Analytical assurance statement

Analytical Assurance Statement for transport and air quality modelling.

1. Limitations of the Analysis
- Has the Analysis been constrained by time or cost, meaning further proportionate analysis has not been undertaken?
- Could the further analysis that could be done lead to different conclusions?
- Does the analysis rely on appropriate sources of evidence?
- How reliable are the underpinning assumptions?

2. Risk of Error / Robustness of the Analysis
- Has there been sufficient time and space for proportionate levels of quality assurance to be undertaken?
- Have sufficient checks been made on the analysis to ensure absence of errors in calculations?
- Have sufficiently skilled staff been responsible for producing the analysis?

3. Uncertainty
- What is the level of residual uncertainty (the level of uncertainty remaining at the end of the analysis)?

4. Use of analysis

- Does the evidence provided support the business case?
- Is there evidence the agreed target will be achieved?

1. Limitations of the Analysis

- *Has the Analysis been constrained by time or cost, meaning further proportionate analysis has not been undertaken?*

  The analysis has been constrained by time and cost to some degree. The city-wide modelling of transport and air quality of a range of options is complex and time consuming, and the project is working to a time and cost budget. However, we have made effort to ensure that the analysis provided is as robust as possible within these constraints. This has included:
    - A thorough review of modelling assumptions with key stakeholders;
    - A set of sensitivity tests to assess the robustness of the conclusions.

  Therefore, we do not believe further proportionate analysis could usefully be carried out.

- *Could the further analysis that could be done lead to different conclusions?*

  Given the level of review by external stakeholders and the sensitivity tests that have been carried out we do not believe that further analysis would lead to different conclusions.

- *Does the analysis rely on appropriate sources of evidence?*

  The work has aimed to use the best available data sources that could be collected within the time and budget available. The key data sources comprise:

- Traffic flows have been provided by the existing Sub-Regional Transport Model (SRTM) that covers the areas of Southampton, Portsmouth and South Hampshire which has been validated to 2015. SYSTRA have prepared a transport model review note for SRTM, the 'Transport modelling methodology report (T3)'. This note has been assessed by JAQU/DfT and SRTM has been approved as being 'Fit for Purpose' to assess the highway impacts of the Southampton CAZ and other air quality proposals.
- The data used to build, calibrate and validate the SRTM includes roadside interview surveys (RSIs), screenline, manual classified and automatic traffic counts, automatic number plate recognition (ANPR) and TrafficMaster data for journey times. More detailed information is included in T2 (already provided).
- Local fleet composition data was derived from an analysis of a comprehensive ANPR survey covering 18 sites across the city over one week from the 5th to 11th December 2016. This has been used to provide both compliant/non-compliant split in the traffic model and the detailed fleet split in terms of Euro standards in the air quality emissions model.
- Speed data has been taken from the national traffic master data set for the road links in Southampton. This is considered to be the most robust speed data set available.
- Vehicle emission data is based on COPERT V as specified by the JAQU guidance and again is consider the best available data for this scale of modelling.
- Ratified diffusion tube and automatic site monitoring data for 2015 has been used to validate the air quality model and was available at some 60 sites across the city. Both automatic sites and diffusion have been used for model validation, as the full set of sites gives good coverage and robust statistics across the whole modelled area.

- *How reliable are the underpinning assumptions?*

  There are a wide range of assumptions used in the transport and air quality modelling and economic assessment work. In general, the study has used the assumptions as provided by JAQU guidance for carrying out the CAZ feasibility studies. However, there are a number of areas where local assumptions have needed to be made and the evidence for these assumptions varies.

  The key assumptions considered that are likely to have the most impact on the analysis are summarised as follows:

  - Within the SRTM, each model component has assumptions and parameters. Generically, the Values of Time are consistent with WebTAG Databook March 2017. Chapter 4 of the Model Forecasting report provides further details about these assumptions, but these are summarised below for each model component, alongside the appropriate reference:
    - MDM – car occupancies were calculated for each purpose based on observed survey data (Table 6)
    - MDM – car availability is expected to change over time (Table 7)
    - MDM – goods vehicle change over time are derived from the National Transport (Freight) model (Table 8)
    - GDM – Southampton Airport growth assumed to follow the DfT's 2013 Aviation Forecasts (Table 9)
    - GDM – Portsmouth Port growth has used a combination of Portsmouth Port Masterplan 2011 and freight growth (Table 10)
    - GDM – Southampton Port growth used draft consultation of 2016 Masterplan (Table 11)
    - RTM – vehicle operation costs parameters as defined in WebTAG Databook March 2017 (Table 12)
    - PTM – bus and heavy rail public transport fares have been assumed to rise at 1% per annum above the growth in RPI
    - PTM – ferry services public transport fares have been assumed to increase in line with values of time (Table 13)
  - Fleet projection – it has been necessary to project the 2015 ANPR fleet data forward to the target year. This has been done with a fleet project tool developed by Ricardo.

