supporting economic growth. The desire for improvements to this route is strongly supported by local and regional strategies from Cornwall Council, the Cornwall and Isles of Scilly Local Enterprise Partnership, businesses and local stakeholders.

The scheme will have a significant impact on travel on the A30 within Cornwall; will significantly reduce current journey times on the route and congestion at key junctions. Due to the improvement in performance, travel patterns in the area will be affected and the improved route will be likely to attract traffic from other routes. Truro is a major attractor of trips within Cornwall, and travel patterns for traffic using routes across the existing A30, such as from Newquay, Perranporth and other towns to Truro, will be affected. The traffic model therefore needs to be able to model the impact of travel patterns across a wide area.

1.2 Scheme Objectives

The scope of the scheme is to upgrade 12.5km of single carriageway to dual carriageway on the A30 between Chiverton Cross Roundabout and Carland Cross Roundabout. The scope includes addressing the key intermediate junctions which provide connections to the local highway network.

The scheme will contribute to economic growth by supporting employment and residential development opportunities.

The scheme will contribute to regeneration by enhancing the opportunities for previous, existing and future regeneration projects to realise their full potential.

The scheme will minimise the environmental impact of operating, maintaining and improving the network and seek to protect and enhance the quality of its surrounding environment while conforming to the principals of sustainable transport.

The scheme will be developed to be 'expressway' compatible to support the long term aspirations of the Road Investment Strategy.

The specific Transport Objectives identified at the Stage 0 Value Management Workshop are:

- to contribute to regeneration and sustainable economic growth
    - to support employment & residential development opportunities

- to improve the safety, operation & efficiency of the transport network
- improve network reliability and reduce journey times
    - to deliver capacity enhancements to the SRN
- supporting the use of sustainable modes of transport
- delivering better environmental outcomes, and;
- to improve local and strategic connectivity

1.3 Data Collection Context

Traffic data will be used to inform the appraisal of the scheme for Project Control Framework (PCF) Stage 3. This stage follows the scheme appraisal produced in Stage 1 and 2 used to provide information to support the Public Consultation in October 2016 and the Preferred Route announcement in July 2017.

WebTAG requires that traffic data used to support the development of traffic models should not usually be older than 6 years. It is assumed that any data used for Stage 3 and beyond to support the models required for the DCO application will need to conform to the 6 year data limit specified in WebTAG.

Data was required for the A30 in the vicinity of the study area. No recent origin-destination data was available near the study area. Roadside Interview data was available from 2011 for the A30 near Temple but this site was located too far from the scheme area to be used without survey data from within the scheme area. Detailed junction turning counts were required along the side roads of the A30 within the scheme area to understand the traffic volumes using these routes and the schemes impacts on these routes.

1.4 Data Sets and their Uses

The Stage 2 Traffic Data Collection Report (HA551502-WSP-GEN-0000-RE-TR-00002-P02) fully details the traffic data that was used to inform the appraisal of the scheme at PCF Stages 1 and 2.

A series of roadside interview surveys and postcard surveys on the A30 and on other key roads in the vicinity of the scheme area were undertaken in October 2015. Each of these surveys was also supported by an automatic traffic count (ATC) for the two weeks before and on the day of the survey.

The following existing surveys and national databases were used in the calibration and validation of the PCF Stage 3 A30 Carland to Chiverton Cross SATURN model, which has been used to appraise the scheme:

- Highways England traffic flow data system (Trads) – ATC count data for the A30 and A38
- Highways England journey time database (JTDB) – Journey time data for the A30
- Manual classified count (MCC) data from local Cornwall Council sources
- ATC data from Cornwall Council sources
- Journey time data from Cornwall Council sources
- Origin and destination data in the form of roadside interviews conducted in November 2011 in support of the A30 Temple to Higher Carblake scheme
- Accident data
- Queue length data
- Ordnance Survey mapping

- PCF Stage 1 and 2 A30 Chiverton to Carland Cross SATURN models

A traffic model was developed during PCF Stage 1 for use in PCF Stages 1 and 2. This traffic model was developed in compliance with WebTAG and guidance in Highways England's Professional and Technical Solutions traffic appraisal modelling and economics (TAME) team's Advice Note 1 – RIS Stage 1 Modelling Requirements, issued 9 June 2015. This advice note permits some relaxations to the Department for Transport's transport analysis guidance (WebTAG) in light of the tight programme for PCF Stage 1 and Stage 2.

The Stage 3 model base year will be 2015, in line with the PCF Stage 1 and 2 model and the Regional Model. The modelled time periods will be:

- Neutral month AM peak period matrices (the average hour between 7am and 10am)
- Neutral month Interpeak hour (average hour from 10am – 4pm)
- Neutral month PM peak period matrices (the average hour between 4pm and 7pm)

The proposed approach for the Stage 3 appraisal work is to update the PCF Stage 1 and 2 base year SATURN model to ensure that the model is consistent with Highways England's South West Regional Model; the methodology is detailed in the Stage Apprasial Specification Report (HA551502-WSP-GEN-0000-RE-TR-00009) which has been approved by TAME. The PCF Stage 1 model was based on the Truro SATURN model and was updated for the scheme appraisal for Stage 2. During Stage 1 the level of detail within the model around the A30 was refined and roadside interview data collected in October 2015 was incorporated into the model. This model is considered to be an appropriate model as a basis for the Stage 3 appraisal work; the model has good network coverage in the area of interest, was developed in compliance with WebTAG guidance at the time and has been updated with 2015 roadside interview data collected on key roads in the vicinity of the scheme.

Further detail on the model development process can be found in the Appraisal Specification Report (ASR) for the PCF Stage 3 modelling.

1.5 Data Collection and Model Refinement

Highways England's South West Regional Model is currently being developed and base matrices from prior to the matrix estimation process are now available. The Regional Model will be fully WebTAG compliant and the matrices from the model will be available for use as part of the A30 Chiverton to Carland Cross PCF Stage 3 base model validation process. As part of the development of the Stage 3 base model, it is intended to assess the Stage 3 model against the available information from the Regional Model, to ensure that the two models are consistent.

2. Existing Data

2.1 Review of Existing Volumetric Data

ATC data was collected from various locations along the A30 from the Highways England's TRADS database. Cornwall Council have also provided ATC data for a number of key local roads. The average hourly flow at each count location between 07:00 and 19:00 was extracted. A summary of the average flow over each peak period will be used in the calibration of the 2015 base year model. A plot of the locations of the ATC counts can be found in Section 5 of this report. All ATC data collected was from 2014 or 2015. This data is considered of high quality given the availability of almost entire years at all TRADS sites. The local CC ATC sites are also considered to be of good quality as they provide at least an entire neutral month of data.

Manual Classified Counts (MCC) data, collected in October 2014, was also provided by Cornwall Council, providing detailed turning movements for all side road junctions with the A30 within the scheme area. The location of these counts is detailed in Section 5. The MCC's were undertaken in October 2014 and March 2015. The MCC at Chiverton Cross was undertaken in March 2015 and so was well after the improvement scheme was implemented at this junction.

2.2 Review of Existing Trip Data

Some origin-destination data is available within the vicinity of the A30 Chiverton to Carland Cross scheme; this data was collected through Roadside Interview (RSI). The locations and sources of this data are detailed in the table below.

Table 2-1: Existing Origin-Destination Data

Ref	Type	Location	Date	Source
1	Roadside Interview	A30 at Temple	Tuesday 22nd November 2011 Friday 13th July 2012	Cornwall Council
2	Roadside Interview	Truro – A390 Truro	September 2009	Cornwall Council

Data from other RSIs conducted within Cornwall is available. However these locations are more remote from the scheme and therefore it is not considered necessary to make use of these datasets.

2.3 Review of Existing Journey Time Data

Journey Time data was collected from the HATRIS JTDB (Journey Time Database) on the A30 trunk road. The JTDB is a national dataset of average vehicle journey times between fixed points on the trunk road network. The dataset contains average speeds of all vehicles passing between two points. The list below details the location of the surveys on the A30:

- A3074 Hayle and Penzance (Westbound only)
- A3074 Nut Lane, Lelant and Tolvaddon Interchange;
- Tolvaddon Interchange and Scorrier Interchange;
- Scorrier Interchange and Chiverton Cross roundabout;
- Chiverton Cross roundabout and Carland Cross roundabout;
- Carland Cross roundabout and Mitchell Interchange;
- Mitchell Interchange and Chapel Town;
- Chapel Town and St Enoder;

- St Enoder and Indian Queens;
- Indian Queens and junction with A389/A391;
- Junction with A389/ A391 and Carminnow Cross; and,
- Carminnow Cross and Launceston Rd, Bodmin;
- A30 Entry Slip and A395, Tregadillett (Eastbound only)

These routes cover the A30 in detail between Lelant, near Hayle and Bodmin. The journey time corridor provided by this model extends outside of the proposed simulation network. The location of the journey time routes is shown in Section 7.

Traffic Master journey time data has been supplied by Cornwall Council which covers the following routes:

- A390 between Chiverton Cross and County Hall, Truro;
- A39 between Carland Cross and Union Hill junction, Truro;
- A3075 between Chiverton Cross and Newquay;
- B3284 between Chybucca and Truro via Shortlanesend;
- A39 between Arch Hill, Truro and Carnon Gate, Devoran;
- B3285 between the A30 and the A3075; and
- B3277 between Chiverton Cross and St. Agnes
- A30 between Chiverton Cross and Carland Cross

This data supplements the TRADS data to provide a wider coverage and the combined dataset is considered to have a sufficiently wide coverage.

The journey time data will be used as part of the base model validation process.

2.4 Review of existing Mapping, Geometric and Operational Data

2.4.1 Mapping

Google maps and aerial photography from Google street view were used as a reference when building the network. No further data had to be collected for the model network build as Google maps and street view proved adequate in obtaining knowledge of the highway layout.

Detailed OS Mapping is available for the scheme corridor and has been used in the plotting of data collection data.

2.4.2 Accident Data

Accident data for the A30 Chiverton to Carland Cross section of the A30 was obtained from Cornwall Council between 01/04/2010 and 31/03/2015. In the study area there were 96 collisions of which 86 were slight collisions, nine were serious collisions and one was a fatal collision.

The data will be used in the scheme appraisal to determine the impact of the scheme on the number of accidents and their severity.

2.4.3 Queue Length Data

Queue length data is available for Chybucca and Carland Cross junctions. This has been described further in Section 5.1.2 of this report.

3. Existing Processed Data and Models

3.1 Existing Models

The PCF Stage 2 traffic model (based on the existing Truro SATURN model) will be used as the basis for the Stage 3 modelling work. The original model had a base year of 2009 and covers the AM peak and PM peak hours only. The modelled network covers the key routes across Cornwall and the South West and is more detailed around the Truro area, including the A30 section from Chiverton to Carland Cross. To make the model more robust for the Stage 3 appraisal, the modifications will be made to ensure that the model complies with WebTAG guidance.

3.2 Existing Datasets

The original 2009 base SATURN network was developed to assess the traffic impact of strategic developments around Truro. It encompasses a large area which incorporates the whole of Cornwall. This modelled area includes all the primary and strategic routes in Cornwall, with the following sections of the coded in simulation part of the network; the A390 between the A30 Chiverton Cross Roundabout and Truro, the A39 between the A30 Carland Cross Roundabout and Truro. Much of the modelled area is not detailed: the highway network across this broad area is coded as buffer-type links, and includes no simulation-type coding of junctions. The Truro 2009 matrix was built using RSI data from six sites on the key routes into Truro. Two of the sites, on the A390 near Highertown and the B3284 near Shortlanesend were surveyed in 2009. The other sites were surveyed in 2003. A gravity model was then used to estimate unobserved trips. A30 through trips were added from an older model matrix.

The existing model traffic flows were validated using WebTAG criteria and GEH statistical analysis on a cordoned area and on specific key routes including the A30, A39 and the A390. These criteria were passed with the exception of the A39 Trispen, which failed to meet the WebTAG criteria in the AM peak by only 2 PCUs, and the total outbound flow from the cordon in the AM Peak, which failed the GEH criteria with a value of 4.4. The cordon passed the associated DMRB criteria and only fell outside of the cordon GEH criteria by 0.4. As the model was recalibrated as part of PCF Stages 1 and 2, neither of these is a significant issue.

The journey times were validated along the A390 corridor which was the focus of much of the study the Truro model would be used to assess. These passed WebTAG criteria in both the AM and PM peaks. Details of this analysis can be found in the Truro Model Local Model Validation report (LMVR). A copy of this is found in Appendix 1.

3.3 Existing Demand Models

There are no existing demand models or mode choice models that could be used for this assessment.

3.4 GPS and Mobile Device Datasets

The South West Regional Traffic Model (SWRTM) is a SATURN model developed on behalf of Highways England which covers the whole of the south west region. The purpose of this model is to assist in the appraisal of the Highways England RIS schemes in the South West region.

The Regional Model mobile phone matrices for both Prior and Post calibration have been provided for use by ARUP. It is proposed the prior matrices will be used as part of the A30 Chiverton to Carland Cross PCF Stage 3 validation.

The matrices provided are from SWRTM runs 072 and 073 (DF2 model) which uses a 60:40 blend of unconstrained to constrained growth.

The 2015 base year average weekday Regional Model matrices have been provided for the following time periods:

- Neutral month AM peak period matrices (the average hour between 7am and 10am)
- Neutral month Interpeak hour (average hour from 10am – 4pm)
- Neutral month PM peak period matrices (the average hour between 4pm and 7pm)
- Neutral month Offpeak period matrices (7pm to 7am)

The Regional Model matrices are split into the following user classes:

- UC1 – Employers Business (Car)
- UC2 – Commute (Car)
- UC3 – Other (Car)
- UC4 – LGV
- UC5 – HGV (PCU factor = 2.5)

The time periods and user classes are in line with those used in the A30 Chiverton to Carland Cross SATURN model.

An equivalence matrix has been created between the Regional Model zones and those of the A30 Chiverton to Carland Cross model as the Regional Model provides a detailed zone system across the whole of the South West which is mainly aligned to LSOA boundaries but with additional detail in urban centres. For the purposes of the A30 Chiverton to Carland Cross appraisal this level of detail is not required outside the immediate study area. This allowed a bespoke matrix to be created which assigns the correct proportion of the Regional Model trips to the relevant A30 Chiverton to Carland Cross zones.

GIS software was used to determine the correspondence between the two zoning systems. A GIS layer of the Regional Model zone boundaries was supplied by ARUP to assist with this task. For the rest of the UK outside of Cornwall, the two zone systems aligned well with the Regional Model showing a more granular zone system in the South and West of England and Wales. This led to many Regional Model zones being contained within single large A30 Chiverton to Carland Cross zones.

In Cornwall, the A30 Chiverton to Carland Cross zoning system is more detailed and did not exactly follow LSOA boundaries as the Regional Model zone system does. This led to Regional Model zones overlapping multiple A30 Chiverton to Carland Cross zones. Where this occurred, a factor based on the area of the Regional Model Zone contained within the A30 Chiverton to Carland Cross zones was calculated.

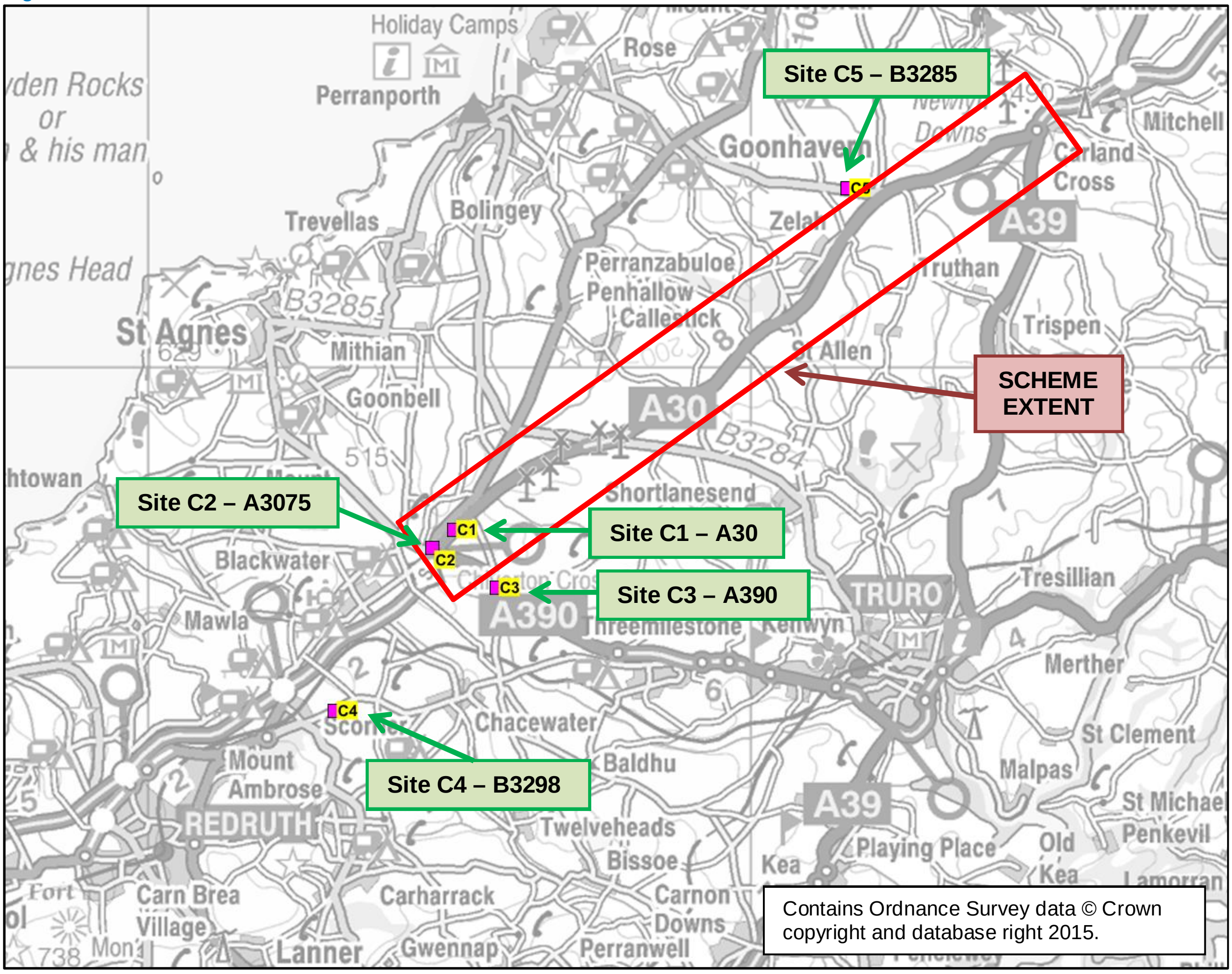
4. Specification and Execution of Surveys

4.1 Additional Data Obtained

Mott MacDonald Grontmij commissioned Nationwide Data Collection Ltd (NDC) to undertake a series of RSI surveys at key locations on the A30 and on other key roads in the vicinity of the scheme area to aid the development of the base year A30 Chiverton to Carland traffic assignment model. ATC and MCC counts were also undertake by NDC at these locations.

The figure below shows the location of these surveys with regards to the study area.

Figure 4-1 : RSI Interview Locations



4.2 Survey Programme

Two survey methods were used as part of the data collection exercise with three of the surveys being undertaken through direct face to face interviews, and the remaining two surveys conducted by issuing postcards to be filled in and returned to NDC.

All RSI's were undertaken on the 20th and 21st of October 2015 at the following locations:

Wednesday 21st October 2015

a. C1 – A30 westbound approaching Chiverton Roundabout - RSI
b. C2 – A3075 southbound approaching Chiverton Roundabout – Postcard Survey
c. C3 – A390 northbound approaching Chiverton Roundabout– Postcard Survey

Thursday 22nd October 2015

d. C4 – B3298 eastbound towards Truro - RSI
e. C5 – B3285 eastbound towards A30 - RSI

4.3 Representative Basis of Surveys

All surveys were conducted during a neutral month on a neutral weekday to obtain a dataset representative of typical conditions and to align with the time periods being modelled. The survey dates of Wednesday 21st October and Thursday 22nd October are outside of the late summer holiday season but are before the schools autumn half term holiday which took place from 26th to 30th October in 2015 (source: http://www.cornwall.gov.uk/media/3625817/Cornwall-Term-Dates-2015-2016-FINAL.pdf).

All surveys covered a 12 hour time period (0700-1900), this allowed for the surveys to include all peak periods.

Several drivers reported that interview sites on the 21st October were being mentioned on local traffic reports, advising drivers to avoid the area. It was noted that the Highways England published the locations and dates of all upcoming South West RSI surveys on the gov.uk webpage on the 9th of October 2015 (source: https://www.gov.uk/government/news/traffic-surveys-taking-place-on-south-west-main-roads), in advance of the surveys. Intense pressure from motorists was reported on the 21st October to inform locals about the following day's survey locations due to the extensive queuing on the morning of the 21st. These were reluctantly provided in in the interest of transparency.

4.4 Outcome and Quality of Surveys

Purpose cleaning was undertaken by NDC as part of their checks before issuing the data to WSP | PB. This process removed purposes where both origin and destinations were illogical such as both being listed as 'Usual place of work' or 'Home'. More details are found in Appendix C of the NDC 'Mott MacDonald South West Traffic Survey – Survey Report October & November 2015' (December 2015).

The table below shows the number of surveys completed at each site. Note this sample rate is before any data was removed as part of the NDC cleaning process.

Table 4-1 : RSI and Postcard Survey Sample Rates

Site	Location	Total	MCC	Sample Rate
C1	*A30 between Chiverton Cross and Chybucca*	1090	9101	**12.0%**
C2	*A3075 North of Chiverton Cross*	242	4367	**5.5%**
C3	*A390 East of Chiverton Cross*	833	9160	**9.6%**
C4	*B3298 Near Chacewater*	916	2859	**32.0%**
C5	*B3285 Between Goonhavern and A30*	560	1348	**41.5%**

The table shows that both postcard surveys recorded a sample rate of below 10%. While low, this type of survey does not generally produce high sample rates due to the nature of the survey distribution and returns process.

RSI Data Collection Issues

The following issues were encountered whilst conducting the RSIs:

- The survey caused the traffic to slow through the site causing the associated ATC at each site to miscount on day of the respective survey.

Site C1
- Several survey participants mentioned that the site was being mentioned on local traffic reports with drivers advised to avoid the area where possible.

Site C2
- Postcard distribution did not commence until 08:00 due to the late arrival of the Police Traffic Officer
- Traffic management was relocated further north at 12:00 to allow three lanes at the stop line of the junction. Postcard distribution restarted at 13:45.
- Postcard distribution was then restricted to 5 minutes in every 15 after this time.
- Surveying was suspended at 17:15 to clear a ½ mile queue caused by 2 tractors passing through the vicinity of the site.
- Several survey participants mentioned that the site was being mentioned on local traffic reports with drivers advised to avoid the area where possible.
- The site showed a low return rate with only 5.5% of total traffic on the route sampled. This is sample rate is before NDC cleaned the data.

Site C3
- Postcard distribution did not commence until 08:00 due to the late arrival of the Police Traffic Officer
- From 12:30 there were frequent suspensions to clear queuing traffic.
- The site was temporarily suspended from 14:15 to 14:45, postcard distribution was then restricted to 5 minutes in every 15 after this time.
- Several survey participants mentioned that the site was being mentioned on local traffic reports with drivers advised to avoid the area where possible.

Site C4
- No specific issues reported.

Site C5
- No specific issues reported.

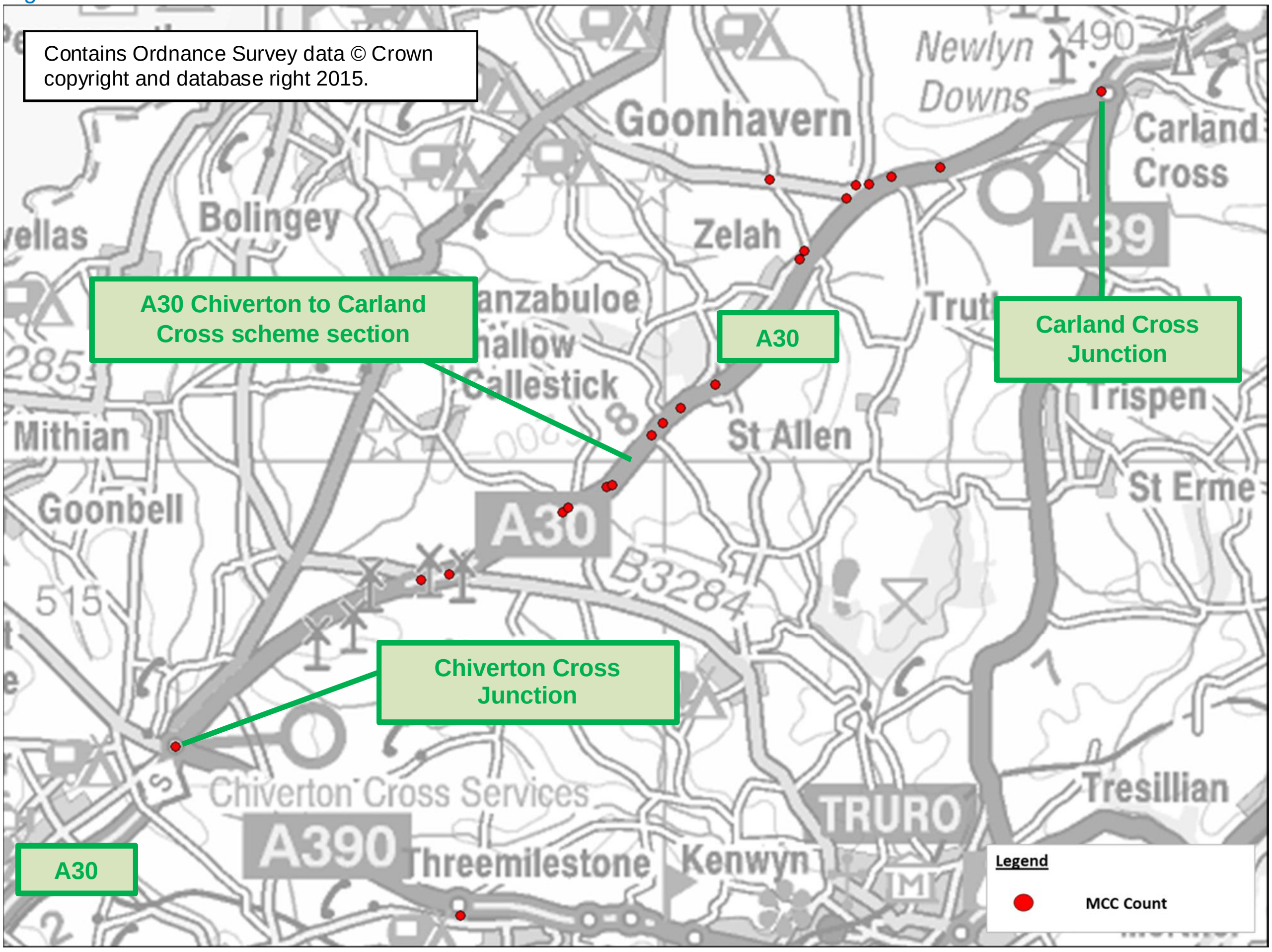
5. Final Volumetric Dataset

5.1 Location of Existing Data Sites

5.1.1 Traffic Count Data

Manual Classified Count (MCC) data was collected by Cornwall Council in October 2014 at all the junctions on the A30 section from Chiverton Cross to Carland Cross, as well as at other key junctions in the area. The locations of these counts are shown in Figure 5-1.

Figure 5-1 : Location of Available Manual Classified Counts

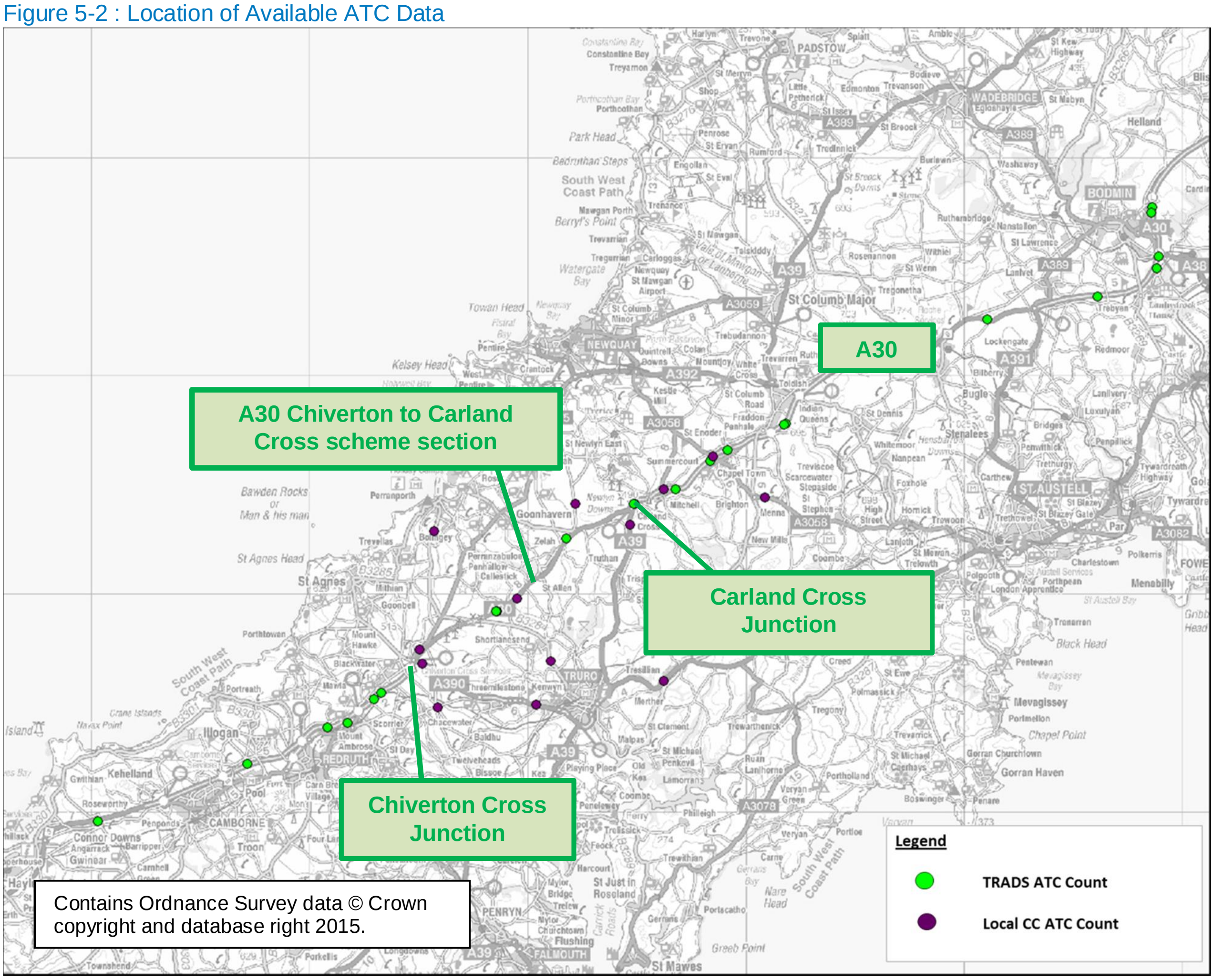


The figures in Annex A show the average peak hour turning movements at 20 junctions within, and surrounding, the A30 Chiverton to Carland Cross study area. These diagrams show a trend in the traffic movements between the AM and PM peak periods; during the AM it is clear to see the major flows of traffic are heading from the A30 and north of the A30 to Truro. In the PM peak this trend is reversed with a larger proportion of trips heading northbound from Truro back towards the A30.

The MCC data will be used to calibrate the base model turning flows at the key junctions on the A30 in the vicinity of the scheme area including Chiverton roundabout, Chybucca roundabout and Carland Cross roundabout. Data for the minor junctions between Carland Cross and Chiverton has also been extracted and with the key junctions providing viable routes into Truro used for calibration purposes at these locations.

Automatic Traffic Count (ATC) data is available on the A30 from Highways England's TRADS database and count data for key routes on the local highways network is available from Cornwall Council. The locations of these counts are shown in Figures 5-2.

Figure 5-2 : Location of Available ATC Data



Analysis of ATC and TRADS counts is conducted in Section 5.4 of this report.

5.1.2 Queue Length Data

Queue data at a number of key locations on the A30 was also collected by Cornwall Council in February 2013. This data covered the junctions in the figure below but will not be used for the key Carland Cross and Chybucca junctions as more up-to-date data is available (22nd/23rd October 2014). Surveys of queuing on minor arms on the A30 were also undertaken by CC during October 2014.

The figures below show the locations of the surveys conducted.

Figure 5-3 : Location of Available 2013 Queue Length Data

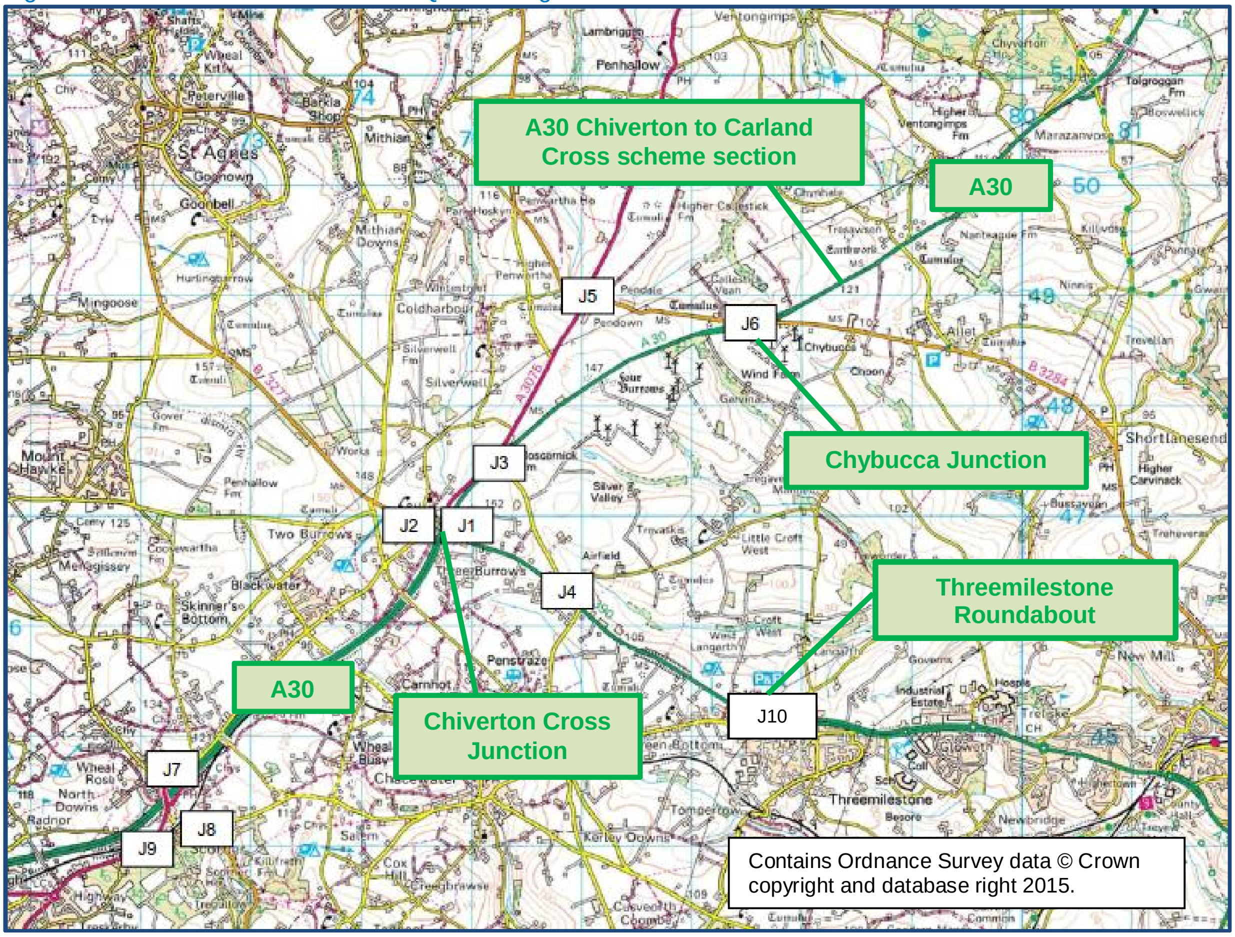
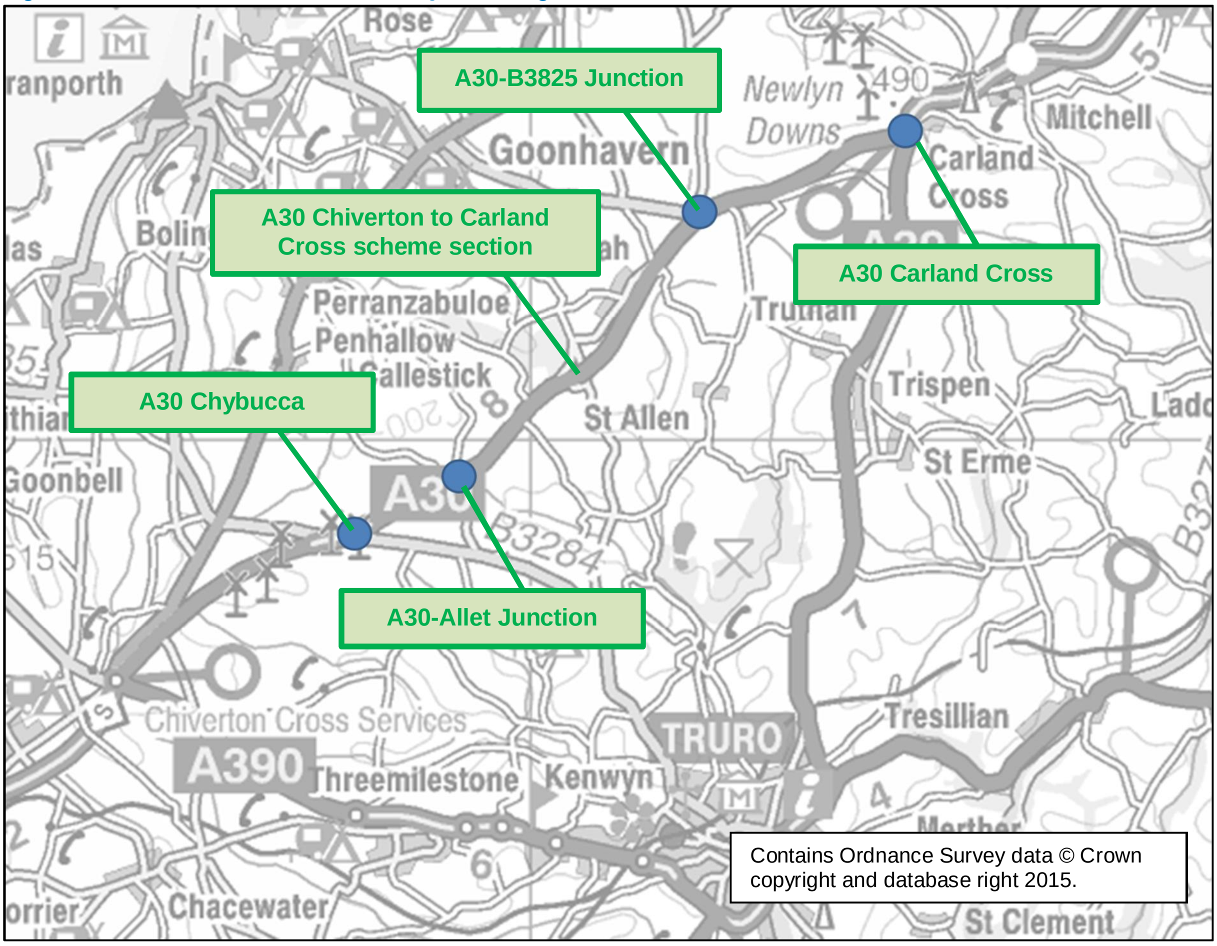


Figure 5-4 : Location of Available 2014 Queue Length Data



The tables below show a summary of the queuing at Chybucca Junction and at Carland Cross Roundabout using the data gathered in 2014. The data was reported as the maximum queue observed in 1 minute intervals. The other junctions that were surveyed in 2014 show limited queuing with very low average queuing at these junctions over the course of the peak periods. Each of the junctions were surveyed on one day only:

- Chybucca Junction – Wednesday 22nd October 2014
- Carland Cross Roundabout – Thursday 23rd October 2014

Table 5-1 : 2014 Queue summaries at Chybucca junction

Junction	Queue Type	Peak Period	B3284 Northbound		A30 Eastbound		A30 Westbound	
			Lane 1	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2
Chybucca	Average over the Period (no. Vehicles)	AM	1	1	1	1	1	1
		PM	5	5	5	5	5	5
	Maximum (no. Vehicles)	AM	6	2	0	38	0	27
		PM	22	3	0	10	0	27

Table 5-2 : 2014 Queue summaries at Carland Cross (excluding wind farm arm)

Junction	Queue Type	Peak Period	A30 Eastbound		Services Northbound	A39 Northbound		A30 Westbound	
			Lane 1	Lane 2	Lane 1	Lane 1	Lane 2	Lane 1	Lane 2
Carland Cross	Average over the Period (no. Vehicles)	AM	0	2	1	0	13	0	0
		PM	0	0	1	1	20	0	0
	Maximum (no. Vehicles)	AM	**3**	**26**	**4**	**2**	**35**	**0**	**2**
		PM	**4**	**19**	**4**	**15**	**35**	**0**	**3**

5.2 Vehicle Classification

The model has 3 vehicle classifications: Cars, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV). The surveys also classified Motorcycles and Passenger Service Vehicles (PSV). These are not modelled so have been excluded from further analysis.

