Mesoscopic Network Representation

Aimsun Network Coding Guidelines
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1 Introduction

1.1 Purpose of this document

Transport Performance and Analytics (TPA) is implementing a process to enable the consistent development, re-use and maintenance of base mesoscopic model network representations of the Sydney Greater Metropolitan Area (GMA) in the Aimsun software platform. This document sets out the current recommended approach for coding Aimsun network elements.

The Aimsun Network Coding Guidelines (the ANC Guidelines or the Guidelines) are not intended to provide modelling advice around the appropriate use and application of mesoscopic modelling methods but rather establish a consistent method for the coding of Aimsun networks that can be applied by the wider modelling community.

A consistent network representation of the current base conditions will enable Project Model development time to be reduced during critical phases of broader planning studies.

Note: this is the first issue of the ANC Guidelines. It is intended that the Guidelines will be kept current in respect of industry best practice and as such will evolve over time. In acknowledgement of future improvements to the way in which base transport model network data is managed an overview of likely longer term changes is given in Section 13.

1.2 Objectives

The primary objective of the Guidelines is to promote a consistent approach to Aimsun model network coding across all Project Models.

These Guidelines should be applied by industry when undertaking NSW State Government Aimsun modelling commissions in order to achieve consistency in base network representations. Application of the Guidelines will also ensure compatibility with, and continued development of, the Sydney Aimsun Foundation Network (SAFN) and will assist in achieving the following objectives:

- Comparability of model outputs across different Project Models
- Data transferability based on a common structure
- Model mobility between industry and NSW Government
- Consolidation of multiple models with ability to move towards geographical information system (GIS) platform in the future
- Ability to integrate with other modelling levels in the future.

1.3 Related guidance documents

1.3.1 Protocols for Model Handling (TfNSW, October 2016)

The Guidelines are intended to be read in conjunction with the “Mesoscopic Network Representation: Protocols for Model Handling” (TfNSW, October 2016). The Protocols provide more general guidance on the exchange of model information, data sources, checking, auditing and consolidation of network data, and specifically provide details around the application and maintenance of SAFN.
The objectives of the Protocols are to:

1. Provide guidance to facilitate a consistent approach for meso modelling in AIMSUN
2. Identify opportunities for introducing automation and checking processes.

In combination, the Guidelines and Protocols are being implemented to ensure that opportunities for model re-use are maximised, and to deliver consistency of approach and analysis across projects using the Aimsun mesoscopic modelling software.

The Protocols can be accessed via the TPA website.

1.3.2 Mesoscopic Modelling Guidelines (RMS, Draft)

RMS is developing guidelines that specifically address the modelling requirements for development, calibration and validation of mesoscopic simulation models as well as addressing some of the issues around the use of hybrid simulation modelling.

The RMS Mesoscopic Modelling Guidelines are to be used as a resource for Model Developers to draw upon in delivering Project Models, with a particular focus on the demand development, calibration and validation of these models. The network representation advice, where provided, is consistent with these Guidelines.

The Mesoscopic Modelling Guidelines are currently in draft format and may be made available to Model Developers at the discretion of RMS.

1.3.3 Other references

The following documents are also referenced:

- Queensland Department of Transport and Main Roads 2002, Road Planning and Design Manual, Qld.
2 Application of the Guidelines

2.1 Overview

The ANC Guidelines concentrate on the general model environment capabilities and suitable conventions rather than developments for specific projects (such as project specific scripts, which may be subject to change). Discussion of relevant general capabilities is provided and recommended methods for automation put forward. Note that this automation often provides a good means of enforcing standards in the network.

It is expected that readers have a sound knowledge of Aimsun modelling methods and terminology.

2.2 Document structure – network elements

These Guidelines provide advice for the coding of core network elements, which are addressed in the following sections:

- Section 3 - Reference network and projection system
- Section 4 - Global network parameters (Macro, Meso, Micro)
- Section 5 – Network element identifiers
- Section 6 - Zone system
- Section 7 - Public transport
- Section 8 - Intersection
- Section 9 - Traffic management
- Section 10 - SCATS import
- Section 11 - General modification of sections and nodes
- Section 12 - Slope modelling

2.3 Notes on interpretation

The Guidelines provide recommendations for coding of core network elements, which have been grouped into sections as listed above. Each section contains the following sub-sections:

- Discussion - general discursive comments regarding some of the processes that will aid the adoption of a consistent approach to meso modelling
- Key points – a summary of the coding practices relevant to the network element being considered
- Recommended good practice - important processes and recommendations. These are highlighted with a text box as illustrated below.
Recommended good practice – 3.2

Mesoscopic models within the GMA should use the GDA94 / MGA zone 56 projection system and be developed from aerial photography or Geo Objects that reflect this projection system.

Throughout this document those terms shown in **bold italic** are Aimsun modelling terms and modellers should refer to the Aimsun manual for definitions and usage.

Reference is also made to Aimsun modelling scripts. It is the user’s responsibility to understand the use of the scripts mentioned in this guideline. These scripts were developed for various projects across the Sydney GMA and may require a certain degree of customisation to cater for project specific needs.

Industry partners are requested to comply with these guidelines unless some prior arrangement with the Project Proponent and TPA has been agreed.
3 Reference network and projection system

3.1 Overview

This section provides guidance on the preferred network projection system and geometric alignment.

The recommendations are based on the projection system utilised in the Sydney Aimsun Foundation Network referred to as SAFN. SAFN is a wide area Aimsun network that has been developed over time as an amalgamation of project specific networks.

Whilst the network covers a broad area it lacks detail in some areas for which Project Models have yet to be developed (or where Project Model network data have not yet been incorporated). In order to promote network coding efficiencies and enable reuse of Project Model network data, this guidance recommends the Project Models utilise sub-area extracts of SAFN as a starting point for network development. Once the Project Models are complete the resulting network detail will be imported back in to SAFN to facilitate a progressive refinement of the wide area network. Further details of this approach are given in “Meso Network Representation: Protocols for Model Handling” (TfNSW, October 2016).

SAFN also retains references, such as link identifiers, that enable the network elements to be related back to the Sydney Strategic Travel Model (STM). It is useful to retain a correspondence between SAFN, and sub-area Project Models, and STM to facilitate the exchange of data between the models, such as travel times, and to enable sub-area meso networks to be readily identified within STM. Note that SAFN is not updated to reflect network coding changes in STM. It is possible therefore that the STM identifiers retained in SAFN become superseded over time and it may be necessary to review STM change records in order to compare networks, or undertake a manual inspection.

SAFN employs the Travel Zone 2006 (TZ06) zoning system as used in STM2. The current version of STM, STM3, utilises the TZ11 zoning system, which will be incorporated within SAFN in due course. Refinements to the zoning systems for Project Models should be undertaken in line with the guidance provided in Section 6.

Recommendations for the retention of STM identifiers are elaborated upon in the relevant network element sections

3.2 Discussion

The SAFN utilises a standard projection system referred to as the GDA94 / MGA Zone 56 projection system. It is recommended that all Project Models use the same projection system. The details of the projection system are illustrated in Figure 1.

![Figure 1 Projection system information for SAFN](image-url)
It is the Model Developer’s responsibility for ensuring the application and accuracy of the projection system adopted for Project Models. It should also be noted that the SAFN sub-area networks used for initial network development may lack the required level of detail and geometric accuracy required for meso networks. For example, some links may be represented by straight point-to-point lines rather than following the actual road curvature. Apart from a general lack of detail, in terms of intersection definition, this also has implications for positioning of network objects such as detectors or public transport stops, which the Model Developer should review and address as part of the network development process.

