TRANSPORT IMPACT ASSESSMENT GUIDELINES

VOLUME 5

TECHNICAL GUIDANCE

REVISED
AUGUST 2016

Department of Planning

Western Australian Planning Commission

Disclaimer

This document has been published by the Western Australian Planning Commission. Any representation, statement, opinion or advice expressed or implied in this publication is made in good faith and on the basis that the Government, its employees and agents are not liable for any damage or loss whatsoever which may occur as a result of action taken or not taken, as the case may be, in respect of any representation, statement, opinion or advice referred to herein. Professional advice should be obtained before applying the information contained in this document to particular circumstances.

Published by the
Western Australian Planning Commission
Gordon Stephenson House
140 William Street
Perth WA 6000

Locked Bag 2506
Perth WA 6001

Published August 2016

website: www.planning.wa.gov.au
email: corporate@planning.wa.gov.au

tel: 08 6551 9000
fax: 08 6551 9001
National Relay Service: 13 36 77
infoline: 1800 626 477

This document is available in alternative formats on application to Communication Services.

Contents

Part A – Further technical guidance

1 Introduction

The guidance notes in this technical appendix expand on those in the main text. They are intended to provide further advice on the information required and how it should be presented. They are also intended as a discussion on the general traffic engineering and transport planning principles relevant to a *Transport Impact Assessment* (TIA) and expand on the suggested methodology.

To that end, they are not all encompassing and reference to other relevant traffic engineering and transport planning documents is recommended for those less familiar with the preparation of TIAs.

Also included are a number of examples of suitable graphical representations of data required within the TIA reports.

2 Traffic data

Sufficient up-to-date traffic flow information is required to provide a picture of the current situation in the study area. It is important that the traffic flow data is appropriate for the level of assessment being undertaken and the type of land use development being assessed. For development applications, detailed peak period intersection turning movement data is likely to be required, while peak period link flow data may be sufficient for long-term structure plan and subdivision assessments.

The required data can be obtained either from existing traffic flow databases or from traffic surveys. The two main sources of existing data are Main Roads Western Australia (MRWA) and local councils.

MRWA produces a document called *Statewide Traffic Digest*, which can be found on their website. This covers the most recent six-year period for which data is available, and includes traffic counts on selected roads within the various regions. Separate *digests* are also provided for each of the following regions:

- Goldfields-Esperance;
- Great Southern;
- Kimberley;
- Metropolitan;
- Mid-West and Gascoyne;
- Pilbara;
- South West; and
- Wheatbelt.

Links to all of these data sources can be found at:

MRWA Traffic Digests

https://www.mainroads.wa.gov.au/OurRoads/Facts/TrafficData

Main Roads undertakes traffic counting throughout Western Australia. Strategic locations are monitored on a continuous basis and are referred to as Network Performance Sites (NPS). Sampling of the wider network is performed using portable equipment over a short period. Although many local government roads are counted, the focus is on providing information about the State road network.

It should be noted that not all sites are counted on a regular or annual basis. Historic growth rates may be obtained by interpretation of the available data.

The daily flow data is usually quoted as one of the following:

- AADT – Annual average daily traffic (includes weekends).
  that is, average daily traffic adjusted for seasonal variations;
- AAWT – Annual average weekday traffic (excludes weekends).
  that is, average weekday daily traffic adjusted for seasonal variations;
- AWT – Average weekday traffic.
  that is, average weekday daily traffic for the days surveyed.

MRWA also has the ability to produce turning movement data for signalised intersections from its SCATS traffic signal control system. This can be reasonably accurate when all lanes have a single movement, for example, ahead only or left turn only. It has limitations when there are lanes allowing more than one movement, (for example, ahead plus left turn), as SCATS only records how many vehicles use the lane, not which way they turn. Free (give way) left turns at signals are also not generally counted, although MRWA has begun including loops for these movements in some new installations. Caution should therefore be applied when using SCATS turning movement data at face value and without expertise.

MRWA and councils may also have manually counted turning movement data for specific intersections. This data is usually fairly limited and if available, may be dated. The validity of the data with respect to current conditions should therefore be established prior to its use.

If no appropriate, up-to-date data is available, traffic surveys should be conducted. The four main types are outlined below. The type and scale of surveys required vary from site to site and should be discussed and agreed with the approving authority prior to commencement.

Automatic Traffic Counters

Automatic traffic counters (ATCs), for example, detectors placed across the road. These should preferably be put down for a minimum of one week and count hourly flows by direction. However, counts of just a few days may be acceptable, particularly if they coincide with the peak days of the proposed development.

Some counters can classify vehicles by type, for example, cars, light goods and heavy goods. Others can also record speeds. ATCs are usually used to count mid-block flows, that is, remote from intersections.

Intersection turning movement counts

These are manual turning movement counts at intersections, normally counted for two hours, in ¼ hour intervals, for the highway peak periods (usually the AM and PM weekday peaks). For developments with a peak outside the highway peaks, a count should be undertaken for the development peak period.

Where the development would generate more than minimal levels of traffic in the highway peaks, this count should be in addition to the highway peak counts. Where the development would generate only minimal levels of traffic during the highway peaks, the highway peak counts may not be required.

The counts should also be classified by vehicle type. Usually two classifications, car/light goods and heavy goods/buses, should be sufficient. Pedestrians and/or cyclists may also need to be counted.