The trip matrices are specified in Passenger Car Units (PCU).

The PCU factors used are shown in Table 5-4 below.

Table 5-3: PCU Factors

Vehicle Class	PCU Factor
Car	1
LGV	1
HGV	2

The PCU factor of 2 for HGVs has come from the 2009 Truro model. TAG Unit M3.1 states that the PCU equivalent for HGVs on motorways and all-purpose dual carriageways should be 2.5 and the PCU equivalent for HGVs on other road types should be 2.0. This model study area includes dual carriageway on the A30 to the east of Carland Cross and the west of Chiverton Cross but focuses on the single carriageway section of the A30 between Carland and Chiverton Cross, and other road types around Truro and the routes. The PCU factor is therefore considered to be reasonable.

HGV proportions have been calculated for the peak periods for both the MCC and ATC data. HGV data for both count types has been further separated into OGV1 and OGV2 vehicle classifications in addition to a combined HGV value.

The MCC counts provided OGV1 and OGV2 proportions on a 15 minute basis. These proportions were organised into a series of hourly proportions for each site. The vehicle breakdown for the average peak hour was then calculated from these hourly values. The table below shows the MCC average peak hour vehicle breakdowns at each count site.

Table 5-4 : MCC Vehicle Proportions

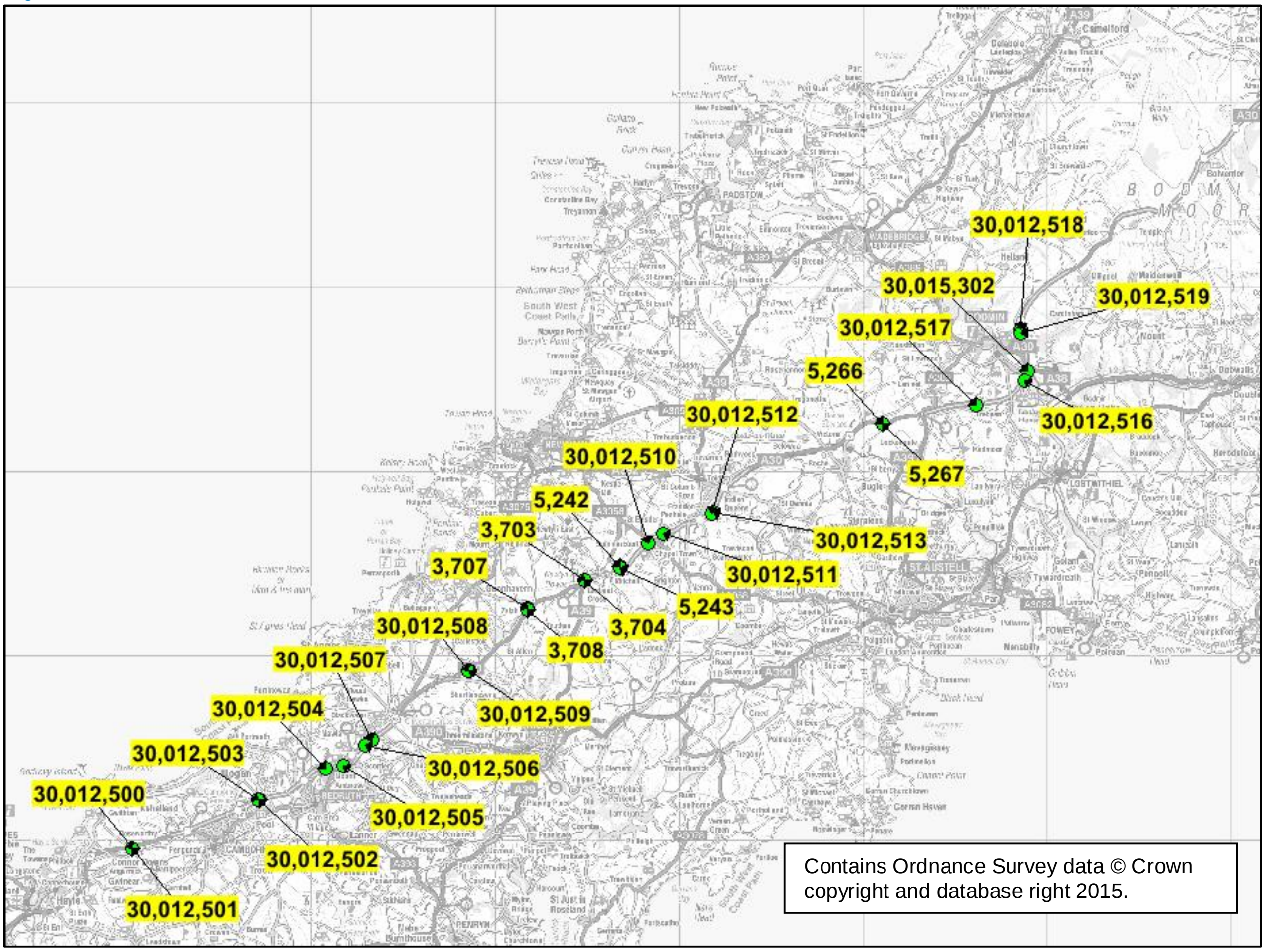
Junction Number from Plan	Site Name	Veh % (12hr Entry Flows)				
		Car	LGV	OGV1	OGV2	HGV
1	Chybucca	83%	15%	2%	1%	3%
		73%	18%	5%	3%	8%
		70%	19%	7%	4%	10%
2	Allet Junction	73%	19%	8%	0%	8%
		80%	13%	3%	4%	7%
		74%	17%	4%	6%	9%
		75%	20%	5%	0%	5%
3	Lower Ventongimps Junction	77%	18%	5%	0%	5%
		0%	0%	100% (N.B. Only one vehicle observed)	0%	100%
		77%	23%	0%	0%	0%
5	Shortlanesend Junction, Marazanvose	58%	37%	0%	5%	5%
		45%	55%	0%	0%	0%
		83%	17%	0%	0%	0%
6	Perranzabuloe Junction	94%	6%	0%	0%	0%
		71%	29%	0%	0%	0%
		83%	17%	0%	0%	0%
		67%	33%	0%	0%	0%
7	Western Slip Road, to Zelah	0%	0%	0%	0%	0%
		0%	0%	0%	0%	0%
		72%	17%	10%	1%	11%
8	Shortlanesend/Zelah Junction	81%	12%	2%	5%	8%
		0%	0%	0%	0%	0%
		81%	14%	3%	3%	6%
9	Zelah Hill Slip Road	84%	14%	2%	0%	2%
		67%	26%	7%	0%	7%
		89%	10%	1%	0%	1%
10	St Allen Junction	58%	32%	11%	0%	11%
		100%	0%	0%	0%	0%
		71%	14%	14%	0%	14%
11	Boxheater (w) Junction	80%	19%	2%	0%	2%
		75%	25%	0%	0%	0%
		79%	18%	3%	0%	3%
12	Boxheater (e) Junction	77%	18%	4%	1%	5%
		71%	20%	5%	3%	9%
		70%	20%	5%	4%	10%

Junction Number from Plan	Site Name	Veh % (12hr Entry Flows)				
		Car	LGV	OGV1	OGV2	HGV
13	Trispen Junction	76%	21%	1%	1%	3%
		97%	3%	0%	0%	0%
		83%	13%	4%	0%	4%
14	Ventonteague Junction	66%	26%	8%	0%	8%
		90%	10%	0%	0%	0%
		57%	36%	7%	0%	7%
15	Carland Cross Roundabout	74%	18%	5%	3%	8%
		74%	19%	6%	2%	7%
		80%	15%	3%	2%	6%
		70%	21%	5%	4%	9%
		0%	0%	0%	0%	0%
16	Scotland Road/Henver Lane Junction	86%	12%	2%	0%	2%
		77%	18%	4%	1%	4%
		85%	14%	1%	0%	1%
		80%	16%	3%	1%	4%
17	Fiddlers Green Junction	78%	18%	4%	1%	4%
		77%	19%	4%	1%	5%
		62%	15%	3%	20%	22%
		74%	17%	4%	5%	9%
18	Chybucca East	70%	21%	5%	4%	9%
		83%	14%	3%	0%	3%
		73%	20%	5%	3%	8%
19	Chiverton Cross Rbt	78%	19%	3%	0%	3%
		70%	21%	5%	3%	8%
		83%	14%	2%	1%	3%
		77%	18%	4%	2%	6%
		79%	18%	3%	1%	3%
20	A390 Threemilestone Bypass Rbt	94%	5%	0%	0%	0%
		87%	11%	2%	0%	2%
		86%	12%	2%	0%	2%
		84%	13%	2%	1%	3%

MCC vehicle proportions have been used for A30 ATC counts downloaded from Highways England's TRADS website. MCC counts on the A30 at Chiverton Cross Roundabout, Chybucca, Zelah and Carland Cross Roundabout were used. A 12hr average proportion has been applied to all TRADS outputs, an assumption was made that all sites either side of the scheme will use proportions generated from the Chiverton and Carland MCC sites.

Figure 5-5 shows the locations of the individual counts.

Figure 5-5 : TRADS ATC Count Locations with TRADS count references



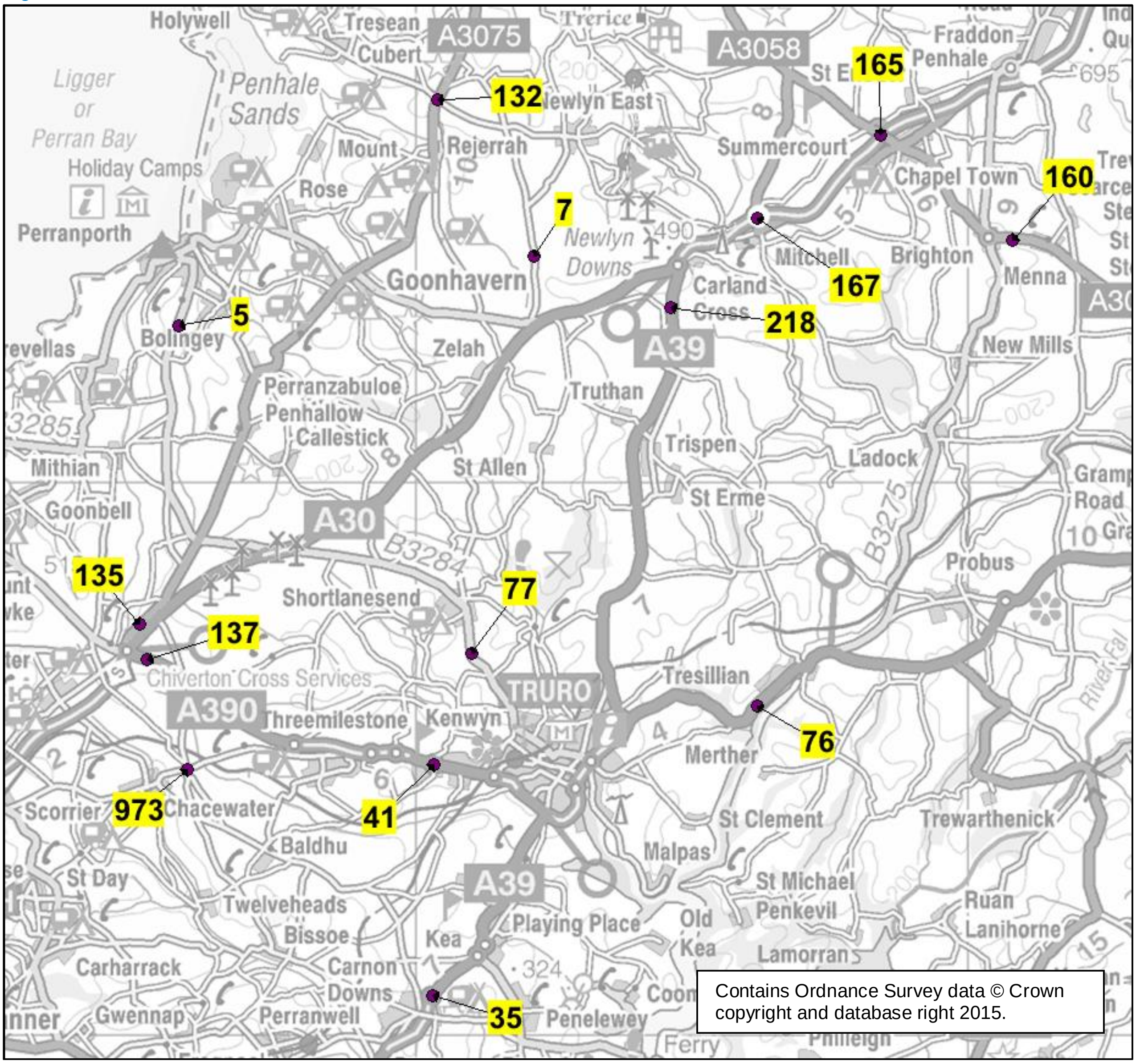
The table below shows the MCC vehicle proportions used at each TRADS ATC count site.

Table 5-5 : MCC Vehicle Proportions applied to TRADS ATC sites (percentage)

Vehicle Type	TRADS_3703	TRADS_3704	TRADS_3707	TRADS_3708	TRADS_5242	TRADS_5243	TRADS_5266	TRADS_5267	TRADS_30012500	TRADS_30012501	TRADS_30012502	TRADS_30012503	TRADS_30012504	TRADS_30012505	TRADS_30012506	TRADS_30012507	TRADS_30012508	TRADS_30012509	TRADS_30012510	TRADS_30012511	TRADS_30012512	TRADS_30012513	TRADS_30012516	TRADS_30012517	TRADS_30012518	TRADS_30012519	TRADS_30015302
Car	76	74	71	71	76	74	76	74	77	76	76	77	77	76	76	77	71	71	76	74	76	74	74	76	76	74	76
LGV	19	18	20	20	19	18	19	18	18	19	19	18	18	19	19	18	20	20	19	18	19	18	18	19	19	18	19
OGV1	3	5	5	6	3	5	3	5	4	3	3	4	4	3	3	4	5	6	3	5	3	5	5	3	3	5	3
OGV2	2	3	4	3	2	3	2	3	2	2	2	2	2	2	2	2	4	3	2	3	2	3	3	2	2	3	2

Local ATC sites provided by CC did not have vehicle breakdowns included in the data. Vehicle proportions from MCC sites have therefore been applied to these sites. Using the MCC site locations and junction type, each local ATC was assigned an MCC from which vehicle proportions were applied. The figure below shows the locations of the local ATC counts.

Figure 5-6 : Local ATC Count Locations



The table below details the local ATC vehicle proportions:

Table 5-6 : MCC Vehicle Proportions applied to local ATC sites (percentages)

Vehicle Type	ATC_5_SB	ATC_35_NB	ATC_35_SB	ATC_41_EB	ATC_41_WB	ATC_76_EB	ATC_76_WB	ATC_77_NB	ATC_77_SB	ATC_137_EB	ATC_137_WB	ATC_218_NB	ATC_218_SB	ATC_973_EB	ATC_973_WB
Car (<5.2m)	83	83	80	80	87	87	80	80	83	83	83	83	80	80	86
LGV (5.2-6.6m)	14	14	15	15	11	11	15	15	15	15	14	14	15	15	12
OGV1 (6.6-11.6m)	3	3	3	3	2	2	3	3	2	2	2	2	3	3	2
OGV2 (>11.6m)	0	0	2	2	0	0	2	2	1	1	1	1	2	2	0
HGV	3	3	6	6	2	2	6	6	3	3	3	3	6	6	2

5.3 Adjustments for Expansion Purposes

The ATC data extracted from the TRADS and CC counts is presented hourly. For the purposes of the modelling it is necessary to be able to convert peak hour data into the average hour during a 3hr peak period. The table below show the factors for converting the initial peak hour matrices into the average peak hour for that period. All other data is an average of the 3 hours.

Table 5-7 : ATC Peak Hour to Average Peak Hour Factors

Peak Period	A30 between Chiverton and Carland Factor	Trunk Road (excluding Chiverton to Carland) Factor	Average A30 Factor
AM	0.935	0.930	0.930
PM	0.879	0.896	0.893

The conversion to average peak hour will take place before any forecasting factors such as TEMPRO are applied to the matrices.

5.4 Interpretation of Results

Existing traffic conditions have been analysed on the A30 between Chiverton and Carland Cross using the TRADS ATC counter between Zelah and Carland Cross roundabout, Figures 5-7 and 5-8 below show the existing daily traffic conditions on the A30.

Peaks in both graphs appear to occur during the AM and PM peak periods, from this it could be assumed that traffic is using the route in both directions as part of a commute.

Figure 5-7 : Average hourly 2015 westbound traffic flows between Zelah and Carland Cross.

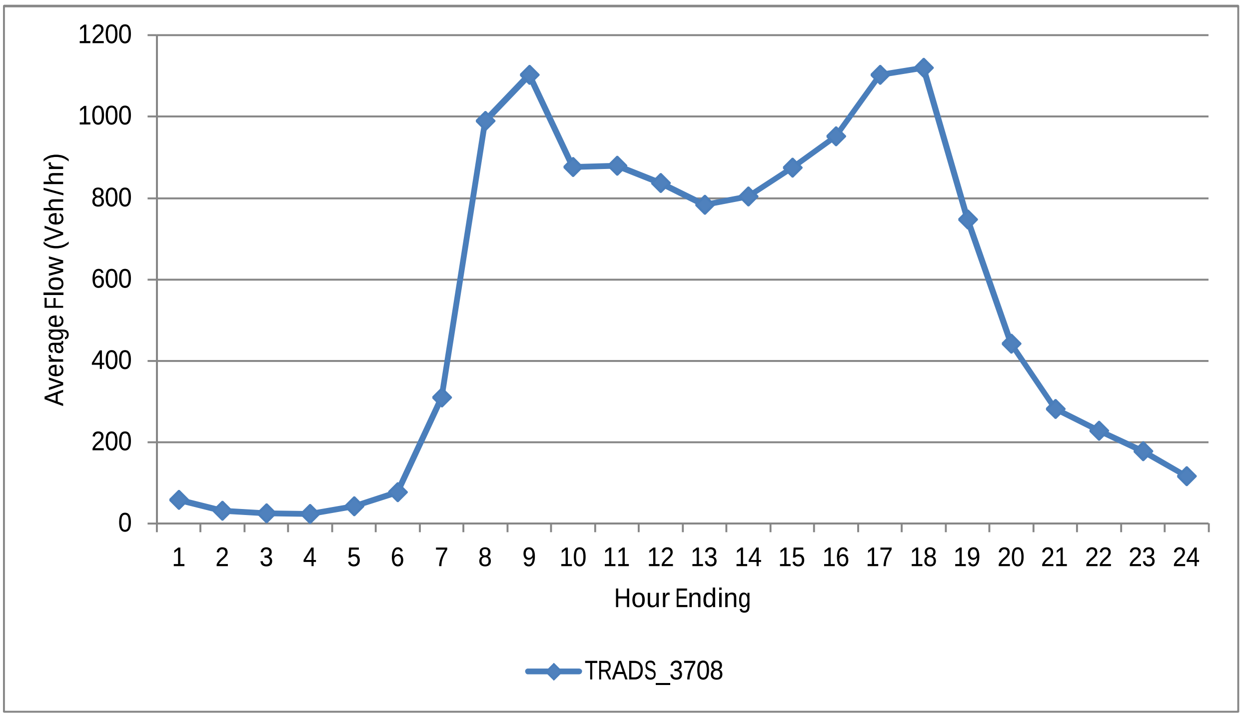


Figure 5-8, shows that the eastbound flow on the A30 experiences its largest level of traffic during the PM peak. This trend could suggest that in the AM peak, these vehicles could be using alternative routes such as the A3075 or A39.

Figure 5-8: Average hourly 2015 eastbound traffic flows between Zelah and Carland Cross.

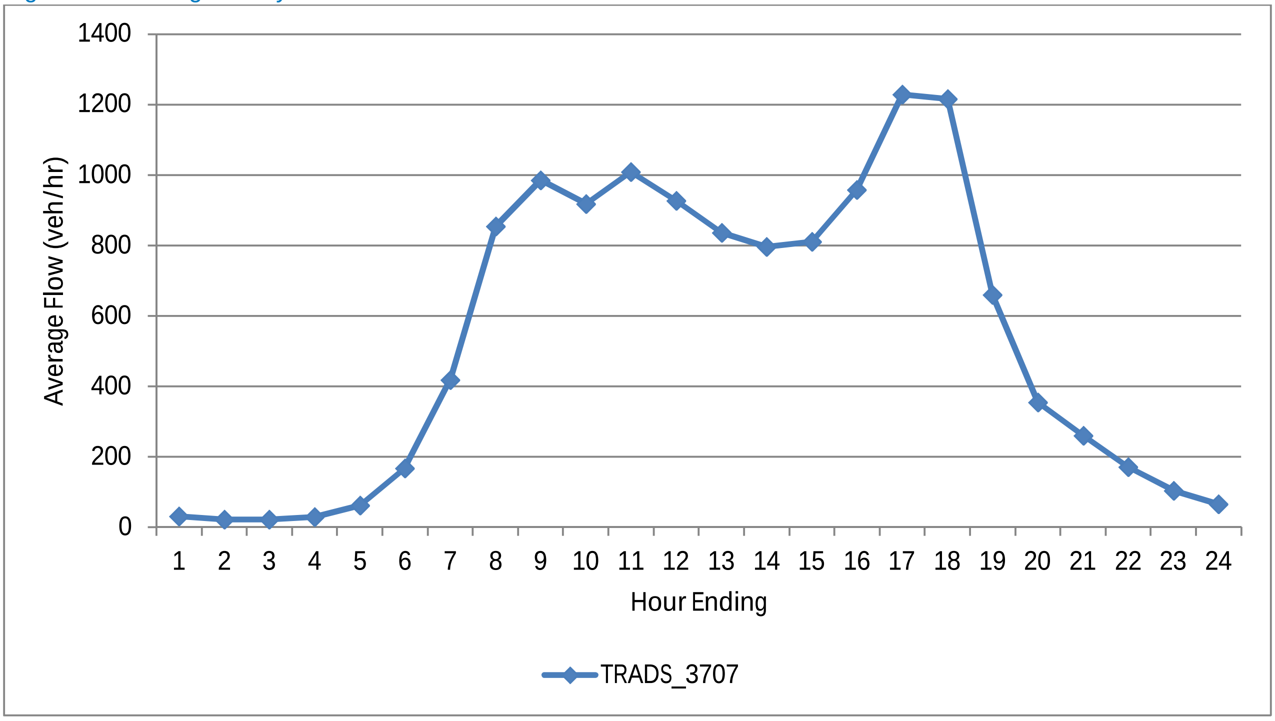


Figure 5-9 and 5-10 below show the monthly traffic flows between Zelah and Carland Cross on the A30.

Figure 5-9 below shows the westbound monthly traffic flows for the A30. The graph shows a peak in traffic levels during July and August with the trend indicating that the route experiences it highest levels of traffic during the summer. This trend can also be seen in Figure 5-10 where the traffic levels gradually increase throughout the year from January to the peak summer months of July and August. These two months are expected to be when traffic is busiest as Cornwall experiences a high volume of tourist traffic over the summer period, especially the school summer break.

Figure 5-9: Monthly 2015 westbound traffic flows between Zelah and Carland Cross (TRADS 3708).

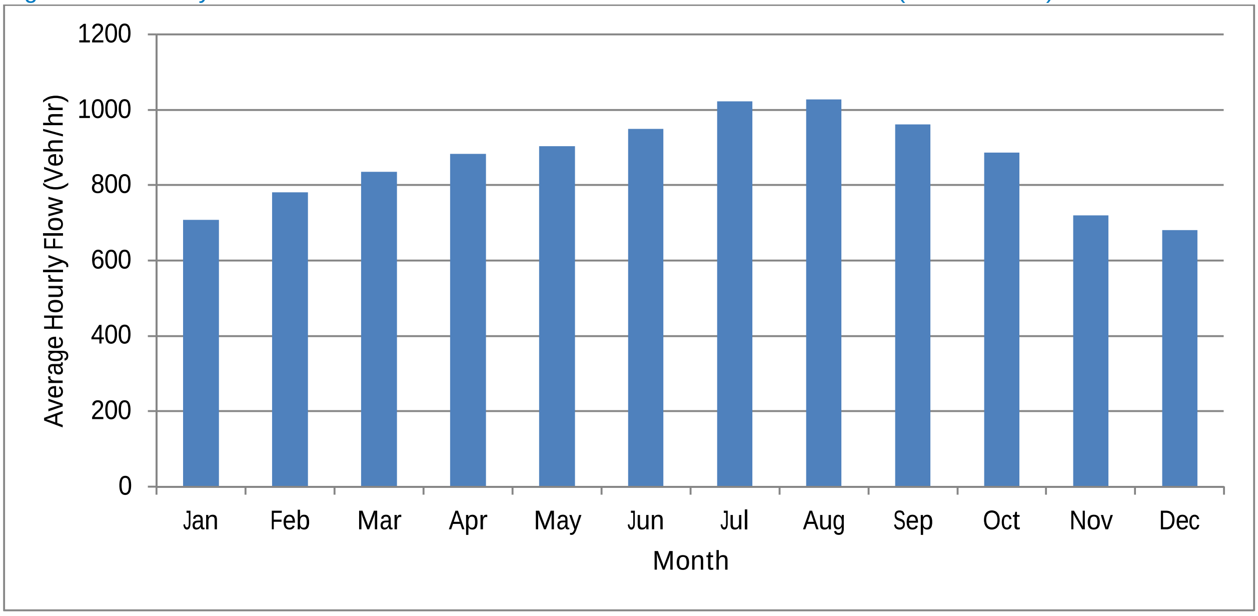
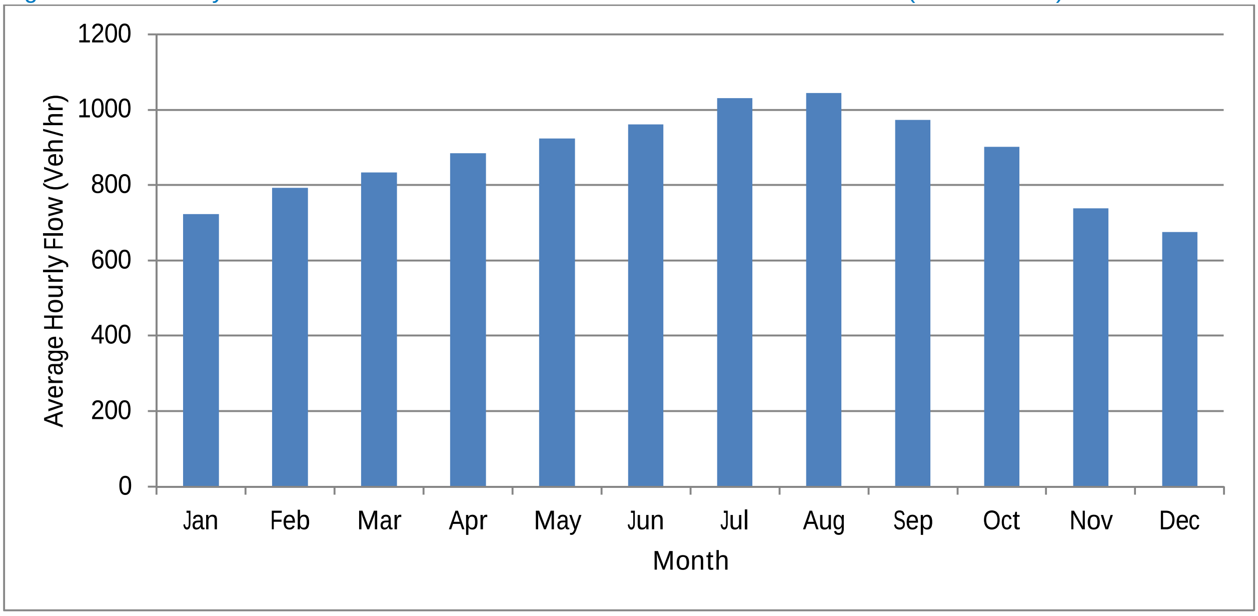


Figure 5-10: Monthly 2015 eastbound traffic flows between Zelah and Carland Cross (TRADS 3707).



Using the annual report for the 2014 flows for the sites in the figures above, the A30 in these locations is shown to be subject to the following seasonality indexes.

Table 5-8: Seasonality Indexes for the A30 between Zelah and Carland Cross

Site	Seasonality Index
TRADS_3707	1.1841
TRADS_3708	1.1691
Non Built-up Trunk Typical Value (COBA Manual)	**1.10**

The A30 between Zelah and Carland Cross is within the Range of Seasonality Index Encountered (1.0 - 1.5) for a Non Built-up Trunk road as stated in the COBA Manual. It is above the typical value of the seasonality index for a Non Built-up Trunk road.

6. Final Trip Dataset

6.1 Roadside Interview Data

For the final trip dataset, the RSI and postcard surveys undertaken by Nationwide Data Collection Ltd will be used. As previously outlined these were conducted on the following routes:

- A30 - Westbound towards Chiverton Roundabout - RSI
- A3075 – Southbound towards Chiverton Roundabout – Postcard
- A390 – Northbound towards Chiverton Roundabout – Postcard
- B3298 – Eastbound towards Truro
- B3285 – Southbound towards the A30

The surveys undertaken as part of the 2009 A390 improvements have already been incorporated into the initial 2009 Truro model matrix. The November 2011 RSI undertaken for the A30 Temple to Higher Carblake modelling will be used in the matrix building process of the Stage 3 modelling.

6.2 Additional Surveys

No other additional interview or stated preference surveys were undertaken as part of the Stage 3 data collection. The RSI surveys, covering five locations, are deemed to provide sufficient coverage of the main study area for the purposes of the modelling at this stage.

6.3 Data from other Sources

No other data sources were used outside of those previously specified.

6.4 Data Processing

The following data was recorded in each interview and postcard:

- Time
- Vehicle type
- Number of occupants; adults and children
- Trip origin
- Trip origin purpose
- Trip destination
- Trip destination purpose
- Was the trip one-way
- Estimated return time if two-way

Origin Destination Data Cleaning

Before the received data from the surveys was included in the trip dataset, WSP undertook a series of checks to ensure the received data was suitable and that all illogical trips had been removed.

As they will not be modelled, entries for motorcycles were removed. Each origin and destination recorded in the survey has been converted into British OS Coordinate system.

To identify illogical records the origin and destination of each survey record was plotted in MapInfo GIS software. Screen lines were used to logic check the origins and destinations and suspect points were further interrogated to determine if a logical route exists for the O/D pairing. Survey records with ambiguous or illogical origins or destinations have been removed.

A total of 117 records were removed based on illogical origins or destinations. It was suspected that the origin and destinations were reversed in some records which had been highlighted by NDC. As no additional information was available on these records, they were removed.

Following this cleaning process, the data was further interrogated by peak period to assess the peak period sample rates. The table below shows these peak period sample rates at each site.

Table 6-1 : Cleaned RSI data peak period sample rates

Site	Peak Period	ATC (Peak Period)	Number of Interviews (Peak Period)	Sample Rate (Peak Period)
C1	***AM***	2885	179	**6.2%**
	IP	4796	505	**10.5%**
	PM	2934	246	**8.4%**
C2	***AM***	1267	38	**3.0%**
	IP	2216	85	**3.8%**
	PM	1175	73	**6.2%**
C3	***AM***	1919	231	**12.0%**
	IP	5100	413	**8.1%**
	PM	3302	164	**5.0%**
C4	***AM***	1046	268	**25.6%**
	IP	1275	348	**27.3%**
	PM	541	155	**28.7%**
C5	***AM***	378	120	**31.7%**
	IP	609	229	**37.6%**
	PM	373	100	**26.8%**

Site C2 was undertaken as a postcard survey. The sample rates of usable data from this type of survey are often lower as it relies of the surveys being returned and the fact that the interviewer cannot guide the respondent ensuring that questions are answered correctly and minimising illogical journey types such as permanent home to permanent home. At site C2 the sample rates in two of the peaks, AM and IP, are below 5% in both directions while the PM is below 5% in the non-interview direction. As such it has been decided that data from this site is to be excluded from the final trip dataset as it cannot be considered representative.

A full breakdown of the sample rates for each site by vehicle type can be found in Annex B.

ATC data was provided at each count site for a two week period leading up to, and including, the day of the survey. This data was used to calculate an expansion factor to growth the RSI sample to the average peak period traffic volume for the respective peak. ATC data for the day of the survey was excluded as NDC stated the slow moving traffic caused by the RSI/postcard surveys caused discrepancies with the count on those days. Therefore seven neutral weekdays before the commencement of the surveys were instead used for expansion purposes.

6.5 Interpretation of Data

The trip purposes from each site of the survey are presented in the table below. This data is further broken down by peak period to allow a comparison across the day. Car has been broken down into three purposes:

- Employers Business
- Commute
- Other

Table 6-2 : Trip Purpose proportions of survey data by site and time period (interview direction only)

Site	Time Period	User Class Proportion				
		Car - Employers Business	Car - Commute	Car - Other	LGV	HGV
C1	*AM*	2%	70%	28%	100%	100%
	IP	11%	23%	66%	100%	100%
	PM	7%	47%	45%	100%	100%
C2	*AM*	15%	44%	41%	100%	100%
	IP	8%	18%	75%	100%	100%
	PM	7%	26%	67%	100%	100%
C3	*AM*	9%	56%	36%	100%	100%
	IP	10%	14%	76%	100%	100%
	PM	1%	66%	34%	100%	100%
C4	*AM*	3%	65%	32%	100%	100%
	IP	6%	16%	77%	100%	100%
	PM	4%	35%	61%	100%	100%
C5	*AM*	5%	57%	39%	100%	100%
	IP	4%	15%	81%	100%	100%
	PM	2%	44%	54%	100%	100%

The trip purposes from each survey record was recorded and compared against the proportions quoted in TAG Data Book March 2017.

All sites are shown to have a lower than national average trip proportion for employers business. The sites located on more strategic corridors (C1 on the A30 and C3 on the A390) show a higher than average proportion of commuting trips across all peaks (70% at C1 and 56% at C3 compared to 46% nationally in the AM peak). The other sites also show this trend in the AM but are more consistent with or lower than the national average in the PM.

Table 6-3 : Daily Vehicle Proportions

Site	Car Proportions		
	Employers Business	Commute	Other
C1	8%	39%	53%
C2	9%	26%	66%
C3	7%	37%	56%
C4	5%	37%	59%
C5	4%	32%	64%
TAG Data Book Weekday Average (March 2017)	**15%**	**31%**	**54%**

The table above shows the daily proportions of car journey purposes over the course of the 12 hour survey period compared to the TAG Unit average. It shows that, as with the individual peak period data, there is a higher incidence of commuting trips in the survey sample, with the exception of site C2. The volume of trips with an 'Other' purpose is also the same or higher than the national average. Employer's business trips form less than 10% of the sample of car trips recorded in the cleaned interview data at all site. This is below the national average of 15%.

Truro is likely to be the largest attraction for Employers Business trips. Route choice exists when access Truro, especially from the east and north. Trips to and from Truro from these directions would not necessarily use the Chiverton to Carland Cross section of the A30, instead using the A39 or routing via Shortlanesend.

Given that Sites C1 to C4 are all on roads that can reasonably be used as routes to Truro from various population centres, the high volume of commuter traffic recorded appears reasonable. Employers business is consistently lower than average at all sites in all peaks. For the purposes of the PCF Stage 3 modelling, and in the absence of up-to-date data from other sources, the sample is suitable for inclusion in the final trip dataset.

Table 6-4 to Table 6-7 show the statistically representative sample rates need at each RSI site for each vehicle type. These have been calculated as per the calculations outlined in Appendix D13 of the Traffic Appraisal Manual (August 1991)[1].

