Roads

Master Specification

RD-GM-D4 Traffic Analysis and Modelling

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DEPARTMENT FOR INFRASTRUCTURE AND TRANSPORT

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Document Management

Contents

RD-GM-D4 Traffic Analysis and Modelling

1 General

1.1 This specification provides the traffic analysis and traffic modelling requirements of a project related to those elements of the geometric road design that affect its functional and operational performance. The geometric elements includes the length and number of lanes required for intersections, interchanges and other forms of road junctions.

1.2 In order to relate the analysis and modelling requirements of this specification to contractual provisions of the specification, the person responsible for the modelling, i.e. the modeller, is referred to hereafter as the “Contractor”.

1.3 Where in a contract the traffic analysis and modelling differs from specification requirements, the changes will be found in the contract documents.

1.4 The Contractor shall design the road geometry to achieve not less than the minimum specified traffic performance measures.

1.5 The Contractor shall demonstrate by traffic analysis and modelling that sufficient capacity is provided in the road design to cater for design traffic volumes and prove that the design meets the Operational and performance standards specified.

1.6 Traffic analysis shall be used to determine elements of the road geometry.

1.7 The traffic modelling will be used to confirm that the road performs as predicted by the traffic analysis.

1.8 The Contractor shall prepare a traffic model scoping document before commencement of model creation.

1.9 The traffic model scoping document shall be submitted for approval by the Principal.

1.10 Traffic analysis and traffic models are required to review and confirm that the road geometry will achieve the operational capacity and efficiency objectives, as well as demonstrating it will meet the functional and operational performance requirements including proof that the design is fit for purpose.

1.11 The Department may have traffic data and existing model data that can support the design of projects. Where data is not supplied in Contract Documents it shall be formally requested in writing to the Department.

1.12 Where the Department has supplied traffic or modelling data as part of a contract, it is the Contractor’s responsibility to ensure that it is complete and up to date. It is the Contractor’s responsibility to collect any additional information required to augment the supplied data. For traffic model calibration purposes data elements and outputs need to be compatible between models, and it is the Contractor’s responsibility to demonstrate the suitability of the data for this purpose.

1.13 In this specification a “base case model” shall represent the existing situation in terms of physical elements, operational controls and traffic volumes. It is the base case model that is subject to the rigorous calibration and validation (see Section 12 - Base Case Model Calibration and Validation). In some other Departmental documentation this model may be referred to as a “base model” or a “base year model”.

1.14 In this specification the traffic model associated with the approved project design is called the “approved model scenario”.

2 Definitions

2.1 The following terms, abbreviations and acronyms will be used in this Part:

Term	Definition
AIMSUN	The AIMSUN software product produced by Aimsun.
Approved model scenario	The model outcome that describes the final design.

Term	Definition
Base case model	The model representing the existing situation.
Contractor	The person responsible for the design of the project including the transport / traffic modelling requirements.
DIT or the Department	Department for Infrastructure and Transport.
DREE	Discharge Rate Evaluation Extension.
Freeway	Any form of restricted access road or part of a road with restricted access.
GTM	Guide to Traffic Management;
GTRD	Guide to Road Design.
HCM	Highway Capacity Manual.
ITS	Intelligent Transport Systems.
LINSIG	Software produced by JCT Consultancy.
MATSAM	Metropolitan Adelaide Traffic Simulation and Assessment Model.
Motorway	A freeway for the purpose of this specification.
Native files	Data file types generated by the proprietary software application, using a unique file name extension identifier.
PAC	Pedestrian Actuated Crossing
SCATS®	Sydney Coordinated Adaptive Traffic System, property of RMS NSW.
SIDRA	Intersections software produced by Akcelik and Associates.
TAMR	Traffic Analysis and Modelling Report
Traffic	Generically to include all forms of road transport including pedestrians & cyclists.
Traffic model scoping document	Describes the modelling intention and requirements before commencement of modelling.
TRANSYT	Software produced by TRL Software.
TSOPR	Traffic Signal Operation Performance Report.

3 References

3.1 Unless specified otherwise, traffic analysis, modelling and the resulting geometric design shall be undertaken in accordance with the following:

a) Austroads Guide to Traffic Management (GTM).

b) Austroads Guide to Road Design (GTRD).

c) AS 1428 Design for Access and Mobility.

d) Austroads Design Vehicles and Turning Path Templates.

e) Department references and guidelines as follows:

i) Guidelines for Disability Access in the Pedestrian Environment.

ii) Road Design Standards and Guidelines.

iii) Pavement Marking Manual.

iv) Operating Instruction 14.2 Traffic Signal Faces.

v) PC-EDM1 “Design Management”.

vi) PC-EDM3 “Independent Design Certification”.

vii) RD-ITS-D1 “Design for Intelligent Transport Systems (ITS)”.

viii) RD-EL-D2 “Traffic Signals Design”.

ix) Metropolitan Adelaide Traffic Simulation and Analysis Model (MATSAM) Traffic Simulation Model Development Guidelines – Aimsun Next.

x) Traffic Modelling Guidelines: SIDRA Intersection.

xi) Traffic Modelling Guidelines: TRANSYT 15.

xii) Drawing S-6841: Sheet 1 and 2 Traffic Signal Design Guide, detectors, Signal Groups, Phasing and Pole numbering.

f) Transport Research Board: Highway Capacity Manual 2016 (HCM 2016).

g) VicRoads Managed Freeways, Freeway Ramp Signals Handbook 2013 Chapter 6 Design of Ramp Signal Installations.

h) National Heavy Vehicle Register, National Transport Commission – Performance – Based Standards Scheme – Network Classification Guidelines July 2007.