Video surveillance is becoming more popular for data collection. However, it requires extensive post processing and can be very time consuming. Nonetheless, it does allow all vehicles to be tracked and results can be checked/verified.

Origin/destination surveys

A third, previously less common, survey type is an origin/destination (O/D) survey to determine where vehicles have come from and/or are going to. This is usually done by recording and then matching number plates at a number of locations. In the past, only a sample was generally taken, for example, white vehicles only or number plates ending in a particular number(s). The sample results were then factored up by the ratio of total vehicles to recorded vehicles. However, with the advent of numberplate recognition software, this option is gaining more acknowledgement as a viable alternative.

Interview surveys

Sometimes interview surveys can be undertaken where it is possible to interview patrons at an existing development. This can be particularly useful to establish existing origin and destination suburbs (i.e. the existing catchment), the routes taken and the mode split (car, public transport, cycle and walk).

More subjective information on travel behaviour can also be obtained by this method, such as why that particular destination was chosen and why a particular mode was used, (or why another mode wasn't used, for example, public transport).

3 Traffic crash data

Crash data for the study area for the last five recorded years can be obtained from MRWA's online CARS database.

The crash data should be analysed to identify any patterns in crashes and hence potential safety issues and possible remedial measures.

Care should be exercised in assessing five-year crash data with regard to any other developments and/or changes to the road network configuration that may have occurred during this time period.

Note that the absolute number of crashes at an intersection or on a road is not necessarily an indication of the relative safety of that location but that the volume of traffic passing through the intersection, or along the road, should also be taken into consideration.

4 Time periods for analysis

The analysis in a TIA may focus on one or more peak hours, depending on the type of land use proposed and the specific issues to be addressed.

The peak hours should be identified on the basis of the 'worst case' combination of site-generated trips plus background trips. To determine this, two peak scenarios should be considered:

- the peak period(s) for the surrounding roads; and
- the peak period(s) for the development.

For residential or employment-based land uses, such as offices, the surrounding road and development peaks usually coincide. Both are normally the AM and PM weekday peaks. (The AM peak hour usually occurs within the 7am to 9am period and the PM peak hour within the 4pm to 6pm period). A more specific indication of the peak periods of the surrounding roads can be gained from examination of SCATS data obtained from MRWA for any existing signalised intersections in the vicinity of the development.

For retail uses, the peak development periods have historically been the Thursday evening peak hour (Friday evening peak in the City of Perth) and a late morning or early afternoon Saturday peak hour. Both these peaks will initially need to be considered. Traffic flows may show that one or the other is clearly the 'worst case' and the assessment can then concentrate on that one peak. However, as a consequence of the relaxation of the restrictions regarding retail shopping hours, Thursday evening is no longer the only opportunity for late night shopping, and other peaks may also need to be considered.

In any case, care must be taken in using this approach as specific intersections or movements may be critical in another peak. For example, for a retail development the total flow through an intersection providing access may be much higher in the weekday PM peak than the Saturday peak but the right turn at that intersection into the development may be much higher on the Saturday. Analysing the PM peak alone may therefore not identify, for example, a potential shortfall in the length of the right turn lane, resulting in blocking of the through traffic.

This should be discussed with the approving authority and, if there is any doubt, both peak periods should be assessed in full.

Other peak periods may be required to be assessed for specialised uses such as places of worship, entertainment uses, sporting facilities and eating establishments

(particularly fast food outlets). In some cases, the surrounding road peaks may not be the normal AM and PM weekday peaks, for example, on roads close to the coast, where flows may be highest on summer weekends.

For developments close to schools, or where the development traffic would pass close to a school, it may also be appropriate to undertake an assessment during the end-of- school-day period, for example, 2.30pm to 3.30pm to determine whether there is likely to be any adverse operational or safety issues for the school.

It is therefore important that the appropriate times for assessment are ***discussed and agreed with the approving authority in advance of the assessment***.

5 Trip generation rates

Ideally, trip generation should be calculated based on generation rates encompassing all person trips regardless of the transport mode chosen. Person-trip generation rates for residential land uses may be derived from household travel surveys such as the Perth and regions travel survey (PARTS).

However, such person-trip generation data is often unavailable, particularly for other than residential land uses. In these cases it is usually sufficient to use vehicle-trip generation rates with adjustments as appropriate to reflect anticipated higher or lower non-car mode share for the particular development.

The person and/or vehicle trip generation of a development can be estimated by:

- surveying a comparable development in a similar location;
- using existing traffic data for a comparable development(s); and
- using typical rates for similar developments.

The first option is the most expensive but potentially will give the most accurate data, especially if a very similar development in a similar location can be found. For example, an existing residential subdivision could be surveyed to assess the likely traffic generation of an adjacent proposed residential subdivision.

The second option can also provide reasonably accurate data but this type of data is fairly scarce in WA as, at the date of this document, no traffic generation database for developments is available for general use. Local councils may be able to provide some data and are a good first step before organising a traffic survey.

The most common method, and potentially the least accurate, is to use typical rates for the type of development in question extracted from published land use traffic generating databases. In the past, the main such sources have been:

- *Land Use Traffic Generation Guidelines*, March 1987 - Director General of Transport, South Australia;
- *Guide to Traffic Generating Developments*, Version 2.2, October 2002 - Roads and Traffic Authority, New South Wales; and
- *Trip Generation Manual* - Institute of Transportation Engineers (ITE), Washington, USA.