[1] DMRB Volume 12 Section 1 (November 1997) *The Application of Traffic Appraisal to Trunk Road Schemes*. Available at: http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol12/section1/12s1p1.pdf

Table 6-4 – Site C1 - Comparison of Statistically Representative Sample Rate to Actual Sample Rate

Site	Direction	Vehicle Type	Peak Period	Statistically Representative Sample Rate	Actual Sample Rate
C1	Interview Direction	*Car*	AM	8%	5%
			IP	5%	9%
			PM	5%	8%
		LGV	AM	83%	13%
			IP	74%	15%
			PM	89%	13%
		HGV	AM	94%	20%
			IP	89%	28%
			PM	95%	4%

Table 6-5 – Site C3 - Comparison of Statistically Representative Sample Rate to Actual Sample Rate

Site	Direction	Vehicle Type	Peak Period	Statistically Representative Sample Rate	Actual Sample Rate
C3	Interview Direction	*Car*	AM	9%	5%
			IP	3%	8%
			PM	3%	5%
		LGV	AM	88%	14%
			IP	78%	11%
			PM	91%	1%
		HGV	AM	98%	18%
			IP	95%	9%
			PM	97%	0%

Table 6-6 – Site C4 - Comparison of Statistically Representative Sample Rate to Actual Sample Rate

Site	Direction	Vehicle Type	Peak Period	Statistically Representative Sample Rate	Actual Sample Rate
C4	Interview Direction	*Car*	AM	14%	5%
			IP	14%	27%
			PM	22%	29%
		LGV	AM	93%	30%
			IP	91%	23%
			PM	97%	36%
		HGV	AM	100%	100%
			IP	99%	138%
			PM	100%	41%

Table 6-7 – Site C5 - Comparison of Statistically Representative Sample Rate to Actual Sample Rate

Site	Direction	Vehicle Type	Peak Period	Statistically Representative Sample Rate	Actual Sample Rate
C5	Interview Direction	***Car***	**AM**	34%	32%
			IP	30%	39%
			PM	26%	24%
		LGV	**AM**	98%	40%
			IP	95%	37%
			PM	98%	75%
		HGV	**AM**	100%	0%
			IP	99%	20%
			PM	100%	0%

The tables show that the sample rate for cars is approximately that needed to be statistically reliable. To achieve statistically reliability, the LGV and HGV sample rates are much higher. However the HGV data was not used so the low actual sample does not affect the model. The LGV sample rate may affect the reliability of the model for this vehicle type but in the absence of alternative data, the RSI data has been used in the A30 Carland to Chiverton Cross model.

6.6 Regional Model Mobile Phone Matrices

For the final trip dataset, the SWRTM compressed matrices will be used to compare the outputs from the Regional Model with the A30 Chiverton to Carland Cross PCF Stage 3 base year model.

The trip purpose proportions for the Car vehicle type from the full Regional Model matrices are presented by time period and user class in Table 6-8.

Table 6-8 : Trip Purpose proportions of Regional Model matrices by time period

Site	Time Period	User Class Proportion		
		Car - Employers Business	Car – Commute	Car - Other
South West Regional Model	***AM***	8%	44%	47%
	IP	9%	22%	69%
	PM	6%	36%	58%
TAG Data Book Weekday Average (March 2017)		**15%**	**31%**	**54%**

The table suggests that the Regional Model matrices have a lower proportion of Employers Business trips that the Weekday Average outlined in TAG Databook March 2017. Commuting trips make up a higher proportion of car trips in the AM and PM Regional Model matrices, with a similar trend in the Interpeak and PM Regional Model matrices for 'Other' type trips.

7. Journey Time Data

7.1 Journey Time Routes

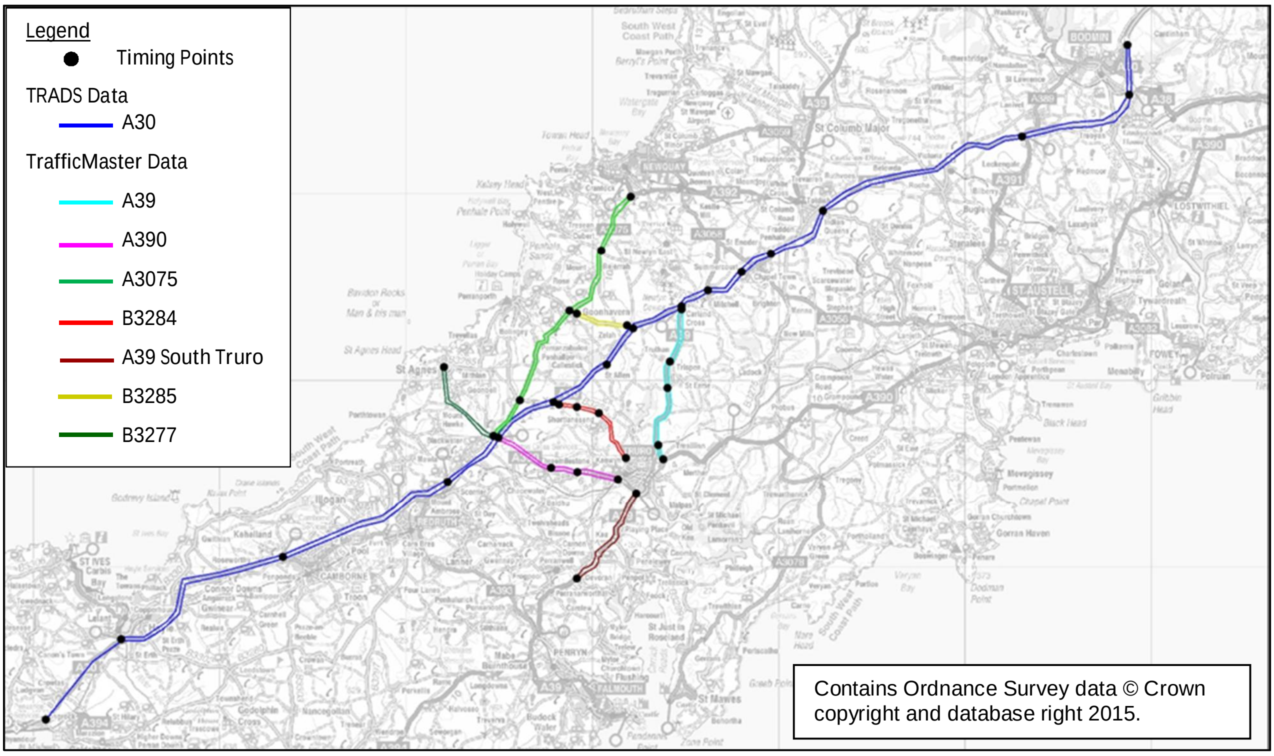
Journey time data is required to provide an understanding of traffic conditions experienced by road users on an average neutral day. The journey time data will also be used in validating the transport models.

Journey Time data was collected from the HATRIS JTDB on the A30 trunk road. The list below details the location of the routes on the A30 corridor in the vicinity of the study area:

- A3074 Hayle and Penzance (Westbound only)
- A3074 Nut Lane, Lelant and Tolvaddon Interchange;
- Tolvaddon Interchange and Scorrier Interchange;
- Scorrier Interchange and Chiverton Cross roundabout;
- Chiverton Cross roundabout and Carland Cross roundabout;
- Carland Cross roundabout and Mitchell Interchange;
- Mitchell Interchange and Chapel Town;
- Chapel Town and St Enoder;
- St Enoder and Indian Queens;
- Indian Queens and junction with A389/A391;
- Junction with A389/ A391 and Carminnow Cross; and,
- Carminnow Cross and Launceston Rd, Bodmin;
- A30 Entry Slip and A395, Tregadillett (Eastbound only)

These routes cover the A30 in detail between Lelant, near Hayle and Bodmin. The A30 journey time routes are shown in dark blue in Figure 7-1.

Figure 7-1 : Journey Time Routes



7.2 Data Cleaning

The data used has come from the TRADS HATRIS database and is therefore considered to be viable and accurate. As such no data cleaning was undertaken on this data.

7.3 Data from other Sources

Cornwall Council has provided Traffic Master journey time data for a cordon encompassing the study area. Figure 7-1 shows these routes.

This data provides journey times between the 01/09/2013 and 31/10/2013 for the AM (07:00-10:00), Interpeak (10:00-16:00) and PM (16:00-19:00) peak periods. This represented the most up-to-date data available for the months required. The journey times have been extracted for the following routes:

- A390 between Chiverton Cross and County Hall, Truro;
- A39 between Carland Cross and Union Hill junction, Truro;
- A3075 between Chiverton Cross and Newquay;
- B3284 between Chybucca and Truro via Shortlanesend;
- A39 between Arch Hill, Truro and Carnon Gate, Devoran;
- B3285 between the A30 and the A3075; and
- B3277 between Chiverton Cross and St. Agnes
- A30 between Chiverton Cross and Carland Cross

7.4 Interpretation of Data

Each hour of journey time data is classified as high, medium or low quality. Table 7-1 shows the average quality of the data for each modelled period. The table shows that the majority of the data is of 'Low' quality. This means that there is a high proportion of synthesised data per kilometre with fewer journey time loops per route to collect the data. This data is created by in-filling where data is lacking using data from either similar days or from before or after the missing time period. High and medium quality data would be preferable but the journey time data is limited to what is available from the HATRIS database and in this case low quality data has therefore had to be used.

Table 7-1 : Journey Time Dataset Quality

Site	Location	Neutral Weekday AM Peak			Neutral Weekday Interpeak			Neutral Weekday PM Peak		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
AL784	*A30 Westbound (Between Camborne and Hayle)*	0%	1%	99%	0%	1%	99%	0%	0%	100%
AL801	*A30 Eastbound (Between Chiverton Cross Rbt and Carland Cross Rbt)*	0%	6%	94%	0%	12%	87%	0%	15%	84%
AL802	*A30 Westbound (Between A3076 Newquay Junction and Carland Cross Rbt)*	1%	18%	81%	0%	8%	92%	0%	6%	94%
AL1907	*A30 Eastbound (Between Mitchell and Summercourt)*	0%	4%	96%	0%	10%	90%	0%	15%	85%
AL1908	*A30 Westbound (Between Summercourt and Chapel Town)*	1%	18%	81%	0%	6%	94%	0%	5%	95%
AL1909	*A30 Eastbound (Between Carland Cross Rbt and A3076 Newquay Junction*	0%	5%	95%	0%	11%	88%	0%	15%	85%
AL1910	*A30 Westbound (Between Mitchell and Summercourt)*	1%	19%	80%	0%	6%	94%	0%	7%	93%
AL1911	*A30 Westbound (Between Chiverton Cross Rbt and Scorrier)*	1%	17%	82%	0%	9%	91%	0%	14%	85%
AL1912	*A30 Eastbound (Between Camborne and Scorrier)*	0%	10%	90%	0%	10%	90%	0%	15%	85%
AL1913	*A30 Eastbound (Between Hayle and Camborne)*	0%	1%	99%	0%	1%	99%	0%	0%	100%
AL1914	*A30 Westbound (Between Scorrier and Camborne)*	0%	1%	99%	0%	0%	100%	0%	1%	99%
AL1918	*A30 Eastbound (A389 Lanivet Junction and A38 Bodmin)*	0%	1%	99%	0%	2%	98%	0%	1%	99%
AL1919	*A30 Westbound (Between A30 Entry Slip Bodmin and A38 Bodmin Junction)*	0%	2%	98%	0%	1%	99%	0%	1%	99%
AL2195A	*A30 Eastbound (Between Indian Queens and A389 Lanivet Junction)*	0%	11%	89%	1%	14%	86%	2%	13%	85%

Site	Location	Neutral Weekday AM Peak			Neutral Weekday Interpeak			Neutral Weekday PM Peak		
		High	Medium	Low	High	Medium	Low	High	Medium	Low
AL2196A	*A30 Westbound (Between A38 Bodmin Junction and A389 Lanivet Junction)*	1%	20%	78%	0%	9%	91%	0%	10%	89%
AL3077	*A30 Eastbound (A38 Bodmin and A30 Entry Slip Bodmin)*	0%	2%	98%	0%	4%	96%	0%	2%	98%
AL3081	*A30 Westbound (Between Hayle and Penzance)*	0%	2%	98%	0%	1%	99%	0%	1%	99%
AL3083	*A30 Eastbound (Between Penzance and Hayle)*	0%	0%	100%	0%	1%	99%	0%	1%	99%
AL3084	*A30 Westbound (Between Carland Cross Rbt and Chiverton Cross Rbt)*	0%	4%	96%	0%	1%	99%	0%	1%	99%
AL3085	*A30 Eastbound (Between Scorrier and Chiverton Cross Rbt)*	0%	1%	99%	0%	3%	97%	0%	3%	97%
AL3086A	*A30 Eastbound (Between Chapel Town and Indian Queens)*	0%	4%	96%	0%	8%	92%	0%	10%	89%
AL3087A	*A30 Westbound (Between A389 Lanivet Junction and Indian Queens)*	0%	12%	88%	0%	4%	96%	0%	6%	94%
AL3088	*A30 Westbound (Between Indian Queens and Summercourt)*	0%	15%	84%	0%	5%	95%	0%	4%	96%
AL3089	*A30 Eastbound (Between Summercourt and Chapel Town)*	0%	3%	97%	0%	8%	92%	0%	11%	89%

Both data sources included the A30 Chiverton to Carland Cross and presented some differences between them. They are summarised in the Table 7-2.

Table 7-2 - Journey time differences (seconds) between HATRIS and Cornwall Council between Chiverton Cross and Carland Cross

		AM	IP	PM
Eastbound	**Cornwall Council**	684	642	702
	HATRIS	656	652	697
	Relative Difference	4.09%	-1.56%	0.71%
Westbound	**Cornwall Council**	804	673	748
	HATRIS	734	657	690
	Relative Difference	8.71%	2.38%	7.75%

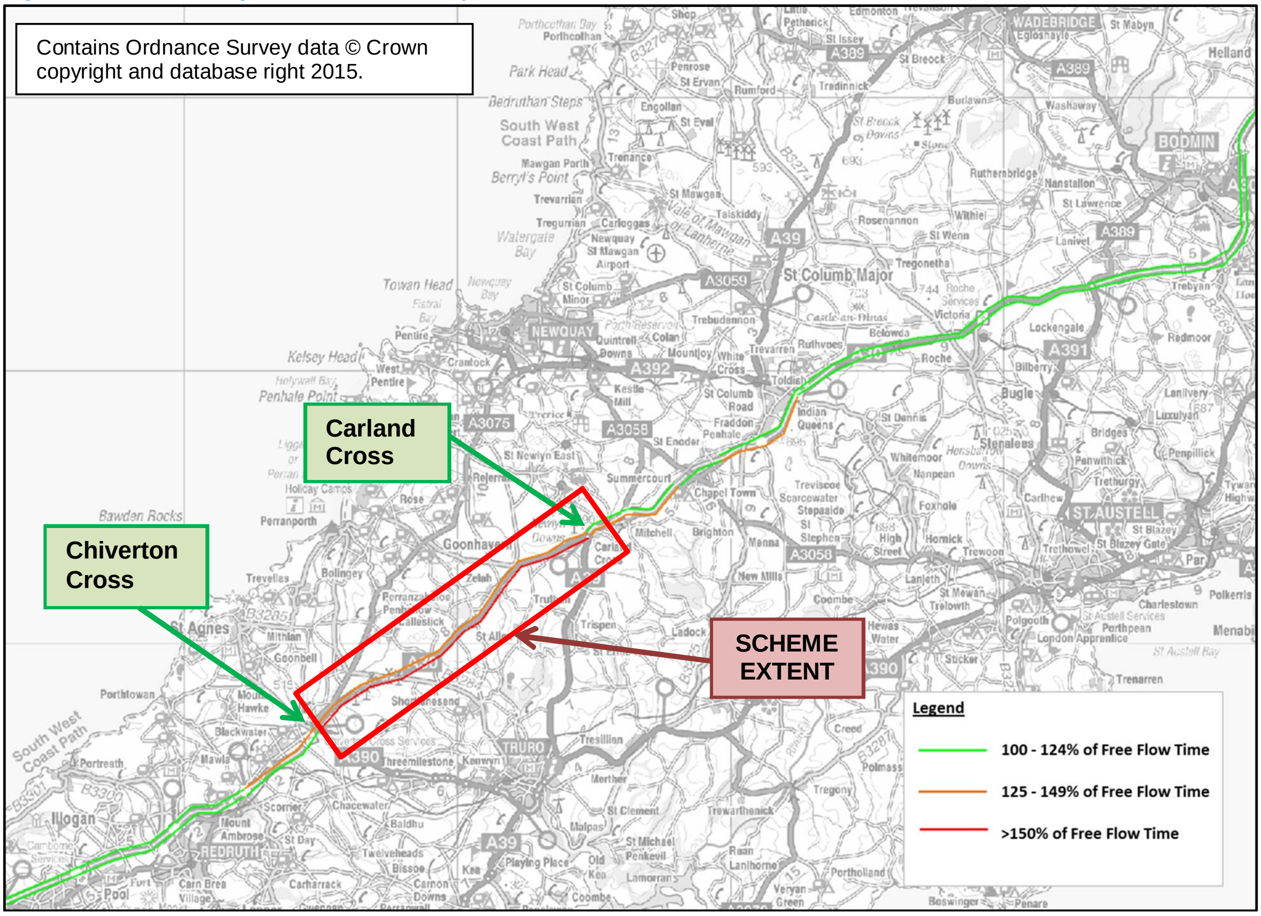
As shown above, there are only two significant differences. These are in the westbound direction during the AM and PM peaks. These differences are 70 and 58 seconds, which represent, approximately, 8- 9% of the journey time. Given that the HATRIS data was described as low quality, it was agreed with TAME[2] to use the Cornwall Council data that was collected during two neutral months (September and October).

2014 journey time data will be used for the purpose of calibrating the A30 to the east and west of the scheme and the data provided by Cornwall Council will be used to calibrate the A30 between Chiverton and Carland and the surrounding routes. While some 2015 data is available, a whole year of data will not be available in time for inclusion within the Stage 3 model. There are also differences in the site locations and lengths between the 2014 and 2015 datasets.

Sites were chosen to ensure full coverage of the A30 corridor through the study area, whilst ensuring the data collected was suitable for input to developing and validating the transport models.

The figures below show that on the Chiverton to Carland Cross section of the A30 there are high levels of congestion in the AM and PM peaks with the journey times higher than 150% of the free flow journey times. These free flow times represent the 99th percentile of the observed journey times on each route. In the interpeak period journey times are still above 125% of the free flow journey time. The figures also show that there are delays on the A30 on both of the approaches to this section.

Figure 7-2 : AM Average Peak Hour Journey Times in relation to link Free Flow Time



2 Agreed with TAME via email on 22/02/17.

Figure 7-3 : IP Average Peak Hour Journey Times in relation to link Free Flow Time

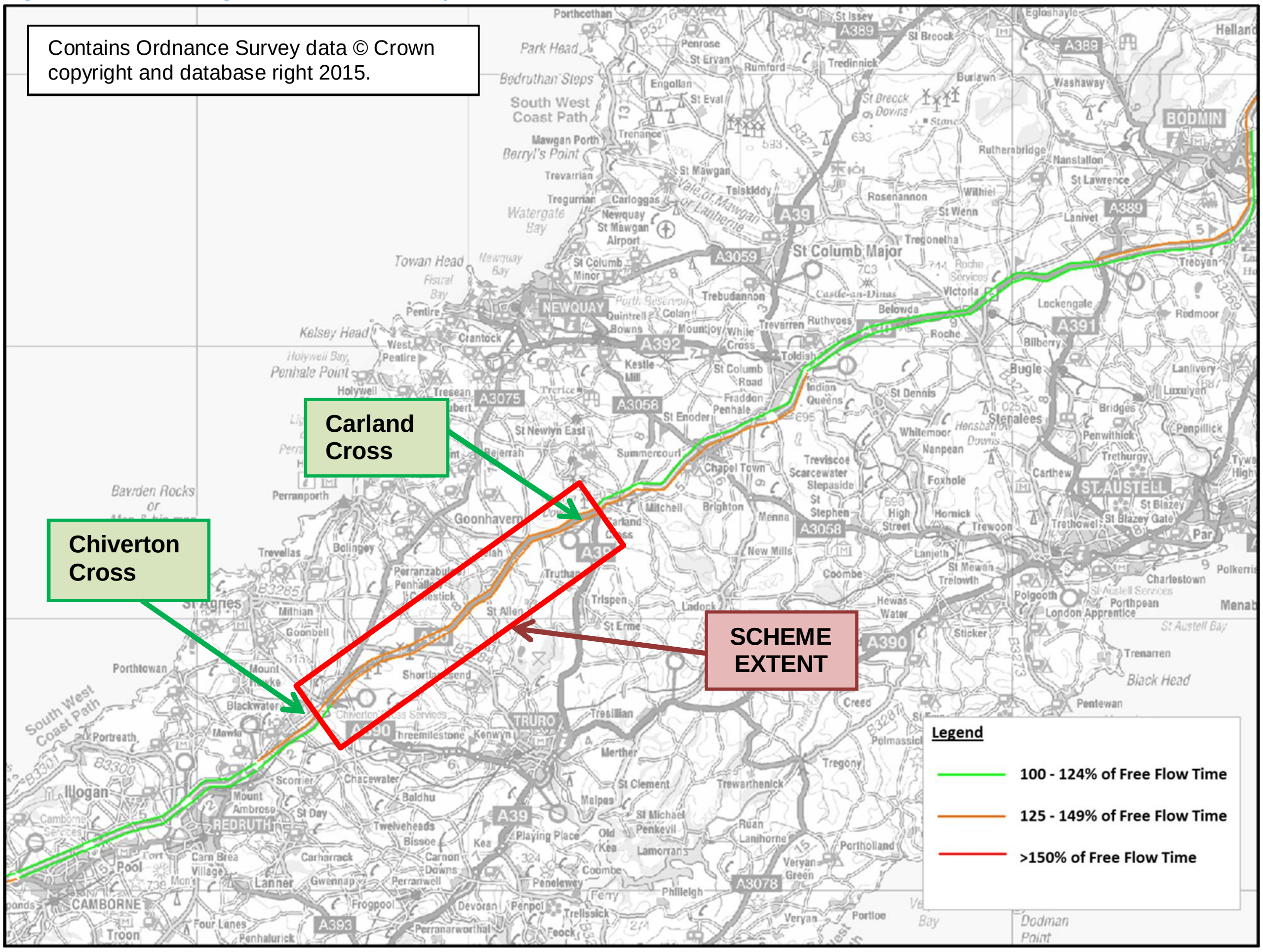
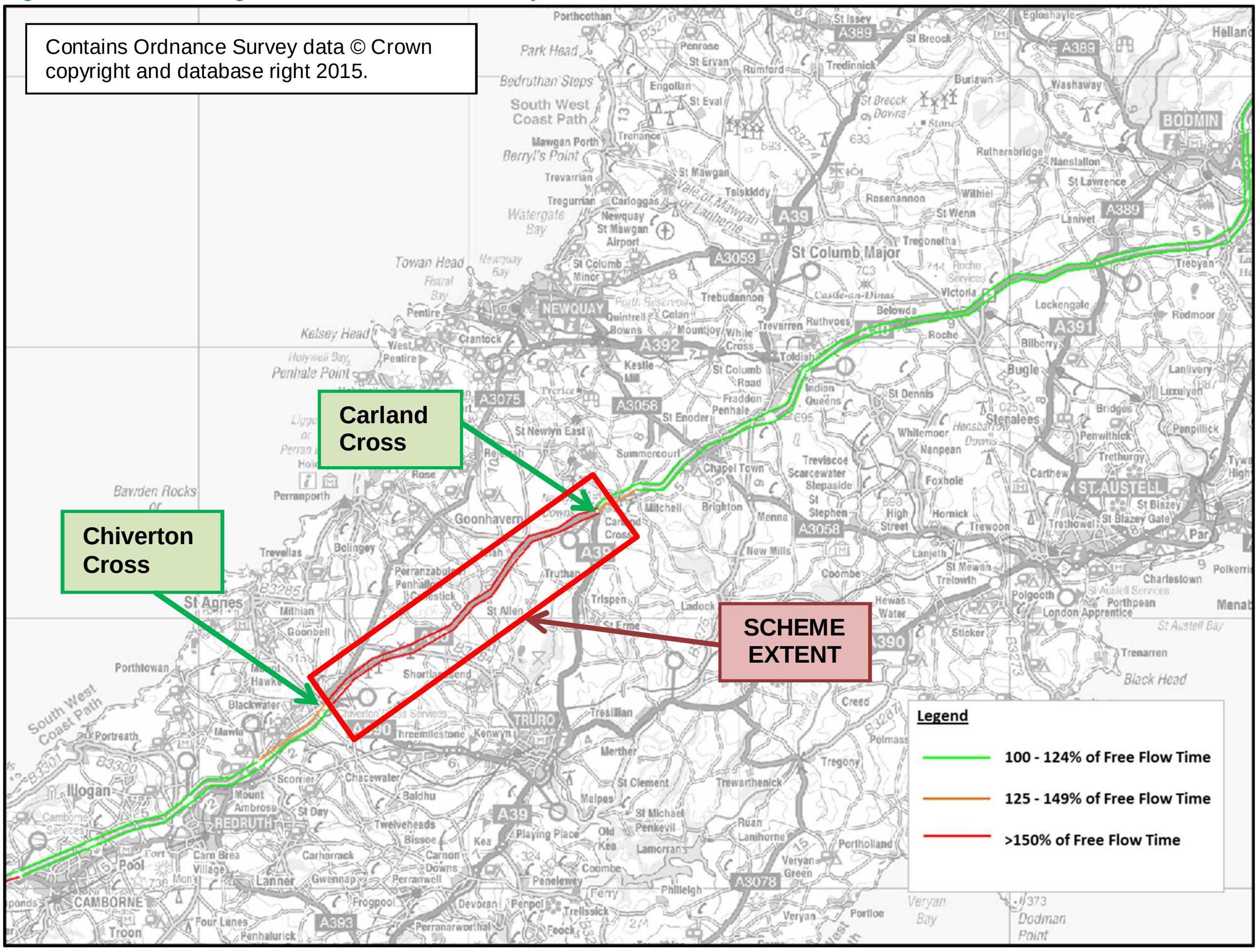


Figure 7-4 : PM Average Peak Hour Period Journey Times in relation to link Free Flow Time



A full breakdown of the journey times for each link are found in Annex C.

Table 7-3 below shows the average speeds along the corridor between Hayle and Bodmin. The analysis shows the corridor exhibits an average speed of approximately 101kph (or 63mph) which is below the 70mph speed limit in operation for the majority of the route. This suggests that the single carriageway sections of the A30 between Carland Cross and Chiverton and between Camborne and Hayle are suppressing the average speed. There is a lower speed limit for the single carriageway section (60mph or 96kph). The table below shows that average speeds on the A30 between Chiverton Cross roundabout and Carland Cross Roundabout are significantly below this.

Table 7-3 : Average Journey Time Speeds

Site	Location	Link Length (km)	Average Speeds (kph)		
			Neutral Weekday AM Peak	Neutral Weekday Interpeak	Neutral Weekday PM Peak
AL784	A30 Westbound (A3047 Camborne to A3074 Hayle)	***10.88***	83	77	73
AL801	A30 Eastbound (A39 Carland Cross Rbt to A3076 Newquay Junction)	***1.78***	93	93	95
AL802	A30 Westbound (A3076 Mitchell to A39 Carland Cross Rbt)	***1.72***	91	96	95
AL1907	A30 Eastbound (A3058 Chapel Town to A3058 Summercourt)	***1.9***	108	107	111
AL1908	A30 Westbound (A3058 Summercourt to A3058 Chapel Town)	***1.86***	110	107	114
AL1909	A30 Eastbound (A3076 Mitchell to A3058 Chapel Town)	***2.24***	107	108	111
AL1910	A30 Westbound (A3058 Chapel Town to A3076 Mitchell)	***2.26***	109	108	112
AL1911	A30 Westbound (A390 Chiverton Cross Rbt to A3047 Scorrier)	***3.68***	99	97	100
AL1912	A30 Eastbound (A3047 Scorrier to A390 Chiverton Cross Rbt)	***3.6***	93	94	91
AL1913	A30 Eastbound (A3047 Camborne to A3047 Scorrier)	***9.9***	108	108	113
AL1914	A30 Westbound (A3047 Scorrier to A3047 Camborne)	***9.9***	112	109	110
AL1918	A30 Eastbound (A38 Bodmin to A30 Entry Slip Bodmin)	***2.76***	110	99	113
AL1919	A30 Westbound (A30 Exit Slip Bodmin to A38 Bodmin Junction)	***2.66***	115	114	118
AL2195A	A30 Eastbound (A391 Lanivet Junction to A38 Bodmin)	***6.74***	108	106	112
AL2196A	A30 Westbound (A38 Bodmin Junction to A391 Lanivet Junction)	***6.86***	109	108	111
AL3077	A30 Eastbound (A30 Entry Slip Bodmin to A395 Tregadillett)	***27.46***	107	96	108
AL3083	A30 Eastbound (A3074 Hayle to A3047 Camborne)	***11.08***	90	87	90
AL3084	A30 Westbound (A39 Carland Cross Rbt to A3075 Chiverton Cross Rbt)	***12.64***	62	69	66
AL3085	A30 Eastbound (A3075 Chiverton Cross Rbt to A39 Carland Cross Rbt)	***12.66***	69	70	65
AL3086A	A30 Eastbound (A39 Indian Queens to A391 Lanivet Junction)	***11.92***	110	110	114
AL3087A	A30 Westbound (A391 Lanivet Junction to A39 Indian Queens)	***11.92***	110	110	112
AL3088	A30 Westbound (A39 Indian Queens to A3058 Summercourt)	***4***	108	105	109
AL3089	A30 Eastbound (A3058 Summercourt to A39 Indian Queens)	***3.96***	101	102	106
Average			**101**	**99**	**102**

The following surveys are within the single carriageway section between Carland Cross and Chiverton:

<u>Between Carland Cross and Chiverton</u>

- AL3084
- AL3085

The table below shows the journey time on these routes compared to the free flow journey time.

Table 7-4 : Single Carriageway Journey Time comparison to Free Flow Time

Site	Location	Free Flow Time (s)	Journey Times (s)			Difference from Free Flow Time		
			Neutral Weekday AM Peak	Neutral Weekday Interpeak	Neutral Weekday PM Peak	Neutral Weekday AM Peak	Neutral Weekday Interpeak	Neutral Weekday PM Peak
AL3084	A30 Westbound (Between A39 Carland Cross Rbt and A3075 Chiverton Cross Rbt)	**451**	739	657	690	**64%**	**46%**	**53%**
AL3085	A30 Eastbound (Between A3075 Chiverton Cross Rbt and A39 Carland Cross Rbt)	**454**	656	652	697	**44%**	**44%**	**53%**

These sites show high levels of deviation from the free flow time suggesting that these links experience a high level of congestion. The table shows these links are as much as 64% (AL3084) and 53% (AL3084 and AL3085) higher than the free flow time in the AM and PM peaks respectively.

8. Operational Data

8.1 Network Mapping

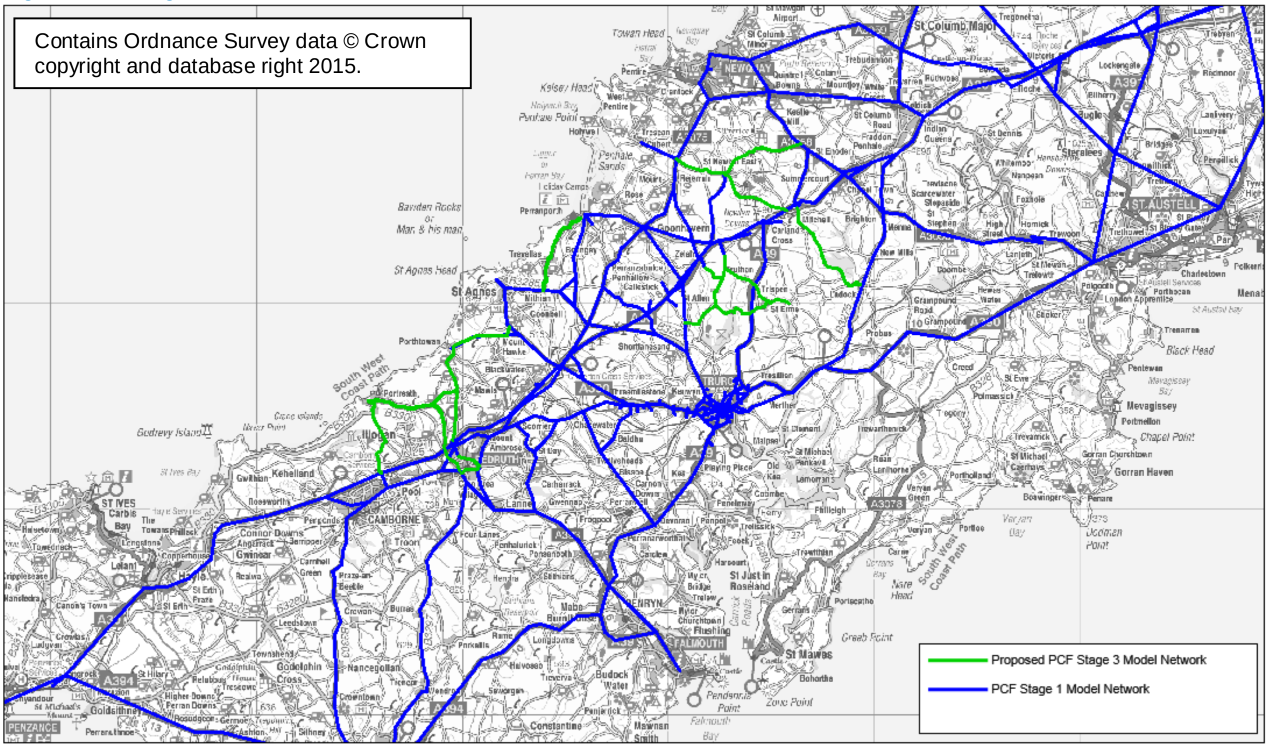
The original 2009 Truro model simulation and buffer networks will both be expanded for the 2015 base year. The simulation network will be expanded to include more detail on and to the north of the A30. This will encourage accurate route choice for trips accessing the A30 from towns to the north. The simulation network will be formed of the following sections:

- A30 between Indian Queens and Redruth
- A3075 between Chiverton Cross Roundabout and Newquay
- The city of Truro
- The key routes around the western side of Redruth
- Minor routes to smaller population centres have been added including routes to Perranporth and St Agnes located north of the A30.

Additional local roads to the south and north of the A30 and in Redruth were added to the Stage 3 simulation network.

Figure 8-1 shows the additional network added to the model.

Figure 8-1 : Original and Additional Network



The buffer network was expanded to include the rest of the UK. This allows realistic modelling of long range trips. The additional UK network consists of the major strategic routes used to access major population centres such as the M4, M6 and M25

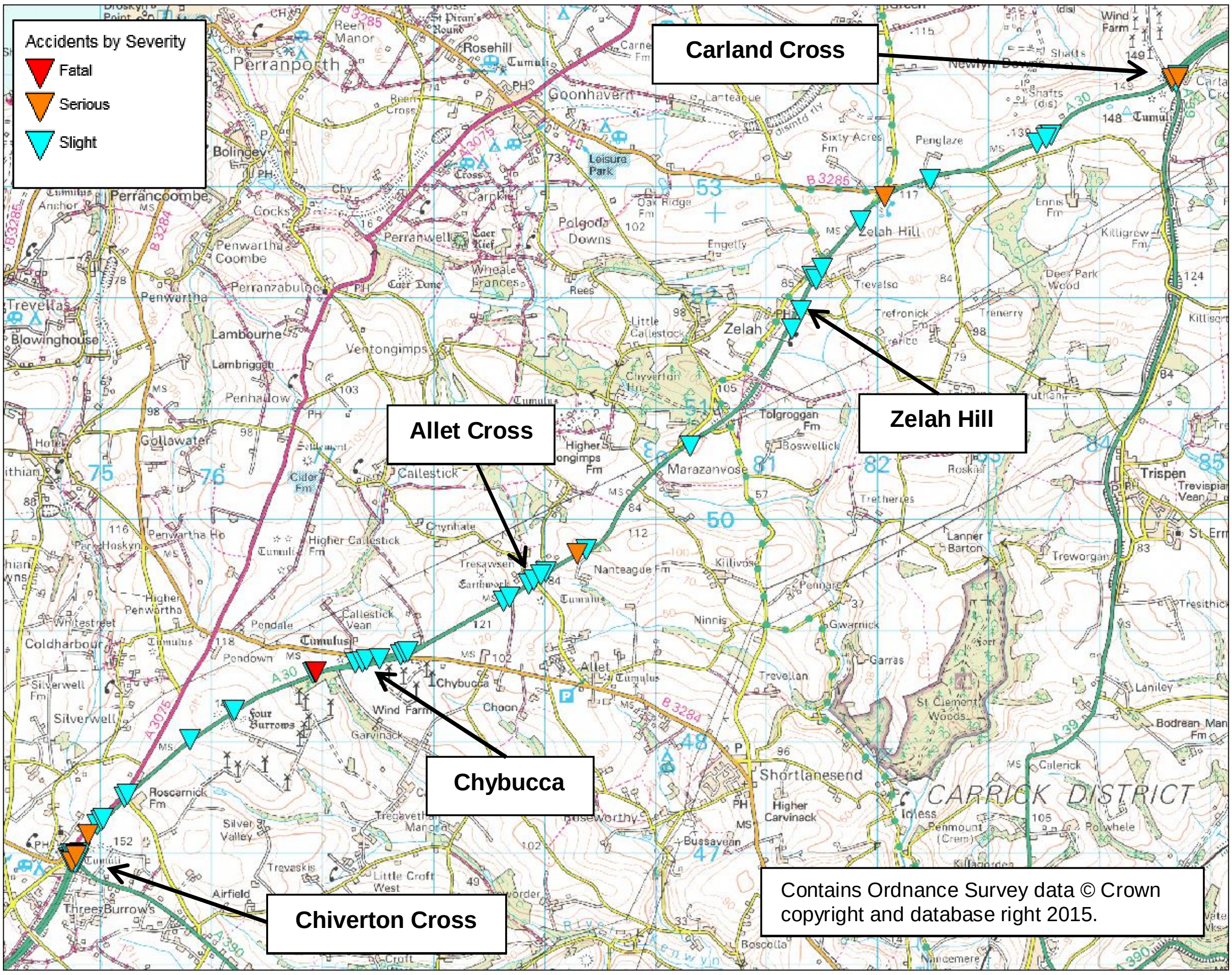
8.2 Geometric and Operation Data

8.2.1 Accident Data

A summary of traffic Personal Injury Accidents (PIA) was provided by Cornwall Council for the A30 between Chiverton and Carland Cross between 01/04/2010 and 31/03/2015. During this time there was a total of 1 Fatal, 9 Serious and 86 Slight accidents.

The figure below shows the location of the Personal Injury Accidents (PIAs) within the study area.

Figure 8-2 : PIA Maps (April 2010 to March 2015)[3]



Accidents were more frequent in the vicinity of Chiverton Cross, Carland Cross, Zelah Hill, Chybucca and Callestick / Allet Cross Junction.

[3] © Crown copyright and database rights 2015, Ordnance Survey, Cornwall Council, Licence No:100049047

Regarding severity, the map does not show a clear distributional pattern of the killed or seriously injured (KSI) collisions. Out of 9 serious collisions, 3 occurred at Chiverton Cross, two at Carland Cross with the remaining four spread along the route. The only registered fatal collision occurred near Chybucca junction.

Table 8-2 shows the breakdown of the accidents by year and severity.