4 Intellectual Property of Traffic Models

4.1 Completed Traffic Models are the Intellectual Property (IP) of the Department. The IP includes a copy of the model native files (i.e. all data files sufficient to run the model and recreate the results) that are included in the Final Design Report.

4.2 The Department shall hold the intellectual property (IP) of the traffic model(s) and related outputs including design reports. After the project has finished, the Contractor shall require the written permission of the Department to use the traffic model(s).

4.3 The use of externally developed software which enhances the functionality of the core software applications is not permitted if the model is not capable of being run by the Department to replicate the results. The Contractor shall not use modelling software versions or variations, including the use of “plug-ins” for which the Department does not own software licences.

5 Reports

5.1 Various “Design Reports” are required by PC-EDM1 “Design Management”, Design Documents.

5.2 The “Traffic model scoping document” shall be completed and included in the “Design Basis Report” (representing 15% completion of the Design Report). This document shall include all the details specified in Section 6 - Scoping and Documentation.

5.3 The Traffic Analysis and Modelling Report (TAMR) shall form a technical discipline component for the fulfilment of the work requirements of the various stages of the Design Reports. The Traffic Analysis and Modelling Report shall be submitted for approval at the Preliminary Design Report Stage (30% completion).

5.4 Design Report stages requirements for submission of documents are detailed in the Design Management Plan as required in PC-EDM1 “Design Management” Submission of Design Documents or as detailed in the Contract Documents.

5.5 The “data report” identifying traffic data already available and that required for the completion of the traffic analysis and traffic modelling shall be included in the Design Basis Report.

5.6 The “base case model” shall be completed, included in the Preliminary Design Documents (representing 30% completion), and approved by the Principal. Modelling of other scenarios cannot commence before approval of the base case model.

5.7 The “approved model scenario” traffic modelling assessments will be included in the Preliminary Design Documents (representing 30% completion) and approved by the Principal.

5.8 The “approved model scenario” shall represent the Design used in the Final Design Documents (representing the 100% Design Report) and the “Issued for Acceptance” (IFA) documentation.

5.9 The design shall not be substantially changed from that included in the approved model scenario, approved at the Preliminary Design Documents stage. Any change to the design or model that affects function, operation, and performance represents a substantial change.

5.10 No changes to the IFA design are permitted in the “Issued for Construction (IFC) documents”.

5.11 The Traffic Analysis and Modelling Report shall present the results of all the analysis and modelling, including the calibration validation of the base model, and findings by the independent Design Verifier (See Section 7 - Traffic Model Auditing and Checking).

5.12 The Traffic Analysis and Modelling Report shall comprise a printed document that shall include an executive summary of the findings supported by detailed tables and graphs, lists of input data (sources of traffic volumes and signal timings), and native data files of the models. The printed report shall be supplied as a *.pdf format document.

5.13 The Traffic Analysis and Modelling Report shall include a copy of the original approved traffic model scoping document.

5.14 A section of the Traffic Analysis and Modelling Report shall be dedicated to explaining the extent of the calibration and validation of the base case model and the processes that were used. Where special modelling techniques were used (including virtual lanes and other assumptions) these shall also be detailed in this section. This section shall demonstrate how the base case model is an accurate representation of the data, including its operation and performance.

5.15 The report shall include a list of calibration parameters. Justification shall be provided in the Traffic Analysis and Modelling Report where model parameters differ from those in the Department's Guidelines or conventionally accepted parameter standards.

5.16 For each modelled intersection, the Traffic Analysis and Modelling Report shall include the overall capacity, maximum reported Degree of Saturation, traffic volumes, delays, number of stops, queue lengths, level of service.

5.17 For each traffic signal controlled intersection the report shall include, phase sequences, green splits, cycle length, and traffic signal offsets to adjacent intersections.

5.18 For each modelled intersection the report shall include for each lane: traffic volumes, delays, queue lengths, capacity, level of service, and Degree of Saturation.

5.19 For each modelled road section, the report shall include traffic volumes, capacity, density, speed and level of service.

5.20 In addition to the supply of native AIMSUN model files, the Contractor shall include the associated files used to define the network, and the associated database file with other outputs provided in the Traffic Analysis and Modelling Report.

5.21 The Discharge Rate Evaluation Extension (DREE) output shall be included in the Traffic Analysis and Modelling Report for all AIMSUN models.

5.22 DREE derived Saturation Flows will be tabulated in the Traffic Analysis and Modelling Report, adjacent to measured saturation flow values (or SCATS® MF output) from existing traffic signal sites, to enable validation of saturation flows across each lane of the model.

5.23 Modelled lane and section densities are to be reported for all diverging, merging and weaving sections for each 15 minute period in accordance with the definitions in the HCM (2016).

5.24 Where a video presentation of the traffic model is a requirement in the contract, this video shall be provided only for the approved model scenario. This video shall demonstrate the operation of the project, including 2D and 3D representation and "drive through" options. The form of the content of the video is to be included in the traffic model scoping document as part of the Design Basis Report.

5.25 The video representation of the approved model scenario shall be included in the Final Design Documents.

6 Scoping & Documentation

6.1 A "traffic model scoping document" is required before model development commences.

6.2 The traffic model scoping document shall include a detailed timeline outlining each stage of the model development, and will identify tasks to be completed in line with the Design Basis Report and each related stage of the Design Report.

6.3 In considering the development of traffic model(s), the Contractor will assess the availability of skilled and competent personnel to undertake the modelling and to audit or check the model and the output data supplied. If not otherwise identified in the contract, these personnel shall be listed in the traffic model scoping document.