3.3 Key points

For manual editing, the preferred method of aligning geometry is to utilise geo-located aerial imagery, which may be imported into a layer, with modelled links (sections) adjusted to match the underlying road alignment. Following this adjustment of model links, it is necessary to undertake a range of geometric checks and edits that will typically include:

- Insertion of additional sections to reflect road geometry
- Cutting of existing sections to enable the connection of additional sections into the network from newly created nodes
- Alteration of section elements to reflect additional lanes (including lateral lanes which do not run along the length of the entire section), as well as the inclusion of slip lanes at intersections.

If data to be imported are provided in an alternative reference or projection system to that recommended above, provided that the correct projection is specified at the time of import the Aimsun environment should place the geo-objects correctly.

### Recommended Good Practice – 3.2

Mesoscopic models within the GMA should use the GDA94 / MGA Zone 56 projection system and be developed from aerial photography or geo objects that reflect this projection system.
4 Global network parameters

4.1 Overview

This section considers Aimsun global network parameters at the macro, meso, and micro levels.

The terms micro, meso, and macro refer to the three main levels of network representation within Aimsun. Micro and meso are broadly similar, however, there are some differences particularly in relation to awareness of downstream turns. The macro network representation has substantial differences, when compared to meso and micro, as would be expected.

4.2 Discussion

In addition to horizontal geometry, a range of supplementary data are required for network development across the various levels of representation available in Aimsun. For the meso and micro levels these include speed, presence of static priority indicators, lanes reserved for public transport. Vertical geometry, or Z-heights, may also be required if the impact of gradients is of interest.

These data may be incorporated into the model network by using one or a combination of the following methods:

- Input manually for each network element
- Developed using default values by applying the Aimsun Road Types data, provided as standard within the Aimsun software (this may also include application of relevant default values for dynamic and static modelling values such as local reaction time factor and capacity respectively), or
- Be set (or tested) by scripting operations (such as detecting missing priorities or setting priority indicators at major/minor intersections).

Existing Aimsun Road Types provided within the Aimsun software reflect the link hierarchy applied in SAFN, which was in turn derived from the hierarchy used in the Sydney Strategic Travel Model (STM). In addition, Aimsun provides a "New Sections" Road Type, which may be used for the creation of new road sections in the network where other information is unavailable. When establishing the attributes of a new section the Model Developer may choose to preserve the existing set of attributes in the section, or retrieve all settings from the Road Type. The latter is the preferred method.

For the appropriate parameter range to be used, please refer to the RMS 2015 “Parramatta CBD and Wider Area Mesoscopic Model - Model Development Report” (RMS, 2015).

4.3 Key points

It is recommended that use is made of appropriate user created View Modes to assist in checking the accuracy of the coded network data. For example, a view style showing posted speeds will assist the Model Developer in confirming the coded speeds. An example View Mode showing coded speeds by colour is illustrated in Figure 2.
Figure 2 Using a view style to view section speed

Recommended Good Practice – 4 (a)

The use of the SAFN link hierarchy shall be maintained. Any new road type shall be discussed with TPA for possible inclusion into the standard framework of SAFN.
5 Network element identifiers

5.1 Overview

This section raises some issues relevant to the identification of network elements within the network and sets-out the short term methods for implementation.

5.2 Discussion

A number of identifiers are currently used within Project Model network definition. Sections and nodes (and indeed centroids) within the network, created from the initial SAFN importation, have identifiers relating them back to the original strategic links that are based on the STM. These are currently stored in the section and node Name attribute, as shown in Figure 3.

![Figure 3 Identifying sections from strategic model](image)

For convenience these names are also copied to relevant detectors and, from these section and node names, turn names may be set as shown in Figure 4.

Such an approach provides identifiers suitable for use at the validation level (Real Data such as count information may be imported into the model using the Aimsun ID, Name or External ID - since no control is available over Aimsun ID the Name or External ID is recommended for use). The script “PopulateTurningNamesWithEMMENames” carries out this turn naming process.

This is the most suitable convention for temporary count locations. However, for permanent detection sites the source ID should be used.
Sections that are split will maintain their identifiers, new sections, nodes (or turns) will require a new identifier to be specified.

In the absence of a naming convention, names for sections could, for example, be developed from the Aimsun identifiers for the origin and destination nodes of the section (identified by the prefix A) as shown below in Figure 5.

An additional identifier available at certain locations within the network is the SCATS site identifier. An example is shown in Figure 6, with section and turn labels based on the SCATS Traffic Controlled Signal (TCS) ID.
It should be noted that the section identifiers will not be unique, particularly in the case where a link between two nodes is composed of more than a single section. The script “LabelScatsLinkName” may be used for this labelling task.

If an alternative identifier is available, such as from an external GIS database, this may be stored in the Aimsun **External ID** of the node, section, turning or centroid, or in another **user defined attribute** (also known as a column). It should be noted that there may not be a one to one relationship between sections and nodes in the Aimsun network and equivalent features in an external GIS database. For example, in the event that a section is cut in Aimsun, the original identifier will be maintained on both sections thus creating a duplicate identifier in Aimsun. Thus there is the possibility of duplicate identifiers within Aimsun, or conversely, of individual identifiers in Aimsun being composed of multiple identifiers for the external system. Model Developers should be cognisant of the relationship between Aimsun and external GIS identifiers and ensure concordance is maintained as required.

Geo-objects such as sections and turns are unlikely to be the only objects that would benefit from a consistent naming convention. Other relevant objects, including those accessed from the **projects window** - such as **control plans, public transport lines**, and **traffic management** - should be named appropriately to allow easy identification, particularly for use in future scenarios. There is also the option to add an additional **custom attribute** for easy discovery and organisation of such objects.

### 5.3 Key points

A number of methods exist for defining sections and section identifiers:

- As the Model Developer cannot interact with or control the **Aimsun ID** attribute it is not recommended for use. Rather, the **Name** and **External ID** attributes, which can be manipulated by the user, should be used to achieve the desired outcomes

- The Model Developer should adopt a standard method for naming turns, including linkages to count data, and, where possible, should use meaningful references such as TCS numbers in the case of signalised intersections
• While any sections that are split will maintain their identifiers, new sections, nodes (or turns) will require a new identifier to be specified

• When disaggregating the network representation from the original SAFN sub-area network, new section identifiers can take the Aimsun node name with prefix “A” i.e. “A{Aimsun node no.}_N{original SAFN node number}”

• SCATS site identifier in the form “{TCS no_TCS no}” can be used to identify some (but not all) sections and these may not always be unique

• While the Aimsun External ID can relate to an external GIS database, this has limitations unless a one to one relationship exists for sections

• The External ID or user defined attribute can be used to establish ID equivalencies with an external GIS database with care.

<table>
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<tr>
<td>The current practice of retaining the SAFN network node numbers shall be maintained. This link ID should be included in the Aimsun model as the object Name attribute. Additional identifiers, such as SCATS_ID_STRATEGIC, shall be added as additional user defined attributes to maintain the relevance of different data sources until such time when all identifications have been standardised. New sections may have identifiers generated according to the processes outlined above.</td>
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6 Zone system

6.1 Overview

This section considers network coding requirements relating to zone aggregation and disaggregation as well as recommendations for connecting zone centroids to the meso network.