These databases provide general rates for a range of land uses expressed in terms of daily and/or peak hour trips based on relevant criteria such as floor-space or number of dwellings.

The *Guide to Traffic Generating Developments* and its *2013/04a Updated Traffic Surveys*; and the ITE *Trip Generation Manual* remain recognised sources for trip generation rates, however, these databases are generally based on surveys from NSW, SA and the USA. Much of the data is old and may not be particularly relevant to WA. The rates also tend to be averages implying that, even if they are appropriate, 50 per cent of that type of development is likely to generate at a higher rate.

If using these databases, sensitivity tests using higher rates (for example, 85th percentile) may need to be carried out to ensure that if the development does generate at a higher rate than the average, the additional traffic can be accommodated.

Trip rates, and whether sensitivity tests using higher rates are required, should be agreed with the approving authority prior to carrying out the assessment.

There are other, more recent sources of data, but again the user must establish their applicability to developments in WA. These include:

- Trips databases held in the UK (www.trics.org) and NZ (www.tdbonline.org);
- *NSW Guide to Traffic Generating Developments 2013- NSW Transport Road and Maritime Services (RMS).*

The individual trip generation rates used for each land use component and each time period should be shown in a table and any sources employed should be fully documented in the assessment report. The resultant number of trips generated by each land use component in each time period should also be presented in table form. It should be clearly indicated whether these are person trips or vehicle trips.

For mixed use developments, or those with a range of retail outlets, there is likely to be a degree of cross-visitation, that is, two or more of the individual land uses, or retail outlets, being visited on a single trip. There may therefore be some justification in reducing the individual land use trip rates to account for this.

For those mixed use developments with a residential component there is a greater potential for more trips to be made on foot or by bicycle, for example, walking to work or shops. This should also be taken into consideration when determining appropriate car trip rates.

The objective is to ensure that the car generation is not overestimated and that no more road infrastructure is provided than will be required. This should be assessed on a case-by-case basis and any reduction in rates agreed in advance with the approving authority.

It should be noted that this cross-visitation may reduce the number of vehicle trips but generally does not reduce the parking demand as average parking duration increases accordingly.

In the absence of any site-specific trip rates, **Table 1** below quotes a range of values for a number of the more common land uses. These have been extracted from the currently available data bases. Use of these values will generally be accepted, and any significant deviation from them should be recorded and justified.

6 Mode choice

When trip generation is determined on a person-trips basis the next step is to determine what proportion of trips would be made by each available transport mode (that is, car driver, car passenger, bus, train, cycle, walk).

It should be noted that the mode choice may vary in different parts of the study area depending on factors such as proximity (for example, some of the catchment may be within walking or cycling distance of the site) and public transport provision (for example, some of the catchment may be along a bus route that runs close to the site).

There is also the potential for developers to influence the mode choice by, for example, the provision of bus stops adjacent to the site or the rerouting of buses closer to the site (in consultation with Transperth). For larger subdivisions the provision of new bus services may be appropriate. Proposals such as this would be viewed favourably by the approving authority and may allow a reduction in the vehicle trip generation rates to be used in the assessment.

When vehicle trip generation rates are used it is usually appropriate to omit the mode choice step. However, it may still be appropriate, in some cases, to analyse the potential for some of these car trips to be made by other transport modes. This would be important, for example, where

Table 1: Typical land use vehicle trip rates

LAND USE	UNIT	AM peak hour trip rate			PM peak hour trip rate		
		In	Out	Total	In	Out	Total
Residential	Dwellings	0.2	0.6	0.8	0.5	0.3	0.8
School	Pupils	0.5	0.5	1.0	0.5	0.5	1.0
Commercial	100m² GFA	1.6	0.4	2.0	0.4	1.6	2.0
Retail (Food) [ab]	100m² GFA	2.0	0.5	2.5	5.0	5.0	10.0
Retail (Non-food) [b]	100m² GFA	1.0	0.25	1.25	2.0	2.0	4.0
Industrial	100m² GFA	0.8	0.2	1.0	0.2	0.8	1.0

GFA = gross floor area

a – These rates should be applied to retail developments/ shopping centres that have a significant food retail component.

b – The trip rates for both food and non-food retail stores can vary significantly depending upon a number of issues including type of goods sold, location and size. Caution should be used in applying these rates arbitrarily.

a significantly improved public transport service to an area is proposed as part of the land use proposal.

The basis for the mode choice analysis should be clearly documented in the report or technical appendices, including any survey data or published sources, and any assumptions incorporated in the analysis. If the approval authority is concerned about the mode choice analysis then sensitivity testing may be appropriate to determine how critical this factor is in the overall assessment.

7 Trip types

Not all trips attracted to the development will be new to the surrounding road network. Depending upon the type of development, a proportion will already be on the network passing directly in front of or nearby the development and will simply divert in. An example of this is PM peak period shopping trips where customers may shop on the way home from work.

Some developments will generate relatively few totally new trips, for example, petrol stations and some fast food outlets. Most of their customers are drawn from cars directly passing, or passing very close to, the development. The traffic impact of these types of developments is therefore usually very localised, often just at the access to the development itself.