This takes as its basis that the local trends in fleet turn over will be the same as the national data in the NAEI, but from a different starting point. This is clearly a simplification and there are likely to be some differences locally. However, given no local projections exist, this was viewed to be the best approach and in-line with JAQU guidance.

- Behavioural assumptions – in terms of how vehicle owners respond to the different options will be important and varies from each of the options assessed:
  - Non-charging CAZ – the behaviour/activity assumptions used are based on existing information from key stakeholders involved in implementing these measures which covers:
    - Detailed information and data on the current and planned impact of the delivery and services plans, and consolidation centre initiatives provide by the city council;
    - The planned uptake of shore power by cruise liners provided by Southampton Port;
    - Modelling of a simple £5 charge on freight movements in the transport model to assess the impact of the £5 port booking fee.
  - The city wide CAZ B charging scheme – the key assumption used here is in relation to the upgrade behaviour of drivers in relation to the charge. The standard behavioural response provided by JAQU, based on TfL data, have been used. It is recognised that in practice this response may be different in Southampton, and some draft work has been carried out to understand the impact on the local context. However, given that the charging scheme is unlikely to be progressed it was felt that adopting the JAQU assumptions was a proportionate approach without the time and resource available.
- Impact extrapolation – to provide the economic assessment over a 10-year period an estimate of the benefits and costs over 10 years needs to be made. Generic guidance has been provided by JAQU on this topic and we have taken this into account in developing the approach for this study. The key impact that needs to be extrapolated is the emission benefit and how this will reduce in future years. Without modelling further future years at this stage it was felt to be proportionate to model the reduction in emission benefit of the scheme using the PCM trends from 2020 to 2030 for the Southampton baseline PCM results. We recognise that this does not account for a number of local factors, not least future development and highways schemes. However, as explained further in E1, this approach was deemed appropriate and most proportionate given:
  - Further resource would be needed to develop an adequate model to depict changes in emissions over the future period, akin to an emissions model extrapolated to 2030 (which wasn't appropriate purely to apply to the economics case)
  - Even then, it is questionable how different the results between such a local model and national trends would be. Given lack of local-specific projection parameters, such a model would instead use national parameters anyway
  - Also it is questionable whether one could have confidence in any difference produced from a local relative to national modelling. There is always inherent uncertainty associated with projecting parameters forward. Hence the results attained from such a local fleet projection model, and those represented by the extrapolation factors derived from the national plans (in particular given the overlap in inputs used), are deemed likely to fall within the range of uncertainty around this exercise.

In summary there are limitations and uncertainties in the assumptions made but we feel what has been done is proportionate the for time and budget available to provide a robust evidence base for the final preferred option.

2. Risk of Error / Robustness of the Analysis

- *Has there been sufficient time and space for proportionate levels of quality assurance to be undertaken?*

  Quality management for all Ricardo projects (and all deliverables produced) is delivered in accordance to the requirements of the International Standard ISO 9001:2008. Principles of quality assurance (QA) are integrated in all our activities and at all levels through established and implemented procedures according to the international standard. The formally appointed Project Manager and Project Director lead in ensuring the project is undertaken in accordance with the current Ricardo Quality Assurance processes and that the system is effective.

  As noted above the citywide modelling of the CAZ options is both complex and time consuming, whilst being carried under tight delivery times scales. However, all analysis for the Southampton (air quality and economic) has been developed in accordance with these over-arching Ricardo QA policies and procedures to ensure high quality and accuracy of deliverables. Specifically, this includes:

    - Use of the core principles from our modelling QA group in the design of analysis spreadsheets;
    - Technical oversight of methodological modelling issues from our modelling knowledge leader;
    - Day-to-day oversight of the modelling work by the lead modeller;
    - Checks of assumptions, input data, calculation sheets and output results
    - Overall review and sign off by the project director.

  All models have been developed in accordance with Ricardo's 'best practice' modelling guidance for the construction of workbooks and tools. This includes having separate sheets for data import, manipulation and results. In addition, the model has been developed with strict version control procedures (to avoid version error) and with assigned governance and responsibilities (i.e. the PM holds overall responsibility for the quality of the model, with analysts holding joint responsibility for the elements they developed).

  In some cases, some data transformations have been carried out in MS Excel prior to import to the economic model. Each of those transformation workbooks has been identified and also subject to scrutiny.

  All data sources used in the model are appropriately referenced and clearly marked where data is inputted into the model. All assumptions and data sources have been logged, in particular as part of the Air Quality and Economic Methodology Reports.