6.4 The Contractor shall extend the modelled area beyond the immediate physical scope of the project, to ensure that the pattern of traffic is realistically modelled and the projected operational performance of the project can be properly assessed.

6.5 The traffic model scoping document shall include:

a) a statement on the background to the project;

b) a statement of what issues the traffic modelling analysis shall address in relation to the project;

c) a list of the personnel who will be involved in the model development;

d) a description of the model process proposed to be used, including: the base case models, a list of the proposed future year models, an outline of how the process is to be staged, and a timetable for the completion of each stage;

e) a list of the modelling software applications to be used and the reason for using each application, i.e. the purpose;

f) a list of alternative scenarios to be considered;

g) a description of how route choice is to be modelled and by which application;

h) model time periods which are to be evaluated, e.g. AM, PM and weekends;

i) a list of the scenarios to be analysed and the combinations of these scenarios;

j) how the scenarios are to be evaluated. The measures of effectiveness for each model type are to be described including total network traffic delay, Level of Service, route journey time change, pedestrian delay, patronage changes on public transport, etc.;

k) a statement of what calibration, validation and audit of the models to be proposed by the Contractor;

l) a description of how the model calibration, validation and audit is to be carried out, and by whom;

m) a statement of what measured and assumed values are to be used in the assessment of future year model scenarios; and

n) a description of how heavy vehicles, public transport, cyclists and pedestrians will be considered in the model assessment.

6.6 The traffic model scoping document shall address the following issues:

a) How pedestrians are to be modelled. State what concessions are being made in the analysis of pedestrians because of limitations in the capability of the modelling software application. If pedestrians are specifically to be included, state how this shall be done.

b) Identify which intersections outside the project / development area are to be included in the traffic models. Intersections connected via SCATS® groupings shall be included.

c) Estimate the time and resources required to complete the modelling and include in the proposal any proposed alternative modelling options to reduce both time and resources.

d) Clarify what is out of scope for the analysis and modelling options.

e) The traffic assignment process to be applied to traffic simulation models for all models.

f) Identify what traffic volume data is to be used, including the age and source of the data, to calibrate the base case model and for future year model scenarios.

g) Identify the gaps in the available data and the data requirements to complete the traffic analysis and traffic modelling. Report how data is to be acquired (collected) to fill the gaps in the available data.

h) Consider how intersection controls will be modelled including traffic signals, roundabouts and priority intersections. Review what intersection parameters are to be used and how they will be determined.

6.7 For AIMSUN traffic simulation models the traffic model scoping document shall detail:

a) confirmation that all models shall be part of, or based on, the MATSAM (Metropolitan Adelaide Traffic Simulation and Assessment Model) as required by the MATSAM Guidelines;

b) the proposed independent auditing processes. A general description of the model auditing requirements are contained in the MATSAM Guidelines; and

c) the background that shall be built using GDA94.

6.8 Provision of the Traffic Modelling Scoping document shall constitute a **Hold Point**.

7 Traffic Model Auditing and Checking

7.1 The provisions of PC-EDM1 “Design Management” Design Verification and Certification, shall apply to traffic models.

7.2 Requirements for auditing models are contained in the various Departmental traffic modelling guidelines.

7.3 The traffic models shall be subject to an Independent Design Review, and audited by an Independent Design Certifier who is independent of the Contractor, as provided for in PC-EDM3 “Independent Design Certification”.

7.4 PC-EDM3 “Independent Design Certification” Independent Design Certification Process, makes provision of the Design Review Process. An Independent Design Certifier shall be approved for the traffic analysis and modelling. The Certifier and their personnel shall be identified in the traffic model scoping document.

7.5 In addition to the verification requirements of the contract, traffic models may be checked by Departmental personnel.

7.6 To enable checking of traffic models by the Department, the Contractor shall ensure that the Department has a current licence for the software applications or “plug-in” additions. The cost to the Department of any additional modelling software licence fees is the contractor’s responsibility.

8 Traffic Data Availability

8.1 The Contractor shall be responsible for the collection of all data to enable completion of the traffic analysis and modelling requirements.

8.2 It is the Contractor's responsibility to demonstrate that the data is fit for purpose.

8.3 Where the Department has traffic data available from its data stores or from previously constructed models pertinent to the project this may be made available to a Tenderer or Contractor following a request in writing for the information.

8.4 Where previous models or model data is supplied to the Contractor to assist in the preparation of base case models, it remains the Contractor’s responsibility to ensure that all models prepared for the project are fully calibrated, validated and fit for purpose.

8.5 Where O/D matrices are to be used, it is the Contractor’s responsibility to ensure that these contain values that are suitable for use in the models. The Contractor shall use the vehicle type information correctly in the model. Any profiled traffic demand flows required for specific models shall be developed as specified by the relevant Departmental guidelines.

8.6 The Contractor shall determine if supplied turning movement counts are suitable for use and whether additional surveys are required.

8.7 SCATS® summaries of traffic signal controlled intersections contain historical operational information on cycle lengths, average phase times, phase sequences, signal groups, and saturation flows for each lane with detection. These SCATS® summaries will be supplied by the Department upon written request. The indicative time for the supply of this data is 10 working days. The summaries are derived from SCATS® Traffic Reporter and SCATS® History Viewer utilities.

8.8 Existing traffic signal linking data is available from the Department in the form of SCATS® GROUP SYSTEM LINKS reports, where a number of existing intersections within the scope of the project are coordinated. The linking offsets in these reports are to be used for network model base case evaluation.