Table 8-1 : Breakdown of PIA by Severity and Year

Year	Fatal	Serious	Slight	Total
2010	0	0	16	***16***
2011	0	1	14	***15***
2012	0	2	17	***19***
2013	1	2	13	***16***
2014	0	3	24	***27***
2015	0	1	2	***3***
Total	**1**	**9**	**86**	**96**

8.2.1.1 Combined Link and Junction Accident Rate

Based on this accident data, the combined link and junction accident rate was calculated using the formula below.

$$A = \frac{P}{(365 \times R \times N \times T \times 10^{-6})}$$

Where: A = Accident rate (PIAs/mvkm*)

P = Number of PIAs recorded between Y1 and Y1+N

R = Link length (km)

N = Number of consecutive years accident data has been collected for

T = Mean annual average daily traffic figure from the first year for which accidents were collected to the final year of accident data (veh/day)

*Million Vehicle Kilometres

A = 0.208 PIAs/mvkm

The accident rate is lower than the national average for an S2 A road type using combined Link/Junction analysis, which according to the TAG data book Summer 2016 v1.6 is 0.244 PIAs/mvkm.

8.2.1.2 Link Only Accident Rate

Accident rates have been calculated for links and junctions within the A30 study area between Chiverton and Carland Cross for input into the COBA-LT assessment that will be undertaken to monetise accident savings as part of the economical appraisal.

Table 8-2 shows the local accident rates calculated for the three main sections of the A30 through the study area. These will form the local accident rates used in the COBA-LT analysis and include collisions that did not occur at or within 20m of one of the key junctions.

Table 8-2: Link Accident rates (PIAs/mvkm)

Section	Direction	Accident Rate (PIAs/mvkm)	National Average (TAG Databook Summer 2016)
Chiverton to Chybucca	***EB***	0.10	**0.143**
	WB	0.13	
Between Chybucca	***EB***	0.00	
	WB	0.20	
Chybucca to Carland	***EB***	0.11	
	WB	0.09	

All but one section of the route is below the national average rate for link based collisions for an S2 A road type. The westbound section between the two Chybucca junctions is the only section in which a higher rate is observed.

8.2.1.3 Junction Only Accident Rate

Local accident rates have also been calculated for the key junctions within the study area. These rates include collisions that occur at or within 20m of one of the key junctions. These rates are outlined in Table 8-3. Given the distance between the two priority junctions at Chybucca, these have been calculated separately from one another with the link in between entered into the combined link and junction assessment. The rates in the table have been calculated using the average number of accidents per year over a five year period to remove any bias that could be present if there were a large number of collisions in a single year.

Table 8-3: Junction Accident Rates

Junction	Type	Accident Rate	National Average (TAG Databook Summer 2016)
Carland Cross	***Standard Roundabout***	0.042	**0.033**
Chiverton Cross	***Standard Roundabout***	0.034	**0.019**
Chybucca (West)	***Priority with single lane dualling***	0.107	**0.195**
Chybucca (East)	***Priority with single lane dualling***	0.080	**0.195**

The table shows that both Chybucca junctions have a lower accident rate than the national average for a priority with single lane dualling type junction. Carland and Chiverton are both shown to have an accident rate higher than the national average. Chiverton in particular, shows a large volume of accidents with 39 PIAs occurring at or within 20m of the junction between 2010 and 2014.

The junction accident rates will be used as inputs for the COBA-LT analysis and will be used instead of the default values for the four junctions outlined in the table.

8.3 Data Quality and Risk Mitigation

The data is considered of adequate quality for the Stage 3 modelling. Checks have been conducted to ensure the mapping used is up to date.

9. Suitability of Accumulated Database

9.1 Data Organisation

The traffic data has been summarised in a series of Excel spreadsheets. These spreadsheets can be supplied on request.

9.2 Summary of Data Collection

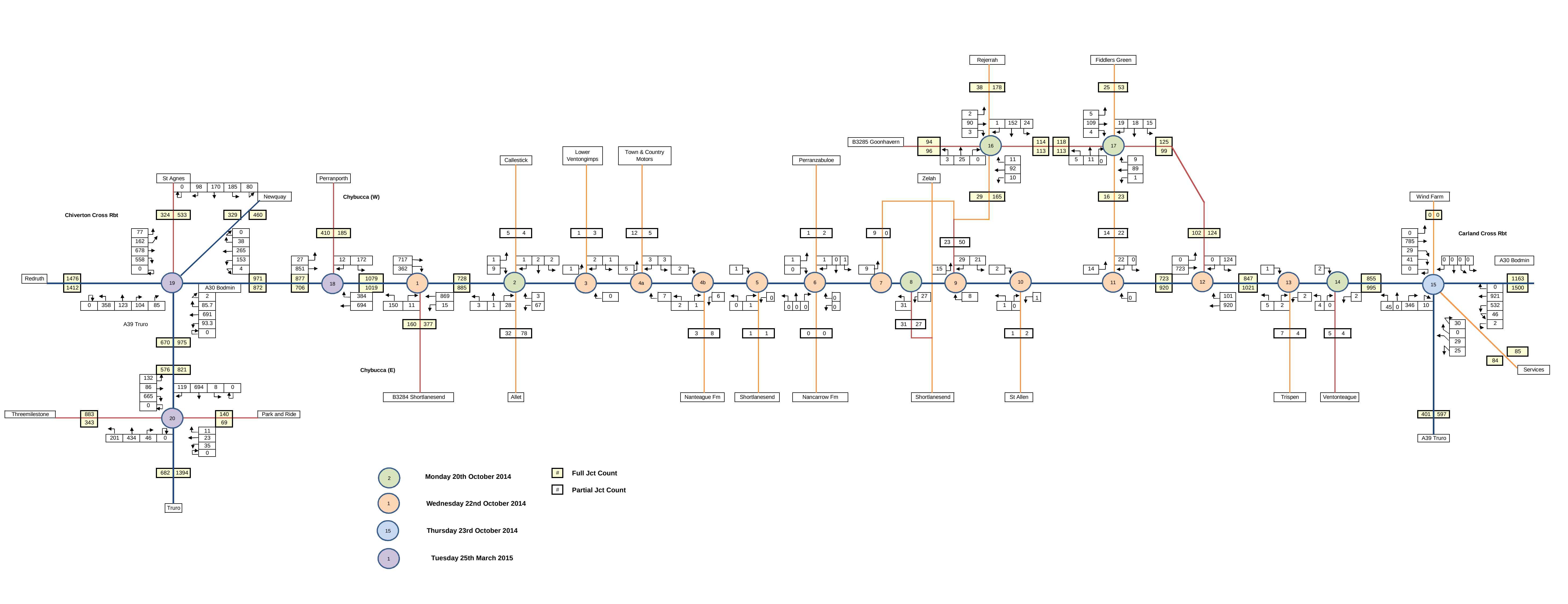
Data has been collected from a range of sources including:

- MCC data from local Cornwall Council sources;
- ATC data from both TRADS and Cornwall Council sources;
- Journey Time Data from TRADS HATRIS database and Cornwall Council sources;
- Origin/Destination data in the form of Roadside Interviews conducted in October 2015 specifically for the PCF Stage 1 modelling of this scheme and suitable for inclusion in the PCF Stage 3 appraisal;
- Accident data;
- Queue length data;
- OS mapping;
- An existing Saturn model of the Truro area providing the basis for the PCF Stage 3 model network and matrices; and
- Mobile Phone matrices from Highways England's South West Regional Model

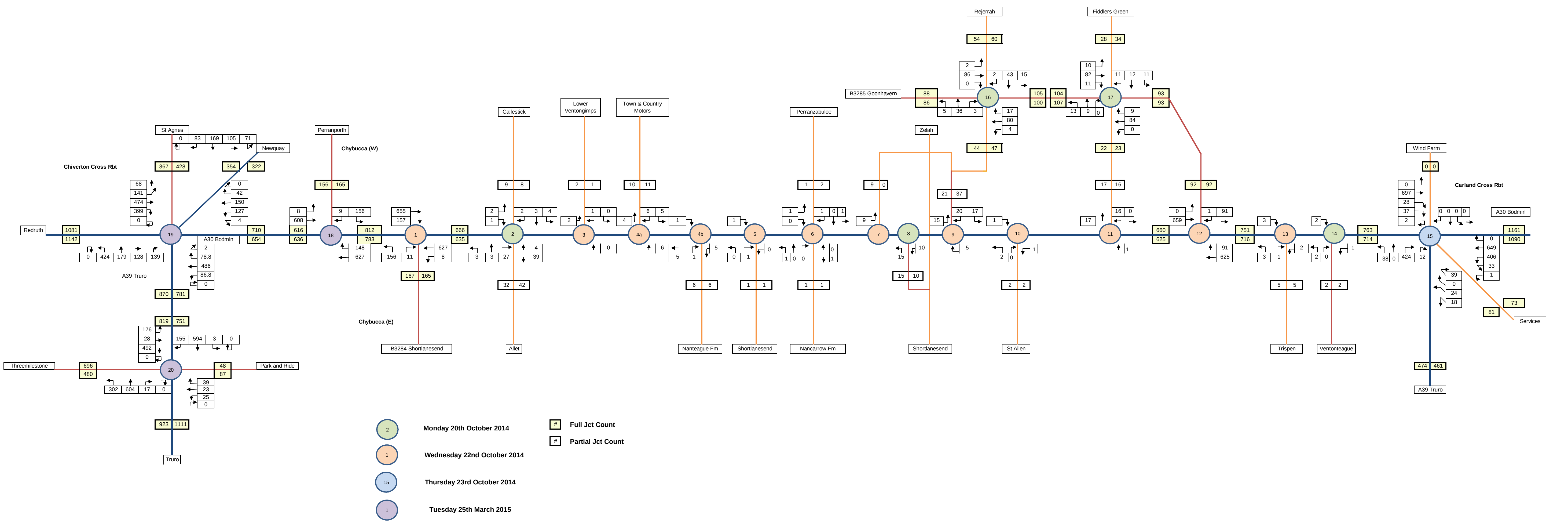
The list above shows a thorough and diverse range of sources. Having reviewed and analysed the data collected for this report, it is deemed that the datasets are suitable for the PCF Stage 3 modelling.

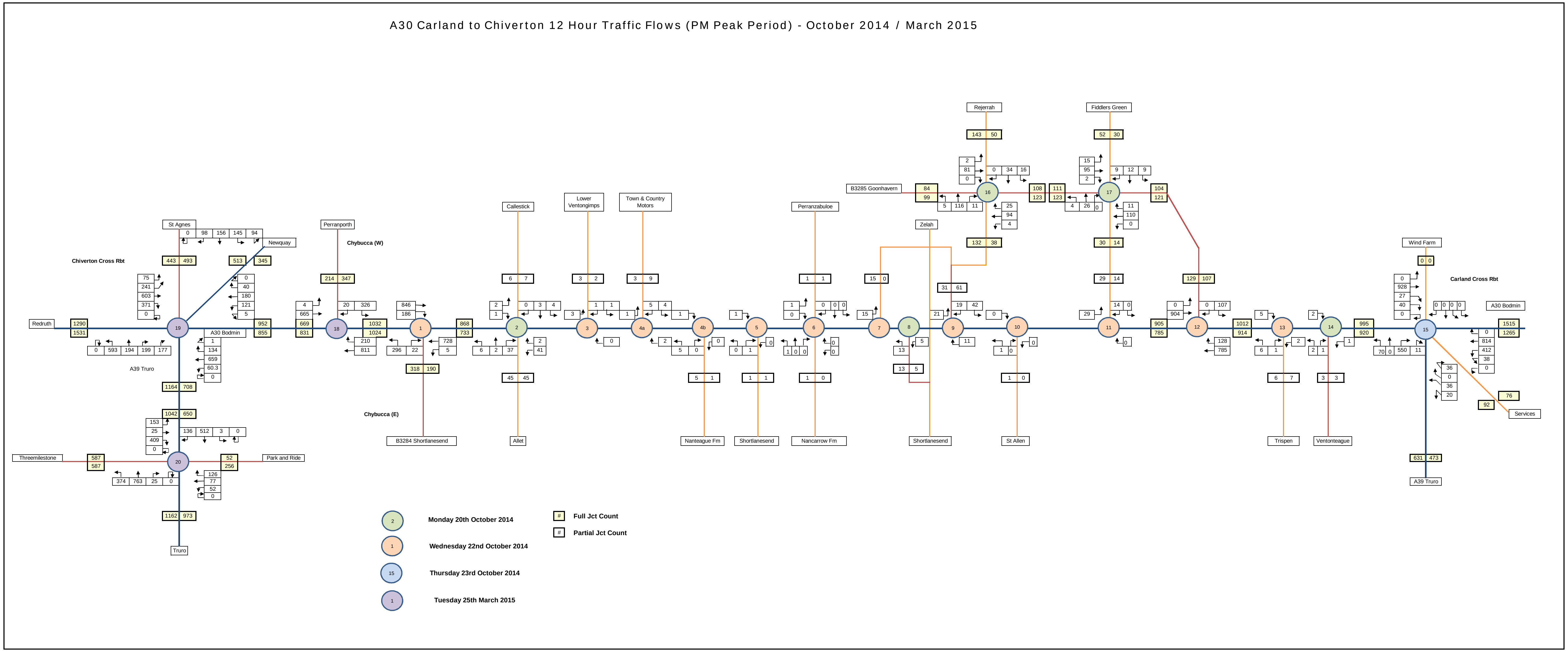
ANNEX A - MCC Flow Diagrams by Peak Period

A30 Carland to Chiverton 12 Hour Traffic Flows (AM Peak Period) - October 2014 / March 2015



A30 Carland to Chiverton 12 Hour Traffic Flows (IP Peak Period) - October 2014 / March 2015





A30 Carland to Chiverton 12 Hour Traffic Flows (PM Peak Period) - October 2014 / March 2015
Chiverton Cross Rbt
Carland Cross Rbt
Redruth
St Agnes
Newquay
A30 Bodmin
A39 Truro
Threemilestone
Park and Ride
Truro
Perranporth
Chybucca (W)
Chybucca (E)
B3284 Shortlanesend
Callestick
Allet
Lower Ventongimps
Town & Country Motors
Nanteague Fm
Shortlanesend
Perranzabuloe
Nancarrow Fm
B3285 Goonhavern
Rejerrah
Zelah
St Allen
Fiddlers Green
Trispen
Ventonteague
Wind Farm
Services
Monday 20th October 2014
Wednesday 22nd October 2014
Thursday 23rd October 2014
Tuesday 25th March 2015
Full Jct Count
Partial Jct Count

ANNEX B - RSI Site Sample Rates by Vehicle Type

Site	Direction	Vehicle Type	Peak Period	Total RSI Trips	Ave Period ATC Trips	Sample Rate
C1	**Interview Direction**	***Car***	**AM**	122	2491	**5%**
			IP	366	4098	**9%**
			PM	219	2660	**8%**
		LGV	**AM**	37	289	**13%**
			IP	73	489	**15%**
			PM	23	184	**13%**
		HGV	**AM**	19	93	**20%**
			IP	52	187	**28%**
			PM	3	75	**4%**
	Non-Interview Direction	***Car***	**AM**	12	2682	**0%**
			IP	120	4361	**3%**
			PM	130	2511	**5%**
		LGV	**AM**	4	268	**1%**
			IP	34	524	**6%**
			PM	27	210	**13%**
		HGV	**AM**	0	100	**0%**
			IP	23	180	**13%**
			PM	13	66	**20%**

Site	Direction	Vehicle Type	Peak Period	Total RSI Trips	Ave Period ATC Trips	Sample Rate
C2	Interview Direction	*Car*	AM	34	946	4%
			IP	80	2046	4%
			PM	61	1634	4%
		LGV	AM	4	106	4%
			IP	4	206	2%
			PM	12	89	14%
		HGV	AM	0	16	0%
			IP	1	23	4%
			PM	0	7	0%
	Non-Interview Direction	*Car*	AM	18	1124	2%
			IP	61	1976	3%
			PM	50	1084	5%
		LGV	AM	3	110	3%
			IP	6	197	3%
			PM	4	72	6%
		HGV	AM	0	15	0%
			IP	1	28	4%
			PM	1	9	20%

Site	Direction	Vehicle Type	Peak Period	Total RSI Trips	Ave Period ATC Trips	Sample Rate
C3	**Interview Direction**	***Car***	**AM**	200	1698	**12%**
			IP	363	4591	**8%**
			PM	163	3085	**5%**
		LGV	**AM**	25	181	**14%**
			IP	43	402	**11%**
			PM	1	146	**1%**
		HGV	**AM**	5	28	**18%**
			IP	7	77	**9%**
			PM	0	42	**0%**
	Non-Interview Direction	***Car***	**AM**	164	2647	**6%**
			IP	231	4372	**5%**
			PM	144	1874	**8%**
		LGV	**AM**	6	174	**3%**
			IP	21	342	**6%**
			PM	17	113	**15%**
		HGV	**AM**	1	54	**2%**
			IP	5	76	**7%**
			PM	2	20	**10%**

Site	Direction	Vehicle Type	Peak Period	Total RSI Trips	Ave Period ATC Trips	Sample Rate
C4	Interview Direction	*Car*	AM	228	916	25%
			IP	302	1105	27%
			PM	137	479	29%
		LGV	AM	30	99	30%
			IP	33	142	23%
			PM	16	45	36%
		HGV	AM	4	4	100%
			IP	12	9	138%
			PM	1	2	41%
	Non-Interview Direction	*Car*	AM	16	374	4%
			IP	134	1212	11%
			PM	137	988	14%
		LGV	AM	1	47	2%
			IP	13	124	10%
			PM	15	67	23%
		HGV	AM	1	2	54%
			IP	3	5	62%
			PM	1	3	29%

Site	Direction	Vehicle Type	Peak Period	Total RSI Trips	Ave Period ATC Trips	Sample Rate
C5	Interview Direction	*Car*	AM	106	334	32%
			IP	199	516	39%
			PM	82	339	24%
		LGV	AM	14	35	40%
			IP	26	71	37%
			PM	18	24	75%
		HGV	AM	0	7	0%
			IP	3	15	20%
			PM	0	5	0%
	Non-Interview Direction	*Car*	AM	2	329	1%
			IP	52	546	10%
			PM	73	388	19%
		LGV	AM	0	41	0%
			IP	6	75	8%
			PM	14	32	44%
		HGV	AM	0	9	0%
			IP	1	14	7%
			PM	0	8	0%

ANNEX C - Journey Time Analysis

Site	Location	Link Length (km)	Free Flow Time (s)	Journey Times (s)			Difference from Free Flow Time		
				Neutral Weekday AM Peak	Neutral Weekday Interpeak	Neutral Weekday PM Peak	Neutral Weekday AM Peak	Neutral Weekday Interpeak	Neutral Weekday PM Peak
AL784	A30 Westbound (A3047 Camborne to A3074 Hayle)	*10.88*	***366***	473	508	537	129%	139%	147%
AL801	A30 Eastbound (A39 Carland Cross Rbt to A3076 Newquay Junction)	*1.78*	***57***	69	69	67	120%	120%	118%
AL802	A30 Westbound (A3076 Mitchell to A39 Carland Cross Rbt)	*1.72*	***52***	68	65	65	130%	125%	125%
AL1907	A30 Eastbound (A3058 Chapel Town to A3058 Summercourt)	*1.90*	***52***	63	64	62	122%	123%	119%
AL1908	A30 Westbound (A3058 Summercourt to A3058 Chapel Town)	*1.86*	***49***	61	62	59	124%	127%	119%
AL1909	A30 Eastbound (A3076 Mitchell to A3058 Chapel Town)	*2.24*	***61***	75	75	73	123%	123%	119%
AL1910	A30 Westbound (A3058 Chapel Town to A3076 Mitchell)	*2.26*	***60***	75	75	72	125%	125%	121%
AL1911	A30 Westbound (A390 Chiverton Cross Rbt to A3047 Scorrier)	*3.68*	***110***	133	136	132	121%	124%	120%
AL1912	A30 Eastbound (A3047 Scorrier to A390 Chiverton Cross Rbt)	*3.60*	***107***	139	138	142	130%	128%	132%
AL1913	A30 Eastbound (A3047 Camborne to A3047 Scorrier)	*9.90*	***275***	330	331	316	120%	120%	115%
AL1914	A30 Westbound (A3047 Scorrier to A3047 Camborne)	*9.90*	***269***	320	326	324	119%	121%	120%
AL1918	A30 Eastbound (A38 Bodmin to A30 Entry Slip Bodmin)	*2.76*	***75***	90	100	88	120%	134%	117%
AL1919	A30 Westbound (A30 Exit Slip Bodmin to A38 Bodmin Junction)	*2.66*	***68***	83	84	81	122%	124%	120%
AL2195A	A30 Eastbound (A391 Lanivet Junction to A38 Bodmin)	*6.74*	***182***	224	228	217	123%	125%	119%
AL2196A	A30 Westbound (A38 Bodmin Junction to A391 Lanivet Junction)	*6.86*	***184***	226	228	223	123%	124%	121%
AL3077	A30 Eastbound (A30 Entry Slip Bodmin to A395 Tregadillett)	*27.46*	***789***	926	1029	913	117%	130%	116%
AL3083	A30 Eastbound (A3074 Hayle to A3047 Camborne)	*11.08*	***369***	445	456	445	120%	124%	121%
AL3084	A30 Westbound (A39 Carland Cross Rbt to A3075 Chiverton Cross Rbt)	*12.64*	***451***	739	657	690	164%	146%	153%
AL3085	A30 Eastbound (A3075 Chiverton Cross Rbt to A39 Carland Cross Rbt)	*12.66*	***454***	656	652	697	144%	144%	153%
AL3086A	A30 Eastbound (A39 Indian Queens to A391 Lanivet Junction)	*11.92*	***320***	390	392	377	122%	122%	118%
AL3087A	A30 Westbound (A391 Lanivet Junction to A39 Indian Queens)	*11.92*	***317***	389	390	381	122%	123%	120%
AL3088	A30 Westbound (A39 Indian Queens to A3058 Summercourt)	*4.00*	***108***	133	137	132	123%	126%	122%
AL3089	A30 Eastbound (A3058 Summercourt to A39 Indian Queens)	*3.96*	***114***	141	140	135	124%	123%	118%

APPENDIX 1 - TRURO MODEL LMVR

Truro Sustainable Transport Strategy

Local Model Validation Report

Cornwall Council

March 2012

PARSONS BRINCKERHOFF

Truro Sustainable Transport Strategy

Local Model Validation Report

Report Number: WHV285300DK/3/3

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1 INTRODUCTION

1.1 Background

1.1.1 Parsons Brinckerhoff (PB) has been commissioned by Cornwall Council to develop a transportation strategy for Truro. As part of the development of the strategy the existing traffic model of Truro and surrounding area has been updated in order to make it suitable to assess future development scenarios, highway improvement options and mitigation measures.

1.1.2 The existing Truro Transport Model was originally prepared as a SATURN model by Mott MacDonald in 2003, and updated to its current form by Mouchel in 2005. The model was built using data from six Roadside Interview sites on each of the major routes into Truro. This roadside interview data remained as the basis for demand in the model during the 2005 update. At this time the updated model was calibrated and validated to DMRB guidelines and used to produce forecasts of traffic flow which were used in the appraisal of the Truro Local Distributor Road major scheme (TLDR). The model forecasts and scheme appraisal were used to provide key information for the Major Scheme Business Case for the TLDR which was submitted to the DfT in 2006.

1.1.3 The 2005 traffic model was due to be updated again by Mouchel in 2009 / 2010 in order to re-evaluate the TLDR scheme and re-submit an updated Major Scheme Business Case to the DfT. The second update included revisions to the base year trip matrices using origin-destination data collected in 2009 at 2 roadside interview (RSI) sites and the recently opened Park and Ride site at Langarth Farm. All unobserved movements were retained from the original matrix (and hence the update should not be considered a full matrix rebuild). The collection of new data and update of the model were required in order to address concerns from the DfT regarding the age of the data used in the previous model.

1.1.4 The second update of the model was not completed by Mouchel, however work on incorporating new survey data into the existing trip matrices was completed and handed over to PB, along with the existing model network. PB has used these components to complete the update of the model to a base year of 2009.

1.1.5 This report summarises the updates made to the traffic model and the techniques used to calibrate the model to a base year of 2009. It also demonstrates that the base traffic model has an acceptable level of validation and provides a sufficiently robust representation of the operation of the highway network in Truro in order to be used to assess future development in Truro and to model the impact of the proposed transportation strategy in a future year.

1.2 Report Structure

1.2.1 Following this introductory section, this report is set out as follows:

- **Section 2** provides an overview of the key aspects of the updated model.
- **Section 3** details the data that has been used to update, calibrate and validate the model.
- **Section 4** details the key updates that have been made to the model network, including links, junctions and centroid connectors.
- **Section 5** details changes that have been made to the zone system.

- **Section 6** describes the calibration and validation process and details how matrix calibration has been undertaken.
- **Section 7** outlines the methodology that has been used to validate the model and summarises validation requirements.
- **Section 8** demonstrates that the model assignments reach a satisfactory level of convergence.
- **Section 9** presents validation results and identifies strengths and weaknesses in the validated model.
- **Section 10** discusses wider issues in the model which remain after validation and may be useful for consideration if the model is updated in the future.
- **Section 11** provides a summary of this LMVR and the key conclusions.

2 MODEL OVERVIEW

2.1 Model Format

2.1.1 The Truro model is a SATURN model, prepared using release 10.9.24.

2.2 Study Area

2.2.1 The Truro model encompasses a large area which incorporates the whole of Cornwall. This wide modelled area includes all the primary and strategic routes in Cornwall, and has been inherited from the existing version of the model.

2.2.2 Much of the modelled area is not detailed: the highway network across this broad area is coded as buffer-type links, and includes no simulation-type coding of junctions.

2.2.3 The area of primary interest for the Truro Sustainable Transport Strategy is that which includes the road network within the urban area of Truro, the A390 corridor between Truro and Threemilestone, and the main routes into Truro (A390, A39 and B3284). Within this area the model is more detailed, with smaller zones and simulation-type coding of links and junctions.

2.2.4 The extent of the modelled area is shown in Figure 1 along with the boundary of the detailed study area surrounding the Truro urban area.

2.2.5 The model network is shown in Figures 2a and 2b.

2.3 Zone System

2.3.1 The existing model contains 78 zones. A number of zones have been updated during calibration and validation, and following these updates the zone system in the model has 83 zones.

2.3.2 The zone system is coarse across a majority of the modelled area, but detailed within the Truro urban area. Figure 3a illustrates the wider zone system and Figure 3b illustrates the detailed zone system within Truro.

2.3.3 The zone system has been updated in a number of locations during recalibration. This is detailed in section 5 of this report.

2.4 Time Periods and Base Year

2.4.1 The model has been calibrated to a base year of 2009 as this is when the latest roadside interviews were carried out.

2.4.2 The model is configured to represent the following time periods which correspond to the peaks from traffic counts:

- AM peak hour - 08:00 to 09:00
- PM peak hour - 17:00 to 18:00

2.5 Trip Purposes and Vehicle Classification

2.5.1 The model has 3 vehicle classifications: Cars, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV).

2.5.2 The model has 3 trip purpose classifications for the car vehicle type: Employers Business, Commute and Other.

2.5.3 These classifications are incorporated into 5 user classes as shown in Table 1 below.

Table 1 User classes in the model

User Class	Trip Purpose	Vehicle Class
1	Employers Business	Car
2	Commute	Car
3	Other	Car
4	All	LGV
5	All	HGV

2.6 Unit of Trips

2.6.1 The trip matrices are specified in Passenger Car Units (PCU).

2.6.2 The PCU factors used are shown in Table 2 below.

Table 2 PCU Factors

Vehicle Class	PCU Factor
Car	1
LGV	1
HGV	2

2.7 Generalised Cost Parameters

2.7.1 Table 3 below shows the generalised cost parameters that are used in the model. These values have been derived from values of time and vehicle operating costs in line with guidance from WebTAG Unit 3.5.6.

Table 3 Generalised cost parameters

User Class	Vehicle Class	AM Peak		PM Peak	
		PPM	PPK	PPM	PPK
1 - Employers Business	Car	1.00	0.37	1.00	0.39
2 - Commute	Car	1.00	0.86	1.00	0.87
3 - Other	Car	1.00	0.66	1.00	0.65
4 - LGV	LGV	1.00	1.09	1.00	1.09
5 - HGV	HGV	1.00	3.66	1.00	3.66

3 TRAFFIC DATA

3.1 Traffic Counts

3.1.1 Traffic count data at a number of locations has been obtained from the Cornwall Council traffic count database and from validation spreadsheets handed over to PB with the model.

3.1.2 Traffic count data has been used as follows:

- For familiarisation with the traffic patterns in the local area
- To calibrate the trip matrix
- To validate the traffic flows in the model

3.1.3 A majority of the traffic count data used to update the model was collected in the base year of 2009; however it was necessary to source traffic count data across the wider period of 2007-2010 in order to provide appropriate coverage of count data.

3.1.4 Table 4 below lists all traffic counts used for calibration and validation. The location of each of these traffic counts is illustrated on Figures 4a to 4d. A number of other traffic counts were collected and reviewed to gain an understanding of traffic patterns in the network, but were not formally used to calibrate or validate the model.

Table 4 Traffic Count Data used for Calibration and Validation

Ref	Location	Date	Type	Source	Use
A390					
RSI 1	A390 at Threemilestone	Sep-03	Link Count	MO	V/C
RSI 4	A390 at Tresillian	Sep-03	Link Count	MO	V/C
RSI 6	A390 at Highertown	Sep-09	Link Count	MO	V/C
N132	A390 adjacent to Chiverton Cross	Oct-08	Link Count	CC	C
A30					
P123	Chiverton Cross Roundabout	Mar-09	Turning Count	CC	V
P125	Chybucca Crossroads (west)	Mar-09	Turning Count	CC	V
P126	Chybucca Crossroads (east)	Mar-09	Turning Count	CC	V/PC
Q350	Zelah Hill Junction	Oct-10	Turning Count	CC	PC
Truro Urban Area					
N372	Infirmary Hill/City Road	Jun-08	Turning Count	CC	C
N161	Chapel Hill/City Road	Jun-08	Turning Count	CC	C
N371	Richmond Hill/George Street	Jun-08	Turning Count	CC	C
N388	Tregolls Road/Trevithick Road	Sep-08	Turning Count	CC	PC
N416	Union Hill	Sep-08	Turning Count	CC	V/PC
N417	Fairmantle Street Roundabout	Sep-08	Turning Count	CC	V/PC
L181	Mitchell Hill Signals	Apr-06	Turning Count	CC	PC
P250	Treliske Roundabout	Jun-09	Turning Count	CC	V/PC
P234	Bodmin Road Roundabout	Jun-09	Turning Count	CC	PC
P229	Pydar Street Roundabout	Jun-09	Turning Count	CC	C
P380	Arch Hill Double-Mini Roundabout	Oct-09	Turning Count	CC	V/PC
P371	Dalvenie Roundabout	Nov-09	Turning Count	CC	V/C
P372	Maiden Green Roundabout	Nov-09	Turning Count	CC	V/C
P373	Newbridge Ln Roundabout	Nov-09	Turning Count	CC	PC
P368	Chapel Hill	Nov-09	Link Count	CC	C
P370	St. Georges Rd	Nov-09	Link Count	CC	C
MO03	Moresk Road	Unknown	Link Count	MO	C
MO05	Bodmin Road	Unknown	Link Count	MO	C
MO08	Dalvenie Roundabout Link (one-way)	Unknown	Link Count	MO	V
X001	Station Road	Unknown	Link Count	MO	C

Ref	Location	Date	Type	Source	Use
X003	St Austell Street	Unknown	Link Count	MO	C
MO20	Trelander Highway	Unknown	Link Count	MO	C
MO22	St Clements Hill	Unknown	Link Count	MO	C
L464	Castle Street/River Street	Nov-06	Turning Count	CC	C
MO12	Moresk Road	Unknown	Link Count	MO	C
L277i	Tregurra Lane/Bodmin Road	Jun-06	Turning Count	CC	C
M385	Kenwyn Road/Trehaverne Place	Oct-07	Turning Count	CC	PC
Outside Truro Urban Area					
Q349	Pencalenick Junction	Oct-10	Turning Count	CC	PC
Q170	Langarth P&R (western access gate)	Feb-10	Link Count	CC	PC
RSI 2	B3284 at Shortlanesend	Sep-03	Link Count	MO	V/C
RSI 3	A39 at Trispen	Sep-03	Link Count	MO	V/C
RSI 5	A39 at Carnon Downs	Sep-09	Link Count	MO	V/C
M470	Fore Street, Chacewater	Nov-07	Link Count	CC	C
N300	A3075 Pendown Cross	Jun-08	Turning Count	CC	PC
P124	Threemilestone Roundabout	Mar-09	Turning Count	CC	V/PC
Q172	Chyvelah Mini-Roundabout	Feb-10	Turning Count	CC	V/C
Q173	Link from A390 to Chyvelah Way	Feb-10	Link Count	CC	C

Notes -
1 - V = Validation, C = Calibration (all movements), PC = Partial Calibration (some movements)
2 - CC = Cornwall Council Database, MO = Mouchel validation tables

3.1.5 Table 9 in section 6.7 specifies the individual movements at each site that have been used for calibration.

3.1.6 A majority of traffic count data used was manual classified count data. Where vehicle classification was unavailable the vehicle mix was assumed to be similar to that observed at nearby classified sites or from data relating to similar road types within the study area.

3.1.7 The PCU factors outlined previously in section 2.6 (Table 2) were applied to each vehicle classification in order to convert flows to a unit of pcu, compatible with the model trip matrices.

3.2 RSI Data

3.2.1 The RSI data used to build the model trip matrices was made available for use during calibration and validation of the updated model.

3.2.2 The model incorporates RSI data from 6 sites, located on each of the main routes into Truro. The location of these sites is shown in Figure 5.

3.2.3 Sites 1 to 6 were surveyed in 2003 and were used to build the first version of the model. Sites 2 and 6, located on the B3284 near Shortlanesend and the A390 near Highertown respectively, were resurveyed in 2009.

3.3 Park & Ride Data

3.3.1 Data showing origins and destinations of users of the Langarth Park and Ride site was collected by Mouchel during previous work in updating the model and handed over to PB. This data has been used to add Park and Ride trips to the base model. Specifically, the data has been used to derive a sample of the origins of Park and Ride users during the modelled time periods.

3.3.2 A further survey showing traffic flow into and out of the Park and Ride site in March 2011 was provided by Cornwall Council. Data from this survey has been used to expand the sample of Park and Ride trips.

3.4 Journey Time Data

3.4.1 Journey time data was included in the package of information handed over to PB. This data was collected via moving observer survey during November 2009.

3.4.2 Journey time survey data has been used to validate assigned journey times along the A390 corridor and on the eastbound approach to the Union Hill traffic signal junction.

4 NETWORK UPDATES

4.1 Updates to Model Network

4.1.1 A detailed review of the existing model network has been undertaken in order to identify issues and changes considered improve the model.

4.1.2 The following checks have been undertaken:

- Suitability of model parameters
- SATNET warnings and errors
- Application of speed flow curves within the detailed model area
- Excessive or unusual link speeds
- Link coding (e.g. speed, distance) which differed in opposite directions
- Coding of key junctions within detailed model area

4.1.3 The following checks have not been undertaken because data or information was not available for comparison with the coding in the model:

- Review of traffic signal staging and timings
- Detailed check of suitability of coded link speeds
- Detailed check of coded link lengths
- Network coding outside detailed model area

4.1.4 Following the review of the network a number of updates have been made to the network as follows:

- New links/junctions -
    - Some additional links and junctions have been added to the model to improve the representation of the highway network in Truro.
- Centroid connectors -
    - Changes have been made to how some of the zones are connected to the network to better represent loading of traffic.
- Increased level of detail at links/junctions -
    - Some existing links and junctions have been recoded with a higher level of detail.
- Amendments to existing network -
    - Some existing links and junctions have been amended to rectify errors or reset previous calibration adjustments.
- Speed-flow curves -
    - Some of the links in the simulation area have been coded with speed flow curves in order to represent an appropriate link capacity for the standard of road.

4.1.5 The key changes made to the network are detailed in the sections below. Minor network adjustments made during calibration are not reported here.

4.2 New Links and Junctions

4.2.1 Table 5 below lists the new links and junctions that have been added to the model to enhance the level of detail and add some key routes. The locations of these new links and junctions are shown on Figures 6a to 6d.

Table 5 Links and junctions added to model

Ref No.	Link or Junction Added	Reason Added
1.	Route between A390 west of Tresillian and St Clements Hill via Trelander	The route was identified as a rat-run for inbound traffic during AM peak period.
2.	Route between Threemilestone and A39 near Playing Place	The link represents the minor rural links which connect small villages south of Truro and provide a route between the A39 and A390. It has been added to provide additional route choices for north/south trips to/from the A390 west of Truro.
3.	Main roads through Redruth, Pool and Camborne	To provide additional route choices for trips between Redruth/Pool/Camborne and Truro.
4.	B3303 and B3297 routes between the A394 near Helston to Camborne and Redruth	To provide additional route choices for trips to/from the south of the model.
5.	A391 and B3274 routes between St Austell and A30	These routes were missing from the existing model and causing traffic to travel through Truro to access Newquay, St Austell or the A30.
6.	Access from A390 to Langarth Park and Ride	This secondary access enables traffic to enter the Park and Ride site without using Threemilestone Roundabout.
7.	Connected Bosvigo Road with Richmond Hill	Link missing from existing model.
8.	Slip Road onto Morlaix Avenue from Newham	Link missing from model and causing high flows through Fairmantle Street Roundabout.
9.	Campfield Hill	To reduce southbound demand through the Mitchell Hill signal junction.
10.	The Crescent between Station Road and Chapel Hill	To enable more realistic connection to zone 14.
11.	Railway Bridge bottleneck on Pydar Street	To reflect narrow road width as requested by Cornwall Council.

4.3 Zone Connectors

4.3.1 Connectors to external zones were updated as follows, the zone plan is shown in Figures 3a and 3b.

- Zone 68 (representing south coast of Cornwall adjacent to Penzance) connected to A394 instead of A30 near St Erth.
- Zone 61 (representing St Ives and Hayle) reconnected to A30 near Hayle.
- Zone 67 (representing area south of Truro including Carnon Downs, Playing Place, Poin and Feock) reconnected to A39 near Carnon Downs instead of A393 near junction with B3298.
- Zone 59 (representing large zone at south of Cornwall including Helston) reconnected to A394 at Helston.

4.3.2 All zone connectors within the internal model area were also reviewed, and in a number of instances were updated to provide a better representation of traffic access to the highway network.

4.3.3 The connection to the zone representing Richard Lander School was moved to Mount Pleasant Lane to reflect the recent relocation of the school.

4.4 Amendments to Existing Network

4.4.1 The following junctions were updated with revised saturation flows, approach lanes, turning allocations, stacking capacities, and gap parameters:

- Threemilestone Roundabout
- Chyvelah Road Mini-Roundabout
- Dalvenie Roundabout
- Arch Hill Double Mini-Roundabouts
- Fairmantle Street Roundabout
- Trafalgar Roundabout
- Union Hill Signals

4.4.2 The following junctions were recoded as multi-node junctions:

- Carland Cross Roundabout (junction of A30 with A39)
- Chiverton Cross (junction of A30 with A390)

4.4.3 The A39 corridor between Carland Cross Roundabout and the Union Hill signal junction was recoded to reflect changes in speed and road type along its length.