  In addition, for this specific work additional QA checks have been performed with the input of SCC and the wider consultancy team. For example, where data and assumptions have been drawn from external models, we have discussed directly our interpretation of the data received, and its planned use in the economics model to sense check our approach (e.g. air quality emissions outputs, and transport modelling outputs).

  In accordance with Ricardo's QA processes, all deliverables and outputs have been signed off by both the Project Manager and/or Project Director before release. Also, where time has allowed we will issue draft results to Southampton to allow the city to review and scrutinise results prior to finalising.

- *Have sufficient checks been made on the analysis to ensure absence of errors in calculations?*

  Checks on modelling work are carried out as part of our quality assurance process. Again, with complex models across several thousand road-links there is a large amount of data and calculations to check. With this amount of data it is not possible to check everything. Our approach has been as follows:

    - Review and check all methods being used in the model set up and calculations;

    - Review model input data for consistency, this has focused on samples of data and key locations;
    - Check calculations in all spreadsheets, again using a sampling approach to check calculation steps;
    - Sense check results using the experience of the lead modeller, knowledge leader and project director to ensure that they seem reasonable.

  A log of all checks carried out is kept and where any anomalies in results have been identified in the checking process these have then been explored for errors in data or calculations, and corrected as necessary.

  Finally as part of the model validation process for the base year air quality model the results are compared with monitoring data. Where there is a significant difference with the modelling data, + or – 30% checks are carried out to explore why these differences occur.

  We believe this level of check is proportionate for the time and resources we have available, and has identified a number of issues that have had to be corrected. However, it is not an absolute guarantee that there are no errors, but it is sufficient to ensure that all results are reasonable and consistent.

- *Have sufficiently skilled staff been responsible for producing the analysis?*

  The air quality modelling team at Ricardo have significant experience of developing, assessing and recommending measures to reduce emissions and improve air quality at the city scale, including extensive expertise in air pollution modelling from the development of inventories and baselines to modelling the future impacts of abatement scenarios.

  The team is led by a Project Director who holds over 20 years of experience of working on transport and emissions reduction projects. His key areas of expertise include vehicle emissions modelling, low emission vehicle technologies, sustainable transport measures and local air quality management and policy and he has worked on a number of LES, LEZ and CAZ projects in the UK including in Southampton, Derby, Nottingham, Oxford, London, Leicester and South Oxfordshire.

  The day-to-day modelling work is led by an experienced atmospheric scientist with a strong focus on modelling transport and industrial emissions and characterising their effects on ambient air quality who is an advanced user of ADMS, ADMS-Roads, ADMS-Urban, AERMOD, CALPUFF, Envi-Met CFD, ArcGIS, QGIS and other air dispersion modelling tools as well as meteorological modelling software such as WRF, and has also developed Ricardo’s in-house dispersion modelling suite (RapidAir).

  The modelling lead is supported by our modelling knowledge leader, who developed our RapidAir and RapidEms models, to explore and resolve any methodological issues. In addition a team of experienced consultants specialising in air quality impact assessment and atmospheric dispersion modelling are carry out aspects of the modelling work, guided by the modelling lead.

  All staff have had specific training on all the modelling tools being used for this work.

  The transport modelling team at SYSTRA have significant experience of model development and appraisal work to support funding bids. SYSTRA have developed the Solent Transport Sub-Regional Transport Model (SRTM), a land-use and transport interaction (LUTI) model. They have used the modelling suite as an evidence base for the development of the Transport Delivery Plan for the Solent area. This work has helped to prioritise transport interventions, support Local Plans and the development of a Spatial Strategy for the Solent area, and inform development control, highway authorities and the Local Enterprise Partnership. Using this model SYSTRA have also tested a number of large proposed developments and transport schemes in the area including: the Southampton City Centre Action Plan, Eastleigh Transport Assessment/Transport Strategy, the Smart Motorway Programme (for Highways England), support for the preparation of the Station Quarter Business Case and testing of improvement options in Southampton’s Eastern Corridor. In addition, they have explored the provision of Park and Ride sites and various motorway junction improvement schemes, as part of initiatives aimed to improve access to the city.

The team is led by a project Director with 30 years' experience in transport modelling. He was responsible for the development of the WebTAG compliant SRTM, and has had significant experience on applications of the model to support DfT Pinch Point bids, Regional Growth Fund and Cycle City bids. He was also heavily involved in developing strategies which provided vital evidence and forecasts in support of Local Sustainable Transport Fund (LSTF) and also Better Bus Area Fund (BBAF) bid submissions to DfT, both of which were successful in receiving full funding.

The modelling team at SYSTRA is led by an experienced user of the SRTM, who has advanced knowledge of SQL, C# and CUBE scripting. He is supported by a number of other team members who are experienced transport modellers and users of the SRTM, who are guided by both the project director and the lead modeller.