8.9 The Contractor shall conduct additional surveys to measure the effects on-site of pedestrian behaviour where crowding is a known or predicted issue.

8.10 All data supplied by the Department and collected by the Contractor to fulfil the data collection requirements shall be included in the Traffic Analysis and Modelling Report and the Preliminary Design Documents (30% completion).

8.11 Provision of the Traffic Analysis and Modelling Report shall constitute a **Hold Point**.

9 Traffic Volume and Composition

9.1 It is the Contractor's responsibility to collect all traffic data required for the design of the project.

9.2 The traffic data will comprise, but not be limited to, numbers of vehicles, vehicle composition by mode, pedestrian volumes and pedestrian desire lines, and vehicle occupancy where required.

9.3 The traffic data required for the completion of the traffic analysis and traffic modelling shall be identified in the "data report".

9.4 The data report will identify additional data required to be collected and how this is to be achieved to satisfactorily complete the traffic analysis and traffic modelling.

9.5 The data report shall be included in the Design Basis Report.

9.6 The traffic volume is that representation of traffic flows used for the purpose of analysing the design and for inclusion in the traffic analysis and traffic models.

9.7 Traffic volumes used for the base case will represent the existing traffic flows, which will normally have been recorded within the last 2 years.

9.8 The traffic volume data requirements can be in the form of Annual Average Daily Traffic (AADT), design hourly volume and proportion of commercial vehicles. Peak hour volumes for various temporal periods and detailed vehicle type classification data may also be required. The data requirements shall be clarified in the traffic model scoping document.

9.9 For SIDRA models, a peak hourly volume profile shall be assumed to be based on a 30 minute peak within the design 60 minute peak hourly volume, and a flow factor of 95% shall be assumed between the peak 30 minute volume and the residual period, unless otherwise specified in the Contract Documents.

9.10 Design traffic volumes for future year horizons may be specified in the Contract Documents. Where design future year traffic volumes and other traffic data is provided by the Department as part of a contract, the Contractor is required to use the data provided, including the design future year traffic volumes, to determine the design outcomes.

9.11 Where the Department supplied information is deficient in scope or recent relevance, it is the Contractor's responsibility to augment the data, to fill gaps and update the data.

9.12 Use of design traffic volumes shall be in accordance with the following;

a) Where Passenger Car Units (PCUs) are used for analysis, vehicle volumes shall be converted to PCUs using a passenger car equivalent based on the existing vehicle type composition. Classification data to facilitate conversion to PCUs may be available from, and / or specified by, the Department.

b) Where PCUs are required to be used to aggregate traffic volumes and estimate equivalent vehicle queue lengths, the equivalency factors in Table RD-GM-D4 9-1 shall be used unless specified otherwise in the Contract Documents.

c) For vehicle "queue space," add 2 m gap to the average vehicle length shown in Table RD-GM-D4 9-1.

Table RD-GM-D4 9-1 Passenger Car Vehicle Lengths

Austroads Vehicle Type	Austroads Class	PCU Value	Average Vehicle Length (m)
Short <5.5m	1	1	5
Medium (short + trailer or Rigid) 5.5m – 14.5m	2 – 5	2	12
Long (articulated) 11.5m – 19m	6 – 9	3	19
Medium Combination 17.5m – 36.5m	10 – 11	4	26

Austroads Vehicle Type	Austroads Class	PCU Value	Average Vehicle Length (m)
Road Trains >33m	12	5	33
Tram (Bombardier Flexity)		4	30

10 Traffic Modelling Application Selection

10.1 The Contractor shall consider the following application selection issues when scoping the modelling:

a) Identify what type of modelling applications are required, e.g. AIMSUN Next, SIDRA, TRANSYT, LINSIG.

b) Identify why a particular type of modelling application is to be applied. State how the output will inform and provide proof that the design will match the operational performance specified.

c) Quantify the resources and duration implications for the application options and include in the traffic model scoping document**.**

d) Determine whether a simpler type of modelling can be used to satisfy the design requirements.

e) Where large numbers of pedestrians are to be modelled, the model application will be chosen based on the application capability.

f) Where multiple model applications are proposed, the Contractor shall explain in the Traffic modelling scoping document the level of integration that will be applied between each application.

10.2 Software applications shall be identified in the Traffic modelling scoping document and approved by the Principal as part of the Design Basis Report.

10.3 Where optimised signal timings are required for the project case it is necessary to derive them by using SIDRA, TRANSYT or LINSIG, in accordance with RD-EL-D2 Traffic Signals Design.

10.4 The phase splits for future year projections shall be determined by the Contractor using SIDRA, TRANSYT or LINSIG models.

10.5 Offset timings for traffic signal networks shall be determined using TRANSYT or LINSIG.

10.6 SIDRA is used to inform the design of signal controlled, roundabouts and priority intersections including the required number, length and arrangement of traffic lanes and to demonstrate the design will achieve the functional, operational, and performance requirements of the project.

10.7 AIMSUN traffic simulation modelling is used to inform the analysis, including the design of freeways and freeway elements, to ensure there is no discontinuity between adjacent road sections and to assess where additional capacity is required due to the interactions between different elements of the road network, to ensure that the operation of the road network will achieve the performance requirements of the project.

10.8 For all model applications, in base case models the existing SCATS® data from the SCATS® summaries and SCATS® GROUP SYSTEM LINKS reports shall be used to replicate the phase sequences, intergreen times (yellow and all red), phase splits, signal group times and traffic signal offsets.