There are therefore three types of trips to consider:

- pass-by – directly passing the development and simply turning in before continuing their trip;
- diverted – passing close to the development and diverting to the development before continuing their trip; and
- new trips – totally new to the surrounding road network and made only because of the development.

The proportion of each trip type will depend upon the type and location of the development. This should be assessed on a case-by-case basis and agreed with the approving authority.

Where such an argument is put forward, it should be clearly justified with reference to available research on this subject, analysis of appropriate marketing studies or retail modelling, or analysis of specially designed surveys.

8 Trip distribution

The traffic generated by the development should be distributed to the surrounding road network based on current patterns or using recognised traffic modelling techniques.

For pass-by and diverted trips this is very simple. Trips are diverted from their normal route to the development and back again, generally in proportion to existing flows. For example, if the frontage road has 60 per cent northbound and 40 per cent southbound, pass-by traffic to the development would be split 60 per cent from the south (that is, northbound) and 40 per cent from the north (southbound).

New trips can be distributed by:

- splitting the new trips in the same proportions as existing traffic on the surrounding roads;
- surveying a comparable development adjacent to the proposed site; and
- assessing the likely catchment of the development.

The most common and potentially least accurate method is to simply split the development traffic in the same proportions as the existing traffic passing the site, that is, as per the pass-by and diverted trips. This method is generally less appropriate for the new trip component and its use would need to be justified by the proponent and agreed in advance with the approving authority.

The second and third methods above are more appropriate for the new trip component. The second method involves surveying a comparable development adjacent or close to the proposed site (if one is available), to determine the directional distribution of its traffic. This distribution can then be used as a basis for the proposed site's distribution.

Alternatively, interview surveys of its customers could also be undertaken to identify origins and destinations and approach routes and this data applied to the new development. This would be particularly relevant for expansion of an existing development, where the future travel patterns would likely be similar to existing.

In the third option, the trip distribution is based on an assessment of the likely catchment of the development. It is mainly applied to retail developments but can be applied to employment and other developments.

It should be noted that the catchment of land uses such as retail is strongly influenced by the location of competing shopping centres and this should be taken into consideration in defining the likely catchment. Information on the likely catchment should be extracted from a retail impact assessment if one has been undertaken. The vehicle and retail catchments should be consistent.

The potential trip distribution can then be estimated using a simple gravity model, as follows. The total catchment area is divided into smaller sections. The area of each section is roughly measured and the time to travel from the section to the development estimated. For each section an Area/(Travel time)n value is obtained. The power n is a measure of the reluctance to travel longer distances, the higher the power the greater the reluctance. It is also a measure of the discretionary nature of different trip types.

Work-related trips generally have a low 'n' value, reflecting the lower flexibility in choosing the workplace, however, many can and do choose where they live based on their place of work and vice versa. Shopping trips have a higher 'n' value as there is a greater choice in shopping locations.

Typical values of the power 'n' are:

Shopping: 1.5 – 2.5;

Employment: 1.2 - 1.5.

Note that these values are rough guidelines only and can vary significantly from one location to another. Care should be taken in using them and supporting information, wherever possible, should be provided to justify the 'n' values adopted, for example, calibration against known journey to work data.

An example of the gravity model (A/T^n) method is shown in **Table 2** for a shopping centre surrounded by four residential areas with similar densities and assuming n = 2.

The proportion of trips coming from each area is equal to the ratio of its A/T^n value to the sum of the A/T^n values. Thus, two residential areas of the same size (2 and 4) provide 44 per cent and 7 per cent of the trips respectively based on their travel times to the development.

Whichever method is used, the basis for the distribution of trip origins and destinations should be clearly explained in the report. If this becomes very involved it may be appropriate to include it in a technical appendix with just a brief overview in the body of the report.

9 Parking

This section provides advice on assessing the parking demand of a development. A parking assessment is only likely to be required at development application stage and then only for uses likely to generate significant levels of public parking. The need for the assessment is to be confirmed with the approving authority.

9.1 Parking demand

There are two main methods of projecting parking demand:

- Survey a comparable development;
- Extract typical rates from appropriate land use databases.

The first approach is potentially the more accurate. For the expansion of existing developments, such as shopping centres, the existing parking demand should be surveyed and used as a basis for projecting the parking demand for the expanded centre.

For new developments the demand should be projected based on surveys of comparable land uses in the locality of the subject site or in a locality similar in characteristics to the subject locality, such as surrounding land uses, residential density and public transport accessibility.

It should be noted that the peak parking demand often occurs outside the development's peak periods for traffic generation and the times adopted for the parking survey need to take this into consideration. For example, the busiest hour for traffic to an office development may

Table 2: Example of A/T^n trip distribution method

Residential Area	Size (Hectares)	Travel Time (minutes)	A/T^2	% Trips
1	5	5	0.2	14%
2	10	4	0.625	44%
3	2	2	0.5	35%
4	10	10	0.1	7%
Total			**1.425**	**100%**

be 7.30am to 8.30am but employees may continue to arrive for work until 9.30am or 10am. The peak parking demand may therefore occur at around 10am.

There are two main forms of parking surveys:

- A count of the number of cars in the parking areas; and
- A count of all vehicles entering and leaving the development.

Method 1 involves counting the number of cars in the car park, (or number of vacant spaces if the car park is busy), at regular intervals, usually ¼ hr or ½ hr during the high demand periods.