4.5 Speed Flow Curves

4.5.1 Speed flow curves were added to a number of key routes through the network in order to limit link capacity and provide a better representation of traffic speed at times of high traffic flow. This was particularly important for the routes into Truro where link capacity is more of an issue

4.5.2 Table 6 below shows speed flow curves which have been added to the model for this purpose. These speed flow curves have been derived from the SATURN manual (chapter 15.9.3).

Table 6 Speed flow curves added to the model

Index	Description	Free Flow Speed (kph)	Speed at Capacity (kph)	One-Way Link Capacity (pcu/hr)	No. Lanes	Power
20	Rural - Dual Carriageway (2 Lane, All Purpose)	105	45	4,360	2	3.7
21	Rural - Single Carriageway (10m width, Good)	91	45	1,860	1	2.2
23	Rural - Single Carriageway (7.3m width, Good)	87	45	1,640	1	2.2
24	Rural - Single Carriageway (7m width, Typical)	78	45	1,380	1	2.1
25	Rural - Single Carriageway (6.5m width, Bad)	67	45	1,010	1	1.8
30	Suburban - Single Carriageway (Typical Development)	61	35	1,270	1	2.3
34	Small Town (90% Development)	47	30	1,300	1	2.5

4.5.3 Speed flow curves have been added to the routes shown in Table 7 below.

Table 7 Routes coded with speed flow curves

Route	Curve Index
A390 between Treliske Roundabout and Dalvenie Roundabout	34
B3284 between Chybucca Crossroads and Pydar Street	24
A39 from Carland Cross to Bodmin Road	21, 23, 24, 25
A390 from Tresillian to Union Hill	23
A390 from Chiverton to Threemilestone Roundabout	24
Morlaix Avenue	20
A39 from Falmouth to Calenick/Arch Hill	23
A30 from Hayle to Bodmin	20, 23
A393 from Redruth to Four Cross	24, 30
A3047 through Redruth and Camborne	24, 34
B3303 and B3297 from Helston to Camborne/Redruth	25
A3075 from Chiverton Cross Roundabout to Newquay	23, 25
A3058 from St Austell to A30	24
A391 from St Austell to A30	23
B3274 from St Austell to A30	25

5 ZONE SYSTEM UPDATES

5.1 Internal Zones

5.1.1 A review of the internal model zone system has been undertaken in order to identify the suitability and size of model zones. The internal zone structure was considered to be generally suitable for the level of detail modelled within the Truro urban area. Zones 20 and 44 were identified as zones which would be best split into smaller zones to facilitate loading of traffic onto the network and aid routing into Truro. The zones are shown in Figure 3b.

Split of Zone 20 – Around the A390, south of Dalvenie Roundabout

5.1.2 Zone 20 was split into 2 zones (20 and 82) to enable County Hall and the Sainsburys supermarket to be loaded correctly to their respective arms at Dalvenie Roundabout. Splitting this zone would also enable the new zones to be accurately calibrated using traffic count data. Figure 7 illustrates the boundaries of the new zones created.

5.1.3 An initial estimate of trips to each of the new zones 20 and 82 was made using the existing breakdown of trips by purpose to the parent zone. The trips associated with the trip purposes ‘employers business’ and ‘commute’ were assigned to Zone 20 as it is anticipated that the County Hall zone will primarily generate trips of this type during the peak periods. Trips with other purposes were assigned to the supermarket zone.

Split of Zone 44 – Gloweth and Treliske, south of the A390

5.1.4 Zone 44 was split into 2 zones (44 and 83) in order to separate the residential areas of Gloweth and Newbridge and to enable these areas to correctly loaded onto the A390. Splitting this zone would also enable the new zones to be accurately calibrated using traffic count data. Figure 8 illustrates the boundaries of the new zones created.

5.1.5 Trips to new zones 44 and 83 were split using two-way traffic flows observed on the links into each of the new zones (Newbridge Lane and Chyvelah Vale).

Split of Zone 72 - Threemilestone

5.1.6 Zone 72 was split into 2 zones (72 and 56) in order to separate the Threemilestone settlement and Threemilestone Industrial Estate and enable these areas to be loaded correctly to their respective arms at the Chyvelah mini-roundabout. This was a necessary step in order to achieve good turning flow validation at the roundabout. Figure 9 illustrates the boundaries of the new zones created.

5.1.7 Existing trips to zone 72 were split as follows:

AM Peak

- Existing trips with destination at zone 72 were allocated to the new industrial estate zone because it was considered that employment land uses would attract a majority of inbound trips during the AM peak period.
- Existing trips with origin at zone 72 were allocated to the new residential zone because it was considered that residential land uses would produce a majority of outbound trips during the AM peak period.

PM Peak

- Existing trips originating at zone 72 were allocated to the new industrial estate zone as origins because it was considered that employment land uses would produce a large number of outbound commute trips during the PM peak period.

- Existing trips with destination at zone 72 were allocated to the new residential zone because it was considered that residential land uses would attract a large number of inbound trips during the PM peak period.

5.2 Split of Existing Zones: External

5.2.1 The external zone structure of the model is coarse and in a number of instances external zones cover very large areas which contain more than one settlement or town. In some cases it has been difficult to select a suitable location to connect external zones to the network, particularly as the location of the zone connection can influence the choice of route taken for trips into and out of Truro.

5.2.2 To avoid reconstruction of the prior trip matrices using observed data it was decided not to extensively redevelop the external zone system with smaller zones. However, it was considered necessary to split external zone 61 into a number of smaller zones to enable a better representation of route choice between the A390, B3284 and Chacewater corridors into Truro as this was of particular relevance to the study area.

5.2.3 Zone 61 is a very large zone which contains St Ives, Hayle, Redruth, Portreath, St Agnes, and Chacewater. This zone has been split into 4 smaller zones (61, 79, 80 and 81) as follows:

- Zone 61 - Area to west of Redruth/Camborne containing St Ives and Hayle
- Zone 79 - Area to west of Truro containing St Agnes
- Zone 80 - Redruth
- Zone 81 - Area to south west of Truro containing Chacewater and other small settlements

5.2.4 Figure 10 illustrates the boundaries of the new zones created.

5.2.5 Existing trips were split between the new zones in accordance with the proportion of origins and destinations in each proposed zone which was observed in the RSI surveys.

5.3 New Zones

5.3.1 Zone 55 is a new zone which has been added to enable the model to load non Park and Ride trips from the surrounding rural area onto the northern arm of Threemilestone roundabout.

6 CALIBRATION AND VALIDATION PROCESS

6.1 Overview

6.1.1 The calibration and validation process that has been adopted is illustrated in the flow chart below (Figure 11).

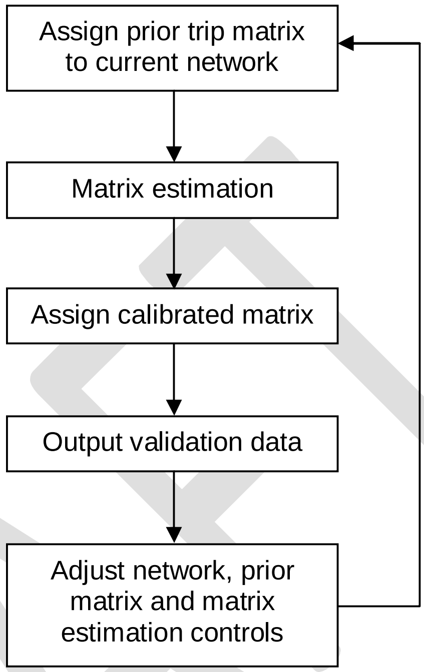


Figure 11 - Calibration and Validation Process

6.2 Matrix Estimation

6.2.1 The prior trip matrix is prepared and assigned to the network, and the resulting assignment is fed into the matrix estimation process which calibrates the trip matrix in line with specified control data. The matrix estimation process iteratively factors the demand matrix (subject to limits set by the control data) until there is satisfactory level of agreement between the assigned flows and the calibration counts. Following matrix estimation the revised trip matrix is reassigned and validation data is output for review. Manual adjustments are made to the network, prior trip matrix and matrix estimation controls in accordance with these outputs, and the process is repeated.

6.2.2 Calibration and validation is therefore an iterative process of running the model, observing its validation and making improvements. Gradually, the level of validation improves and the model becomes increasingly robust.

6.2.3 This section details how each stage of calibration has been undertaken.

6.3 Network Calibration

6.3.1 Network calibration is necessary in the following instances:

- Route choice is incorrect or illogical (due to incorrect times and delays in the assigned network)

- Journey time validation is poor
- Junctions are under or over-saturated

6.3.2 The model network has been gradually calibrated during the process of calibration and validation via adjustment of the following:

- Link speeds
- Link capacities/speed flow curves
- Saturation flow of turning movements at junctions
- Gap acceptance parameter at junctions
- Signal staging and timings

6.4 Matrix Calibration

6.4.1 The trip matrices have been calibrated using the technique of matrix estimation. This process updates unobserved elements in the prior trip matrix using observed traffic flow at key locations in the network. In addition to matrix estimation some manual adjustments have also been made to calibrate the matrix.

6.5 Preparation of Prior Trip Matrices

6.5.1 The prior trip matrices were prepared by Mouchel and handed over to PB. It is understood that the matrix build process was as follows:

1. Construct RSI matrix using ERICA (the DfT matrix building software) to provide internal to external / external to internal / external to external (through Truro) movements.
2. Add initial estimate of Internal to Internal trips using a gravity model.
3. Add A30 through-trips from older model matrices.

6.5.2 A number of further adjustments have been made to the prior matrices by PB for this project as follows:

1 - Add Park and Ride trips
2 - Split zones
3 - Seed zero cells
4 - Remove short distance trips

<u>1 - Add Park and Ride Trips</u>

6.5.3 An origin-destination survey of park and ride users was undertaken by Mouchel. This data was cleaned, coded and expanded into matrix format by Mouchel, and has been added to the prior matrix in order to provide demand to and from the park and ride site.

6.5.4 It was not possible to replace an observed external-to-internal movement for each observed trip to the park and ride site because the prior trip matrix had been prepared using RSI data collected before and after the park and ride side was in operation, and no information was available regarding how this data had been merged. It was therefore decided not to replace trips in the matrix so as to avoid removing valid trips sampled after the park and ride site was in operation.

2 - Split Zones

6.5.5 Demand at the zones to be split was adjusted in accordance with the methodology outlined previously in section 2.3.

3 - Seed Zero Cells

6.5.6 Unobserved zero cells in the prior matrices were seeded to enable the matrix estimation process to have influence over the cell values. Cells with a zero value were seeded with a nominal value of 0.01 trips.

6.5.7 The following movements were not seeded:

- Intra-zonal movements - trips making these movements are not assigned in the model.
- External to internal movements - these movements have been observed.
- All movements with destination at the Park & Ride site (AM peak only) - these movements have been observed.
- All movements with origin at the Park & Ride site (PM peak only) - these movements have been observed.

6.5.8 Table 8 below shows the total number of new trips that were added to the prior matrices due to seeding. This table demonstrates that the seeding process did not add a significant number of additional trips to the prior matrix.

Table 8 New trips added during seeding

	AM Peak	PM Peak
Number of zones	83	
Number of cells	6,889	
Number of trips prior to seeding	19,026	19,610
Seed value	0.01	
Number of new trips due to seeding	72	69
% increase in trips due to seeding	+0.38%	+0.35%

4 - Remove Short Distance Trips

6.5.9 Trips were removed from the matrices for OD pairs less than 500 metres apart. It was considered unlikely that vehicle trips would be made for trips of this length, and it was also desirable to minimise the number of short distance trips added to the matrix during matrix estimation. Distances between model zones were taken as the straight line distance between the centroid of each zone.

6.6 Matrix Estimation Process

6.6.1 A batch file driven process was established to run the matrix estimation process, as illustrated by Figure 12 below.

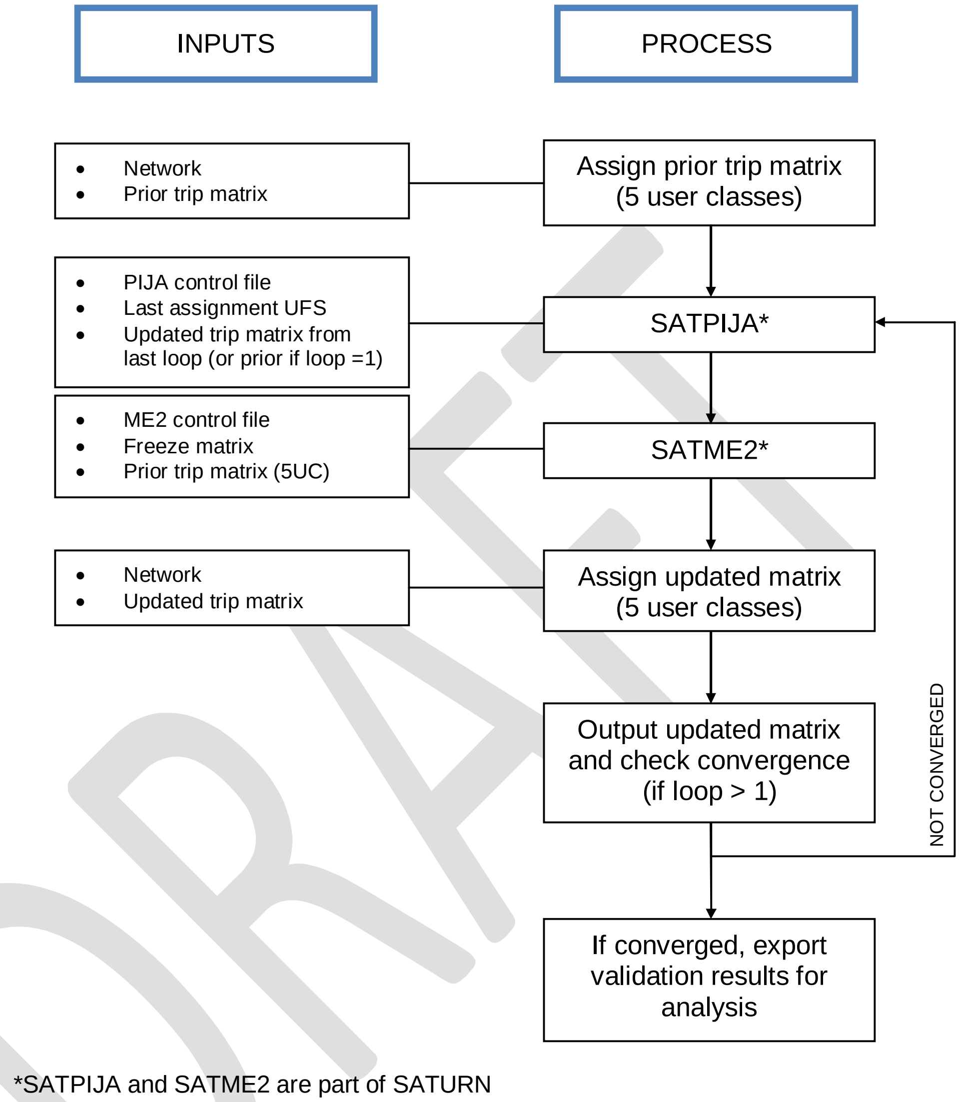


Figure 12 - Matrix Estimation Process

6.6.2 The prior matrix is assigned to the network and the resulting assignment is passed to module SATPIJA with the last updated matrix (if a previous loop is available). SATPIJA is configured using a control file which contains parameters and observed traffic count data.

6.6.3 SATPIJA was configured with parameter IVC set to 1 in order to calculate weighted PIJA factors for control links, based on the flow in all user classes.

6.6.4 SATPIJA outputs PIJA factors which are fed into module SATME2 with a control file which contains parameters and trip end constraints, and a matrix indicating frozen cells which will not be adjusted by the matrix estimation process. The module SATME2 calibrates the matrix in accordance with the input PIJA factors and the trip end constraints.

6.6.5 SATME2 was configured with parameter TURBO set to True in order to automatically aggregate the user classes in the trip matrix prior to matrix estimation, and disaggregate the matrix after matrix estimation using the proportions of trips in each user class.

6.6.6 The process is repeated by assigning the updated trip matrix and recalculating the PIJA factors using the updated assignment. In this way the process converges, with each successive loop of matrix estimation causing less change to the trip matrix.

6.7 Matrix Estimation Constraints

6.7.1 The matrix estimation process has been constrained in the following ways:

- Observed traffic flows at a number of key links and junctions
- Observed or estimated trip ends
- Freezing selected matrix cells during matrix estimation

Observed Traffic Flows

6.7.2 Table 9 below lists the traffic count sites which has been used in the matrix estimation process, and details the specific movements at each location which have been used as constraints. The location of these sites is illustrated in Figures 13a and 13b.

Table 9 Traffic Count Data used for Calibration

Ref	Location	Count Type	Movement(s)
RSI 1	A390 at Threemilestone	Link	2-way
RSI 2	B3284 at Shortlanesend	Link	2-way
RSI 3	A39 at Trispen	Link	2-way
RSI 4	A390 at Tresillian	Link	2-way
RSI 5	A39 at Carnon Downs	Link	2-way
RSI 6	A390 at Highertown	Link	2-way
P380	Arch Hill	Turning	Falmouth Road
P368	Chapel Hill	Link	2-way
X001	Station Road	Link	2-way
P370	St Georges Road	Link	2-way
M385	Kenwyn Road/Trehaverne Place	Turning	Kenwyn Road
M003	Moresk Road	Link	2-way
M005	Bodmin Road	Link	2-way
X003	St Austell Street	Link	2-way
N417	Fairmantle Street Roundabout	Turning	Newham Road Arm* and Fairmantle Street Arm
M020	Trelander Highway	Link	2-way*
M022	St Clements Hill	Link	2-way*
N132	A390 adjacent to Chiverton Cross	Link	2-way
N300	A3075 Pendown Cross	Turning	B3284 between A3075 and A30
Q350	A30 Zelah Hill Junction	Turning	Rural route to Shortlanesend
P372	Maiden Green Roundabout	Turning	1 - A390 between Maiden Green Roundabout and Oak Lane 2 - A390 between Mount Pleasant Way and Maiden Green Roundabout
M470	Fore Street, Chacewater	Link	2-way
Q173	One-way link from A390 to Chyvelah Way	Link	1-way
n/a**	Langarth P&R entry gates	-	2-way*
P229	Pydar Street Mini-Roundabout	Turning	All movements
L464	Castle Street/River Street	Turning	Turns from Castle Street and Little

			Castle Street
N371	Richmond Hill/George Street	Turning	All movements
N161	Chapel Hill/City Road	Turning	All movements
N372	Infirmary Hill/City Road	Turning	All movements
MO12	Moresk Road	Link	2-way
L277i	Tregurra Lane/Bodmin Road	Turning	Tregurra Lane to Mitchell Hill Arm
L181	Mitchell Hill Signals	Turning	Turns from Mitchell Hill and turns from New Bridge Street
N388	Trevithick Road	Turning	Right turn to Tregolls Road South
P234	Bodmin Road Roundabout	Turning	Turns from A39 into Bodmin Road and A39
N416	Union Hill	Turning	Right turn into A39 from St Austell and right turn from A39 to Tregolls Road
P371	Dalvenie Roundabout	Turning	Entries from A390 and Station Road
Q349	Pencalenick Junction	Turning	Turns into/out of minor road
P250	Treliske Roundabout	Turning	A390 straight ahead (both directions)
P373	Newbridge Lane Roundabout	Turning	Straight ahead (both directions)
n/a**	Chyvelah Road/Hugus Road	Turning	Turns into Hugus Road
Q172	Chyvelah Mini Roundabout	Turning	All Movements
P124	Threemilestone Roundabout	Turning	Turns out of P&R arm
Q170	Langarth P&R (western access gate)	Link	Straight ahead Eastbound
P126	Chybucca Crossroads (east)	Turning	Right turn from A30 to B3284 Shortlanesend

* Traffic count used for calibration because it provides entry flow to/from zone
** Derived from adjacent counts

Observed or Estimated Trip Ends

6.7.3 In a number of instances traffic counts are located on the entry link to a model zone. Where this data is available it has been used to provide a zonal constraint in the matrix estimation process in order to ensure that the quantity of trips arriving and departing the zone is robust.

6.7.4 For other zones where data is not available, approximate numbers of arrivals and departures have been estimated based on the apparent land uses in the zone. These estimates have been used to ensure that the matrix estimation process does not cause illogical levels of total demand at zones.

6.7.5 Frozen Cells

6.7.6 All observed cells in the trip matrix have been frozen to prevent any change during matrix estimation. These include the following trips:

- RSI trips (external to internal trips)
- Trips to and from the park and ride site

6.7.7 Additionally, a number of cells in the matrix have been identified as illogical movements and frozen to prevent matrix estimation adding trips. Some examples of movements that were considered illogical are as follows:

- Commute trips between residential-only zones
- Commute trips between employment-only zones
- Commute trips from employment-only zones to residential-only zones

6.7.8 Trips of less than 1 mile in length have also been frozen to prevent the matrix estimation process from adding short distance trips between zones adjacent to traffic count constraint sites.

6.8 Matrix Calibration Results

6.8.1 Table 10 below demonstrates that the overall number of trips in the trip matrices was not significantly changed during matrix calibration. The AM peak matrix total is increased by 1% and the PM peak matrix is increased by 4%.

6.8.2 The matrix estimation process was run over 3 loops for the AM Peak model, whilst the PM Peak model was run over 6 loops. The table below shows that the matrix estimation process stabilises and converges quickly after the initial loop.

Table 10 Change in total matrix trips due to matrix estimation (all vehicle types)

	AM Peak			PM Peak		
ME2 Loop	Trips (pcu)	%Change on Loop	%Change from Prior	Trips (pcu)	%Change on Loop	%Change from Prior
Prior Matrix	22,868	-	-	23,103	-	-
Loop 1	23,251	+1.7%	+1.7%	24,015	+3.9%	+3.9%
Loop 2	23,123	-0.6%	+1.1%	24,056	+0.2%	+4.1%
Loop 3	23,058	-0.3%	+0.8%	24,033	-0.1%	+4.0%
Loop 4	-	-	-	24,023	-0.0%	+4.0%
Loop 5	-	-	-	24,015	-0.0%	+3.9%
Loop 6	-	-	-	23,981	-0.1%	+3.8%

6.8.3 The overall change in the trip matrices due to calibration is shown in Table 11 below.

Table 11 Change in trip matrix totals due to calibration

Matrix	AM Peak	PM Peak
Prior	22,868	23,103
Post	23,152*	23,981
Change	+1.24%	+3.8%

* Following matrix calibration, some minor manual adjustments were made to the AM peak matrix.

7 VALIDATION METHODOLOGY

7.1 Overview

7.1.1 This section of the report outlines the areas of the model that have been considered in detail during validation in order to ensure that the model is fit for the intended purpose of assessing future development and modelling the impact of the proposed transportation strategy for Truro in a future year.

7.1.2 Where output from the model has been compared to observed data, DMRB guidelines have been applied to verify that the model is a suitable representation of the observations. The DMRB acceptability criteria which has been used to validate traffic flows and journey times have been outlined in section 7.4 below.

7.2 Key Model Requirements

7.2.1 In order to be fit for purpose it is considered that the following elements of the model need to be a good representation of the existing highway network in Truro:

- Traffic flow into and out of Truro
- Traffic flow and journey time on A390 corridor west of Truro
- Traffic flow on the A30 corridor
- Traffic patterns at key junctions
- Delay at existing congestion hotspots

<u>Traffic Flow into and out of Truro</u>

7.2.2 During the peak periods there are strong commuter movements between Truro, surrounding local settlements and the wider Cornwall area. These commuter movements are predominantly in the direction of Truro during the AM peak and away from Truro in the PM peak. It is important that the total modelled flow is a good representation of the observed traffic flow in the direction of these commuter movements because this demand will form the base from which new demand will be pivoted when preparing future year models.

7.2.3 Similarly it is also important to correctly model the balance of traffic between each competing route into and out of Truro. This is particularly true for routes into the city from the west, specifically the balance of traffic between the A390 and B3284, which both share traffic with common origins and destinations. Proposed residential, retail and office development along the A390 corridor in the future forms an important component of future growth in the city, and it is likely to have an impact to existing traffic using these corridors because the minor routes are likely to carry displaced traffic from the A390 corridor when demand on the A390 increases. It is important that the base model represents a robust balance of traffic along these routes so that the future model can provide robust estimates of the impact of traffic growth caused by future development.

7.2.4 Traffic patterns into and out of Truro in the model have been validated by comparing modelled and observed flows in the direction of commuter movement at a cordon around Truro which intersects each of the main inbound routes. The cordon is illustrated in Figure 14. Both total traffic volume crossing the cordon and individual intersecting link flows have been validated.

Representation of A390 Corridor

7.2.5 The model will be used to develop a transportation strategy for Truro and needs to have strong flow validation near to key development locations. It is therefore important that the model is a good representation of the A390 corridor, particularly to the west of Truro, because in addition to it being a key existing commuter corridor it provides connection to a number of proposed development sites which comprise a majority of the future development in Truro, and will therefore be a focus for the transportation strategy.

7.2.6 Traffic flow along a number of sections of the corridor and journey time along the western section of the corridor has been validated against observed data.

Representation of A30 Corridor

7.2.7 The A30 is a principal north-south route through Cornwall which passes close to Truro and carries Truro-based traffic to and from the A390, A39 and B3284.

7.2.8 As the model will be used to assess the impact of future growth in Truro and associated mitigation measures it is important that the base model is a good representation of the traffic flow on the A30 corridor in the vicinity of Truro. This will enable the model to reliably forecast the impact of growth on the corridor and to the operation of the key junctions of Chiverton Cross and Chybucca crossroads.

7.2.9 Traffic flow along a number of sections of the corridor in the vicinity of Truro has been validated against observed data.

Traffic Patterns at Key Junctions

7.2.10 The model needs to validate well at the key junctions along the A390 such as Threemilestone roundabout, Treliske roundabout, Maiden Green, County Hall and Arch Hill, and also at the Chiverton Cross and Chybucca junctions on the A30 corridor.

7.2.11 The modelled turning flows at each of these junctions have been validated against observed flows.

Representation of Existing Congestion Hotspots

7.2.12 A number of junctions within Truro operate above capacity in the present day. It is desirable that the model includes a representation of this congestion so that traffic forecasts are able to highlight worsening or improvement of existing congestion problems in the future.

7.2.13 Whilst journey time data is available to validate the modelled representation of traffic congestion at Threemilestone roundabout and Union Hill junction, a number of other key hotspots have been highlighted by Cornwall Council for which data is not available. For these locations the model has been analysed to verify how the junction performs.

7.3 Summary of Validation Methodology

7.3.1 Table 12 below summarises which elements of the model will be validated in order to assess the suitability of the model for its intended purpose.

Table 12 Summary of validation methodology

Model Element	Validation
Traffic flow into/out of Truro	Comparison of modelled and observed traffic flow on a cordon around Truro which intersects all major routes into the city.
Representation of A390 corridor	Comparison of modelled and observed traffic flow and journey time along a number of sections of the A390 corridor.
Representation of A30 corridor	Comparison of modelled and observed traffic flow along a number of sections of the A30 corridor near to Truro.
Traffic patterns at key junctions	Comparison of modelled and observed turning flows at each junction identified.
Representation of existing congestion hotspots	Verify junction performance against journey time data where possible.

7.4 DMRB Acceptability Criteria

7.4.1 Where traffic flow data output from the model has been compared to observed data the following DMRB acceptability criteria have been used to validate traffic flows:

Table 13 DMRB acceptability guidelines for traffic flows

Criteria	% of cases	Acceptability Guidelines	GEH Statistic
Link Flows < 700 vph	> 85% of cases	±100 vehicles	< 5
Link Flows 700 - 2,700 vph		±15%	< 5
Link Flows > 2,700		±400 vehicles	< 5
Cordon Totals	All	As above	< 4

7.4.2 The GEH statistic is calculated using the following formula:

$$GEH = \sqrt{\frac{2(M-C)^2}{(M+C)}}$$

Where M = Modelled traffic flow
C = Observed traffic flow

7.4.3 Where journey time data output from the model has been compared to observed data the following DMRB acceptability criteria has been used to validate the journey times:

Table 14 DMRB acceptability guidelines for journey times

Criteria	% of cases	Acceptability Guidelines
Journey Time	> 85%	±15%

8 ASSIGNMENT CONVERGENCE

8.1 DMRB Convergence Acceptability Criteria

8.1.1 DMRB criteria requires that the Delta measure of convergence is stable and below 1%, and that at least 90% of links should have flow change of less than 5% for four consecutive assignment iterations.

8.1.2 The model has been configured with more rigorous stopping criteria, whereby at least 95% of links have flow change of less than 5% for four consecutive assignment iterations before the assignment will terminate.

8.2 Assignment Convergence Results

8.2.1 Table 15 below shows the assignment summary statistics for the final AM peak and PM peak models. The results in Table 15 demonstrate that the model converges well and meets the required convergence criteria in each modelled time period therefore the assignment is robust and stable.

Table 15 Assignment convergence statistics

Time Period	Loop	% Link Flows <1% Change	Delta (%)
AM	6	95.9	0.137
	7	95.9	0.109
	8	97.6	0.058
	9	97.6	0.116
PM	9	95.7	0.138
	10	95.1	0.222
	11	97.2	0.093
	12	96.9	0.209

9 VALIDATION RESULTS

9.1 Traffic Flow Into and Out of Truro

9.1.1 Inbound and outbound flow has been validated at a cordon which intersects each of the primary routes into and out of Truro. For reference, the cordon is illustrated in Figure 14.

9.1.2 Table 16 below shows the total inbound and outbound flow across the cordon in the AM and PM peak. This table demonstrates that the total flow in each direction across the cordon validates satisfactorily in both modelled time periods, with each movement passing the DMRB criteria. The AM peak outbound movement is less than observed and narrowly fails the GEH criteria with a GEH value of 4.4, however this is not considered to be a significant issue.

Table 16 Summary of Total Flow at Cordon

Time Period	Direction	AM Peak					
		Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	DMRB
AM Peak	Inbound	5,650	5,595	-55	-1%	0.7	Pass
	Outbound	3,136	2,896	-240	-8%	4.4	Pass
PM Peak	Inbound	3,596	3,597	1	0%	0.0	Pass
	Outbound	4,977	4,832	-145	-3%	2.1	Pass

Notes -
1. Obs = Observed, Mod = Modelled

9.1.3 Table 17 below shows the AM peak validation on each intersecting link of the cordon. For clarity, these results are also illustrated on Figure 15.

9.1.4 At this more detailed level, the AM peak model is shown to have a very good level of validation, with 90% intersecting links passing both the GEH and DMRB criteria. Whilst the A39 Trispen link is shown to fail the DMRB criteria, the difference between modelled and observed flows just exceeds the maximum by 2 pcu and is therefore not a significant issue meriting further investigation.

Table 17 Summary of Flow on Intersecting Links of Outer Cordon (AM Peak)

Link	Direction	AM Peak					
		Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	DMRB
A390 Threemilestone	Inbound	1,704	1,613	-91	-5%	2.2	Pass
B3284 Shortlanesend		902	895	-7	-1%	0.2	Pass
A39 Trispen		747	804	57	8%	2.0	Pass
A390 Tresillian		1,030	998	-32	-3%	1.0	Pass
A39 Carnon Downs		1,267	1,285	18	1%	0.5	Pass
A390 Threemilestone	Outbound	747	717	-30	-4%	1.1	Pass
B3284 Shortlanesend		301	352	51	17%	2.8	Pass
A39 Trispen		607	505	-102	-17%	4.3	Fail
A390 Tresillian		653	590	-63	-10%	2.5	Pass
A39 Carnon Downs		828	732	-96	-12%	3.4	Pass

Notes -
1. Obs = Observed, Mod = Modelled

9.1.5 Table 18 below shows the PM peak validation on each of intersecting link on the cordon. For clarity, these results are also illustrated on Figure 16. This table demonstrates that, similar to the AM peak model, the PM peak model has a very good level of validation in both directions at the cordon, with all of the intersecting links at the cordon passing both the GEH and DMRB criteria.

Table 18 Summary of Flow on Intersecting Links of Outer Cordon (PM Peak)

Link	Direction	PM Peak					
		Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	DMRB
A390 Threemilestone	Inbound	1,143	1,096	-47	-4%	1.4	Pass
B3284 Shortlanesend		310	367	57	18%	3.1	Pass
A39 Trispen		587	510	-77	-13%	3.3	Pass
A390 Tresillian		641	625	-16	-2%	0.6	Pass
A39 Carnon Downs		915	999	84	9%	2.7	Pass
A390 Threemilestone	Outbound	1,140	1,231	1	0%	2.6	Pass
B3284 Shortlanesend		752	672	91	8%	3.0	Pass
A39 Trispen		760	734	-80	-11%	1.0	Pass
A390 Tresillian		1,066	1,055	-26	-3%	0.3	Pass
A39 Carnon Downs		1,259	1,140	-11	-1%	3.4	Pass

Notes -
1. Obs = Observed, Mod = Modelled

9.1.6 Based on the cordon validation results presented in the tables above, it is considered that the model is a good representation of the existing travel patterns into and out of Truro in the AM and PM peak periods.

9.2 Representation of A390 Corridor

Traffic Flows

9.2.1 Table 19 below compares modelled and observed traffic flows in the direction of the main AM peak commuter movement along a number of sections of the A390 corridor to the west of Truro. For reference, these sections are highlighted on Figure 17.

9.2.2 This table shows that the modelled traffic flows along the A390 validate well and are an acceptable representation of the observed flows.

Table 19 Inbound Link Flow Validation - A390 Corridor to West of Truro (AM Peak)

Links		Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	DMRB
Site Description	Direction						
1 - East of Chiverton Cross	EB	888	883	-5	-1%	0.2	Pass
2 - Threemilestone Rbt to Maiden Green Rbt	EB	1,633	1,523	-110	-7%	2.8	Pass
3 - Maiden Green Rbt to Treliske Rbt	EB	1,200	1,301	101	8%	2.9	Pass
4 - Treliske Rbt to Newbridge Ln	EB	983	855	-128	-13%	4.2	Pass
5 - Highertown	EB	891	1,007	116	13%	3.8	Pass

9.2.3 Table 20 below compares modelled and observed traffic flows in the direction of the main PM peak commuter movement along the A390 corridor to the west of Truro.

9.2.4 Similar to the modelled AM peak, this table demonstrates that the PM peak model is also able to replicate existing traffic flows to an acceptable standard on each of the sections considered.

Table 20 Outbound Link Flow Validation - A390 Corridor to West of Truro (PM Peak)

Links		Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	DMRB
Site Description	Direction						
1 - East of Chiverton Cross	WB	1,271	1,101	-170	-13%	4.9	Pass
2 - Maiden Green Rbt to Threemilestone Rbt	WB	1,541	1,502	-39	-3%	1.0	Pass
3 - Treliske Rbt to Maiden Green Rbt	WB	1,647	1,466	-181	-11%	4.6	Pass
4 - Newbridge Ln to Treliske Rbt	WB	1,096	1,235	139	13%	4.1	Pass
5 - Highertown	WB	1,150	1,270	120	10%	3.5	Pass

Journey Times into Truro (AM Peak)

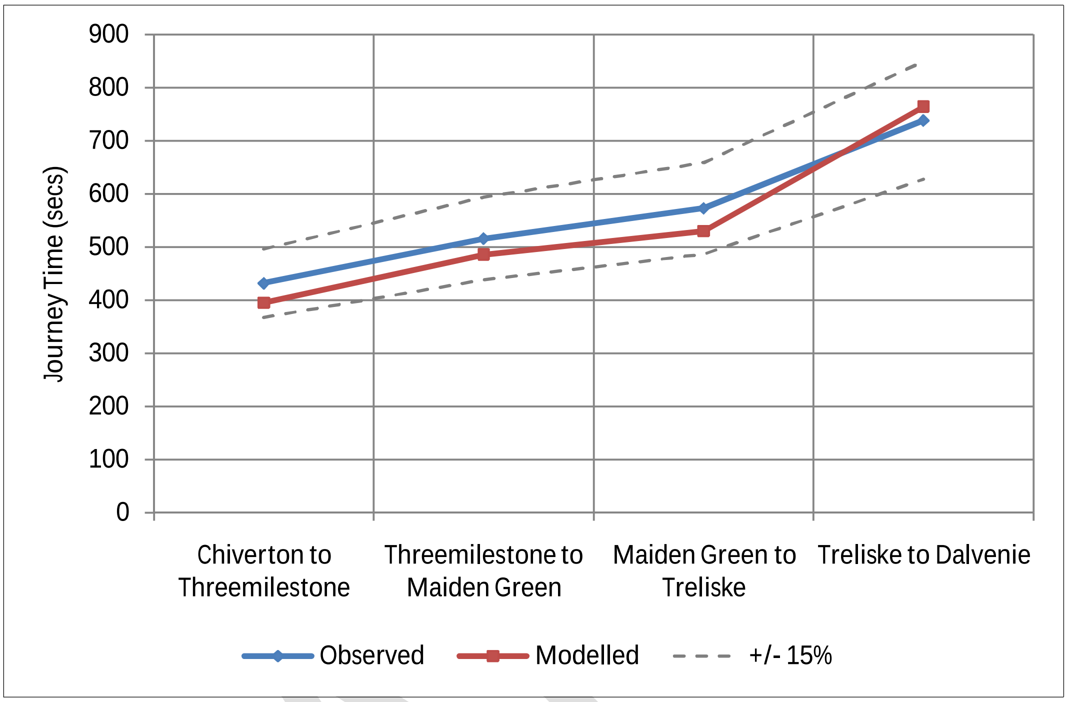
9.2.5 Table 21 and Figure 18 below compare modelled journey time with observed journey time in the direction of the main commuter movement along the A390 corridor during the AM peak period.

Table 21 Journey Time Validation - A390 Corridor Eastbound (AM Peak)

Section	Observed (secs)		Modelled (secs)		Difference (secs)	
	S	C	S	C	S	C
Chiverton to Threemilestone	432	432	395	395	-37	-37
Threemilestone to Maiden Green	84	516	91	486	7	-30
Maiden Green to Treliske	57	573	44	530	-13	-43
Treliske to Dalvenie	165	738	234	764	69	26
Total	738		764		26 (+4%) DMRB PASS	

Notes -
1 - S = Section, C = Cumulative

Figure 18 - Journey Time Profile - A390 Corridor Eastbound (AM Peak)



9.2.6 Modelled travel time between Chiverton Cross and Threemilestone roundabout is approximately half a minute less than observed. It is considered that this is because the model slightly underestimates eastbound delay at Threemilestone roundabout, however it was found during calibration and validation that this junction is critical in determining the route choice between the A390, B3284 and Chacewater routes into Truro from the south and west. Where the junction is configured to produce more delay on the A390 eastbound approach, less traffic is assigned to the junction via the A390 in favour of alternative routes. Therefore the junction has been set up to provide the optimal balance between traffic flow validation and journey time validation.

9.2.7 Modelled travel time for the sections between Threemilestone roundabout and Treliske roundabout closely resemble the observed time.

9.2.8 Modelled travel time between Treliske and Dalvanie is approximately 1 minute higher than observed. This is due to the speed flow curve which has been coded into the network to limit the capacity of this section of the A390 in line with the road standard.

9.2.9 As a whole route, the model is a good representation of actual journey time along the A390 corridor during the AM peak, and passes the DMRB criteria.