6.2 Zonal disaggregation and aggregation

6.2.1 Discussion

Development of a Project Model meso network requires centroids (or zones) to be disaggregated such that they provide a relatively detailed representation of trip origin and destinations. SAFN utilises the STM zoning system, TZ06, which is generally not sufficiently disaggregate for meso level representation (although this may be more refined in some locations where Project Model detail has been incorporated back in to SAFN). Furthermore, whereas a strategic model might connect directly into strategic level nodes (and indeed be connected to more than a single node or link), for detailed dynamic modelling it will usually be necessary not only to connect zones to the network in a more sensitive manner, but also to divide demand between various child sub-centroids to reflect the required level of traffic detail. These child centroids may be chosen based on land use, presence of count data, presence of parking entrances or minor roads, etc. The decision of how to disaggregate demand (and the selection of suitable criteria) might be based on land use information, parking capacities and other relevant available data.

To maintain a link between the Project Model, SAFN, and STM, the naming and identification of new centroids should reference Name or External ID of the parent centroid. This can be achieved via a naming/identifier convention script, for example:

- ParentCentroidIdentifier_ThisCentroidIdentifier

This could also be achieved by using a new centroid attribute to store the name of the parent centroid. Maintaining this link should not only allow easier tracking of model development, but also ensure unambiguous exchange of information with SAFN and STM.

Figure 7 provides an example of a child centroid name based on both the parent centroid name and the name of the network element (in this case ‘section’) into which the centroid in connected. In this example the child centroid name is:

- ParentCentroidName=ParentCentroidExternalID=SectionName=SectionExternalID

Whereas, the child centroid External ID (not shown) is:

- ParentCentroidAimsunID_SectionAimsunID.

This External ID for the child centroid should therefore be unique within a centroid configuration for any given model.
An alternative, and preferred, approach observes the same principles of maintaining a link back to the original zone system and includes the naming of child centroids with a single letter suffix. That is, child centroids of zone 1234 would be given External Identifiers 1234A, 1234B, etc. These centroids could be subdivided further, for example, 1234A could be divided to 1234AA, 1234AB, 1234AC. In this approach the parent name attribute can be maintained for child centroids. An example of the naming convention for split zones is shown in Figure 8.

The relationship between the original and ‘new’ zoning system should be maintained so that it continues to relate to TZ06, at least for internal zones. This would allow for easy identification and traceability.

One approach to zonal disaggregation for the Model Developer to consider is to first re-assign the centroid connectors for each parent centroid, and then to carry out zonal disaggregation as necessary, creating a separate child centroid for each connected node or entrance/exit pair, respecting the name conventions reflected above.

Given the naming convention above, an automated creation of Groups via a script would assist not only in model management, but also in the display of information, for example at matrix level. Figure 9 illustrates the zone grouping function.
Once the centroids have been split, it will be necessary to distribute trips for the parent centroids to the child centroids. The description of options for demand splitting is outside of the scope of this Guideline, however, the use of groupings can be helpful for display and comparison purposes. Figure 10 provides an example of matrix manipulation using zone grouping.

6.2.2 Key points

Model Developers are encouraged to consider the following in regards to zone naming:

- To maintain a link with SAFN, STM and the TZ06 zoning system the naming of new centroids should reference Name or External ID of the parent centroid
- This can be achieved via a naming/identifier convention script or by using a new centroid attribute to store the name of the parent centroid.

- An improved method is to include a single (or double) letter suffix for the naming of child centroids e.g. Zone centroid 1234 would be given External Identifiers 1234A, 1234B, etc. or 1234AA, 1234AB, 1234AC for even finer-grain disaggregation.

- Any new zone centroids should relate back to the TZ06 zoning system using methods described above.

- The creation of groups and specifically zone groupings will assist the Model Developer with handling child centroids.

**Recommended Good Practice – 6.2 (a)**

The parent-child system should be used wherever applicable to maintain the strategic linkage of the model demand to STM and the TZ06 zoning system. Scripting has been, and should continue to be, used to aid in the creation and management of the parent/child system. For example, scripting can be used to automate creation of centroids based on existing connections, or to detect possible duplications/conflicts in naming.

### 6.3 Centroid Connectors

#### 6.3.1 Discussion

Within a strategic network centroids may be connected directly into a convenient strategically important node on the network and it is often the case that centroid connectors are joined directly in to an intersection. However, for a detailed dynamic network, connecting centroids directly into an intersection will in most cases result in unrepresentative traffic behaviour at these locations and may cause significant calibration issues. It is also more realistic for traffic to emerge on to the network from other locations, such as parking entrances, taxi ranks or other un-modelled access points. Entrance on to the network from these locations may be represented by connecting the centroid to the midblock of the link.

Figure 11 shows an example of a strategic level centroid that has been amended to correctly reflect traffic behaviour at the meso level by connecting into a new section on the more detailed network representation.

![Strategic centroid connection](image1.png)  ![Meso centroid connection](image2.png)

**Figure 11 Example of centroid connector relocation**
As the connection of centroids should ideally be informed by relevant zone boundaries, a possible approach would be to first re-assign the centroid connectors for each centroid, and then to carry out zonal disaggregation as necessary, creating a separate child centroid for each connected node or entrance/exit pair, respecting the name conventions discussed in the previous section.

### 6.3.2 Key points

Model Developers are encouraged to consider the following in regards to the connection of zone centroids to the network:

- Connection of zone centroids to strategically important nodes or nodes at turning count locations should be avoided where possible
- New sections and/or section splits should be introduced by the Model Developer to reflect locations of actual traffic loading onto the network
- Centroid connectors should first be re-assigned to correctly reflect traffic loading points and then zonal disaggregation can take place, creating a separate child centroid for each connected node.

#### Recommended Good Practice – 6.3 (a)

All centroid connections internal to the relevant centroid configuration (i.e. not including model boundaries) should be relocated to connect to the mid-block or to any sections within the road of sub-arterial level or lower. In the short term, a script is available to help identify locations where reconnection is necessary (based on road type, presence of signals or priority information in the node). An exception to this rule might be locations where limited calibration or validation data is available (i.e. non-core areas where travel time or count locations are limited), where additional model detail will only add to model complexity rather than to the development of a robust model.
7 Public Transport

7.1 Overview

This section considers network coding requirements relating to the coding of public transport elements.

7.2 Bus stops

7.2.1 Discussion

The SAFN sub-area network used as a starting point for Project Model development may not accurately represent bus stop locations or configuration. It is the responsibility of the Model Developer to review bus stop representation within the core network and refine as necessary.

Bus stop locations may be imported into the model using data from the Operational Spatial Database (OSD) developed and maintained by TPA. This database includes bus stop and route information as well school bus service details. The required data should be requested through TPA.

It is recommended that this importation is undertaken once Project Model network refinements are complete. This should minimise the additional work required to accurately place stops on the road alignment. The Model Developer should ensure that the geometry around the bus stop locations is correct and complete. Figure 12 provides an illustration of bus stop matching outcomes before and after detailed network refinements.