For larger sites such as major shopping centres, the car park should be divided into sections and each counted separately. This gives an indication of the popularity of the various car park areas and allows a parking management plan to be developed, if required.

If the car park is approaching or above capacity, any off-site parking, (and illegal parking within the car park), should be recorded to ensure the true parking demand is measured.

Method 2 involves counting the vehicles entering and leaving at all access points during the survey period, usually subdivided into ¼ hr intervals. The number of vehicles in the car park should be counted at the start and end of the survey period.

From this the number of vehicles in the car park throughout the survey period can be determined. Again, if the car park is approaching or above capacity, any off-site (overflow) parking should be recorded to ensure the true parking demand is measured.

In estimating the potential parking demand for mixed use developments, due regard should be given for the peak parking demands for the various components occurring at different times. For example, at a shopping centre with a multiplex cinema, the peak for the centre is likely to be Thursday evening or mid-afternoon Saturday while the peak for the cinema would probably be Saturday evening.

Combining the two individual peaks would probably result in a significant oversupply of parking. Some reduction in the parking supply should be made to account for the two peaks not occurring at the same time, thereby allowing some spaces to be shared.

This sharing of parking will depend on the mix of land uses and each development would need to be assessed on an individual basis. The combined peak may in fact not occur at the same time as either individual peak. For the example above, this may be 4pm on a Saturday when the shops are starting to close but the cinemas are getting busier.

Specific advice for parking associated with Activity Centres can be obtained from *SPP 4.2 Activity Centres for Perth and Peel*.

9.2 Parking layout

Parking layouts at 1:500 scale must be provided with the TIA. The spaces on the drawing must be counted and labelled. Clear tabular breakdowns of the number of parking spaces being provided are required.

9.3 Parking impacts

On-site parking provision should conform to policies set out in the town planning scheme, Development control policy and in the relevant development plan.

In addition to current parking policy, consideration must be given to the parking strategy, where one exists, for the city or town. A parking strategy will include estimated levels of future parking provision and demand as well as proposed locations for future provision. It is important that any proposed development is assessed against these levels and locations.

The analysis of parking should focus on the requirement for parking, as an output of the design of the development, once other measures have been fully taken into account. It should highlight whether there is potential to level the peaks of parking demand, for instance through shared use of spaces between parts which have different peaks of demand. On-site parking controls and charges may also need to be introduced by the developer and/or occupier to encourage turnover of parking space.

Restrictions on on-site parking may lead to overflow parking in the surrounding area. Off-site parking provision and controls may need to be included in the TIA.

9.4 Parking impact analysis

On-site parking provision should conform to demand management principles and be compatible with the policy guidance on parking and levels stated by the local authority, particularly in the local transport strategy and local and town centre parking strategies.

The TIA should demonstrate how the need for parking has been minimised in new development and redevelopment. It is no longer appropriate to focus on providing sufficient parking to satisfy all demand. Over-provision of parking is still common in development proposals, largely based around the routine use of the 85th percentile in car trip rate assumptions. A more appropriate choice of trip rate will therefore lead to more realistic parking provision. Such an approach will often be of benefit to developers, who may then be able to increase the density of the development.

The analysis of parking should focus on the requirement for parking as an output of the design of the development, once other measures have been fully taken into account. It should highlight whether there is potential to level the peaks of parking demand, for instance through shared use of spaces between parts of the development which have different peaks in demand. On-site parking controls and charges may also need to be introduced.

Off-site parking provision and controls need to be included in the TIA stage and reflected in the other areas of the TIA report. Restrictions on on-site parking may lead to overflow parking in the surrounding area. Development proposals may need to contribute towards the introduction of on-street parking controls, for instance for a residents' parking scheme, as part of the overall package of measures associated with an application.

10 Analysis of intersections

The operation of all site-access locations and all relevant intersections in the study area should be analysed for each time period in the assessment years with and without the proposed land use.

This is invariably a requirement for development applications and usually appropriate for subdivisions. However, this level of analysis is unlikely to be required for structure plans except for major intersections that may require grade separation or where the land requirements of major intersections need to be accurately defined (for example, an intersection of two regional roads where the land requirements will need to be identified on the region or town planning scheme map).

The operational analysis for signalised intersections should generally be conducted using an approved intersection analysis program, such as SIDRA. For intersections without signals, other methods such as detailed in the Austroads *Guide to Traffic Management* series or the US *Highway Capacity Manual* may be appropriate.

All assumptions concerning lane configuration, geometry and use, pedestrian and cyclist activity, signal cycle length and phasing should be documented in a technical appendix. The sources of all information and assumptions should also be documented in the same part of the report as the information or assumption.

For each intersection, the overall volume/capacity ratios (V/C) or degree of saturation, and level of service, should be documented in a table in the body of the report. More detailed results (and full calculations for manual analyses) for each intersection should be documented in the technical appendices. V/C (or degree of saturation), level of service, average delay and queue lengths should be documented for each traffic movement at each intersection.

The information should be presented in tabular format allowing a ready comparison between the with- and without-development scenarios. A discussion of the results should be provided, including an assessment of the scale of impact on the intersection's operation and whether the development traffic can be accommodated under the existing layout or whether remedial measures should be considered.