Journey Times out of Truro (PM Peak)

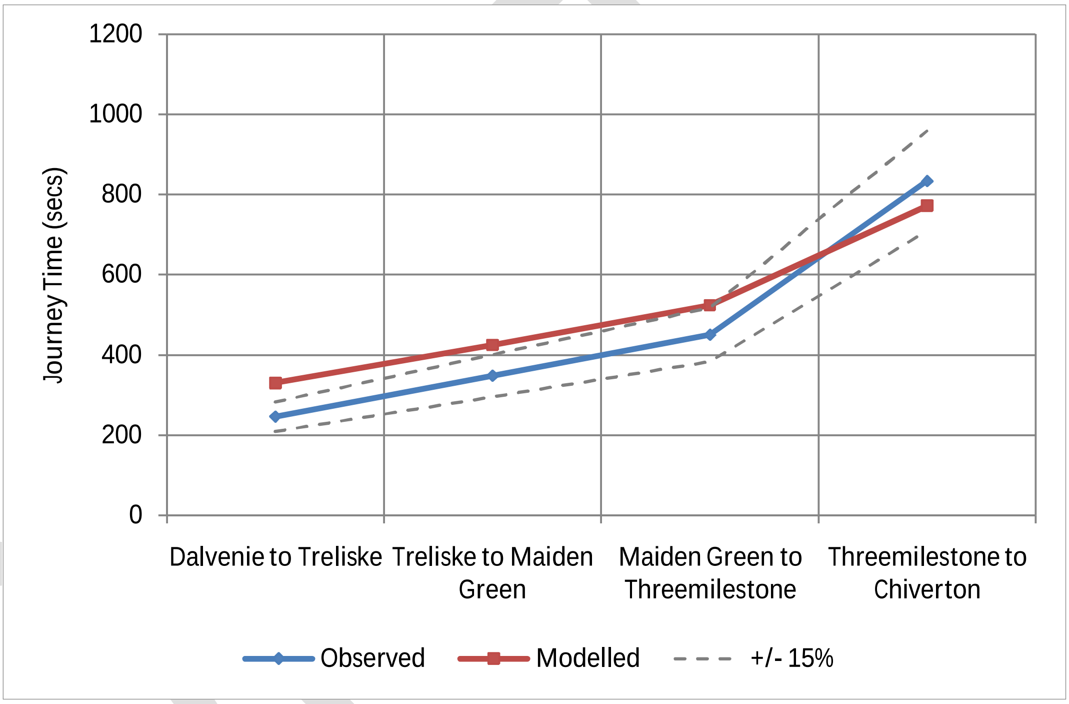
9.2.10 Table 22 and Figure 19 below compare modelled journey time with observed journey time in the direction of the main commuter movement along the A390 corridor during the PM peak period.

Table 22 Journey Time Validation - A390 Corridor Westbound (PM Peak)

Section	Observed (secs)		Modelled (secs)		Difference (secs)	
	S	C	S	C	S	C
Dalvenie to Treliske	246	246	330	330	84	84
Treliske to Maiden Green	102	348	95	425	-7	77
Maiden Green to Threemilestone	102	450	99	524	-3	74
Threemilestone to Chiverton	384	834	248	772	-136	-62
Total	834		772		-62 (-7%) DMRB PASS	

Notes -
1 - S = Section, C = Cumulative

Figure 19 - Journey Time Profile - A390 Corridor Westbound (PM Peak)



9.2.11 The PM peak journey time validation results indicate that the model overestimates travel time between Dalvenie roundabout and Treliske roundabout in the order of 1 to 2 minutes. Similar to the AM peak, this is due to the speed flow curve which has been coded into the network to limit the capacity of this section of the A390 in line with the road standard.

9.2.12 Modelled travel time for the sections between Treliske roundabout and Threemilestone roundabout closely resembles the observed travel time.

9.2.13 For the final section between Threemilestone and Chiverton the model is approximately 2 minutes faster than observed. It is likely that the model underestimates outbound delays at Chiverton Cross during the PM peak, however this is not considered to be a significant issue because all future modelling work will incorporate the Chiverton Cross improvement scheme which is intended to mitigate existing congestion problems at the junction.

9.2.14 As a whole route, the model is a fairly robust representation of actual journey time and delay along the A390 corridor during the PM peak, and passes the DMRB criteria.

9.3 Representation of A30 Corridor

9.3.1 Table 23 and Table 24 below show the traffic flow validation results for three sections of the A30 corridor to the west of Truro. For reference, these sections are highlighted on Figure 20.

Table 23 Link Flow Validation - A30 Links (AM Peak)

Links		Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	DMRB
Site Description	Direction						
1 - Chiverton to Chybucca Crossroads	NB	1,286	1,298	12	1%	0.3	Pass
	SB	1,267	1,163	-104	-8%	3.0	Pass
2 - Chybucca Crossroads to Zelah Hill	NB	896	828	-68	-8%	2.3	Pass
	SB	1,110	1,055	-55	-5%	1.7	Pass
3 - A30 Scorrier to Chiverton	NB	1,758	1,776	18	1%	0.4	Pass
	SB	1,699	1,582	-117	-7%	2.9	Pass

Table 24 Link Flow Validation - A30 Links (PM Peak)

Links		Obs (pcu)	Mod (pcu)	Diff	% Diff	GEH	DMRB
Site Description	Direction						
1 - Chiverton to Chybucca Crossroads	NB	1,064	992	-73	-7%	2.3	Pass
	SB	1,208	1,027	-180	-15%	5.4	Pass
2 - Chybucca Crossroads to Zelah Hill	NB	940	821	-119	-13%	4.0	Pass
	SB	917	923	7	1%	0.2	Pass
3 - A30 Scorrier to Chiverton	NB	1,437	1,299	-138	-10%	3.7	Pass
	SB	1,829	1,707	-122	-7%	2.9	Pass

9.3.2 These results demonstrate that the traffic flows in the model validate well on each of the sections considered, with a majority of links passing the validation criteria. Table 24 indicates that the modelled flow between Chybucca and Chiverton is less than observed during the PM peak and fails the GEH criteria. However, as outlined in section 9.4 below, the entry flow into the Chiverton junction validates well, and it is therefore considered that this is not a significant issue, and likely to be related to inconsistency in the traffic count data due to normal variability in traffic flow along the corridor.

9.3.3 It is considered that the model is an acceptable representation of the A30 corridor in the vicinity of Truro in both the AM and PM peak periods.

9.4 Traffic Patterns at Key Junctions

9.4.1 Turning movements at the 10 key junctions listed below have been validated. For reference, the location of these junctions is shown on Figure 21.

1. Chiverton Cross (5 arm roundabout)
2. Chybucca Crossroads (4 arm staggered crossroads)
3. Threemilestone Roundabout (4 arm roundabout)
4. Chyvelah Road Mini-Roundabout (3 arm mini-roundabout)
5. Maiden Green Roundabout (4 arm roundabout)
6. Treliske Roundabout (4 arm roundabout)
7. Dalvenie Roundabout (5 arm roundabout)
8. Arch Hill Double Mini-Roundabout (4 arm double-mini roundabout)

9. Fairmantle Street Roundabout (4 arm roundabout)
10. Union Hill Traffic Signals (4 arm traffic signal junction)

9.4.2 Appendix A contains turning movement diagrams for each of the junctions which include observed flow, modelled flow and GEH flow for each turn and as a total for each entry arm.

Turning Flows at Junctions

9.4.3 Table 25 and Table 26 below summarise the turning flow validation achieved at each of the junctions in the AM and PM peaks respectively. Appendix A contains a turning movement diagram for each of the junctions which illustrates the observed flow, modelled flow and GEH value for each turning movement. With reference to these diagrams, each junction is discussed in detail below.

Table 25 Summary of Turning Flow Validation at Key Junctions (AM Peak)

Junction	Number Movements	Number Passing GEH	% Passing GEH
SRN			
Chiverton Cross	20	17	85%
Chybucca	12	10	83%
A390 West of Truro			
Threemilestone Roundabout	12	11	92%
Chyvelah Mini Roundabout	6	6	100%
Maiden Green Roundabout*	6	4	67%
Treliske Roundabout*	6	5	83%
Dalvenie Roundabout	20	18	90%
Truro			
Fairmantle Street Roundabout	12	8	67%
Arch Hill	12	7	58%
Union Hill Signals*	12	10	83%

* Denotes junctions which have minor arms that are not modelled

Table 26 Summary of Turning Flow Validation at Key Junctions (PM Peak)

Junction	Number Movements	Number Passing GEH	% Passing GEH
SRN			
Chiverton Cross	20	15	75%
Chybucca	12	8	67%
A390 West of Truro			
Threemilestone Roundabout	12	11	92%
Chyvelah Mini Roundabout	6	4	67%
Maiden Green Roundabout*	6	5	83%
Treliske Roundabout*	6	4	67%
Dalvenie Roundabout	20	18	90%
Truro			
Fairmantle Street Roundabout	12	10	83%
Arch Hill	12	7	58%
Union Hill Signals*	12	9	75%

* Denotes junctions which have minor arms that are not modelled

Chiverton Cross (Appendix A.1)

9.4.4 This junction generally validates well in both peak periods. The straight ahead movements along the A30, and movements to and from the A3075 arm, all validate with GEH values less than 5.

9.4.5 The model does not meet the GEH criteria on the left and right turns from the A390 onto the A30, particularly in the AM peak period. However, as indicated by appendix A.1, the Threemilestone junction upstream feeds a suitable volume of traffic towards Chiverton. It is considered that the missing trips on these turns are likely to originate from minor rural links from Chacewater village, and from the rural area to the north and south of the A390, which are not included in the model.

9.4.6 In PM peak, the turning flow from the A30 to the A390 is low by approximately 150 pcu, however the turning flow into the A390 from the B3277, A3075 and A30 north are all slightly too high, and this compensates for the shortfall.

9.4.7 It has not been possible to configure the model to provide trips for the turn from the A30 north arm to the A3075 arm because no suitable local zones exist to act as origins or destinations for these trips. Where trips have been added for this purpose at larger zones further afield, the model assigns the trips to more direct routes, for example via the B3284 west from Chybucca to the A3075 at Pendown. Since the volume of traffic making this movement is relatively small it is not considered to be a significant issue.

9.4.8 In overall terms it is considered that the validation of this junction is acceptable and that the model is fit for purpose in this location.

Chybucca (Appendix A.2)

9.4.9 The AM peak model has a very good level of validation at the Chybucca junction. The key right-turn movement from the A30 to the B3284 towards Shortlanesend is represented very well with a GEH value of 0.8, and similarly the straight ahead flows on the A30 also achieve good validation with GEH values of up to 1.3.

9.4.10 The AM peak model does not assign any traffic to the right turn movement from the B3284 to the A30 north, however this is a very minor flow of less than 20 pcu and as such is not considered to be a significant issue. The right turn movement from the A30 to the B3284 west arm has a high modelled flow. This may represent traffic which in reality travels south to the Chiverton junction in order to access the A3075 and accounts for the shortfall for the A30 to A3075 turning movement previously mentioned at the Chiverton junction.

9.4.11 In the PM peak model the turning flow for the right turn into B3284 is high and just fails the validation criteria with a GEH value of 5.7. This turning movement is considered to be less important in the PM peak period when the predominant traffic movement is away from Truro and the demand for this turn is relatively low.

9.4.12 It is considered that the validation of this junction is acceptable and that the model is fit for purpose in this location.

Threemilestone Roundabout (Appendix A.3)

9.4.13 This junction validates well in both of the modelled time periods with turning flows on all major movements passing the GEH criteria with values of less than 5.

9.4.14 Given the proposed use of the model in testing future development in the vicinity of this junction, it is considered that the model performs well and is fit for purpose in this location.

Chyvelah Mini-Roundabout (Appendix A.4)

9.4.15 This junction is located very close to the Threemilestone junction and similarly has a very good level of validation in both peak periods. In the AM peak all turning movements validate with GEH values of less than 3. In the PM peak turns between Threemilestone roundabout and the Threemilestone settlement are slightly high, however the total flow passing between Threemilestone roundabout and the Chyvelah roundabout validates well within the maximum GEH value of 5.

9.4.16 It is considered that the model is fit for purpose in this location.

Maiden Green Roundabout (Appendix A.5)

9.4.17 In the AM peak model this junction validates well on the straight ahead movement between the A390 arms and also on the total flow out of the Chyvelah Vale arm, however the right turn movement from the A390 to Chyvelah Vale is high and fails the GEH criteria.

9.4.18 In the PM peak model all turns at this junction validate well, except for the westbound straight ahead movement on the A390 which has a high flow and exceeds the GEH criteria with a value of 6. This is not considered to be a significant issue because the turning movements feeding this arm at Treliske roundabout upstream both validate satisfactorily.

9.4.19 It is considered that the model is fit for purpose in this location.

Treliske Roundabout (Appendix A.6)

9.4.20 All turns at this junction validate well except for the left turn from the A390 to the Hospital, which has a high flow in the AM and PM peaks, and the right turn from the A390 to the Hospital which has a low flow in the PM peak.

9.4.21 The Hospital site is a large generator of traffic in the peak periods and has a complex interaction with the Park and Ride site at Langarth Farm. As referred to in section 6.5 of this report, when adding Park and Ride trips to the trip matrices it was not possible to remove the secondary vehicle component of the trips which would be replaced by the park and ride bus, and this may account for the raised level of traffic demand to the Hospital in the model.

9.4.22 Despite this issue it is considered that the model is a good representation of Treliske roundabout and as such is fit for purpose in this location.

Dalvenie Roundabout (Appendix A.7)

9.4.23 The turning flows at this junction validate well in both modelled time periods. The only issue is the PM peak representation of eastbound flow through the junction on the A390 which is lower than observed and achieves a GEH value of 7.3. It is considered that this is due to the effect of the link capacity which has been added to the A390 upstream of this junction and which limits the amount of flow travelling through this part of the corridor.

9.4.24 The majority of turns at this junction validate well and as such it is considered that the model is fit for purpose in this location.

Fairmantle Street Roundabout (Appendix A.8)

9.4.25 The straight ahead movements through this junction on the A390 carry the highest traffic flow and have an acceptable level of validation in the model with GEH values of less than 5.

9.4.26 In the AM peak model, turning flows from the A390 into Newham Road are low and fail the GEH criteria with GEH values in the order of 6.5. It was not possible to obtain a left turn flow from Newham Road to Morlaix Avenue because the additional slip-road connection to Morlaix Avenue is coded south of the junction and is the lowest cost route for traffic heading south towards Arch Hill.

9.4.27 In overall terms it is considered that the model is fit for purpose in this location.

Arch Hill (Appendix A.9)

9.4.28 In the AM peak the individual turning flows from the north, south and west approaches validate well with GEH values of less than 5, however the total entry flow from the western approach is low and just exceeds the GEH criteria.

9.4.29 The most significant issue in the AM peak model is the low traffic demand exiting Morlaix Avenue from the east. The modelled flow on the straight ahead movement from this arm is low by approximately 150 pcu whilst the left and right turn movements combined are low by approximately 200 pcu. In total this produces a shortfall in entry flow from this arm which leads to a fairly high GEH value in the order of 11. This shortfall in traffic flow is not consistent with the observed flow exiting the Fairmantle Street junction upstream where the model has an acceptable level of validation. It is therefore considered that this issue is due to inconsistency in the observed AM peak data used for validation, rather than a fundamental issue in the model at this location.

9.4.30 In the PM peak model the turning flows from the Morlaix Avenue approach validate well, and a majority of turning flows from the other approaches also validate with GEH values less than or close to the maximum permitted value of 5. The most significant issue at this location in the PM peak model is the right turn from the A39 southern approach to Morlaix Avenue where the turning flow is approximately 200 pcu higher than observed. It is apparent from the turning flow diagram (Appendix A.9) that some of this traffic should be making a left turn onto the westbound A390 or a straight ahead movement to Falmouth Road. Therefore whilst the turning flows do not validate satisfactorily, the total amount of traffic entering the junction from the south does validate with a GEH value of less than 5.

Union Hill (Appendix A.10)

9.4.31 The AM peak model has an acceptable validation on the straight ahead movement between the A390 approaches, however the turning flow for the right turn movement from the A39 to Tregolls Road south is low and has a fairly high GEH value in the order of 10. This is due to an incorrect balance of traffic between the Tregolls Road route into the city, which is congested and delayed, and the alternative rat-run via Bodmin Road which is relatively fast. Whilst this rat-run does exist in reality, it has been difficult to achieve the evident peak period delay at Union Hill and on Tregolls Road whilst also maintaining sufficient traffic flow. A compromise between flow validation and journey time validation has been made so that the model is a fair representation of both.

9.4.32 The PM peak model has a similar issue for outbound traffic, whereby Trevithick Road and Bodmin Road present better routes for exiting the city northwards than the primary route via Tregolls Road and Union Hill. Consequently the left turn movement at the Union Hill junction does not validate well because it has a low turning flow. It has not been possible to capture the correct interaction between Bodmin Road and Tregolls Road in the model and it is recommended that this is a focus for future updates of the model. However, in this instance it is considered that this issue does not significantly detract from the model's suitability for modelling the impact of future development in Truro because a majority of the proposed development is not located in the vicinity of the Union Hill junction.

9.5 Representation of Existing Congestion Hotspots

9.5.1 Through discussion with Cornwall Council and on-site observations made during model development, it is understood that the following junctions are congestion hotspots during peak periods in the present day:

- Threemilestone Roundabout
- Union Hill Signals and Tregolls Road
- Carland Cross
- Chybucca Crossroads

9.5.2 It is desirable that the model is able to represent present day congestion at these locations so that any change in these existing congestion issues in the future will be evident when the model is used to produce forecasts of highway operation.

<u>Threemilestone Roundabout</u>

9.5.3 Cornwall Council has indicated that the A390 and Chyvelah Road approaches to this junction are congested during the AM peak period.

9.5.4 Table 27 below shows the modelled RFC and delay for these approaches in the AM peak. The A390 approach in the model operates well over-capacity and generates delays in the order of 3 minutes. The Chyvelah Road approach in the model also operates over-capacity and generates delays in the order of 1.5 minutes.

Table 27 Congestion at Threemilestone Roundabout in AM peak

Approach	RFC	Average Traffic Delay (secs)
A390 Eastbound	107%	170-181
Chyvelah Road Northbound	103%	80-92

Notes -
1 - RFC denotes Ratio of Flow to Capacity

9.5.5 Table 28 below compares modelled journey time with observed journey time data for the A390 corridor between Chiverton Cross and Threemilestone Roundabout in the AM peak. This table shows that the modelled journey time is a good representation of the observed time, and whilst the modelled travel time is approximately half a minute faster than observed, this is within the maximum permissable 15% limit outlined by the DMRB criteria.

Table 28 Journey Time along A390 Corridor between Chiverton and Threemilestone

Section	Observed Time (secs)	Modelled Time (secs)	Difference (secs)	Difference (%)
A390 Chiverton Cross to Threemilestone Roundabout	432	395	-37	-8.6% DMRB PASS

9.5.6 It is therefore considered that the model is a robust representation of the existing traffic congestion at Threemilestone Roundabout.

Union Hill Signals

9.5.7 Site observation has indicated that the eastbound A39 approach to the Union Hill junction is congested during the AM peak period. In the AM peak model this approach operates very near to capacity and generates delay in the order of 2 minutes, however as shown by Table 29 below, the modelled journey time is below the observed time by approximately half a minute, indicating that the model does not have enough delay at this location.

9.5.8 It has been difficult to achieve a greater delay at this location because an increased journey time encourages traffic to use Bodmin Road as an alternative route to travel south, as discussed in section 9.4 above. A compromise between flow validation and journey time validation has been made so that the model is a fair representation of both.

Table 29 Journey Time along A39 Corridor between Treffry Road and Union Hill

Section	Observed Time (secs)	Modelled Time (secs)	Difference (secs)
A39 Treffry Road to Union Hill	222	185	-37

9.5.9 Site observation has also indicated that the northbound approach to the junction on Tregolls Road is congested during the PM peak.

9.5.10 In the PM peak model this approach operates over-capacity with an RFC of 113% on the straight ahead movement, generating delay of approximately 5 minutes and blocking back upstream past Upland Crescent. Journey time data does not indicate such high delays on this approach, as shown by Table 30 below. However extensive PM peak queueing northbound on Tregolls Road was evident on several occasions during on-site observation and the model has been configured to reflect this.

Table 30 Journey Time along A39 Corridor between Trevithick Road and Union Hill

Section	Observed Time (secs)	Modelled Time (secs)	Difference (secs)
A390 Trevithick Road to Union Hill	132	272	+140

Carland Cross

9.5.11 Cornwall Council has indicated that significant congestion occurs on the northbound A39 arm during the PM peak. No observed data is available to quantify the delay at this location but analysis of the model indicates that this approach operates at an RFC of

106% with a modelled delay in the order of 3 minutes. It is therefore considered that the model is a suitable representation of the congestion which is present at this junction.

Chybucca Crossroads

9.5.12 Cornwall Council has indicated that the right turn movement from the A30 to the B3284 towards Shortlanesend is a critical movement, and one which causes queueing and delay during the AM peak.

9.5.13 Working with the model during calibration and validation has shown that level of delay on this turn determines the volume of traffic using the B3284 to access Truro in the AM peak, and therefore the correct validation of this turning movement, as demonstrated previously in section 9.4, provides confidence that the modelled junction is a robust representation of junction performance in the present day.

9.5.14 Table 31 below demonstrates that the model includes right-turn delay at this junction in the AM peak, however no journey time data is available to validate the modelled delay.

Table 31 Congestion at Chybucca Crossroads in AM peak

Turn	RFC	Average Traffic Delay (secs)
A30 north to B3284 east	106%	161

10 CONCLUSIONS

10.1 Overview

10.1.1 PB has been commissioned by Cornwall Council to update the existing Truro Transport Model to make it suitable to assess future development and develop a transportation strategy for Truro.

10.1.2 This LMVR has summarised the updates made to the existing Truro traffic model and the techniques used to calibrate the model to a base year of 2009. It has also detailed how the model has been validated and presented data showing how the model performs against DMRB validation criteria.

10.2 Calibration and Validation Process

10.2.1 A number of different types of traffic data have been used to calibrate and validate the model, including traffic counts, RSI data, park and ride user data and journey time survey data.

10.2.2 The model network has been reviewed and updated. New links and junctions have been added and some of the existing junctions have been recoded with additional detail. Changes have also been made to how some of the model zones connect to the network. New speed flow curves have been added to a number of links in order to better represent the highway capacity.

10.2.3 The model zone system has been reviewed and updated. A number of zones have been split into smaller zones to facilitate loading of traffic onto the network.

10.2.4 The trip matrices have been calibrated using a combination of manual adjustment and matrix estimation.

10.3 Validation Methodology

10.3.1 The model has been validated in a number of specific areas in order to ensure that the model is fit for the purpose of assessing future development in Truro and assessing a Transportation Strategy for Truro. The following elements of the model have been validated:

- Traffic flow into and out of Truro
- Representation of the A390 corridor
- Representation of the A30 corridor
- Traffic patterns at key junctions
- Representation of existing congestion hotspots

10.3.2 Where modelled traffic flows or journey times have been compared to observed traffic flows or journey times, DMRB acceptability criteria has been used to validate the data.

10.4 Validation Results

<u>Traffic Flow into and out of Truro</u>

10.4.1 Strong commuter movements inbound to Truro in the AM peak and outbound in the PM peak require the model to have a good representation of the total inbound and outbound traffic volumes at peak times and of the balance of traffic between all the key routes into the city. A cordon around Truro has been established in order to evaluate and validate the strength of the model in this respect.

10.4.2 It has been shown that modelled traffic flows across this cordon are a robust representation of the existing traffic patterns into and out of Truro at peak times.

Representation of the A390 Corridor

10.4.3 As the model will be used to develop a transportation strategy for Truro it will need to be able to provide robust forecasts of traffic flows and highway performance near to key development locations. It is currently proposed that a significant proportion of the future development in Truro will be located off the A390 corridor to the west of Truro, and as such the model needs to have good flow and journey time validation along this corridor, particularly in the direction of tidal commuter movement in the AM and PM peaks.

10.4.4 It has been shown that the model is a good representation of traffic flow on a number of sections of the A390 in both the AM and PM peak periods. Modelled journey time along the A390 also validates well in both time periods, however the model appears to underestimate outbound delay at Chiverton Cross in the PM peak. It is considered that the recent junction improvement at Chiverton Cross has mitigated much of the traffic delay at this location and therefore it is not critical that pre-improvement delays are included in the model.

Representation of the A30 Corridor

10.4.5 Due to large amount of growth forecast in Truro and close proximity to the Strategic Road Network, it is important that the model is a good representation of the existing traffic flow on the A30 corridor in the vicinity of Truro. It has been shown that the modelled traffic flow on the A30 validates well.

Traffic Patterns and Congestion at Key Junctions

10.4.6 A number of key junctions in and around Truro have been identified, and the representation of these junctions in the model has been evaluated by validating turning flows at each junction.

10.4.7 The A30 junctions at Chiverton Cross and Chybucca both carry large traffic volumes during the peak periods and are important as they integrate Truro-based traffic with wider north-south traffic on the strategic A30 corridor. The modelled turning flows at the A30 junctions Chiverton Cross and Chybucca validate satisfactorily, and existing delay to turn right to the B3284 towards Shortlanesend in the AM peak is also evident. As a result it is considered that the model is fit for purpose in these locations.

10.4.8 Along the A390 corridor, modelled turning flows at Threemilestone roundabout have been shown to validate well and the model also includes a good representation of present day traffic congestion at this junction, particularly on the eastbound entry from the A390 and the northbound entry for Chyvelah Road. Just off the corridor, turning flows at the mini-roundabout adjacent to Threemilestone roundabout also validate well.

10.4.9 Further east along the A390 corridor, the Maiden Green and Treliske roundabout junctions have a good standard of validation except for turns to the College at Maiden Green and turns to and from the Hospital at Treliske, which are higher than observed. It is considered that this is related to the amalgamation of Park and Ride usage into the model prior to calibration and validation.

10.4.10 Within Truro the A390 junctions at County Hall, Arch Hill, Fairmantle Street and Union Hill have also been validated.

10.4.11 The representation of Dalvenie roundabout in the model is good except for a low eastbound flow along the A390 in the PM peak due to required capacity restraint upstream on the A390. Fairmantle Street roundabout has good validation on the dominant north-south movements on the A390, although has low turning flow into Newham Road in the AM peak. Despite these minor issues, both junctions are considered to be fit for purpose.

10.4.12 The Arch Hill junction has an acceptable level of validation on a majority of turning movements, however the modelled flow entering the junction from Morlaix Avenue is particularly low in the AM peak. It is considered that this is likely to be an issue with the observed data used for validation because flow exiting Fairmantle Street upstream validates satisfactorily.

10.4.13 A good representation of all of the turning movements at the Union Hill junction has been difficult to achieve, however the model does appear to represent existing delay at the junction reasonably well. The straight ahead movements through the junction on the A390 validate well in both directions, however traffic flow turning from Newquay Road to Tregolls Road in the AM peak, and vice versa in the PM peak, does not validate well because the modelled delays deter traffic away from the junction onto alternative routes such as Trevithick Road and Bodmin Road. Whilst it is understood that this does occur to some extent at peak times, it has not been possible to capture the correct interaction between Bodmin Road and Tregolls Road in the model whilst maintaining realistic levels of delay at the Union Hill junction.

10.5 Summary of Model Strengths

- Good representation of inbound and outbound to/from Truro in AM and PM peaks respectively.
- Robust balance of traffic across all inbound and outbound routes to/from Truro during peak periods.
- Good representation of the traffic flows and journey times on the A390 corridor to the west of Truro which is important in the context of proposed future development.
- Satisfactory validation for a majority of turning movements at key junctions along the A390 within, and in the vicinity of Truro.
- Existing congestion hotspots are evident in model, particularly at Threemilestone roundabout, Chybucca crossroads and Union Hill signals.

10.6 Conclusion

This report has demonstrated that the model is fully converged and validates to DMRB standards, and it is considered that the model is fit for the purpose of assessing future development to the west of Truro and testing future transportation strategies for Truro.

FIGURES

KEY:

Area covered by the traffic model

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Local Model Validation Report

TITLE

Extent of Modelled Area

DATE

January 2012

SCALE

Not to scale

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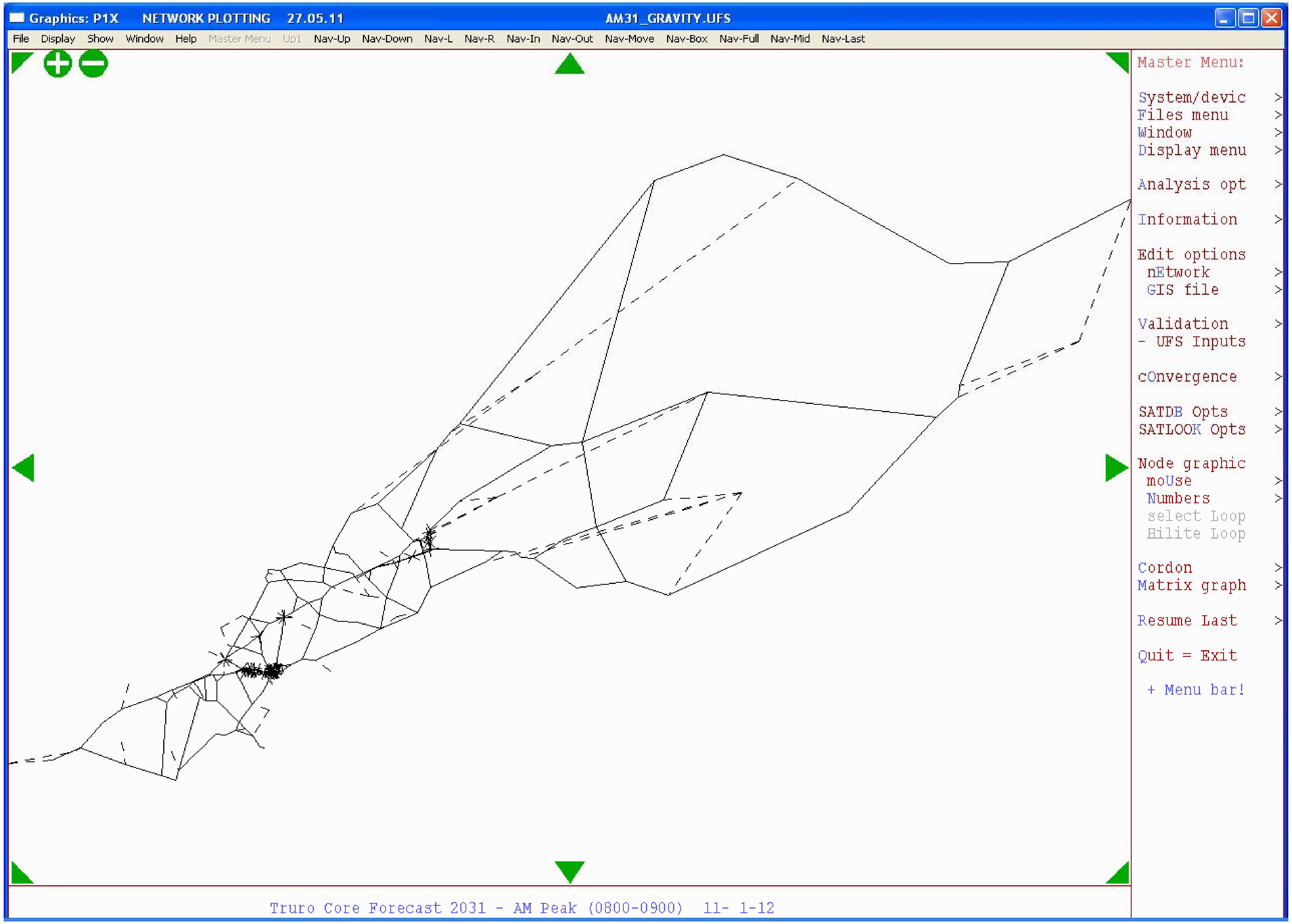
Figure 1



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Local Model Validation Report

TITLE
Modelled Network - Wider Area

DATE	PRODUCED BY
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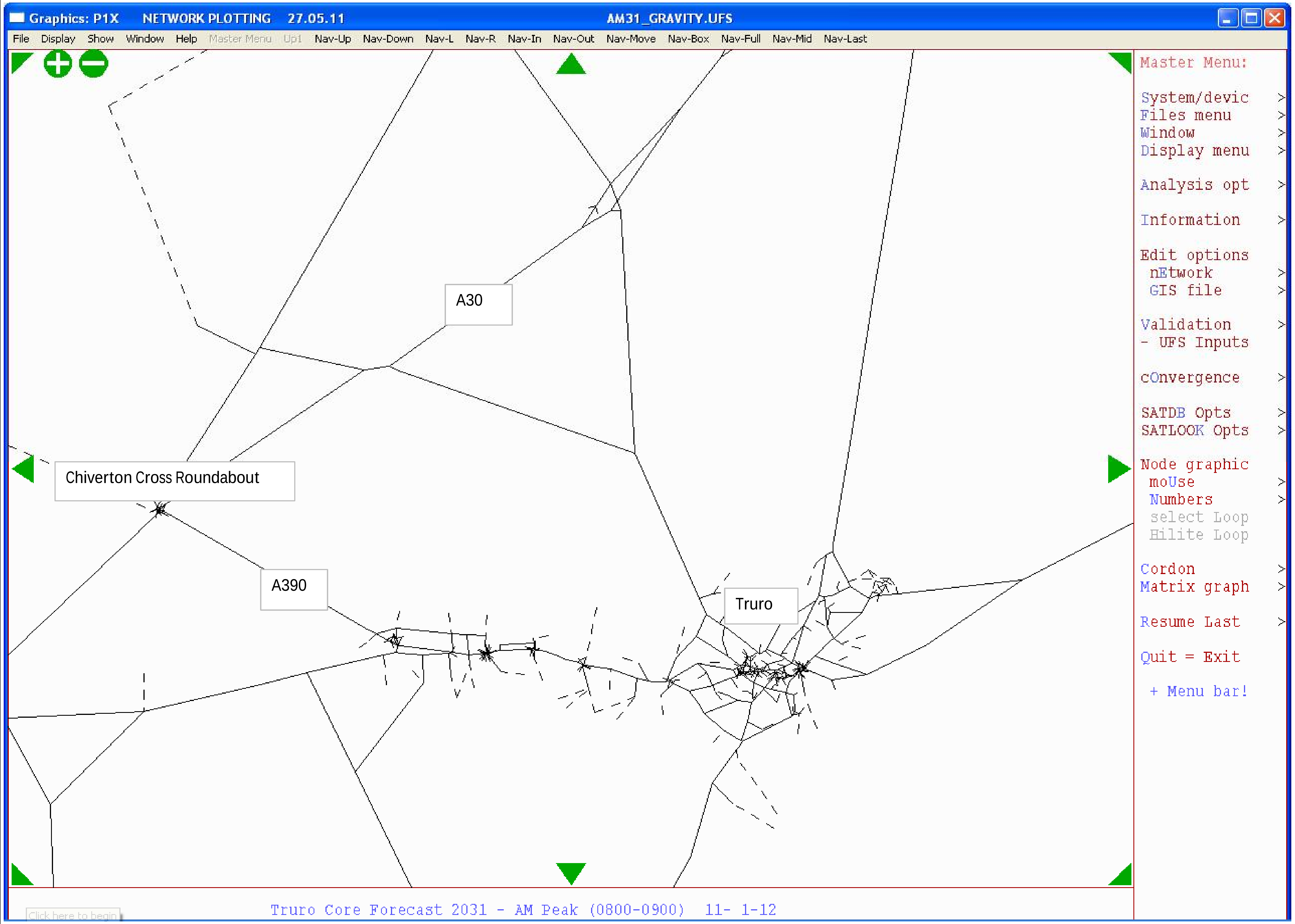
Figure 2a



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Local Model Validation Report

TITLE
Modelled Network - Detailed Area

DATE	PRODUCED BY
January 2012	**CMa**
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SCALE	**ND**
Not to scale	APPROVED
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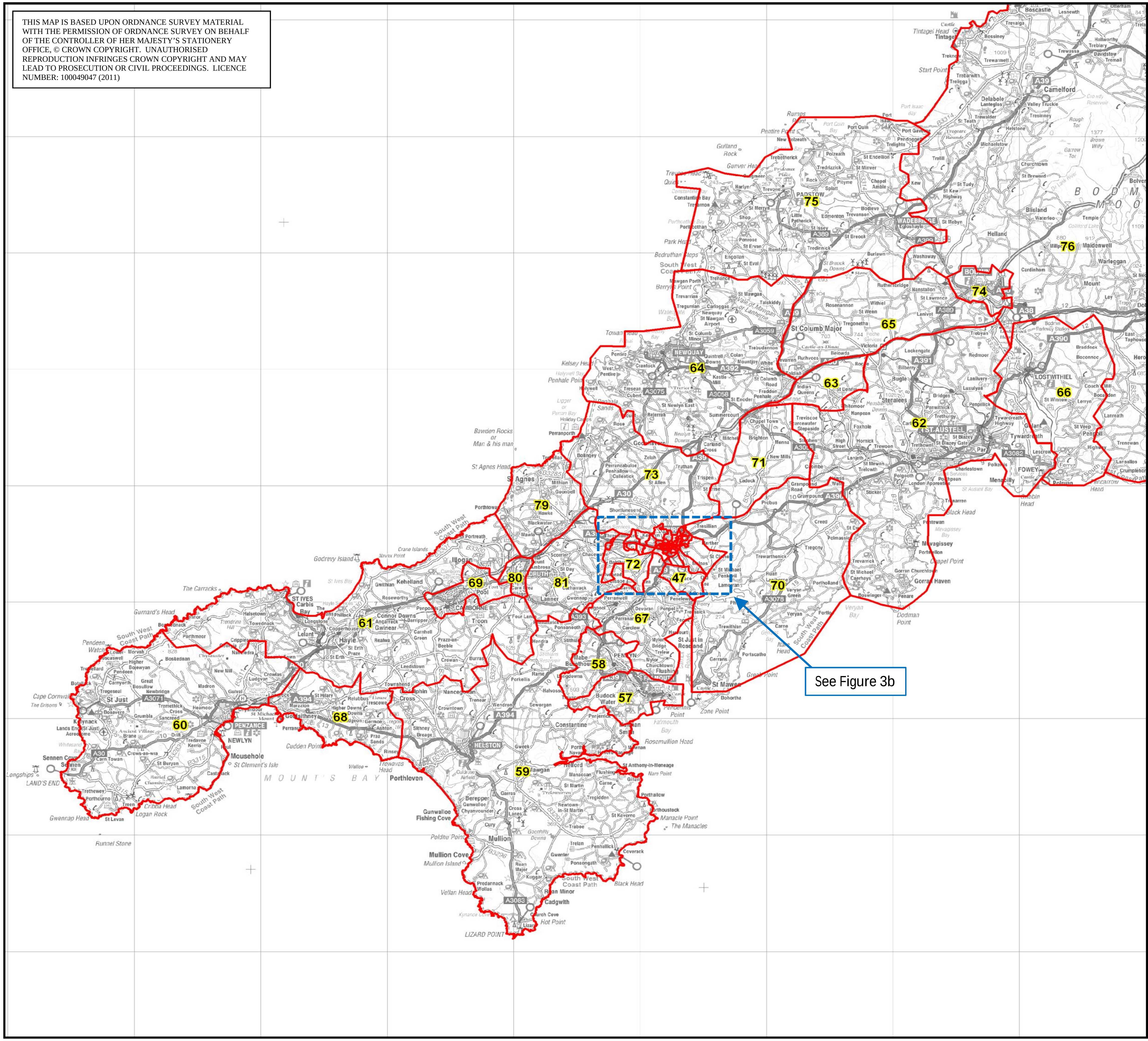
Figure 2b