![Detailed network bus stop placement](image1)
![Initial network bus stop placement](image2)

**Figure 12 Example of bus stop importation outcomes**
In general, bus stops should be modelled using type **Normal** where the bus stops in an area are available to other vehicles. Some stops will, however, require conversion to a **Bus Bay** type. This is expected to be a manual check, although where only a single lane is available for the section on which the bus stop is placed, automatic conversion to bus bay would be preferable, so that vehicles are not unrealistically trapped behind a stopped bus where they might reasonably pass. Reference should be made to the Aimsun user manual for further details on public transport stops types.

### 7.2.1.1 Bus stop scripts

The following scripts have been included in SAFN:

- “PTNB_Cutting_Stops”
- “PTNB_import_ptstops”

These scripts can be utilised in their current form, or they may be customised to reflect project specific requirements, which will also reduce the public transport stop modification processing time. Application of these scripts should be undertaken within the context of the Project Model and the study area requirements. A summary of how the scripts may be applied is provided below.

Within the scripts, bus stops have been coded according to the TSN bus stop identification numbers. Consequently, each bus stop has a unique identifier and is used in the building of public transport (bus) lines from a list of stops.

The “PTNB_Cutting_Stops” script is used to cut sections in order to overcome the Aimsun restriction, which limits the number of public transport lines to one stop per section per line. This means that if a bus must stop at two consecutive stops in the same section, then the section must be cut before the line may be correctly specified.

New stops can be imported using the script “PTNB_import_ptstops”, which imports stops from a space delimited text file comprising the following fields:

- Stop ID
- Stop Name
- Stop Suburb
- X coordinate
- Y Coordinate

The stop length is currently set to 15m for all stops imported using this script. Alternatively, stops may be created manually, but they must retain the **Stop ID** set in the **External ID** attribute field.

### 7.2.2 Key points

Key considerations for the representation of bus stops are:

- Bus stops should be coded using data from the OSD. It is crucial to ensure that geometry around the bus stop locations is correct and complete following importation of the bus stop OSD data
- Bus stops required to operate as bus bays will need to be manually identified
Bus stop scripts are available for the importation of bus stops and automatic cutting of sections for overcoming the one stop per section per line in meso network representation.

**Recommended Good Practice – 7.2 (a)**

The import script “PTNB_import_ptstops” should be used to reduce the processing time for bus stop modification. This places the requirement on the Model Developer to ensure that network geometry in the vicinity of the imported bus stop is correctly represented to ensure that the stop is correctly matched to the section. Manual checks following the modification should be undertaken. Specifically, it is essential that the Model Developer checks that the bus stop has not been coded in the wrong section and/or in the wrong direction. In order to work within the limitation of one stop per section per line, the “PTNB_Cutting_Stops” script can be used.

### 7.3 Public transport lines

#### 7.3.1 Discussion

The preferred source of data for bus services, including school services, is the OSD. The required data may be requested through the TPA. The Model Developer must confirm whether school services are required.

Care must be taken to ensure that buses are coded to enter the network at the correct time and not at the time that they start their route. Similarly, if part of the bus route falls outside of the sub-area network encompassed by the Project Model then the affected route should be split. Bus stops within a schedule may be assigned different dwell times during the day.

The inclusion of sections and turns that cater for bus-only movements (e.g. where bus contraflow to private traffic is possible or where right turn bus-only movements exist) has to be carefully considered by the Model Developer. It is not unusual for such turns to be missing from the base network representation since they are not required for traffic assignment or calibration. The absence of such turns can cause problems for building public transport routes in the network. Bus-only turns and sections may be closed to other vehicle classes using either:

- Turning penalty functionality at macro level
- Cost functions or traffic management actions at dynamic level.

The Model Developer should be consistent in the approach they elect to implement. A recommendation would be that cost functions are implemented if the turn is always closed to private vehicles, or traffic management (specifically turning closures) if the closure only occurs in certain periods.

One limitation of the public transport line definition is that only a single stop may be specified for a section for a particular public transport line. This means that if a bus must stop at two consecutive stops in the same section, then the section must be cut before the line may be correctly specified. Recommendations for cutting sections are discussed further in section 5.

#### 7.3.2 Key points

Key considerations for the importation of public transport lines are:
• The Model Developer has to ensure the correct network representation of bus only sections and turns to ensure available scripts will correctly import PT lines

• To restrict general traffic from bus only turns cost functions should be implemented if the turn is always closed to private vehicles, or traffic management (specifically turning closures) if the closure is only at certain periods

• Scripts are available to import dwell times, schedules and PT lines.

**Recommended Good Practice – 7.3 (a)**

The public transport line scripts should be used to reduce the processing time of public transport line modification. Manual checks should be undertaken to verify changes following the execution of the scripts. Specifically, it is essential to make sure that all the public transport sections (connection between public transport stops) are correctly coded as opposed to being coded as the default shortest path option. One means of checking is by undertaking a direct public transport line distance comparison.
8 Intersections

8.1 Overview

This section considers network coding requirements relating to SCATS/signalised intersections and non-signalised intersections, including slip lanes, priority indicators, roundabouts and major/minor intersections.

8.2 SCATS / signalised intersections

8.2.1 Discussion

8.2.1.1 Slip lanes

This section outlines the requirements for coding of slip lanes at SCATS/signalised intersections. In order to assist any matching process required for placement of detectors or signal groups, it is preferred that section naming is maintained for slip lanes. In the example shown in Figure 13 the slip lane shares the same name as the main lane, and indeed the incoming section. The point at which link N14828_N14833 stops, and where link N14833_N24559 begins can be clearly identified, making it easier to automatically place signal groups (or priority indicators) at their correct location and detectors in their correct lanes. This approach also enables the correct labelling of turns required for calibration.

Figure 13 Section naming within the node

8.2.1.2 Priority indicators

Where conflicting movements are present within the phase plan, priority should be determined by the placement of a give way priority indicator. Within Aimsun it is possible to detect such conflicting turns using the Check and Fix Network tool specifying a suitable control plan. If, at these locations, vehicles wait within the intersection, a stop line should be placed on the turn to indicate the waiting point for vehicles, which should be prior to the downstream conflict area with the opposing
movement. This advance stop line is not considered in the meso model, but having the stop line coded allows for the subsequent adjustment of mesoscopic settings to provide a similar capacity for this movement as provided by the mesoscopic gap acceptance model. Additionally, if this part of the network is represented at the microscopic level, then the placement of these priority indicators correctly represents behaviour without modifications being required. This arrangement is shown in Figure 14.

![Figure 14 Inclusion of stop lines to define storage area in advance of stop line](image)

8.2.1.3 Pedestrian movements

In terms of network editing, pedestrian crossings must first be placed on the network at relevant points. These will generally correspond to traffic signal locations, and since such information is available within the SCATS system, it is possible to transfer such information across to the model, including the information on associated signal groups and phase times.

While the treatment of pedestrian movements is more a modelling specific issue than a network representation issue, at the macro level a fixed delay can be applied at individual turns, while at the dynamic level (macro and meso) this might be achieved by applying speed reductions. Both of these effects can be achieved by a network attribute override applied at (macro or dynamic) experiment level, and informed by a network stored value indicating the volume of pedestrian demand e.g. light, medium, or heavy.

8.2.1.4 Control object naming

The following conventions have been used for convenient identification of relevant objects to assist in automated generation of controller objects. Such conventions are also followed by the SCATS Importer, therefore user defined objects will not be overwritten or ignored, unless explicitly requested, in case of the need to import revised information at unedited locations.

Detectors are named with the detector ID, and the External ID is composed of the SCATS site identifier_number as indicated in Figure 15.
Signal groups are named with simply the number corresponding to the TCS number in SCATS as shown in Figure 16.