Where appropriate, electronic copies of the data and output files used in the analysis should be provided.

In line with changing MRWA policies, any analysis of an intersection should be accompanied by an analysis of alternative intersection controls, such as signals and roundabout, in order to ensure that the analysis is rigorous and the recommended treatment is fully justified.

Further information on intersection controls in WA can be found on MRWA's website.

11 Remedial measures

For priority intersections, lower average delay thresholds have been adopted compared to signalised intersections. This is to counter the uncertainty for drivers on the side road (that is, giving way) in finding a suitable gap in the priority stream and how long they will have to wait.

When priority flows are high, side road delay can be significant and there can be a high degree of uncertainty as to when a gap will become available. This can have safety implications, as drivers may accept smaller gaps in the main traffic stream than normally considered safe.

The impact on main stream traffic, that is, increased delay, needs to be considered in any proposal to change the existing form of control. The ability of pedestrians and cyclists to negotiate the intersection under increased traffic flows due to the development also needs to be considered.

All proposed new traffic signals should be evaluated in terms of Austroads/MRWA signal warrants, distance from other signals, impacts on existing signal coordination and likely timing of implementation. (Note also **Section 10**).

All proposed adjustments to signal cycle lengths, traffic signal phasing and timing should be evaluated in terms of pedestrian crossing times, impacts on queue lengths and adequacy of existing storage, impacts on downstream access points, modifications required to existing traffic signals and controllers (hardware-related) and impacts on offsets and traffic signal coordination. The developer should liaise with MRWA on all issues concerning traffic signals.

MOVEMENT SUMMARY

Santana Rd / McCarney Wy AM

2031 AM Peak
Roundabout

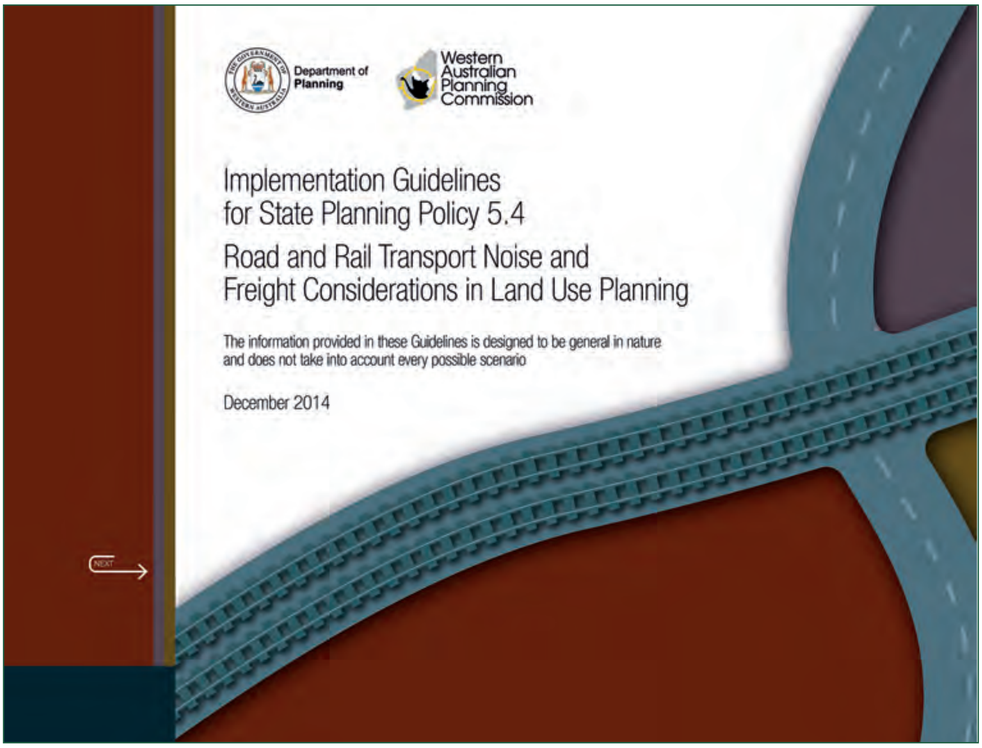
Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast											
21	L2	3	7.0	0.192	6.9	LOS A	0.8	6.1	0.56	0.64	53.0
22	T1	1232	7.0	0.789	9.9	LOS A	9.6	71.4	0.85	0.98	52.4
23	R2	450	7.0	0.789	16.0	LOS B	9.1	67.4	0.89	1.07	50.1
Approach		1684	7.0	0.789	11.5	LOS B	9.6	71.4	0.86	1.01	51.8
NorthEast											
24	L2	237	4.8	0.341	6.4	LOS A	1.3	9.5	0.54	0.74	53.8
25	T1	4	4.8	0.589	6.5	LOS A	3.4	24.8	0.55	0.75	54.5
26	R2	547	4.8	0.589	11.9	LOS B	3.4	24.8	0.64	0.90	51.6
Approach		788	4.8	0.589	10.3	LOS B	3.4	24.8	0.61	0.85	52.2
NorthWest											
27	L2	442	7.0	0.407	5.8	LOS A	2.5	18.3	0.61	0.64	53.1
28	T1	609	7.0	0.332	5.7	LOS A	1.8	12.6	0.58	0.55	54.5
29	R2	2	7.0	0.332	10.9	LOS B	1.7	13.6	0.58	0.56	54.7
Approach		1053	7.0	0.407	5.7	LOS A	2.5	18.3	0.59	0.59	54.0
SouthWest											
30	L2	6	3.0	0.020	11.7	LOS B	0.1	0.7	0.84	0.81	50.1
31	T1	2	3.0	0.020	11.7	LOS B	0.1	0.7	0.84	0.81	51.6
32	R2	6	3.0	0.021	18.7	LOS B	0.1	0.6	0.83	0.89	47.5
Approach		13	3.0	0.021	14.8	LOS B	0.1	0.7	0.84	0.84	49.0
All Vehicles		3537	6.5	0.789	9.5	LOS A	9.6	71.4	0.72	0.85	52.5