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Local Model Validation Report

TITLE

Zone System - Wider Area

DATE	PRODUCED BY
October 2011	**NN**
	CHECKED
SCALE	**ND**
Not to scale	APPROVED
	IB

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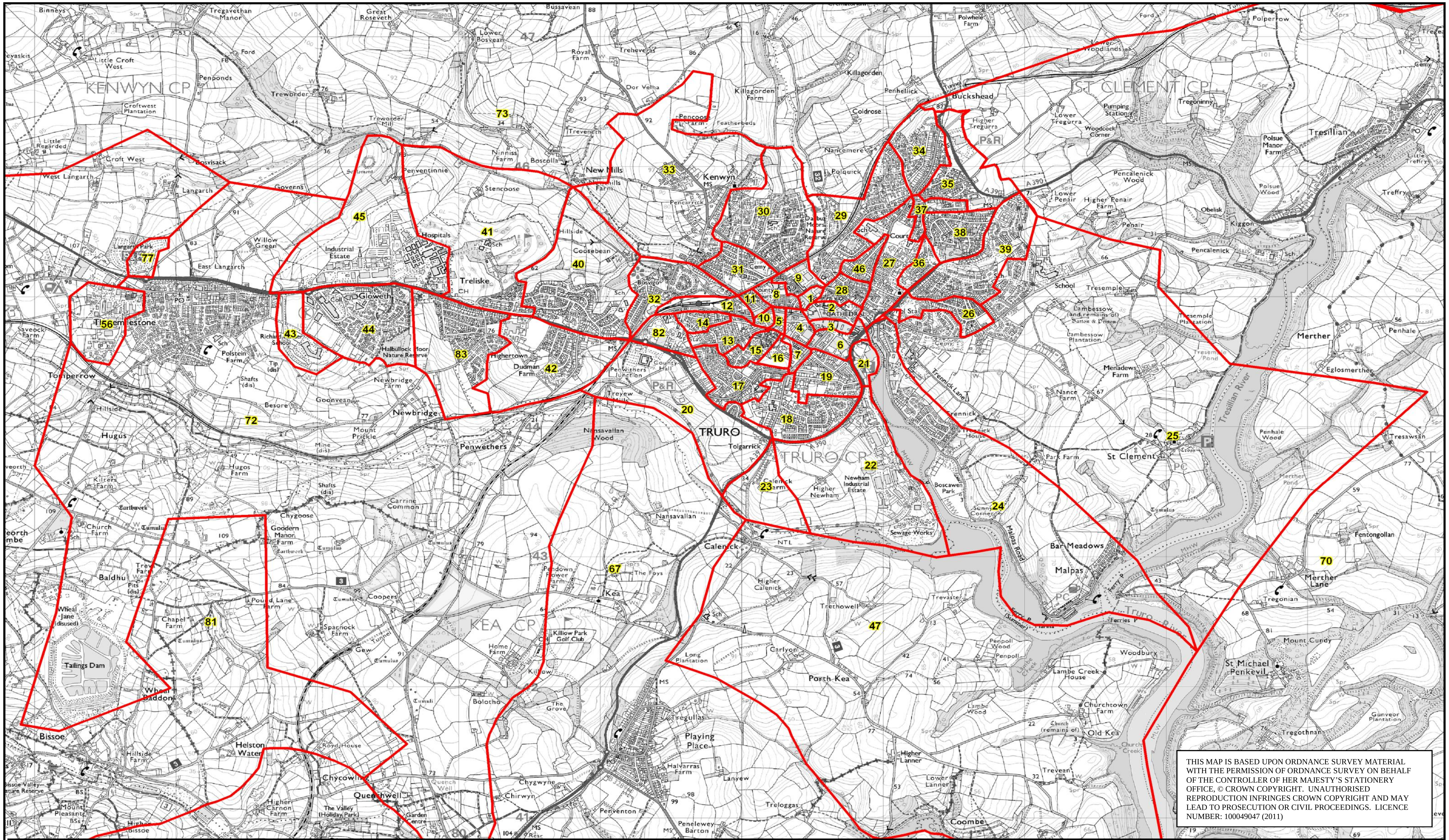
Figure 3a



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Truro Sustainable Transport Strategy - Forecasting Report

TITLE

Zone system - Truro area

DATE
February 2012

SCALE
Not to scale

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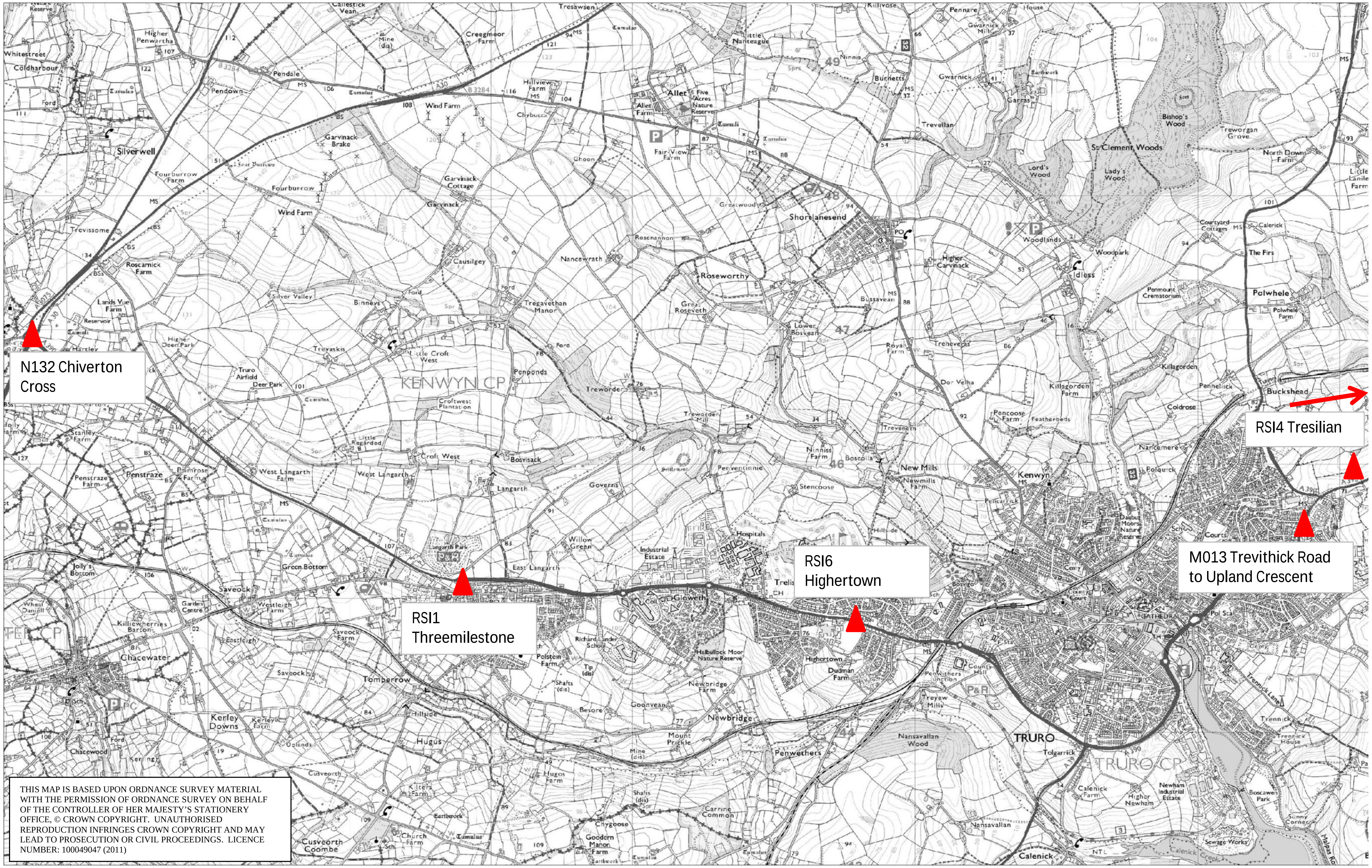
IB

Figure 3b



Link Count

Junction Turn Count

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Local Model Validation Report

TITLE
A390 Traffic Count Locations

DATE
January 2012

SCALE
Not to scale

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ND

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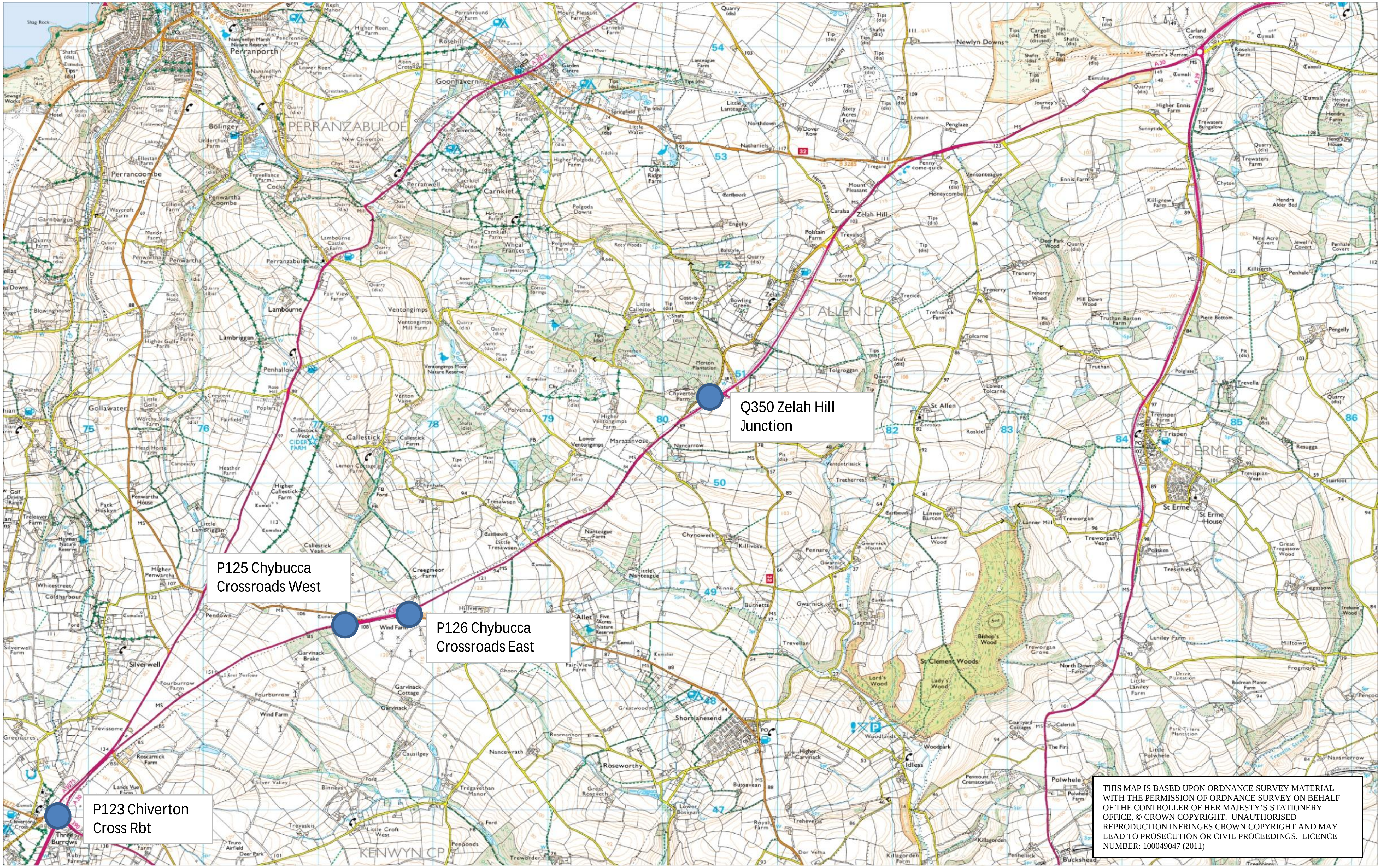
IB

Figure 4a



Link Count

Junction Turn Count

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Local Model Validation Report

TITLE
A30 Traffic Count Locations

DATE
January 2012

SCALE
Not to scale

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CMa

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ND

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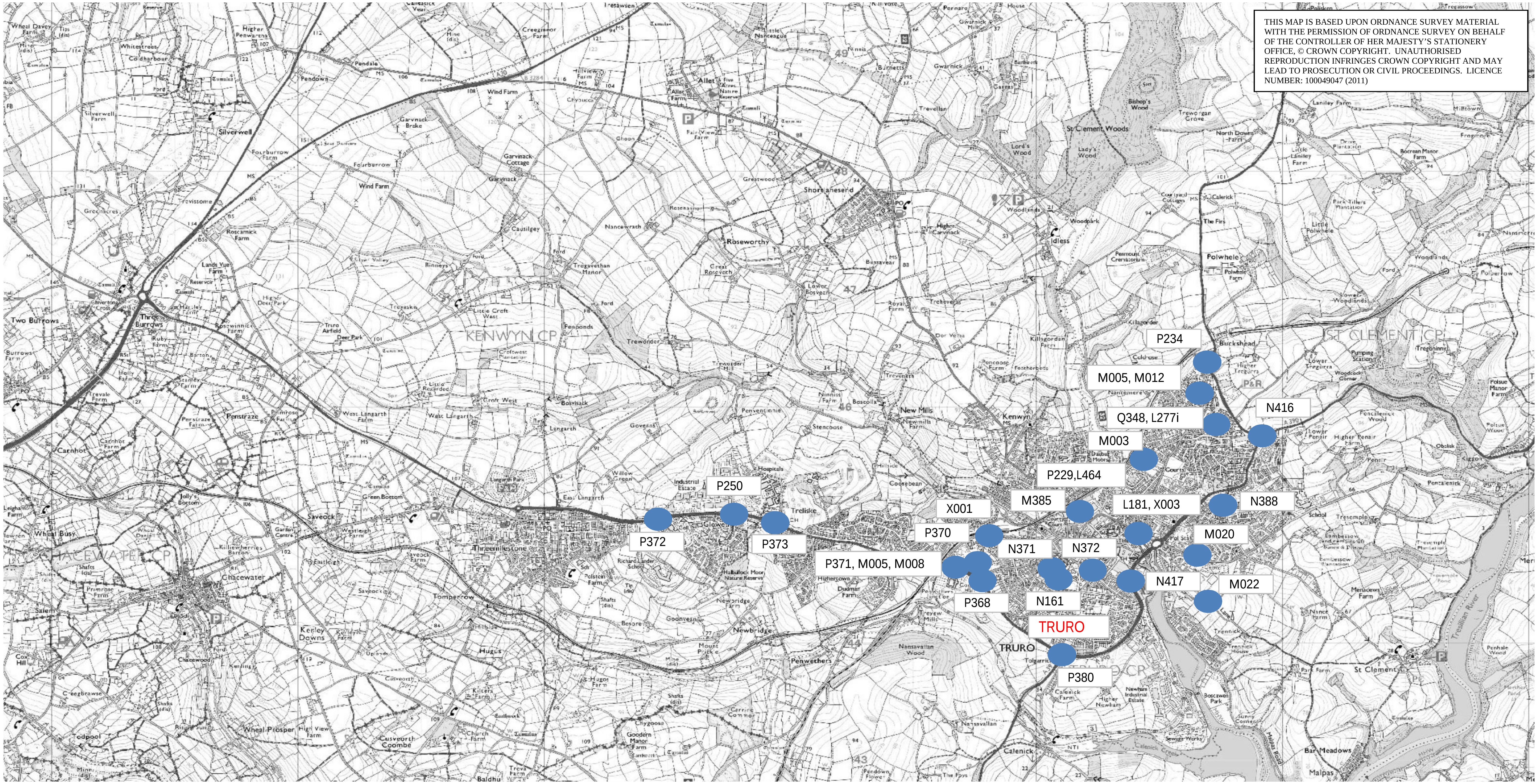
IB

Figure 4b



KEY:

Traffic Count Site Location

Site Reference M470

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Local Model Validation Report

TITLE

Truro Urban AreaTraffic Count Locations

DATE
January 2012

SCALE
Not to scale

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ND

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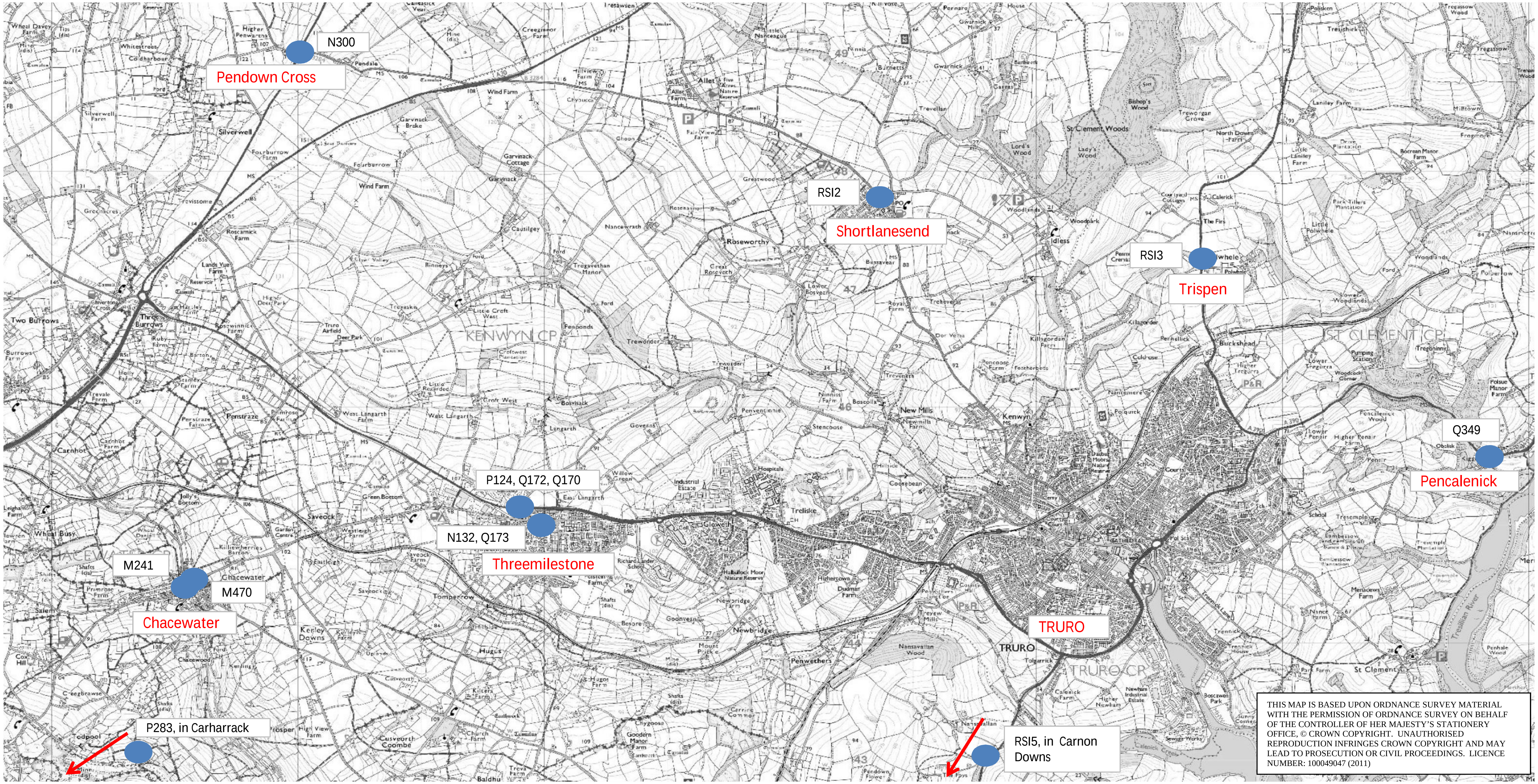
IB

Figure 4c



KEY:

Traffic Count Site Location

Site Reference M470

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TITLE
Wider Area Traffic Count Sites

DATE
January 2012

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Not to scale

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Figure 4d

KEY:

RSI Site Location ●

CLIENT
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TITLE
Location of Truro Roadside Interview Sites

DATE
November 2011

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Not to scale

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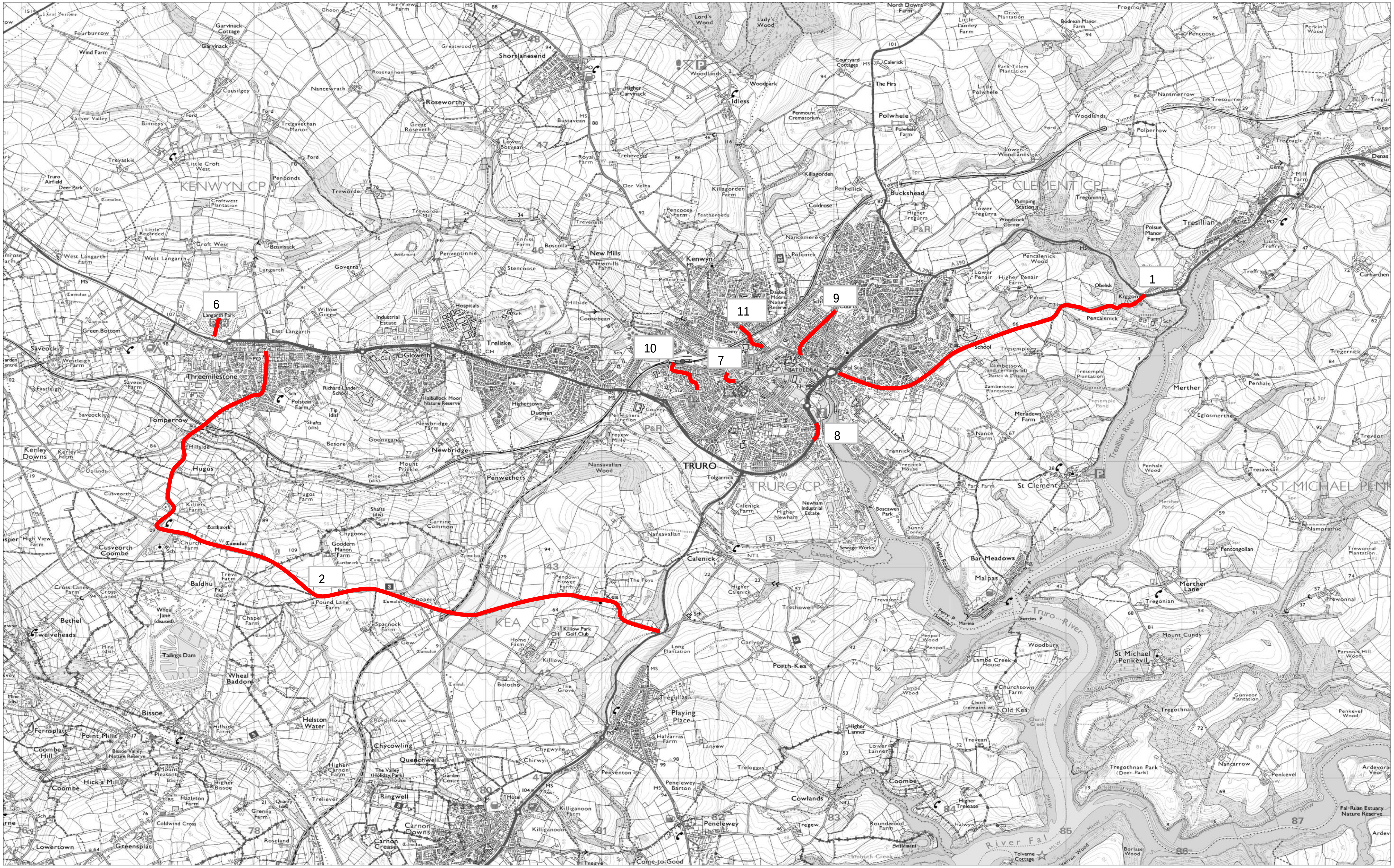
Figure 5



2 Link Reference Number

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TITLE
Links Added to Model - Truro

DATE
January 2012

SCALE
Not to scale

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CMa

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ND

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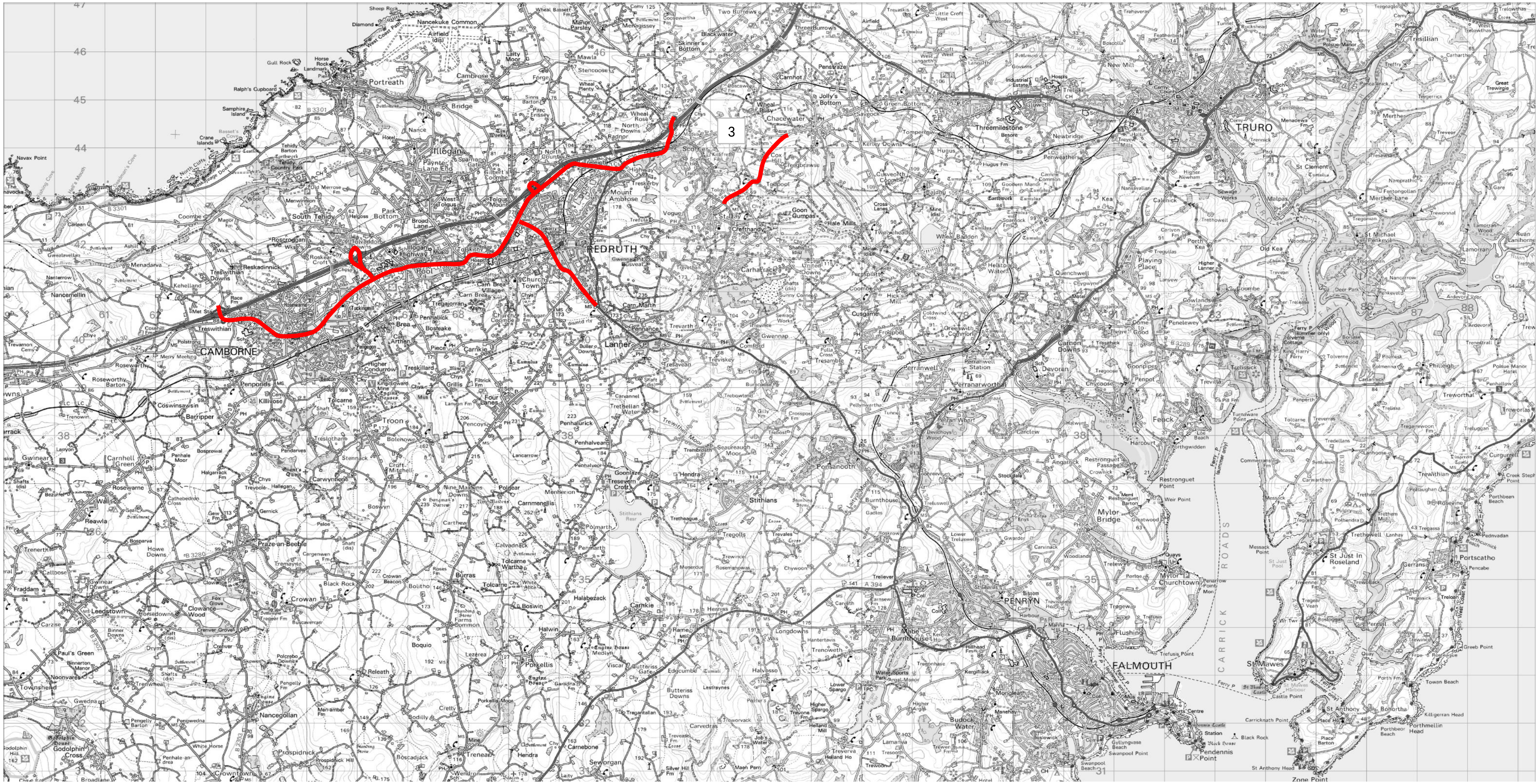
IB

Figure 6a



2 Link Reference Number

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TITLE
Links Added to Model - Redruth

DATE
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SCALE
Not to scale

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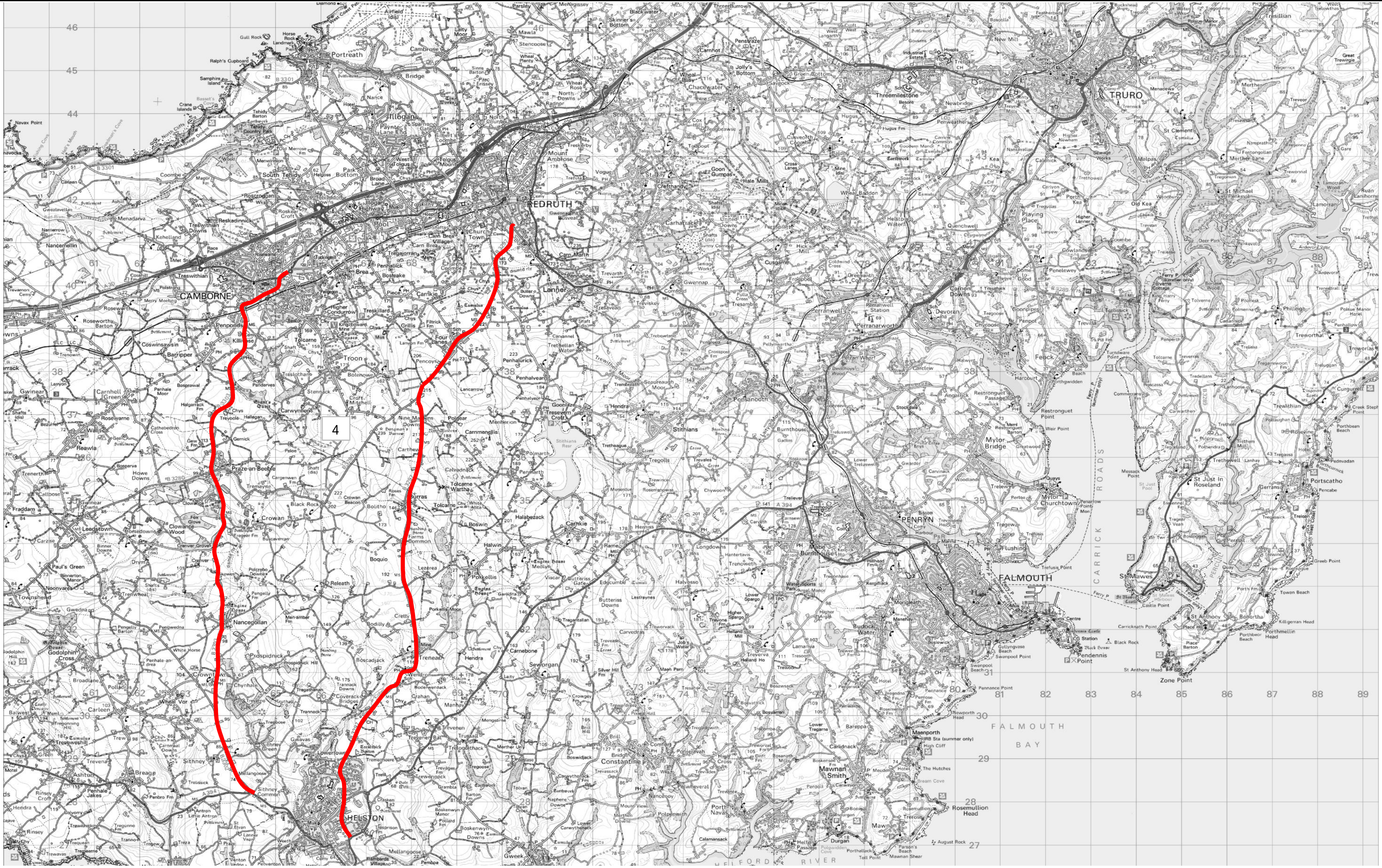
IB

Figure 6b



2	Link Reference Number

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Truro Area Transport Modelling
Local Model Validation Report

TITLE
Links Added to Model - Camborne

DATE
January 2012

SCALE
Not to scale

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ND

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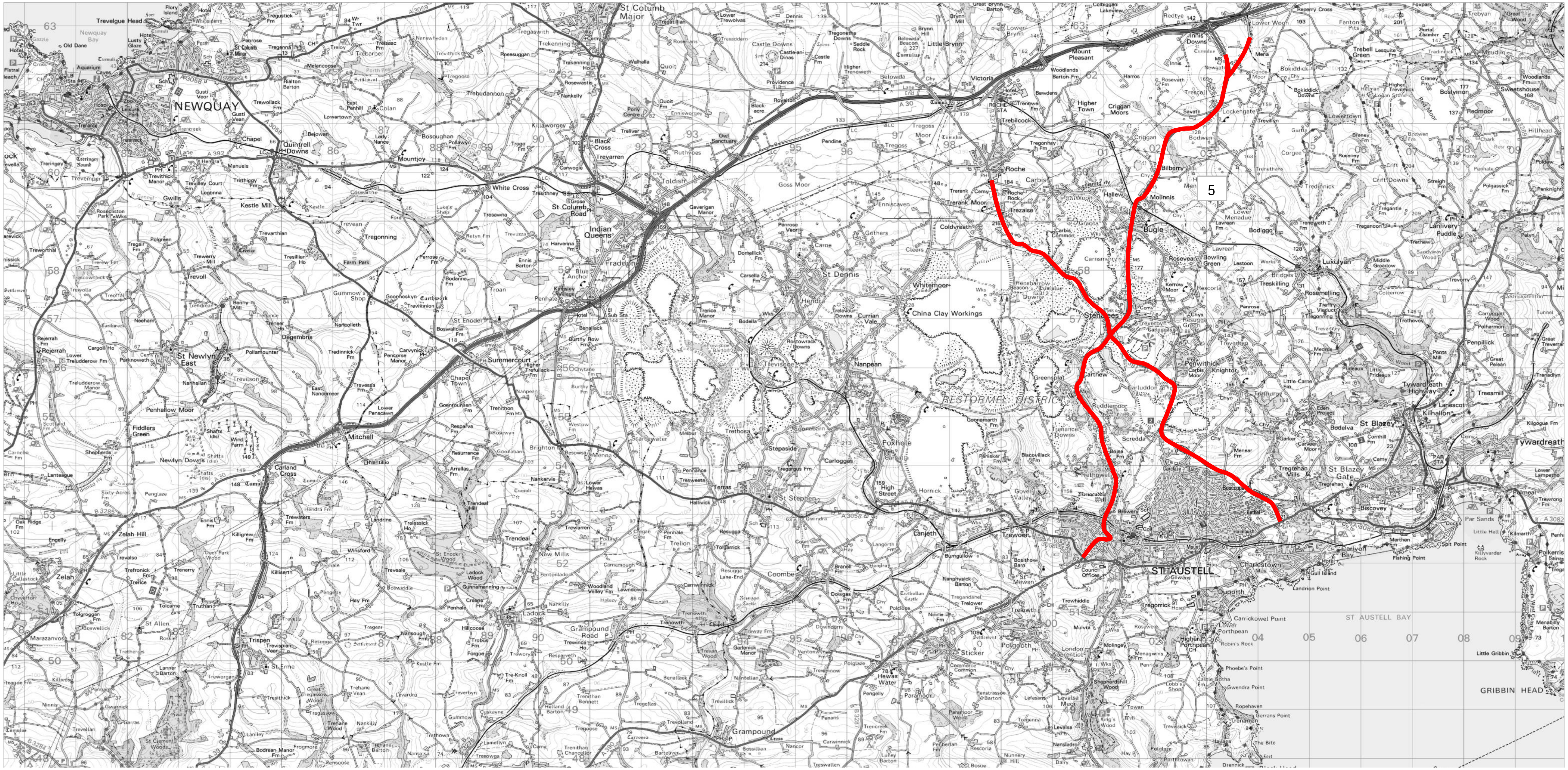
Figure 6c



2 Link Reference Number

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CLIENT/PROJECT
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Local Model Validation Report

TITLE
Links Added to Model - St Austell

DATE
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SCALE
Not to scale

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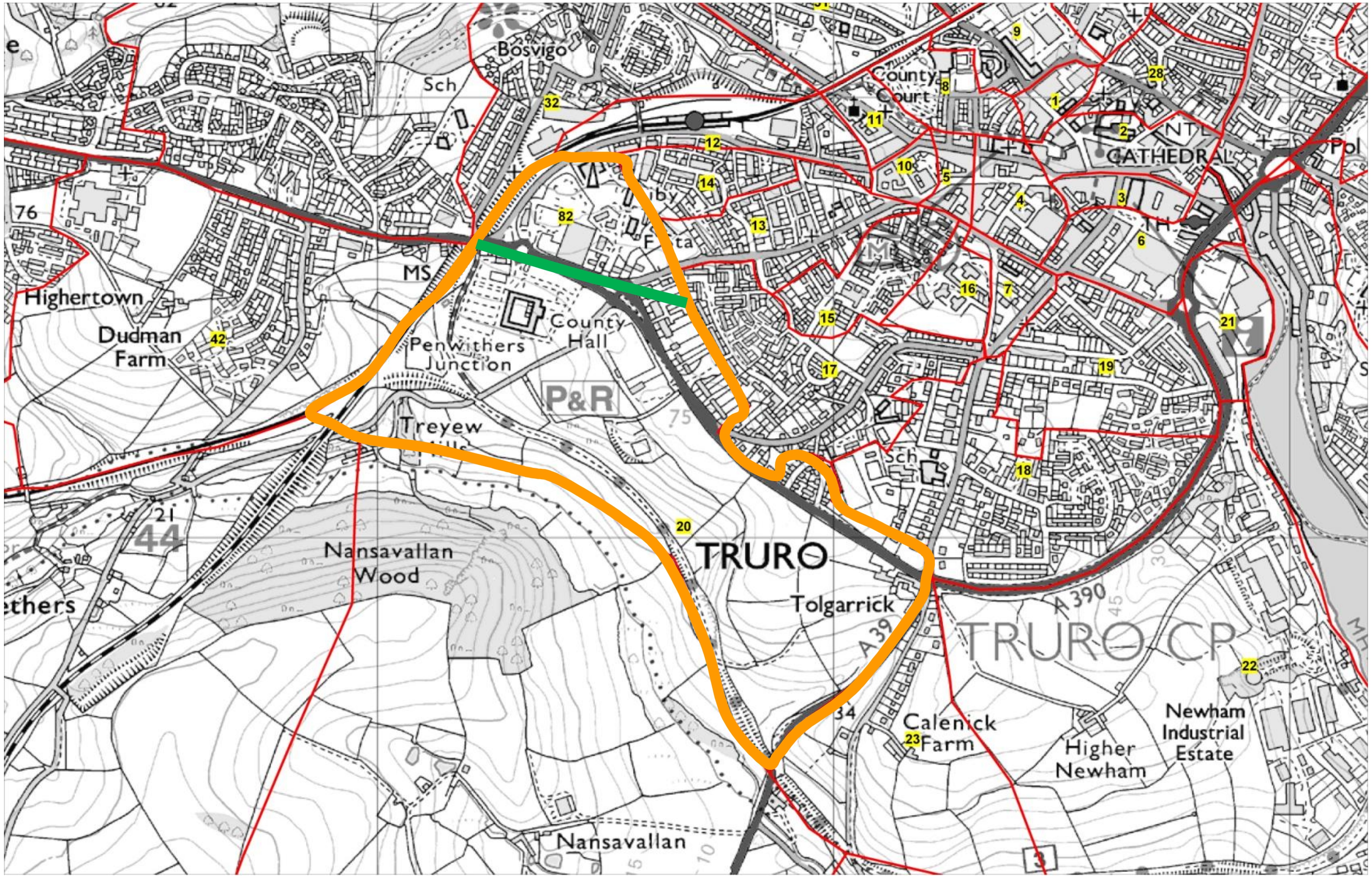
IB