Additionally, the SCATS ITS (Intelligent Transport System) Plugin\(^1\) imports the phase order sequence, and their corresponding signal groups, into a node attribute. This labelling system permits signal timings to be imported from an alternative data source. If a node is manually coded, this field should be populated in this standard manner, facilitating easier detection of possible sources of conflicting information.

Please refer to SCATS ITS Plugin manual for more information.

\(^1\) The SCATS ITS Plugin is an Aimsun plug-in (created in partnership between RMS and TSS) which allows connection of Aimsun into the SCATS ITS Dataport to allow import of SCATS intersection geometry, signal configuration and phase description information, creation of fixed timing plans from historical phase timing data, and creation of real data sets corresponding to historic detector count data to be used within the Aimsun model. Use of the SCATS ITS Plugin is currently restricted to TSS. Full release to all active users with Adaptive Control Interface module is anticipated by end 2015.
8.2.1.5 **Signalised intersection scripts**

The following script has been included in SAFN:

- “Macro turning penalties”.

These scripts can be utilised to update the corresponding **Network Attribute Overrides** (NAOs), used within **Turning Penalty Function** or **Volume Delay Function** at the macro level. Generally these NAOs are used in static assignment to ‘simulate’ additional delay at signalised intersections. Application of these scripts should be undertaken within the context of the Project Model and the study area requirements. A summary of how the scripts may be applied is provided below.

A series of NAOs have been developed to assist in the calibration of the static assignment within the model. These NAOs replace key parameters for links and nodes at the static assignment level to assist in producing more realistic network costs for the purposes of static assignment and static demand estimation. The key NAOs used in this model are:

- **SCATS Master Control Plan AM_TURN**
- **SCATS Master Control Plan PM_TURN**
- **SCATS Master Control Plan AM_LINK**
- **SCATS Master Control Plan PM_LINK**
- **AM Turn Bans.**

The function of these NAOs is to incorporate the additional costs associated with turn penalty functions and link volumes delay functions, computed from traffic signal timings, to reflect the additional components of delay from traffic signals and other intersection treatments. These additional costs are intended to bring the static assignment closer to the dynamic assignment in terms of the routes used by traffic to traverse the network.

The NAOs **SCATS Master Control Plan AM/PM_TURN** sets the user defined cost for turns affected by a control plan, based on the available phase time for that turn. This user defined cost is used as an input to the turn penalty function “TPF Sydney Default”, which returns a cost for the turn based on the relationship between turn flow and turn capacity.

The NAOs **SCATS Master Control Plan AM/PM_LINK** updates the section attributes **EMME_GREEN** and **EMME_CYCLE** with updated values based on the phase times and cycle times for these sections. These attributes are inputs to the fd(70) and fd(71) volume delay function (VDF) fields, which are only used for sections on the approaches to signalised intersections. It is noted that fd(70) and fd(71) are largely the same except fd(70) includes an intersection delay component in the section attribute **EMME_TOLL**.

These NAOs are generated, or updated, using the script “Macro turning penalties”. This script should be executed from the morning or evening peak master control plan. Updating of these NAOs should be undertaken whenever significant changes to traffic signal timings are made.

The **AM Turn Bans** NAO is used to set a very high turning penalty for time dependent turn bans. This NAO sets the turning penalty function at the nominated turns to the **TPF High Macro** function, which returns a prohibitively high turn cost,
effectively banning the turn. This NAO is currently only used for the right turn from Robert Street into Victoria Road, which is banned in the morning peak period.

8.2.2 Key points

The following points are to be considered in the coding of SCATS/signalised intersections:

- The section names, and hence turn IDs, adopted for slip lanes should be as described in Section 8.2.1.1

- The placement of priority indicators in advance of the stop line will enable the parameters within the turning to be adjusted locally to calibrate the mesoscopic gap acceptance model appropriately as well as allow for correct behaviour under microscopic simulation should that be required

- Speed reductions that account for the delay of vehicles by pedestrian crossings can be considered where appropriate

- SCATS naming conventions should be followed at all times for Control Objects

- Users may consider the use of vehicle actuated signal control, where appropriate, to simulate an intersection operation more realistically.

**Recommended Good Practice – 8.2 (a)**

SCATS intersections should be coded according to SCATS standard naming conventions to ensure consistency, transparency and assist with automated network checking. This will also ensure minimal conflict and best compatibility with the import process within the SCATS ITS Plugin. Appropriate scripting tools should concentrate on detecting possible missing information for manual intervention.

8.3 Non-SCATS priority intersections

This section refers to the coding of priority-controlled intersections within the model.

8.3.1 Discussion

8.3.1.1 Roundabouts

The initial SAFN sub-area used as a starting point for Project Model network development will need to be refined in respect of roundabouts where the roundabouts are coded as a single node. It is not currently possible to convert an existing node to a roundabout node using the roundabout creation tool; thus, circulating roundabout sections will need to be created manually. The original SAFN roundabout node should form part of the modified roundabout coding so as not to lose any associated data.

In the future it is intended that SAFN will contain a specific Sydney GMA roundabout road type for the circulating sections within the Project Infrastructure Road Types. This will aid identification of roundabout locations, as well as provide easier adjustment of any model specific parameters (such as the addition of relevant junction delay functions at the macro level, or gap acceptance or look ahead parameters at the dynamic level).
Circulating sections within the roundabout node can be named with identical origin and destination identifiers. For example, the circulating sections for node 17964, following strategic identifiers as set by SCATS import, should be named N17964_N17964, and would therefore not be unique. Similarly circulating turns should be named N17964_N17964_N17964, but entrances and exits would have a unique identifier composed in a similar way.

Figure 17 shows the give way priority indicator placement for a typical large roundabout arrangement.

![Figure 17 Roundabout coding with give way coded at relevant turns](image)

8.3.1.2 Major / minor intersections

Each turn required to give priority to other conflicting turns in the node must be marked with a give way priority indicator (or where appropriate, a stop indicator) as illustrated in Figure 18. Absence of such priority indicators can be detected with the Check and Fix network tool.
Figure 18 Major/minor intersection with give way shown for movements without priority

Where two conflicting turns both have give way indicators, but one turn has priority over the other, this should be specified under the Give Way tab of the node editor. Where the Priority box is marked, the row (turn shown in red) gives way to the column (shown in orange). This is illustrated in Figure 19.

Figure 19 Setting explicit priority rules between conflicting priority turns

8.3.2 Key points

The following points are to be considered in the coding of non-SCATS priority intersections:

- Single node roundabouts from the initial SAFN sub-area network should be modified to incorporate circulating sections. The original SAFN roundabout node should form part of the modified roundabout coding so as not to lose any associated data
• **Check and Fix** network tool should be used to identify conflicting turns that do not have *give way priority indicators* coded.

<table>
<thead>
<tr>
<th>Recommended Good Practice – 8.3 (a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority controlled intersections should be coded to reflect the <strong>effective</strong> available number of lanes to turning traffic (and not just what is marked on the road e.g. wide single lane markings often allow two vehicles side by side enabling both movements to be accommodated simultaneously). All necessary priority rules should be coded. Consideration should be given to the application of scripts to improve model consistency through:</td>
</tr>
<tr>
<td>• Detection of intersections with missing or conflicting priority information within the study area</td>
</tr>
<tr>
<td>• The application of appropriate turning penalty functions or junction delay functions to be used at the macro level.</td>
</tr>
</tbody>
</table>
9 Traffic management

9.1 Overview

This section outlines the preferred methods of coding network requirements relating to traffic management measures including lane restrictions, turn restrictions, tidal flow arrangements and speed restrictions.