11 Multiple Software Applications and Model Integration

11.1 Effective analysis of proposed designs may require the use of a number of model software applications. Some of these applications are capable of integration. The level of integration and therefore the likely benefits of integration may influence the Contractor's decision to use this capability. Whether applications are used independently or in an integrated format, the Contractor shall be responsible for the integrity of the transfer of data between applications.

11.2 Signal timing and phasing data is required as input data for an AIMSUN traffic simulation model. AIMSUN traffic simulation models cannot calculate the timing or phasing arrangements and hence all model scenarios including base case and project scenarios shall require this information as input data. The signal phasing and timing for use in AIMSUN models future year model scenarios shall be optimised using SIDRA®, TRANSYT or LINSIG as input to the AIMSUN Traffic simulation model.

Where green split values derived in future model scenarios are different in each software application the average time differences are to be clearly outlined in the Traffic Analysis and Modelling Report.

11.3 Where pedestrian movements at traffic signals are significant it is necessary to model the pedestrian effects. Most traffic models will only model average pedestrian movements without quantifying the crowding effect. Where pedestrian crowding is an issue, alternative modelling applications to the conventional traffic models will be required. The Contractor shall submit for approval proposals for a suitable modelling application in the model scoping document.

11.4 Where model applications are required to work closely with one another (e.g. for importing and exporting O/D matrices) and for transferring control timing, these applications shall be compatible with one another.

11.5 The Contractor shall be responsible for ensuring the integrity and compatibility is maintained of integrated models using different applications.

11.6 The Contractor shall be responsible for ensuring the integrity and compatibility where the output data from one model application may be an input to another.

11.7 Any changes to the design of intersections resulting from the assessment derived from an AIMSUN model shall not be to a lesser standard than those determined by the SIDRA modelling.

11.8 Differences between outputs from modelling applications representing the same road elements or intersections shall be included in the Traffic Analysis and Modelling Report.

12 Base Case Model Calibration and Validation

12.1 It is necessary to calibrate and validate a base case model for all traffic models, for all software applications.

12.2 Model calibration and validation shall comply with the processes and requirements of the relevant Departmental model application guidelines.

12.3 Base case models, fully calibrated and validated, shall be approved by the Principal. Development of future year model scenario shall not commence prior to approval of the base case models.

12.4 Calibration is a process of placing data into a traffic model to replicate observed conditions which can be verified. Calibration data will include input data including traffic signal timings, lane distances, cruise times, saturation flows, and traffic volumes.

12.5 Validation is a process, independent of the data used in calibration, which is based on an assessment of derived model values that can be compared with site data measurements. The purpose of validation is to provide independent confirmation that a model has been correctly calibrated. Validation can be based on performance measures such as Degree of Saturation, journey times and queue lengths. For models where these parameters are not input values, validation might also include saturation flow, turning movements and directional link volumes.

12.6 For models using O/D matrices, validation shall always include checks that the assigned traffic volumes on all links in the model are statistically representative of the actual observed volumes. The following values shall apply unless alternative values are specified in the contract. The network average GEH statistic for all volumes of <1.5 shall apply. Individual turning volumes are to have GEH values of <3 except non-critical turning movements for which a GEH of <5 is acceptable. Non-critical turning movements shall be defined in the Traffic Model Scoping document. X-Y plots of observed compared to modelled volumes will have a slope of 1±0.01 and R2 >0.99.

12.7 Data is to be collected for the project to enable calibration and validation of the base case models. For AIMSUN Next traffic simulation models, the data shall be assembled into “Real Data Sets” as required by the MATSAM Version 1 User Guidelines.

12.8 As part of the calibration, for consistency and to avoid confusion in model interpretation, the traffic signal site TS numbers, traffic signal group numbers, traffic signal phase labels and detector numbers shall be labelled in models to conform to the Department’s conventions used in drawing S-6841. Where object IDs in the model are numbered automatically, and cannot be changed to the Department’s conventions, the descriptive field of the object shall be completed to match the Department’s standards for labelling these features.

12.9 All model input data shall be auditable and included in the Traffic Analysis and Modelling Report.

12.10 Provision of the base case model report shall constitute a **Hold Point.**

13 Future Year Model Scenarios

13.1 Modelling of other scenarios cannot commence before approval of the base case model.

13.2 The traffic model scoping document will detail various scenarios required in the development of future year models.

13.3 Traffic modelling scenarios may be given various names, e.g. “base case for comparison models”, “base model for economic analysis”, “base model for traffic analysis”, or “future year base models” and “future year scenarios”. Each model scenario and its purpose shall be fully described in the traffic model scoping document.

13.4 The design traffic volumes shall be clearly identified for each model scenario specified.

13.5 Where the contractor proposes to modify a reference design or a previous design which is based on a traffic model scenario which has been provided to the Principal in a report, the contractor shall revise the traffic analysis and model accordingly.

13.6 Notification of a change to the design which affects an approved model scenario is a **Hold Point**.

13.7 Future year model scenarios shall be outlined in the traffic model scoping document and the Traffic Analysis and Modelling Report.

13.8 Provision of future year model scenario reports shall be a **Hold Point**.

14 Performance (Level of Service)

14.1 The traffic analysis shall demonstrate that the proposed infrastructure shall meet the minimum requirements of the Contract Documents. Traffic analysis shall include an assessment of the operational performance of the completed project on the day of opening.

14.2 The Level of Service for each mode of transport and each road system element shall be analysed and evaluated by the Contractor using quantitative service measures.

14.3 The Contractor shall ensure that the prescribed Level of Service is achieved for each mode at each road system element including all intersections, roads, road sections, and road related areas. Modes of transport to be considered shall include pedestrians, cyclists, buses, trucks, motorcycles, and cars.