12 Traffic noise

The assessment of the impacts of traffic noise is beyond both the scope of these TIA guidelines and the expertise of most traffic engineers. However, at structure plan and subdivision stages, the approving authority may request the proponent to identify whether a noise assessment is required under **SPP 5.4.**

In this event, the proponent or the transport consultant should refer to the *Implementation Guidelines for SPP 5.4* to determine whether the traffic flows identified within the TIA exceed the relevant threshold values.



Part B – Derivation of technical data

Trip generation rates are used in **Table 1 of Volume 1** to determine the land use thresholds for the various levels of assessment for subdivisions and individual developments and are provided in **Table 1 of Volume 2** to estimate the trip generating potential of structure plan land uses.

Data on the trip generating potential of the various land uses is fairly limited in Western Australia with the exception of the home end, (from the Perth and Regions Travel Surveys (PARTS) and TravelSmart.

As surveys are undertaken, over time, more data will become available and the above tables can be reviewed and revised.

Where more information is known on the likely trip generation of the development in question, site specific trip rates should be used in lieu of the rates in these guidelines.

The trip rates suggested in these guidelines have been derived mainly from the PARTS and TravelSmart surveys and the *Guide to Traffic Generating Developments Version 2.2, October 2002 – Roads and Traffic Authority, New South Wales (RTA Guide)*, and its *2013/04a Updated Traffic Surveys (RTA Surveys)*; as outlined below.

Residential

The rates are based on the PARTS data averaged over the range of dwelling types. The rates for structure planning (**Table 1, Volume 2**) are 0.8 vehicle trips per dwelling for the AM and PM peak hours, split as follows:

AM peak	25 per cent IN : 75 per cent OUT
PM peak	67 per cent IN : 33 per cent OUT

For the threshold calculations (Table 1, Volume 1) the rate has been rounded up to 1 vehicle trip per dwelling.

Schools

The rates are based on data from the PARTS surveys that indicate that around 65 per cent – 70 per cent of children are driven to primary school, with an average occupancy of around 1.4 - 1.5 children per car. This equates to 0.5 trips per child to school and 0.5 trips per child *from* school, in each of the AM and PM peak hours.

For secondary schools, the PARTS data indicates that the proportion driven to school is generally a little lower, but to simplify the process of determining the level of assessment required, and for the broad assessment of structure plans, it is suggested that the above primary school rates be used for all schools.

Entertainment venues/Restaurants

The *RTA guide* indicates that rates can vary significantly for this land use type and gives an average peak hour rate of five trips per 100 m^2 GFA, or 10 trips per 100 seats (based on two m^2 GFA per person)

For most developments of this type, the peak hour(s) are likely to be outside the normal AM and PM peak hours. Professional judgement should therefore be used when selecting the hours for assessment, appropriate trip rates and in:out splits.

Fast food restaurants

The available data is fairly limited. The *RTA surveys* suggest that the rate is not directly related to floor-space. This could possibly be due to fast food restaurants generally being of a similar size, with location being a greater determinant – a significant proportion of trade being drawn from passing traffic (RTA suggests at least 50 per cent).

The rates adopted in these guidelines assume 20 trips per 100m^2, that is, four times that of a sit-down restaurant above. Due to the dearth of good survey data, this is somewhat intuitive and will be reviewed and revised when better data become available. Where the proponent has more reliable trip rate information for their specific development, this should be used in lieu of the guideline figures.

Retail/shopping centres (with significant food retail component)

Trip rates can vary significantly for this land use. The *RTA surveys* indicate peak hour vehicle trip rates of around 12 trips per 100 m^2. These surveys were carried out in the 1970s and updated in the early 1990s.

With the trend towards longer shopping hours since these surveys were carried out, a lower rate of 10 trips per 100m^2 GFA has been adopted for the PM peak hour, (and 2.5 trips per 100m^2 for the AM peak hour). A 50:50 in:out split has been adopted for the PM peak and an 80:20 split for the AM peak hour.

Non-food retail

Trip rates also vary significantly for this land use as it covers a wide range of retail developments. The *RTA surveys* indicate a range from 0.1 to 6.4 trips per 100 m^2 GFA for the weekday PM peak hour, with an average rate of 2.5 trips per 100 m^2.

These guidelines have adopted a PM peak hour rate of four trips per 100 m^2 GFA in the upper middle of the range (with AM rates around a quarter of this), but these rates should be used with caution in view of the large potential range in trip rates.

Wherever possible, rates more appropriate to the specific development should be used in lieu of the guideline figures.