9.2 Discussion

9.2.1 Lane restrictions

All reserved lane types should be defined at the Infrastructure level within the model. Reserved lane types should reflect the classes of vehicles permitted to travel within the model. Separate reserved lanes should be specified, where, for example, buses and taxis are permitted to use lanes (i.e. to reflect bus lane regulations), against lanes where only buses are permitted (i.e. bus only lanes). It is not recommended to use the default Reserved (Compulsory) for Public Transport lane class. If a reserved lane is of a class that is unknown, then it is possible to establish an unknown class within the model for later identification and refinement.

Reserved lanes are often only active during certain hours of the day, such as during weekday peak periods. If the timing of such closures is uniform throughout the network, then a separate reserved lane type might be justified to more appropriately manage the reservations. Outside the specified hours of operation reserved lanes may be:

1. Deactivated with a traffic management action to reflect unrestricted flow to all vehicles
2. Closed with a traffic management action to reflect unavailability of lane to traffic flow outside hours of operation.

Depending on the variety of rules required, a separate reserved lane types may be justified, for which traffic management can be applied globally across the network or on a lane by lane and section by section basis. This can be achieved through a scripting operation based on section attributes.

In summary, lane reservations may be defined by Vehicle Class and Period of Operation and the lane availability outside this period of operation.

Note that the traffic management actions are not available at the macroscopic level of modelling, but relevant network attribute overrides to be applied in macro experiments can be built and applied from a well-structured traffic management arrangement.

Lane reservations will generally not extend completely along a link. For example, left turning traffic may be permitted to use the lane for a set distance in advance of their turn. Such functionality is best modelled by explicitly un-reserving the final segment of the lane as shown in Figure 20.
The scripts AM Bus Lanes and PM Bus Lanes within the network may be used to reserve lanes for particular scenarios.

9.2.2 Lane restriction scripts

The following scripts have been included in SAFN:

- “AM/PM Traffic Management”
- “AM Bus Lanes (Scenario)”
- “PM Bus Lanes (Scenario)”.

These scripts can be utilised to update the “network description”, and their usage should always be based on the understanding of the model and the study area. Application of these scripts should be undertaken within the context of the Project Model and the study area requirements. A summary of how the scripts may be applied is provided below.

Bus lanes and parking in the kerbside lane have been coded through the use of a script. The purpose of this script is two-fold:

1. Sets up time dependent lane closures to reflect closure of the kerbside lane due to parking.
2. Allows the kerbside lane to be independently restricted to bus lane or T3 lane for any given peak period.

Information regarding the treatment of kerbside lanes in the morning and evening peaks is held in the section attributes Lane_AM and Lane_PM. The following codes are used to denote the function of the kerbside lane in the morning or evening peak periods:

- 1: No lane reservation (general traffic lane)
- 2: kerbside bus lane
- 30: kerbside parking lane
- 31: kerbside parking lane, last segment excluded for turning traffic
- 4: kerbside T3 lane
These codes should be used for any locations where the kerbside lane function changes between peak periods. There are three scripts that use the Lane_AM and Lane_PM section attributes:

- “AM/PM Traffic Management” sets up traffic management policies and actions for parking lane closures and school speed zones. This script only needs to be run once each for peak period to create the policies and actions; unless the Lane_AM and Lane_PM attributes are changed, in which case the script must be rerun to update the policies.

- “AM Bus Lanes (Scenario)” and “PM Bus Lanes (Scenario)” sets the kerbside lane to bus lane, T3 lane or no reservation at the start of a scenario. This script must be selected to run prior to the start of any scenario using the “Pre-run” script option in the “Main” tab of the experiment dialogue.

9.2.3 Turn restrictions

This section is primarily concerned with turn restrictions in regular operation in the network, under equilibrium conditions. Note: it is not concerned with restrictions applied for specific incidents or special scenarios.

In the simplest case, where a turn is unavailable to any vehicle, then the turn should be removed from the model.

In the case of other turn restrictions, the application varies between static and dynamic models, though their descriptions should be consistent. Turn restrictions, as with lane restrictions, can apply to specific vehicle classes, may apply over specific time periods, and require a clear set of vehicle classes to be defined.

The implementation of turn restrictions is facilitated through traffic management actions, which may be interpreted to produce relevant network attribute overrides for use at the macroscopic level. For permanent restrictions, locally set cost functions or turning penalty functions may be used to close the turns at the macroscopic and dynamic levels respectively. However, the preferred method is to utilise a Traffic Management solution to maintain a single point of information storage.

Applying this advice at a dynamic level means that turning restrictions should be modelled as a Turn Closures under Traffic Management, specifically under a Traffic Condition. Force turns should be avoided for base equilibrium scenarios, since they do not make sense in an equilibrium context, and indeed have no parallel at the static level. Since these are equilibrium turning restrictions known to regular travellers, the turn closures should have their influence path costs attribute set to ‘True’, so that vehicles of relevant classes are excluded from assignment to these paths. Force turns are more appropriately applied in investigating special scenarios.

For the static model, all turning restrictions should be applied using Network Attributes Override. This feature allows the user to override parameters, such as User Defined Cost, which could be used in the relevant Turn Penalty Function (TPF). This can then be used to apply an additional, and prohibitively large, cost that would effectively apply a turn restriction to those requisite turns. It is noted that, unlike dynamic simulation, the time-dependent turn restriction cannot be utilised and, consequently, any cost defined is applied to the whole static assignment period. TPFs can also be set to affect particular vehicle classes. It be should be noted that TPFs do not affect public transport vehicles following public transport lines.

For consistency, it is essential that the application of these turn restrictions, and their translation between static and dynamic simulation, are well documented for future scenario replication/consolidation. A clear and ordered naming convention will assist.
in this task and should include relevant days, times, location and reason for
application.

9.2.4 Tidal flow

Tidal flows should be managed under a common traffic management action,
specifically a suitably named Traffic Condition at dynamic level, or a network
attribute override at static level. Normally tidal flows are modelled as a combination
of Turn Restrictions and Lane Restrictions.

9.2.5 Speed restrictions

In this section reference is made to time-dependent Speed Restrictions, which are
applied according to a specified schedule e.g. school hours during weekdays.

As with turn restrictions, the application of speed restrictions differ depending on
whether the application is at the static or dynamic level.

For a dynamic model, all speed restrictions should be defined accordingly using
Traffic Management. More specifically, for scheduled speed changes these
restrictions should be coded as a Traffic Condition, within which a Speed Change
may be applied to a section, grouping (of sections), or a Road Type.

For a static model, all speed restrictions should be applied using Network Attributes
Override. This feature allows the user to override parameters, such as speed or
capacity, used in the calculation of cost in the VDF. It is noted that unlike dynamic
simulation, the time-dependent speed restrictions (e.g. school zones) cannot be
applied and any cost defined is applied to the whole assignment period.

A suitable naming convention, including temporal and spatial references, is
recommended to assist in the correct assignment of Traffic Management and
Network Attribute Overrides to relevant Scenarios or Experiments.