14.4 The performance of the design of the project, for each predicted future year model scenario, shall comply with the Level of Service specified. Level of Service “D” shall apply as a minimum requirement unless otherwise specified in the Contract Documents.

14.5 Where the emphasis of the project is to achieve improvements for discrete modes of transport, e.g. buses, trucks, cyclist’s pedestrians etc., it is the Contractor’s responsibility to evaluate and report on the Level of Service achieved for all modes collectively and each mode separately.

14.6 The measure of Level of Service that shall apply to the assessment of design performance for freeways, highways, urban streets, signalised and unsignalised intersections, and including, but not limited to, facilities for bicycles and pedestrians, and buses, etc., shall be in accordance with AUSTROADS GTM Part 3: Traffic Studies and Analysis, Section 3 Traffic Analysis – Capacity and Level of Service.

14.7 A quantitative assessment of Level of Service is to be based on the design traffic volumes.

14.8 The road design shall achieve the Level of Service for a particular specified forecast year model horizon, using the design traffic volumes.

14.9 The Contractor shall analyse the Level of Service for each temporal period prescribed in the contract for each model scenario. The Contractor shall ensure that the design achieves no less than the minimum Level of Service for any 15 minute period of any hour of any day for the design traffic

loading. The Contractor shall demonstrate that the required Level of Service is met for each temporal period specified for the design. The temporal periods shall include the AM and PM work peak hours.

14.10 Degree of Saturation is a component measure of the Level of Service, as described in GTM Part 3 Traffic Studies and Analysis Section 3.2.4 Degree of Saturation. Intersections shall not exceed the Practical Degree of Saturation of 0.8 for priority intersections, 0.85 for roundabouts, and 0.90 for traffic signals, based on the existing cycle length as required in RD-EL-D2 “Traffic Signal Design”.

14.11 Any change, e.g. in traffic signal cycle length, applying to any intersections in the “approved model scenario” shall require a revised analysis of the Level of Service with notification provided to the Principal which shall be a **Hold Point**.

14.12 Where Level of Service deficiencies are identified the Contractor shall demonstrate what measures have been taken to achieve the specified Level of Service.

14.13 For existing facilities within the vicinity of the project, the existing Level of Service provided by these facilities shall not be degraded by the project proposal.

15 Capacity of Turning Lanes

15.1 The effect of the turning paths of large vehicles is to be taken account of in the analysis and modelling, particularly the resulting reduction in lane capacity.

15.2 The design vehicle and check vehicle will be as specified in the Austroads guides, unless otherwise specified in the Contract Documents**.**

15.3 The Contractor shall create drawings and transport modelling to demonstrate the road design can accommodate the design vehicle and check vehicle. Design and check vehicle templates shall be applied in accordance with AUSTROADS GTRD Part 4 “Intersections and Crossings – General” standard vehicles for design and checking design unless specified otherwise.

15.4 The road design shall accommodate the design vehicle within marked lanes. Swept paths shall include a 0.5 m clearance to kerbs, pavement edge lines; and centre of pavement lines on two-way roads. The minimum turning radii used in the determination of a design vehicle or checking design vehicle shall be not less than the recommended turning radii in Austroads GTRD Part 4 “Intersections and Crossings – General” for those specific types of vehicles.

15.5 The design of all roads shall allow for the design vehicle, including accommodation of vehicle swept paths, for all lanes, including turning lanes, auxiliary lanes and intersections including traffic signal phasing and timings.

15.6 The design of traffic signals at cross intersections shall assume the diamond phasing will be adopted which facilitates simultaneous right turns from opposite approaches. A swept path clearance of 2 m is to be maintained between the left sides of opposed turning vehicles.

15.7 Carriageways shall be designed with the specified level of access in accordance with the requirements of the National Transport Council Performance Based Standards Scheme Network Classification Guidelines. The design shall make allowance for over-dimensional / over-mass vehicles as per the Department’s Over-Dimensional Route Network as detailed in the Department’s Heavy Vehicle Access Framework.

15.8 The design vehicles adopted for simultaneous movements of a double line of right or left turn vehicles shall include both the design vehicle and an 8.8 m design service vehicle, with the service vehicle following the inner line of vehicles.

15.9 The design of left turns at unsignalised intersections, and high entry angle left turn slip lanes, may allow the design vehicle to encroach on the second exit lane of a multi-lane carriageway where it can be demonstrated that the manoeuvre is a legal movement for the Design Vehicle, and that the current access conditions are maintained. Depending on the proportion of large vehicles this will detrimentally affect the capacity of the turn and this affect is to be included in traffic analysis and models.

15.10 The traffic analysis shall consider the effect on the design of pedestrian use of intersections, including traffic islands and the effects of encroachment of turning vehicles on pedestrian usage and capacity.

15.11 Notwithstanding the requirements of the design vehicle and check vehicle, the design shall provide accommodation for the use of the roads by existing vehicle types, including the use of local roads.

15.12 All intersections on bus routes shall assume their use by19 m articulated buses.

16 Traffic Lanes

16.1 The Contractor shall undertake traffic analysis and traffic modelling to determine the number, configurations and length of traffic lanes to the meet the capacity requirements of the design traffic demand, and the Level of Service requirements specified.

16.2 The traffic analysis shall demonstrate that the design meets the specified operational and performance requirements and purpose in respect of each traffic lane.

16.3 Notwithstanding traffic modelling requirements, the number of traffic lanes provided in the design shall meet, as a minimum, the requirements as set out in the Contract Documents.