Figure 6d



KEY:

Original Zone Boundary

Location of Zonal Split

CLIENT
Cornwall Council

PROJECT
Truro Area Transport Modelling Local Model Validation Report

TITLE
Split of Internal Model Zone 20

DATE
January 2012

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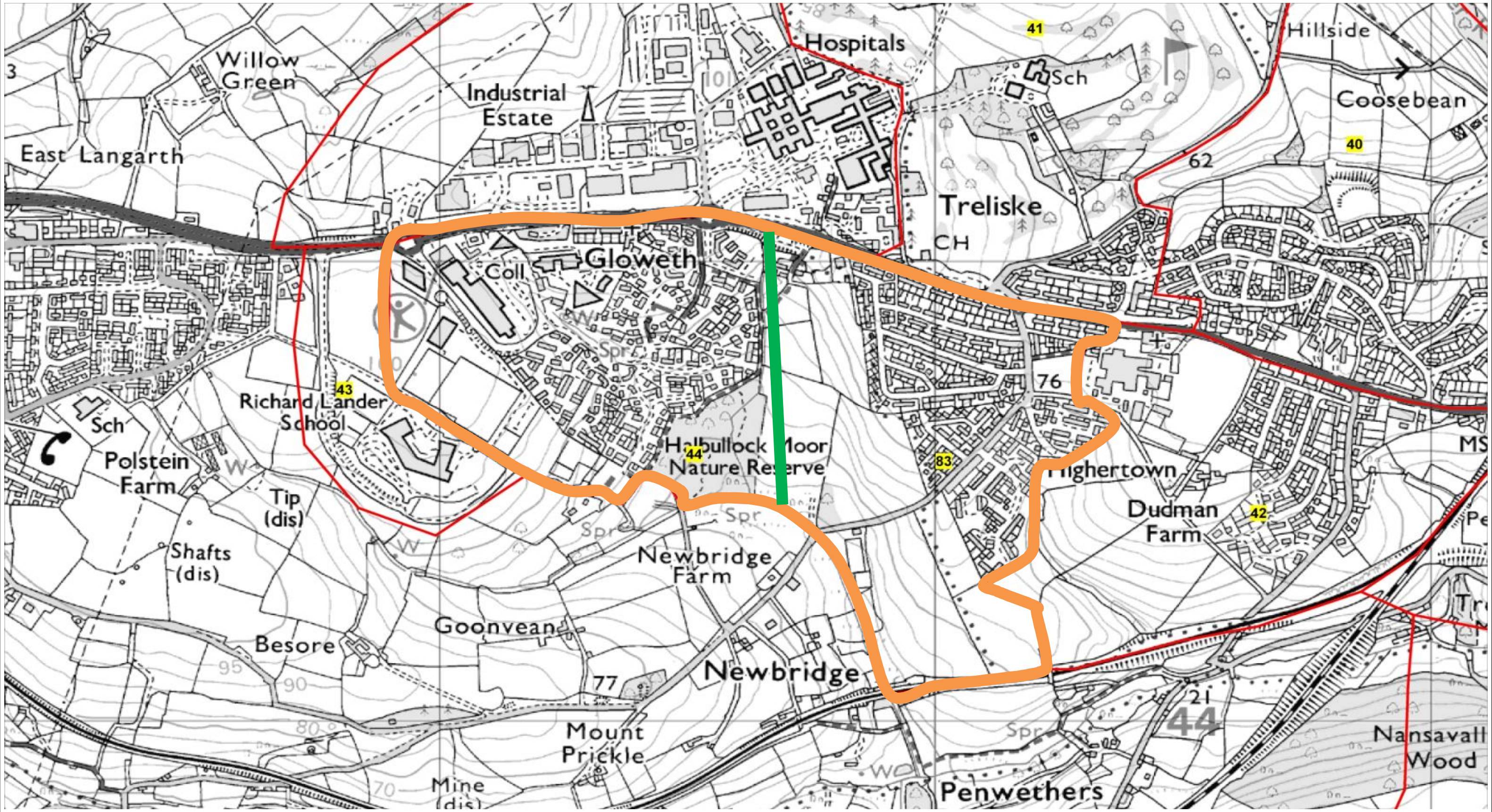
Figure 7



KEY:

Original Zone Boundary

Location of Zonal Split

CLIENT
Cornwall Council

PROJECT
Truro Area Transport Modelling Local Model Validation Report

TITLE
Split of Internal Model Zone 44

DATE
January 2012

SCALE
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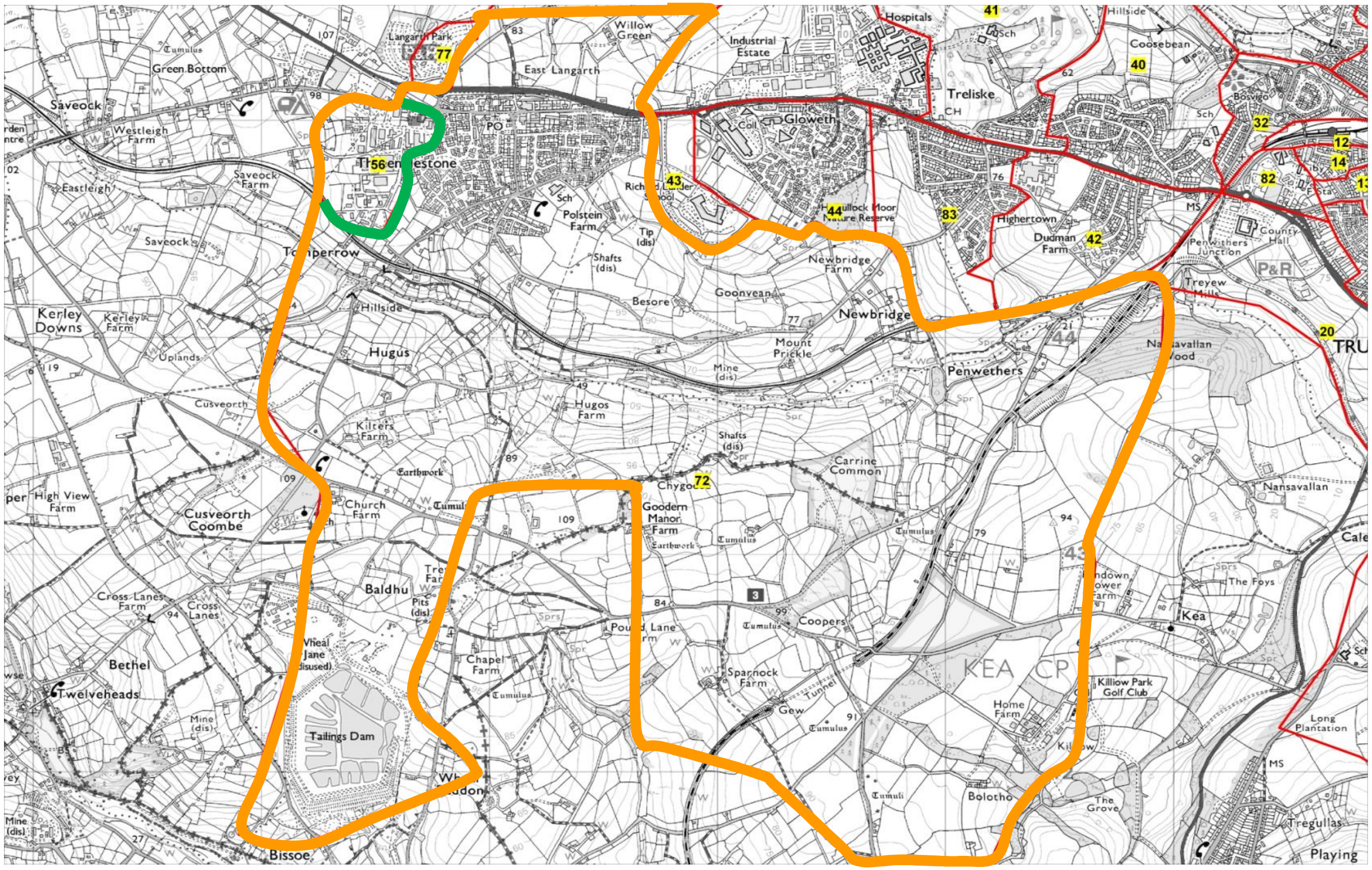
Figure 8



KEY:

Original Zone Boundary

Location of Zonal Split

CLIENT
Cornwall Council

PROJECT
Truro Area Transport Modelling Local Model Validation Report

TITLE
Split of Internal Model Zone 72

DATE
January 2012

SCALE
Not to scale

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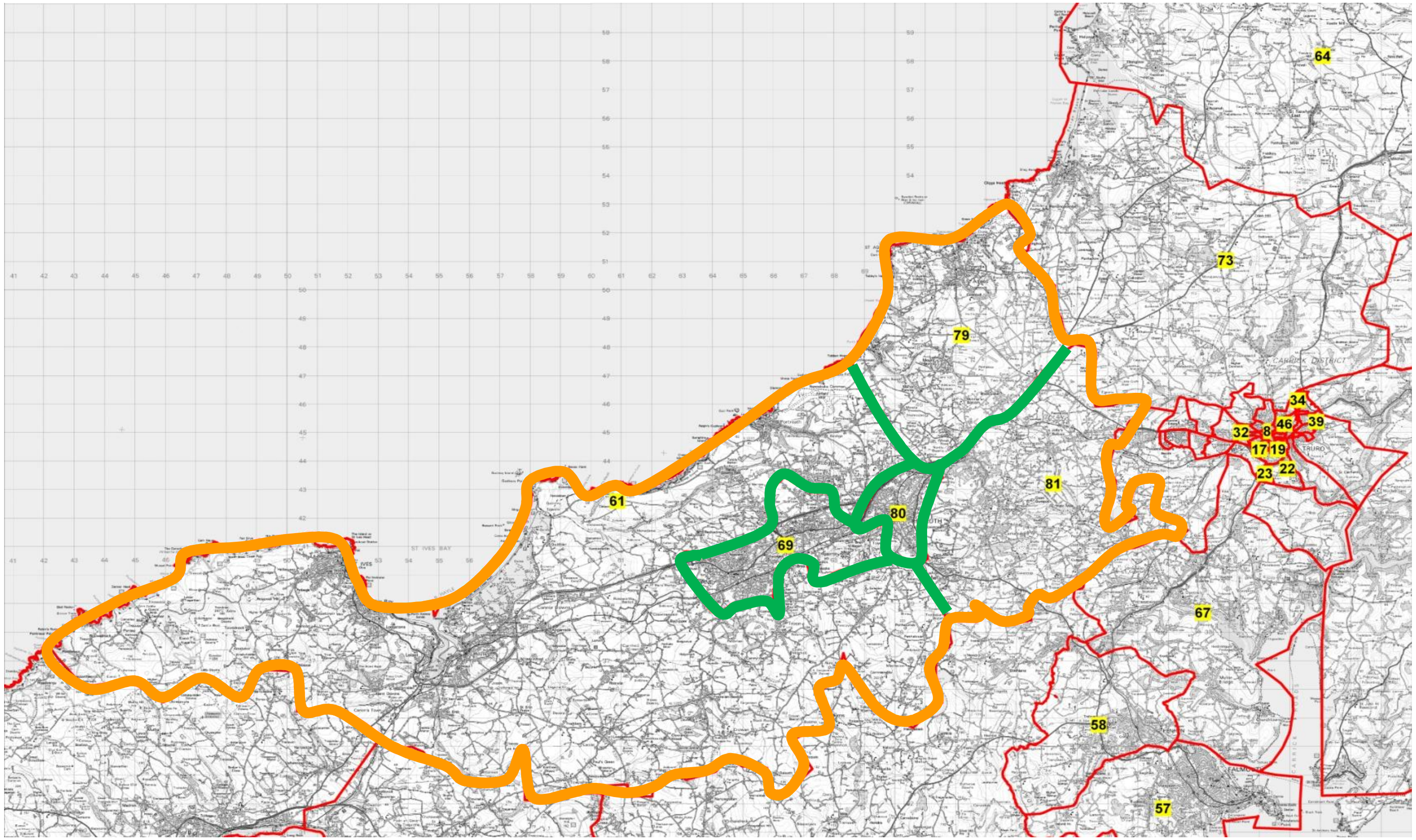
Figure 9



KEY:

Original Zone Boundary

Location of Zonal Split

CLIENT
Cornwall Council

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Truro Area Transport Modelling Local Model Validation Report

TITLE
Split of Internal Model Zone 61

DATE
January 2012

SCALE
Not to scale

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Figure 10

KEY:

Two Way Movement (blue triangle)

One Way Movement (red triangle)

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Truro Area Transport Modelling Local Model Validation Report

TITLE
Traffic Survey Link Data Used for Model Calibration

DATE
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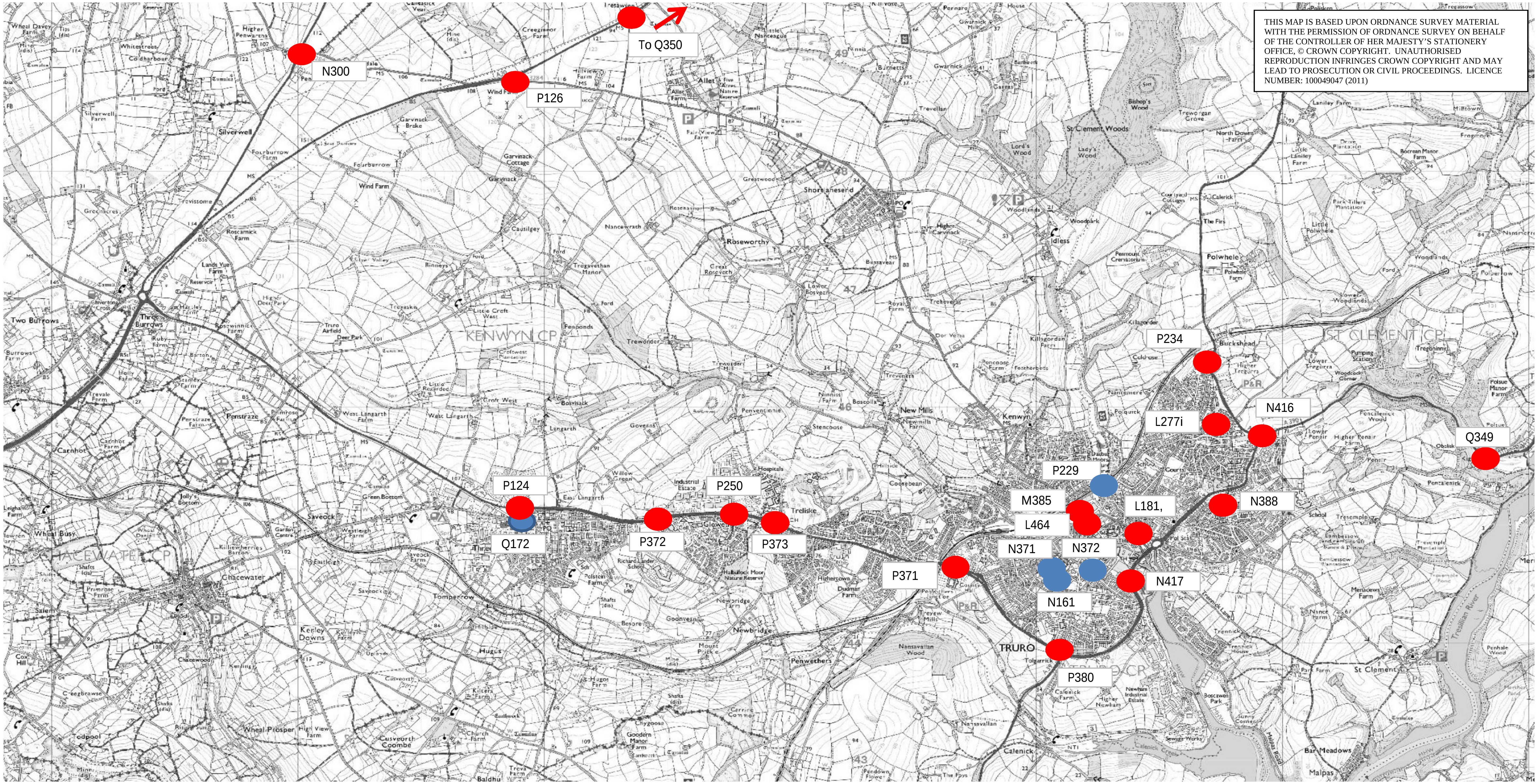
Figure 13a



KEY:

All movement turn count

Partial movement turn count

Site Reference M470

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Local Model Validation Report

TITLE

Traffic Survey Turn Count Data Used for Model Calibration

DATE
January 2012

SCALE
Not to scale

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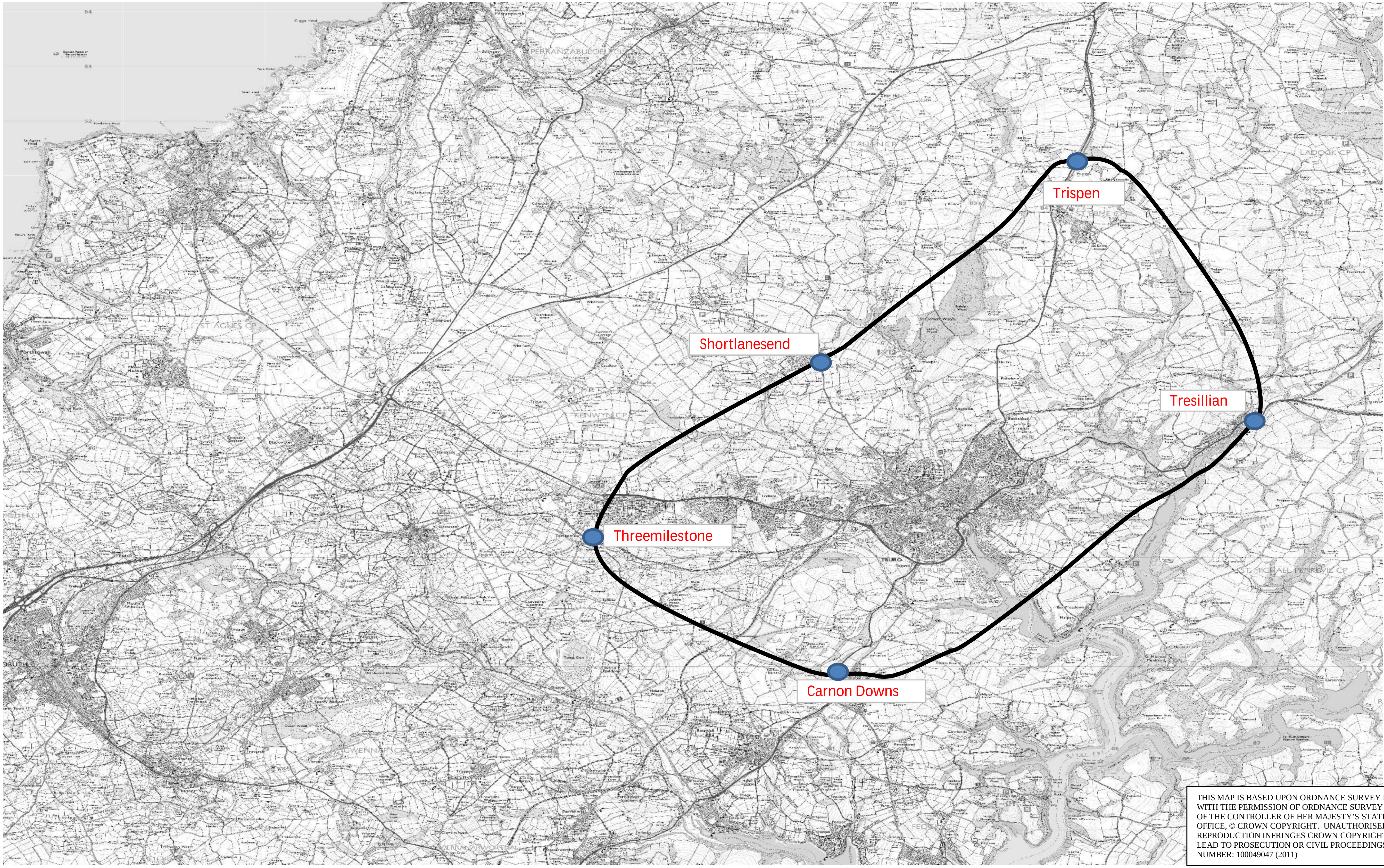
Figure 13b



KEY:

Cordon Boundary

Cordon Intersection Point

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Truro Area Transport Modelling
Local Model Validation Report

TITLE
Cordon Around Truro

DATE
November 2011

SCALE
Not to scale

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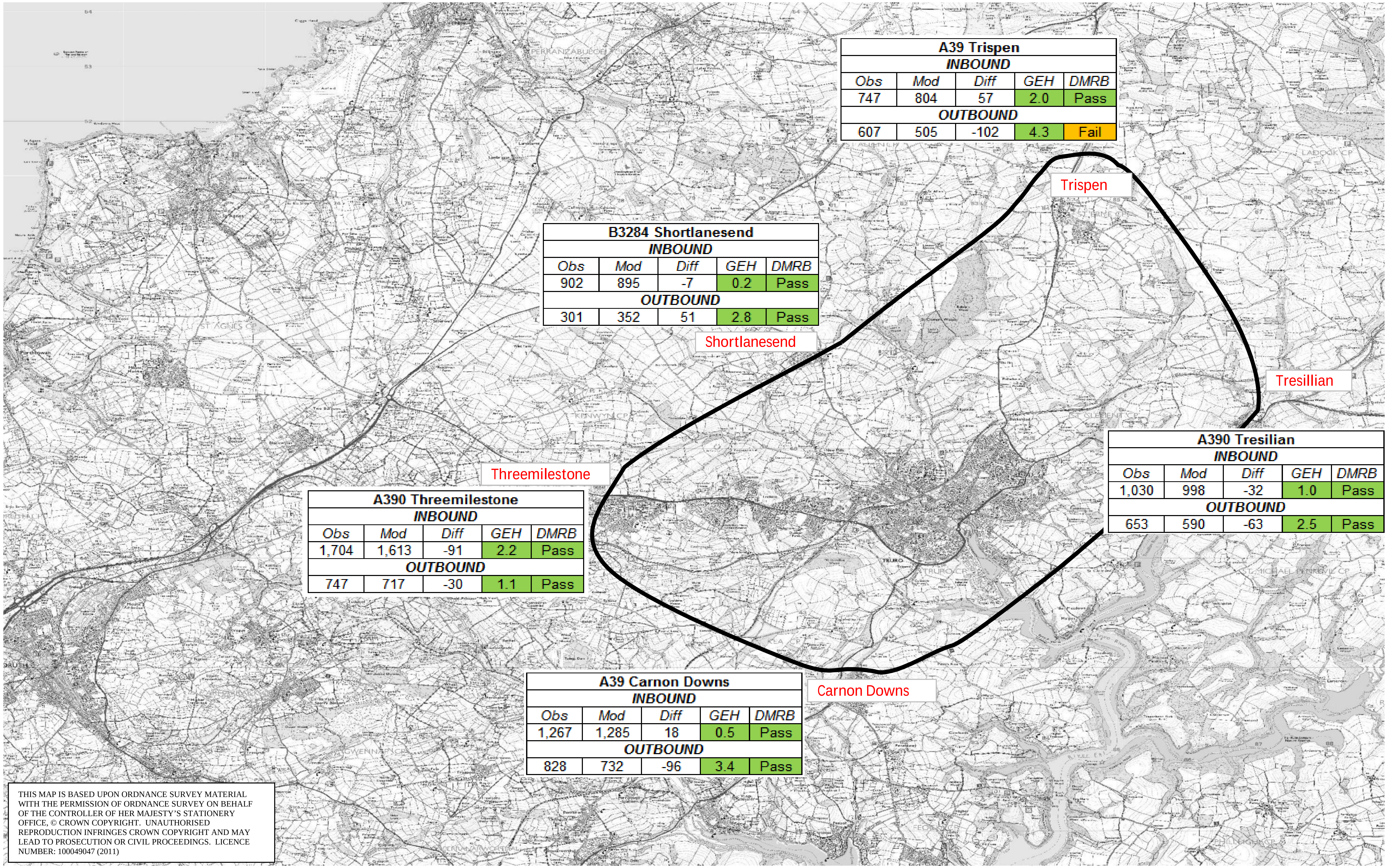
Figure 14



A39 Trispen				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
747	804	57	2.0	Pass
OUTBOUND				
607	505	-102	4.3	Fail

B3284 Shortlanesend				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
902	895	-7	0.2	Pass
OUTBOUND				
301	352	51	2.8	Pass

A390 Tresilian				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
1,030	998	-32	1.0	Pass
OUTBOUND				
653	590	-63	2.5	Pass

A390 Threemilestone				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
1,704	1,613	-91	2.2	Pass
OUTBOUND				
747	717	-30	1.1	Pass

A39 Carnon Downs				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
1,267	1,285	18	0.5	Pass
OUTBOUND				
828	732	-96	3.4	Pass

KEY:

Cordon Boundary

Traffic Flows Presented in PCU's

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Local Model Validation Report

TITLE

Cordon Validation Results - AM

DATE **January 2012**

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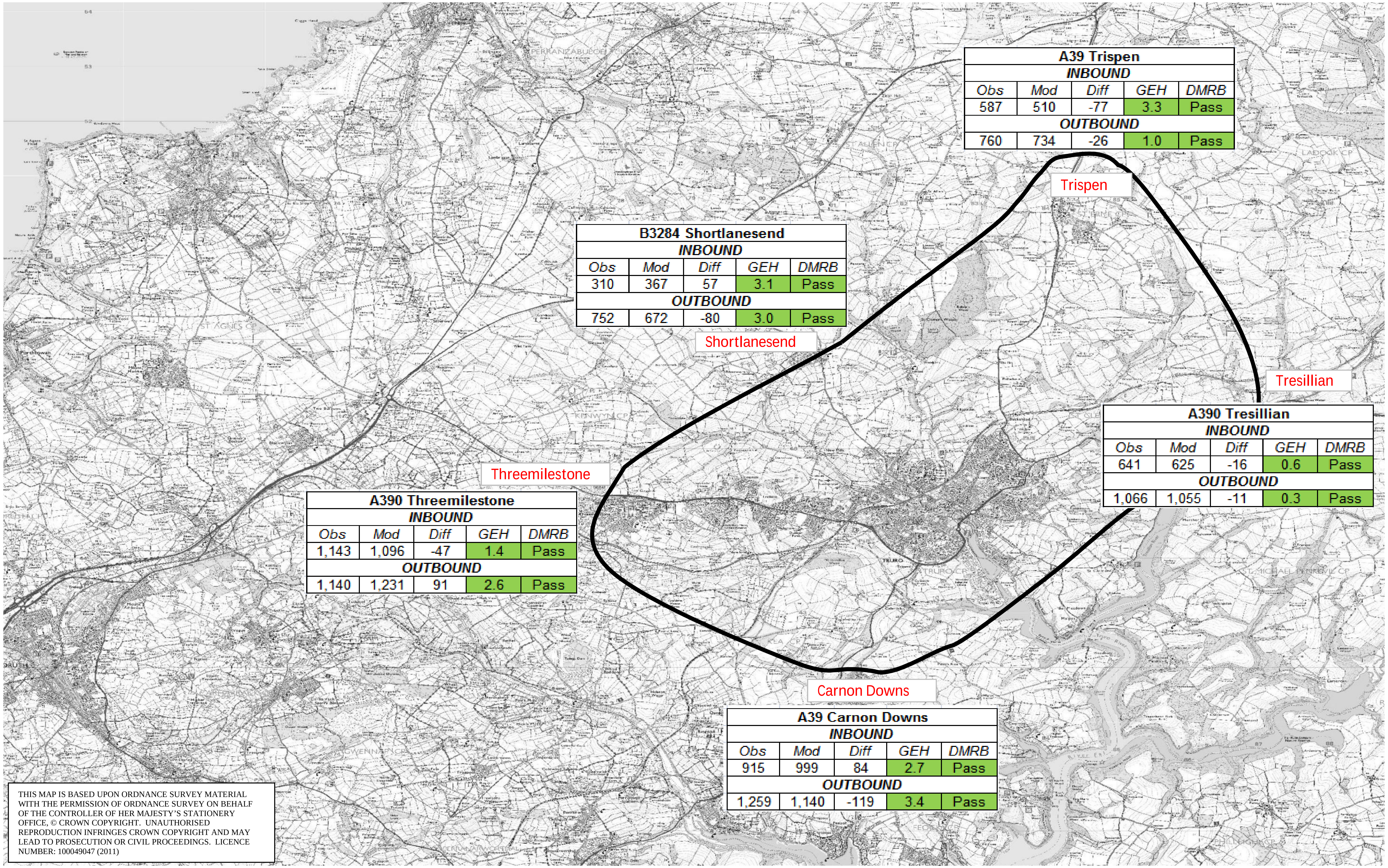
Figure 15



A39 Trispen				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
587	510	-77	3.3	Pass
OUTBOUND				
760	734	-26	1.0	Pass

B3284 Shortlanesend				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
310	367	57	3.1	Pass
OUTBOUND				
752	672	-80	3.0	Pass

A390 Tresillian				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
641	625	-16	0.6	Pass
OUTBOUND				
1,066	1,055	-11	0.3	Pass

A390 Threemilestone				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
1,143	1,096	-47	1.4	Pass
OUTBOUND				
1,140	1,231	91	2.6	Pass

A39 Carnon Downs				
INBOUND				
Obs	*Mod*	*Diff*	*GEH*	*DMRB*
915	999	84	2.7	Pass
OUTBOUND				
1,259	1,140	-119	3.4	Pass

KEY:

Cordon Boundary

Traffic Flows Presented in PCU's

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Local Model Validation Report

TITLE

Cordon Validation Results - PM

DATE **January 2012**

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Figure 16

1. East of Chiverton Cross
2. Threemilestone Rbt to Maiden Green Rbt
3. Maiden Green Rbt to Treliske Rbt
4. Treliske Rbt to Newbridge Lane
5. Highertown

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Local Model Validation Report

TITLE

A390 Corridor Sections

DATE
November 2011

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Not to scale

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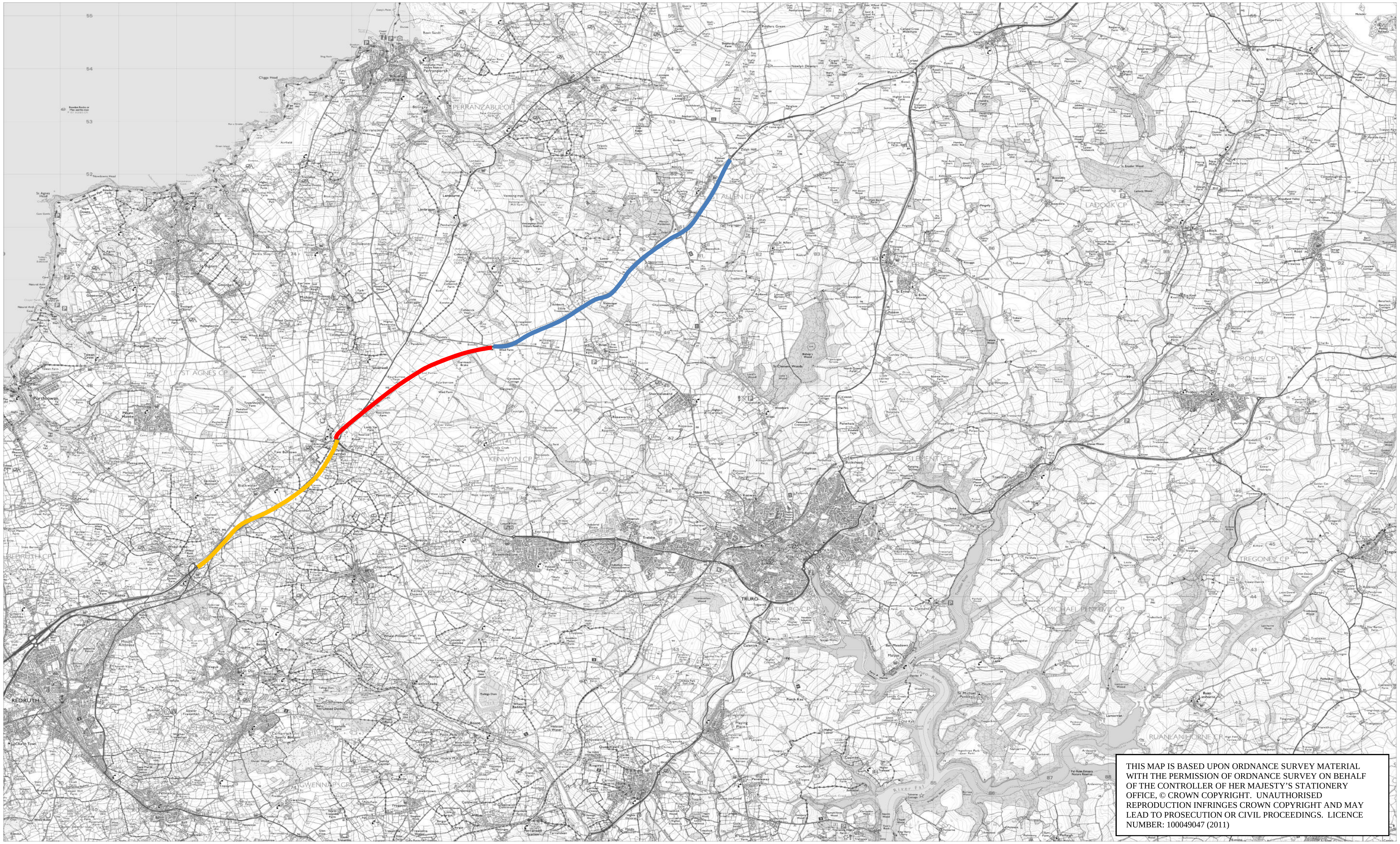
Figure 17



1. A30 Chiverton to Chybucca Crossroads
2. A30 Chybucca Crossroads to Zelah Hill
3. A30 Scorrier to Chiverton

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Local Model Validation Report

TITLE
A30 Corridor Sections

DATE **January 2012**

SCALE **Not to scale**

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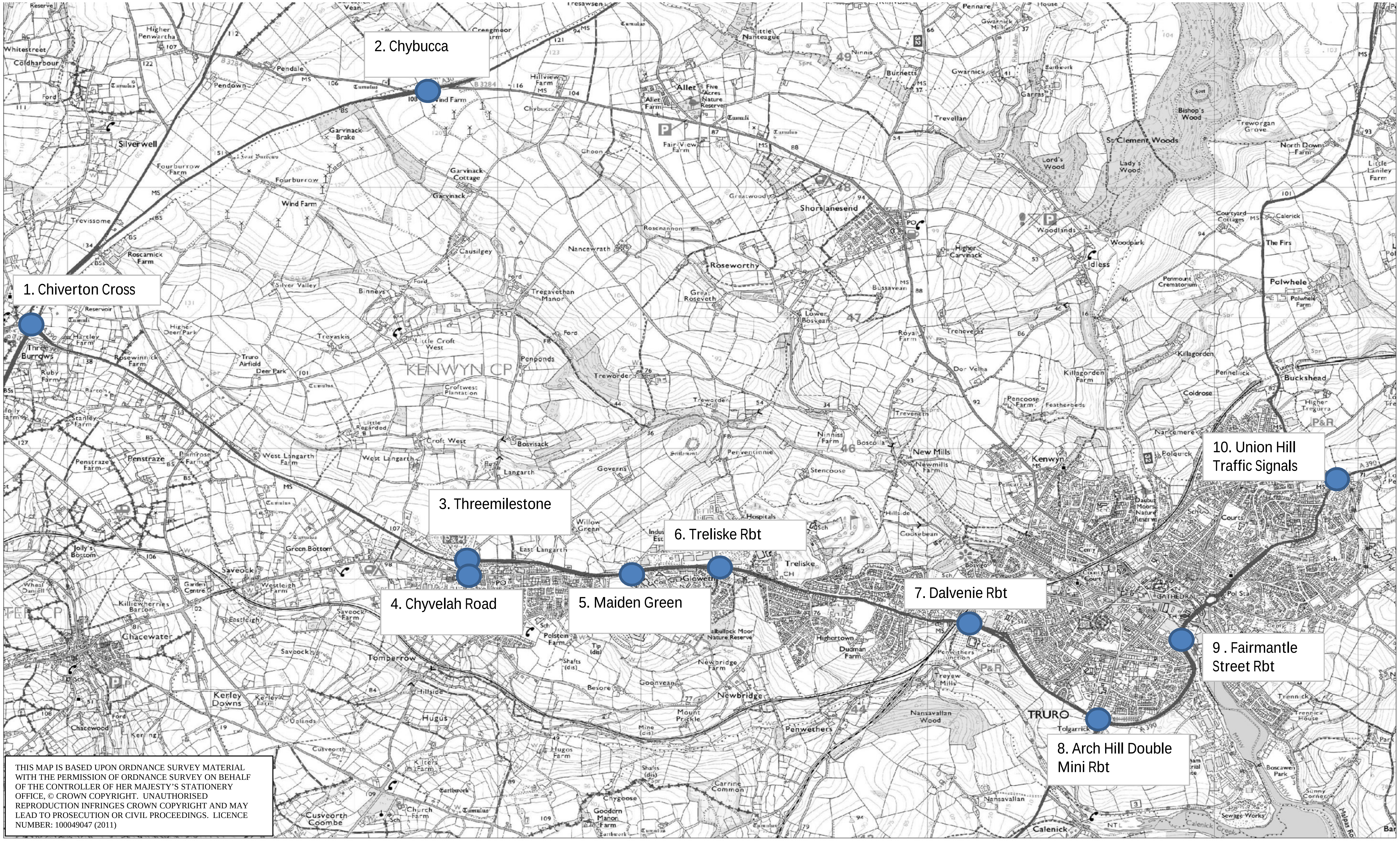
APPROVED **IB**

Figure 20



● Junction Location

PARSONS BRINCKERHOFF

Riverside Chambers, Castle Street,
Taunton, Somerset, TA1 4AP
Tel: (01823) 281190

CLIENT/PROJECT

Cornwall Council
Truro Area Transport Modelling
Local Model Validation Report

TITLE

Location of Validated Junctions

DATE
November 2011

SCALE
Not to scale

PRODUCED BY
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CHECKED
ND

APPROVED
IB

Figure 21

APPENDICES

Appendix A - Junction Turning Flow Diagrams
(to follow)