9.2.6 Conversion of Traffic Management to Network Attribute Overrides

Traffic management actions are only available at the dynamic level. However, it is
possible to build macro level effects from the dynamic level actions to be applied
within macro experiments. Scripting provides a controlled way of doing this.

9.3 Key Points

The Model Developer is encouraged to consider the following key points in the coding
of traffic management elements:

- All reserved lane types should be defined at the Infrastructure level within the
  model and reflect vehicle classes permitted to travel in that lane

- It is not recommended to use the default Reserved (Compulsory) for Public
  Transport lane class

- Reserved lane types can be applied globally across the network under traffic
  management or applied locally through scripting based on section attributes

- As lane reservations will generally not extend completely along a link (as typically
  left turning traffic is permitted to use bus lanes to turn left) then the Model
  Developer should ensure that the final segment of the lane is explicitly un-reserved
• Lane restriction scripts are available to apply combinations of kerb-side bus lane, parking and transit lane restrictions across the model network. The AM/PM Traffic Management script only needs to be run once each for peak period to create the policies and actions. The “AM/PM Bus Lanes” scripts must be run prior to any scenario runs as a “pre-run” script.

• Force turns should be avoided for base equilibrium scenarios.

• Turning restrictions should be modelled as a Turn Closures under Traffic Management, specifically utilising Traffic Conditions. (For the static model, all turning restrictions should be applied using Network Attributes Override).

• Tidal flow should be modelled as a combination of turn restrictions and lane restrictions and be managed as a Traffic Condition.

• Time dependent speed restrictions can have speed changes applied to sections, groupings of sections or road types and be managed as a Traffic Condition.

**Recommended Good Practice – 9 (a)**

Various scripts have been created to apply traffic management actions based on available data from external files, or attributes stored within the network. A more consistent approach to creating, structuring and naming traffic management will emerge from development of SAFN to ensure better reuse throughout the model. This will depend on rules that can be applied throughout the network (by day, time, and type of feature). Until such an agreement is reached Model Developers are requested to document the method employed and provide appropriate descriptions of scripts.
10 SCATS import

10.1 Overview

This section outlines the recommended methods for the importation of SCATS signalised intersection data.

10.2 Discussion

There are currently two methods available for the purpose of incorporating SCATS data within the Aimsun network.

The first option is to manually code the signal groups and signal phases. This would require the Model Developer to use either the signal plans or the SCATS graphics and code in the groups, phases and detectors according to the plan.

Alternatively, the SCATS ITS Plugin may be utilised. Application of the SCATS ITS Plugin is currently only available through the Aimsun software provider, TSS. It is expected that the plugin will be formally released to Aimsun license holders by end 2015. The plugin uses the SCATS ITS interface to gather data from SCATS servers. It is able to import data regarding geometry, signal timings and detector counts from SCATS into an Aimsun network. It helps to build a network representation similar to that used by SCATS.

The general approach in the application of the SCATS ITS Plugin is to import intersection information into a separate layer, so that the geometry information, signal groups and location of detectors can be compared and/or copied down to the model network with an automated process as shown in Figure 21.

This process has some inbuilt quality indicators which are displayed to provide confidence that the copied information is a good match. For instance, it will flag to the Model Developer if an expected approach is missing from the base network.

Fixed-timing plans may be generated based on historic data and are also available via the plugin, or necessary controller objects created in Aimsun to allow connection to SCATSIM. The creation of a fixed (or coordinated actuated with limited variability) timing plan based on historical data is recommended since this may be used to build a more accurate representation of turning capacity and delay for the macro level model, and will also allow use of the Check and Fix network tool, or similar process, to detect missing priority information in controlled intersections.
Based on the current specification of the SCATS ITS Plugin, it is expected that this importer will work with any version of the SCATS database as long as the SCATS version and the database version are compatible. The ITS specifications include:

- **ITS messages and requests:**

- **Intersection graphics:**
  - SCATS6-SP-008-A Intersection graphics format

- **Intersection history (.hist files):**
  - SCATS6-SP-002-A SCATS 6 intersection history format version 1.0, 30 June 2003

- **Detector volumes (.vs files):**
  - SCATS6-SP-004-A SCATS 6 detector volume format version 1.0, 29 April 2003

### 10.3 Key points

The Model Developer is encouraged to consider the following key points in the importation of SCATS data:

- SCATS data may be coded manually with reference to SCATS graphics or signal plans
- Alternatively, the importation SCATS data may be automated through application of the SCATS ITS Plugin
• The SCATS version that was used to generate the SCATS database has to be compatible with the History parser if hist files are to be successfully imported.

• SCATS data, hist files, doesn’t explicitly report overlap/alternative phases. These phases need to be considered in the models.

**Recommended Good Practice – 10 (a)**

To date, the SCATS importer developed by TSS has incorporated the SCATS geometry import, historical signal timing import and historical count data import. This importation process is recommended for any future work involving the modelling of SCATS information. The following information/objects should be preserved to allow any future updates/changes:

- detectors and ITS IDs
- section IDs
- node IDs
- signal group IDs

Manual checking is recommended in ensuring the importation process has been completed correctly. Intersections with alternative phases should be reviewed and corrected where necessary.
11 Modifying Sections and Nodes

11.1 Overview

This section describes recommended methods for modifying sections and nodes, including cutting sections, merging nodes and turn editing.

11.2 Discussion

11.2.1 Changes to number of main lanes on sections

Currently there are differences in how Project Models treat the number of lanes on a particular road and discussion is on-going whether the number of lanes should reflect all available lanes, or only those available for traffic flow - possibly determined by presence of clearways.

As changes to the number of main lanes will lead to changes in the stated capacity of the section (used at macro level), as well as the attractiveness of that route (which will most likely have an impacts on dynamic traffic assignment) it is essential that Model Developers consider and manage these implications before applying a particular approach.

11.2.2 Changes to number of lanes at entrance and exit to sections

If more than one lateral lane needs to be added to either side of a link at the entrance or exit, or if one or more lateral lanes needs to be added at both exit and entrance to the section on the same side, then the section will need to be cut using the cutting tool.

11.2.3 Cutting sections

Cutting sections is not only necessary to enable underlying geometry to be expressed accurately, but also to provide expected behaviour changes in the model. Similarly any cutting operation will have an impact on the underlying models, particularly the meso model, but also the macro model depending on the VDFs being employed in the network.

While the microscopic model has a reasonably robust response to the effects of short sections, the mesoscopic model can be sensitive to sections with a length close to that of a single vehicle and should be avoided.

When a section is cut, the Name, External ID and any other attributes are duplicated in the new section created by the cut operation. If these attributes represent a feature only present at the end of the link, for example some macro level delay relating to traffic signal information at the end of the link, then this delay will be presented twice.

11.2.4 Merging nodes

The initial SAFN sub-area network may in some instances contain multiple nodes to represent a particular feature, which may be better represented in Aimsun as a single node. A good example of this would be a complex node as presented in SCATS.

While a merge tool is available within Aimsun, which can be used to copy turns and signal groups into the merged node, it does not preserve all attributes associated with the node. Nor does the merge tool build a Name or External ID for the new node, or create any other columns (such as the attribute identifying the SCATS site). Consequently, either attributes must be recorded and filled manually by the Model
Developer, or a script should be used to carry out the merge operation in a customised way.

Figure 22 provides an example of a node that has been merged to match the SCATS site information with additional Name and External Id composed of the original node names.