16.4 The provision of the number of traffic lanes and lane widths shall include provision for specific mode types, in accordance with the Department's Functional Classification, for example on a road where bus routes operate the GTRD, bus travel lane requirements shall apply.

16.5 The width and length of roads, and sections of road, shall be designed to ensure the Level of Service and capacity provided is not less than the minimum specified to satisfy merging, diverging and weaving requirements.

16.6 At all signalised intersection approaches a minimum of two lanes shall be provided. A left turn slip lane can be counted as one lane of the two lanes where only one left turn lane is required. Shared turning and through lanes are not permitted.

16.7 Auxiliary turn lanes, short lanes, shall be provided for all permitted turning movements at signalised intersections. At priority controlled intersections, ancillary turn lanes must be provided in accordance with the requirements for desirable treatments described in GTRD Part 4.

16.8 The storage length of short approach lanes shall be determined by their modelled capacity requirements. Auxiliary through lanes and turn lane lengths shall have storage lengths designed to accommodate the predicted 95th percentile queue. The minimum storage length for Auxiliary lanes is equivalent to the length of the design vehicle.

16.9 The design of short lanes and auxiliary approach lanes shall use the full design width of the lane for the storage section of the lane and deceleration section of the lane with adjustments for speed and grade, with the exception of the taper length. The deceleration length of short lanes and auxiliary lanes shall include the taper section.

16.10 In addition to the storage length, auxiliary lanes shall have a length of lane provided to accommodate vehicle deceleration upstream of where a vehicle will arrive at the longest 95th percentile back of queue as demonstrated by an intersection model. (Information note: This describes the dimensions shown in Austroads GRD4A Unsignalised and Signalised Intersections Edition 3.1 Figure 5.1 Components of a deceleration turning lane (a) Deceleration to a stop condition.)

16.11 Where there are parallel turn lanes, adjacent to through lanes, the storage capacity of each lane shall be of equal length. Where equal lengths are impractical because of physical obstructions, the storage requirements shall be achieved by differential lane lengths with the long lane adjacent to the through lane. A traffic model shall be used to determine the storage lengths required.

16.12 For parallel turn lanes, the greater length required for either the deceleration or diverge distance shall apply. Each lane shall be evaluated separately, measuring from the tangent point at the start of the turn lane taper in the adjacent through lane, and shall apply to equal and unequal short lane storage lengths.

17 Traffic Signals

17.1 Traffic signal design will comply with RD-EL-D2 "Traffic Signals Design" which includes traffic modelling requirements. RD-EL-D2 may require additional modelling to the requirements of this Part.

17.2 Where new or modified traffic signals are required for a project a Traffic Signal Operational Performance (TSOPR) will be required as prescribed in RD-EL- D2 “Traffic Signals Design”.

18 Pedestrian Activated Crossings (PAC)

18.1 Pedestrian crossing facilities, i.e. marked crosswalks and associated signals, are normally provided on all approaches at signalised intersections except at “T” intersections where only two crossings are provided. At “T” intersections, one crossing is across the minor road and the other across the major road on the left side of the stem of the “T”. The pedestrian desire lines and volumes should however be checked and modelled where necessary to ensure that the provision of crosswalks matches the demand.

18.2 Where Pedestrian Actuated Crossings (PAC) are to be provided, the location shall match existing pedestrian desire lines. The locations of PACs and extra crosswalks for “T” intersections shall be analysed and justified by the Contractor and approved by the Principal.

18.3 Traffic models shall assume that controlled pedestrian crosswalks are provided at all traffic signal controlled cross intersections.

18.4 Cyclists are permitted to use pedestrian crossings and should therefore be considered in designing pedestrian facilities. Cycle usage shall be combined with pedestrian usage for the purposes of designing and justifying the PAC and crosswalk provisions.

18.5 Where existing crossings are to be upgraded, or new PACs are to be provided, the co-ordination with adjacent traffic signals sites will need to be modelled to determine the signal offsets (see RD-EL-D2 “Traffic Signal Design”).

18.6 All elements of adjoining footpaths and pedestrian crossings shall be designed in accordance with AS 1428 Design for Access and Mobility, the Austroads Guide to Road Design and the Department’s Guidelines for Disability Access in the pedestrian environment.

19 Level Crossing Requirements

19.1 The traffic queuing effects will need to be modelled where traffic signals are located adjacent to a level crossing. Existing queue relocation signals are to be modelled. For proposed traffic signals near level crossings, the railway crossing system shall be actively integrated with the traffic signals as described in RD-EL-D2 “Traffic Signal Design” and these systems will be included in traffic models.

20 Signalised Roundabouts

20.1 Signalised roundabouts may be designed in various formats, including full control, partial control and metering by traffic signals on the approaches. The roundabout signals shall conform to RD-EL-D2 “Traffic Signal Design”. The modelling shall ensure that the roundabout operates without internal queues blocking access to the roundabout. The predicted phasing, cycle lengths, queue lengths and roundabout geometry shall be included in the traffic analysis and modelling report and be approved.

21 Freeway Interchange Analysis

21.1 Restricted access roads or Freeway (Expressway) roads are controlled by a “Road Access” sign or a “Freeway” sign which limits the use of the road to specific types of vehicles.

21.2 Analysis of all road Freeway elements shall be based on the Transport Research Board, Highway Capacity Manual 2016 (HCM 2016) to determine the Level of Service between interchanges and ramp merge requirements. (The analysis required is contained in the following HCM Chapters: 12, Basic Freeway and Multilane Highway Sections, 13, Freeway weaving Segments, 14, Freeway Merge and Diverge Segments, and 23, Ramp Terminals and Alternative Intersections.)