SYSTRA have also been able to draw on support, and share best practices from other teams that have been working on CAZ projects elsewhere in the country, such as Nottingham and Derby.

3. Uncertainty

- *What is the level of residual uncertainty (the level of uncertainty remaining at the end of the analysis)?*

The level of uncertainty included within the transport modelling is only undertaken in the base year model, as part of the validation process comparing the modelled and observed data. The differences between modelled and observed data are quantified and then assessed, with the acceptability of the proportion of instances where the criteria are met is then assessed.

The validation of a highway assignment model includes comparisons of the following:

- Assigned flows and counts totalled for each screenline or cordon, as a check on the quality of the trip matrices
- Assigned flows and counts on individual links as a check on the quality of the assignment
- Modelled and observed journey times along routes, as a check on the quality of the network

The SRTM's standard 'Reference Case' scenarios representing forecast year conditions include both new transport infrastructure schemes and landuse development assumptions to represent expected changes in conditions compared to the Base year.

Reference case transport infrastructure only include those schemes that have received the necessary planning approvals and are fully funded. This provides a high degree of certainty that the schemes will be constructed.

In the standard Reference Case, landuse inputs (sqm floorspace) are derived from the Local Plans for each of the planning authorities and the records of granted planning permissions. The Local Plan information currently input to the SRTM dates from April 2016 and only includes for Adopted Plans at that time (it is anticipated that periodic updates of the landuse inputs will be undertaken to account for newly adopted Plans and planning permissions etc). In later model years, and particularly those beyond current Plan periods, the model includes a process referred to as 'intensification'. This enables continued growth to be represented within existing developed areas to allow TEMPRO forecasts to be met. Intensification is limited to those areas where development already exists because it is not considered appropriate for the model to arbitrarily allocate development to undeveloped areas. It follows that there is less certainty in the actual location of this growth.

A direct assessment of uncertainty in the air quality results is also only carried out for the baseline model as part of the validation process against monitored air quality data and essential indicates the overall uncertainty in the transport and air quality models. In this process model performance and uncertainty is assessed using the Root Mean Square Error (RMSE) for the observed vs predicted NO_2 annual mean concentrations, as detailed in Technical Guidance LAQM.TG(16). In this case the RMSE was calculated at 4.7 $\mu g.m^{-3}$. This can then be used as a measure of error on forecast results for future years. This error metric has been used when considering the results by identifying locations over 35 $\mu g.m^{-3}$ as being at risk of exceedance.

However, when assessing options in future years there will also be uncertainty related to the assumptions we have made in modelling these options. The reliability of the assumptions used in the modelling has been discussed above and has been tested through sensitivity tests. The key outcome of these tests is as follows:

- Higher levels of port growth – this increases concentrations by a maximum of 0.5 $\mu g.m^{-3}$ so did not have an impact on the final results;
- Lower performance of Euro 6 – setting all light duty vehicles to base Euro 6 standard increased concentrations by up to 2 $\mu g.m^{-3}$ which pushed one PCM location up to 40 $\mu g.m^{-3}$ and another to just over 35 $\mu g.m^{-3}$ in the 'do minimum' so increases the risk of an exceedance arising in 2020.
- Lower fNO_2 by 40% - this significantly reduces concentrations and removes all the locations potentially at risk of exceedance in the baseline.
- Lower impact of the non-charging CAZ option – the impact of this option was essentially zero so lowering it would not reduce the benefit.

In summary the overall model uncertainty as measured in the baseline is 4.7 $\mu g.m^{-3}$ which indicates that anything over 35 $\mu g.m^{-3}$ is at risk of exceedance in 2020. This identify 5 locations in 2020 at risk of exceedance. The assumptions around the performance of Euro 6 vehicles and fNO2 have the greatest impact on these results with lower performance of Euro 6 increasing the risk of exceedance and lower fNO_2 removing any risk of exceedance. None of the sensitivity tests pushed the model results into direct exceedance of the NO_2 limit value.

4. Use of analysis

- *Does the evidence provided support the business case?*

  The assessment indicates that under the 'do minimum' scenario, which accounts for measures that have already been funded and are in the process of implementation, compliance with the NO_2 limit value will be achieved. However, when model uncertainty is considered this identify 5 locations that are potentially at risk of exceedance and this risk would be increased if Euro 6 does not perform as expected in terms of emission reduction.

  Given this assessment, even though compliance is indicated in the 'do minimum' case, it suggests that measures should be pursued that help manage the residual risk of uncertainty in the modelling and the Euro 6 standard not performing as expected. In this respect the non-charging measures modelled did not help to significantly reduce this risk so a slightly wider package should be considered including measures that could reduce emissions from light duty vehicles.

- Is there evidence the agreed target will be achieved?

  Yes, the modelling suggests that the 'do minimum' scenario has the potential to achieve compliance with the air quality limits.