### 11.2.5 Turn editing

Apart from matching sections to the road network, effort should also be made to ensure turn lanes correspond with those available for movements. At signalised intersections, destination lanes for turns should normally be set to all lanes of the destination section, rather than the closest lanes, as has often been observed. Exceptions to this might include slips lanes with separate merge lanes at the destination.

Turns are automatically curved and speeds are automatically applied taking into account this curvature and the origin / destination section speeds, unless this speed is manually overwritten. A view style is a useful tool for detecting any turns with artificially low turn speeds.

### 11.3 Key Points

The Model Developer is encouraged to consider the following key points in modifying sections and nodes:

- Model Developers need to consider and manage implications of modelling the correct number of lanes whether they reflect all available lanes, or only those available for traffic flow (in the longer-term likely to move towards reflecting all available lanes with lane restrictions).
• When a section is cut not only is the **Name** and **External ID** duplicated but also any other attributes including macro level delays (that may represent signals) and the Model Developer should remove these at the cut location.

• Complex nodes (including multiple merged nodes) may require scripting or manual inputs to ensure all attributes are correctly represented as the Aimsun merge tool does not preserve all attributes associated with the node.

• Destination lanes for turns should normally be set to all lanes of the destination section rather than the closest lanes (an exception to this includes slips lanes that have a separate merge lane at exit).

• Turns with artificially low turn speeds can be identified by establishing an appropriate **view style**.

### Recommended Good Practice – 11 (a)

When increasing/decreasing the number of lanes along sections, the section capacity will automatically be increased/decreased. Consideration should be given as to whether the stated capacity should be changed or restored to the original value after this lane gain / drop. Any change should be documented.

### Recommended Good Practice - 11 (b)

Care should be taken when cutting sections to ensure that very short sections are not being created. Cutting may have an impact at both the meso and macro level. For simple lane gain or drop, lateral lanes will generally be the preferred method.

### Recommended Good Practice – 11 (c)

The Node Merge process should be followed by manual editing, or carried out with a script to meet the specific requirements for maintaining relevant/useful information.

### Recommended Good Practice – 11 (d)

In terms of turning origin lanes, while it may be possible to detect differences between the SCATS graphic description of the intersection and the model, this process can become complicated for more complex intersection arrangements, and is not available for non-SACTS intersection locations. Therefore, the turning lane distribution will generally need to be adjusted manually, until a more reliable data source is available. For turning lanes to be set correctly, their origin sections also need to include the correct number of available lanes.
12 Slope modelling

12.1 Overview

This section outlines the slope modelling options available in Aimsun 8.1.

12.2 Discussion

Slope modelling is now available in Aimsun 8.1 and its use is advisable on gradients in excess of 3% where there are significant volumes of heavy vehicles or for high speed roads.

Evidence from Queensland suggests that this threshold indicates the need for models to reflect gradients as evidenced in Table 1. Aimsun currently reflects the Queensland Department of Transport and Main Road gradient effects.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Reduction in Vehicle Speed as compared to Flat Grade</th>
<th>Road Type Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uphill Light Vehicle</td>
<td>Heavy Vehicle</td>
</tr>
<tr>
<td>0-3</td>
<td>Minimal</td>
<td>Minimal</td>
</tr>
<tr>
<td>3-6</td>
<td>Minimal</td>
<td>Some reduction on high speed roads</td>
</tr>
<tr>
<td>6-9</td>
<td>Largely unaffected</td>
<td>Significantly slower</td>
</tr>
<tr>
<td>9-12</td>
<td>Slower</td>
<td>Much slower</td>
</tr>
</tbody>
</table>

Table 1 Effect of Grade on Vehicle Type

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<table>
<thead>
<tr>
<th>Grade</th>
<th>Reduction in Vehicle Speed as compared to Flat Grade</th>
<th>Road Type Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Uphill</td>
<td>Downhill</td>
</tr>
<tr>
<td></td>
<td>Light Vehicle</td>
<td>Heavy Vehicle</td>
</tr>
<tr>
<td>12-15</td>
<td>10 – 15 km/h slower</td>
<td>15% max. negotiable</td>
</tr>
<tr>
<td>15-33</td>
<td>Very slow</td>
<td>Not negotiable</td>
</tr>
</tbody>
</table>

Note: Grades over 15% should be used only in extreme cases (e.g. access to an isolated vantage point) and should be for short lengths where no heavy vehicles are required to use them.

For consistency, it is essential that the application of these speed restrictions, and its translation approach between static and dynamic simulation, are well documented for future scenario replication/consolidation.

### 12.3 Key points

The Model Developer is encouraged to consider the following good practice in respect of slope modelling:

**Recommended Good Practice - 12 (a)**

Slope modelling is available in Aimsun since version 8.1. If required an API can be made available for Aimsun 8.0.
13 Towards best practice Aimsun network coding

The preceding Guidelines have been developed as a means to deliver consistent and quality assured Aimsun meso models for all projects. However, it is recognised that the ANC Guidelines are an interim measure to standardise Aimsun network coding whilst progress is made towards a more comprehensive method of developing, maintaining and sharing transport network data.

The current recommended longer term approach is to utilise the Spatially Enabled Networks (SEN) database, implemented in ArcGIS, to act as a repository of all relevant network data that can then be used by Emme or Aimsun depending on the modelling requirements. With the implementation of SEN, all initial Project Model networks will be sub-area extracts from the SEN.

An overview of the expected longer term approach to transport model network development is provided in “Mesoscopic Network Representation: Protocols for Model Handling” (TfNSW, October 2016).

Below is a summary of some of changes expected following the implementation of SEN. In general terms, application of the SEN will minimise manual coding and amendments required to develop base Project Model Networks.

13.1 Future changes to the ANC Guidelines

- **Global network parameters**
  
  A consistent road hierarchy, potentially based on the RMS, Road Asset Management System (RAMS), will be implemented and managed through SEN.

- **Unique identifiers**
  
  The SEN will attribute Aimsun network elements with Globally Unique Identifiers (GUID).

- **Zonal disaggregation and aggregation**
  
  In development of the SEN, consideration will be given to the application of Australian Statistical Geography Standard (ASGS) 2011 zone structure as used by the Australian Bureau of Statistics. Figure 23 shows the fully hierarchical code used for the identification of the main statistical areas (i.e. SA1, SA2, SA3, SA4).

  Application of ASGS SA1 zones within SEN will provide a more disaggregate zone system as a starting point for Project Model development and may mitigate the requirement for further disaggregation whilst avoiding potential duplication in the child naming convention.

  As a minimum, the SEN will utilise the latest TZ zoning system.
• Centroid connectors
The potential to automatically relocate centroid connections to the mid-block of the nearest sections of sub-arterial road types or lower will be investigated as part of the SEN development. Model Developers will still be required to review these connections and adjust as necessary based on their modelling experience and engineering judgment.

• Public transport lines
Public transport lines in SEN will be in the form of the General Transit Feed Specification (GTFS).
In the interim, TSS is currently developing GTFS importer functionality which will enable public transport lines to be directly imported from GTFS. This will also include warning messages in the event that there is more than one stop per section required to be added to the same public transport line.

• Lanes and turns
Information on section lanes and turning geometry will be included in SEN, with any additional lane restrictions to be coded into the network as necessary.

• Slope modelling
Vertical geometry (z-heights) will be incorporated within the SEN at an approximate grid dimension of approximately every 100m.