21.3 Three conditions shall be considered for merging, weaving and diverging movements for each section of road as follows:

a) maximum ramp volume and corresponding freeway volume;

b) maximum freeway volume and corresponding ramp volume; and

c) maximum combined volume with in the freeway segment.

21.4 For the analysis of capacity, density and Level of Service of each of the three conditions, the highest 15 minute period volume multiplied by four shall be used as the volume criteria and the analysis fully documented in the Traffic Analysis and Modelling Report.

21.5 Exit ramp designs are to be designed in accordance with the requirements of GTRD Part 4C Interchanges, Section 11.2 Exit Ramps. Queue storage requirements are to be assessed between the exit and the next downstream intersection. Where analysis demonstrates queues are to extend onto the exit ramp, the design shall accommodate the storage requirements to eliminate queuing on the ramp. Approval is required for freeway exit ramp widths and exit lane lengths at the Preliminary Design Report stage (30% completion).

21.6 Simple merges at entry ramps are not permitted in South Australia. Simple merges are described in GTRD Part 4C Interchanges, Section 11.3 Entry Ramps.

21.7 The basic traffic performance analysis of the road geometry for ramps, weaving, merging and diverging shall not include any benefits that will derive from the provision of ITS.

21.8 The design of freeways, including the number, length and arrangement of lanes, shall be determined in accordance with the Highway Capacity Manual (HCM). In addition to the HCM analysis, to ensure there is no discontinuity between adjacent road sections, an AIMSUN Next traffic simulation model shall be used. As a consequence of any assessment of the outputs of this model the design shall not be changed to a lesser standard than that previously determined by the HCM analysis.

21.9 Differences between the HCM analysis and the AIMSUN Next traffic simulation modelling shall be included in the Traffic Analysis and Modelling Report, Preliminary Design Stage (30% completion).

21.10 The provision of traffic analysis on Freeway ramp capacity, including weaving, diverging and merging, shall be included in the Traffic Analysis and Modelling Report, Preliminary Design Stage (30% completion).

21.11 Provision of the Freeway Interchange Analysis shall constitute a **Hold Point**.

22 Freeway Ramp Metering

22.1 In addition to the traffic analysis of uncontrolled weaving, merging and diverging (as above), entry ramps shall be designed to be capable of being controlled by ramp metering. The storage capacity of the entry ramps shall be designed to ensure that there is sufficient storage on entry ramps so that there is no risk of ramp queues extending to the upstream intersecting roads, and no risk of queues extending to the interconnecting arterial roads.

22.2 The entry ramp lane widths and lane storage requirements shall be determined based on “VicRoads Managed Freeways, freeway Ramp Signals Handbook 2013 Chapter 6 Design of Ramp Signal Installations”.

22.3 The storage on entry ramps shall be designed in accordance with VicRoads Managed Freeways, freeway Ramp Signals Handbook 2013 Chapter 6.3 Capacity and Storage Design.

22.4 An average cycle time is not permitted of less than:

a) 7.5 seconds for 1 and 2 lane ramps; and

b) 6.5 seconds for 3 and 4 lane ramps.

22.5 Only 1 vehicle per green display per lane is permitted.

22.6 No less than 4 minutes maximum vehicle wait time is to be applied to the design.

22.7 The resultant design storage lengths and cycle length and projected wait times require approval and shall be reported in the Preliminary Design Report (30% completion).

22.8 To facilitate the provision of ramp metering, the road geometry shall be constructed to accommodate the number and length of lanes identified through the traffic analysis.

22.9 Provision of the freeway ramp metering design shall constitute a **Hold Point.**

23 ITS Provision

23.1 The provision of the Intelligent Transport Systems (ITS) is covered by RT-ITS-D1 Design of Intelligent Transport Systems (ITS).

23.2 ITS infrastructure will form part of any new road provision. ITS technology might include ramp metering, variable message signs, variable speed signs, and flexible geometry, e.g. tidal flow or other variable lane controls.

23.3 The traffic model shall be capable of providing a performance assessment of what increased incremental benefits will be achieved by the installation of ITS compared to the benefits of the performance achieved with passive traffic engineering measures and conventional traffic control devices.

23.4 Where the installation of ITS infrastructure cannot be achieved as part of the project, the performance improvement, due to the technology, shall not be considered in the analysis of the project.

23.5 The ITS element of the design of ramp metering shall not be completed until the ramp metering analysis has been reported and approved.

24 Hold Points

24.1 Model development shall not start until the traffic model scoping document is approved by the Principal.

24.2 Road Design geometry cannot proceed past the Detailed (70%) design until the traffic modelling of the approved model scenario has been completed including incorporating any identified geometry issues within the model.

24.3 "Issued for Construction" (IFC) road design documents cannot be completed until the Principal has approved the Design Report and issued "Issued for Acceptance" (IFA) documents.

24.4 The following is a summary of Hold Points referenced in this Part:

Ref.	Hold Point	Response Time
6.8	Provision of the "traffic model scoping document"	10 working days
8.11	Provision of the "traffic analysis and modelling report".	10 working days
12.11	Provision of "Base Case Models", fully calibrated and validated.	10 working days
13.6	Notification pf a change in the design.	10 working days
13.8	Provision of "future years" model scenarios	10 working days
14.11	Notification of any change to an intersection in an "approved model scenario".	10 working days
21.11	Provision of Freeway ramp capacity, weaving, diverging and merging analysis	10 working days
22.9	Provision of Analysis for Freeway ramp metering capacity.	10 working days