Offices

Trip rates are based on the *RTA guide* rate of two trips per 100 m^2 in the PM peak hour. The same rate is assumed for the AM peak. An 80:20 in:out split has been assumed for the AM peak and the reverse for the PM peak.

Industrial

Trip rates are again based on the *RTA guide* rate of one trip per 100 m^2 in the PM peak hour. The same rate is assumed for the AM peak. An 80: 20 in:out split has been assumed for the AM peak and the reverse for the PM peak.

2 Assessment of pedestrian/cycle networks

2.1 Rationale

The assessment of pedestrian/cycle networks within these guidelines concentrates on the ability to cross major roads.

While pedestrian crossing facilities are usually provided at major intersections (except at multi-lane roundabouts), these intersections are usually fairly widely spaced (often one kilometre or more apart), to provide for efficient vehicle movement.

This spacing is too wide to provide an efficient pedestrian network and a significant proportion of crossing manoeuvres are likely to be made, or would want to be made, remote from these intersections. This includes access to/from bus stops.

At these 'mid-block' locations, pedestrians require gaps in the traffic of sufficient length to allow them to cross, and sufficient frequency to keep delays to acceptable levels.

The ability to cross a road safely is a function of:

- the width and type of road to cross (for example, two lane undivided or four lane divided);
- the volume of traffic on the road;
- the speed of the traffic; and
- the walking speed of the person crossing (often lower for school children and the elderly).

The key factor in determining whether pedestrians can cross is the traffic volume. At low traffic volumes there are regular gaps of sufficient length for pedestrians to be able to cross safely with minimal delay. As traffic volumes increase, the number of gaps large enough for pedestrians to cross decreases, making it more difficult to cross and increasing delays to pedestrians.

As volumes increase further, a point is reached at which there are few, if any, gaps of sufficient length for pedestrians to cross safely and delays become significant. This has two potential impacts:

- Pedestrians take risks by crossing in less than desirable gaps–with major safety implications; and/or
- Pedestrians do not try to cross, or give up after waiting for some time, and the road becomes an impassable barrier.

Table 3 of Volume 3 gives a maximum desirable average delay for any individual movement at an intersection as 65 seconds (equating to middle of level of service E). It is reasonable to adopt this same delay for pedestrians crossing mid-block.

Indeed, it could be argued that a lower delay threshold should be adopted due to the uncertainty of receiving a sufficient gap. (At signals, pedestrians know that they will be able to cross in due course. At mid-block, there is no guarantee that there will be a suitable gap).

2.2 Threshold volumes

The volumes at which pedestrians are likely to experience this level of delay, that is, the threshold volumes used in these guidelines, have been determined using a walking speed of 1.2 m/s and a safety margin of three seconds.

2.3 Spacing of crossings

The spacing of safe crossings is a compromise between improved pedestrian efficiency and safety (close spacing) and the installation/maintenance costs and disruptions to vehicles (wider spacing).

It is generally recognised that pedestrians will walk up to 400 metres to local facilities and bus stops and up to 800 metres to town centres or train stations. The spacing of safe crossings can obviously have a major impact on walk catchments and the level of walking.

For example, safe crossing facilities 800 metres apart would cause a maximum detour of 800 metres, that is, if someone midway between the two crossings simply wanted to cross the road to a bus stop immediately opposite there would be an 800-metre detour to a safe crossing point. This is twice the distance most people would be prepared to walk to local facilities. The road therefore becomes a barrier to pedestrian movement and a major deterrent to walking.

These guidelines have adopted the following spacings, based on the road's vehicle function and the extent pedestrians would have/be prepared to detour.

For arterials with minimal frontage activity, a 400-metre spacing is proposed, equating to a maximum detour of 400 metres or five to six minutes. The average detour would be 200 metres or 50 per cent of the average maximum walk distance.

For arterials with significant frontage activity but outside town centres, a 200-metre spacing is proposed, equating to a maximum detour of 200 metres or two to three minutes.

For arterials with significant frontage activity within town centres, a 100-metre spacing is proposed, equating to a maximum detour of 100 metres or one to one-and-a-half minutes.

Table 2: Traffic Volumes to give a 65 second crossing delay

Road Type	Crossing width (m)	Crossing time (s)	2-way Traffic Volume for 65 second delay (vph)
Four lane divided	8	10	1,100
Two lane divided	5	7	2,800
Four lane undivided	14	15	700
Four lane divided*	8	10	1,600

* Total delay is the combined delay to cross both carriageways. A 60/40 directional split in traffic is assumed.

2.4 Supplementary information

Additional information and guidance on pedestrian and cyclist levels of service can be found in the following MRWA documents:-

Pedestrian LOS guidelines.pdf –

https://www.mainroads.wa.gov.au/Documents/e80529_20060518140840511.u_1240822r_1n_D06%5E2347977.pdf

Cycling LOS guidelines.pdf –

https://www.mainroads.wa.gov.au/Documents/los_guidelines_cycling.RCN-D06%5E2347971.PDF

Part C – Examples of graphical data representation

The following is a selection of examples of the way in which various data may be more clearly presented in a graphical format within the assessment report, rather than solely stated in text or tabular format.

These examples should not be taken as the definitive format to be used, but merely an indication of one alternative. In some cases, superimposing data on a satellite image may be preferable.

1 Traffic flow data

Figure 1: 2015 Existing traffic flows – pm Peak (veh/h)

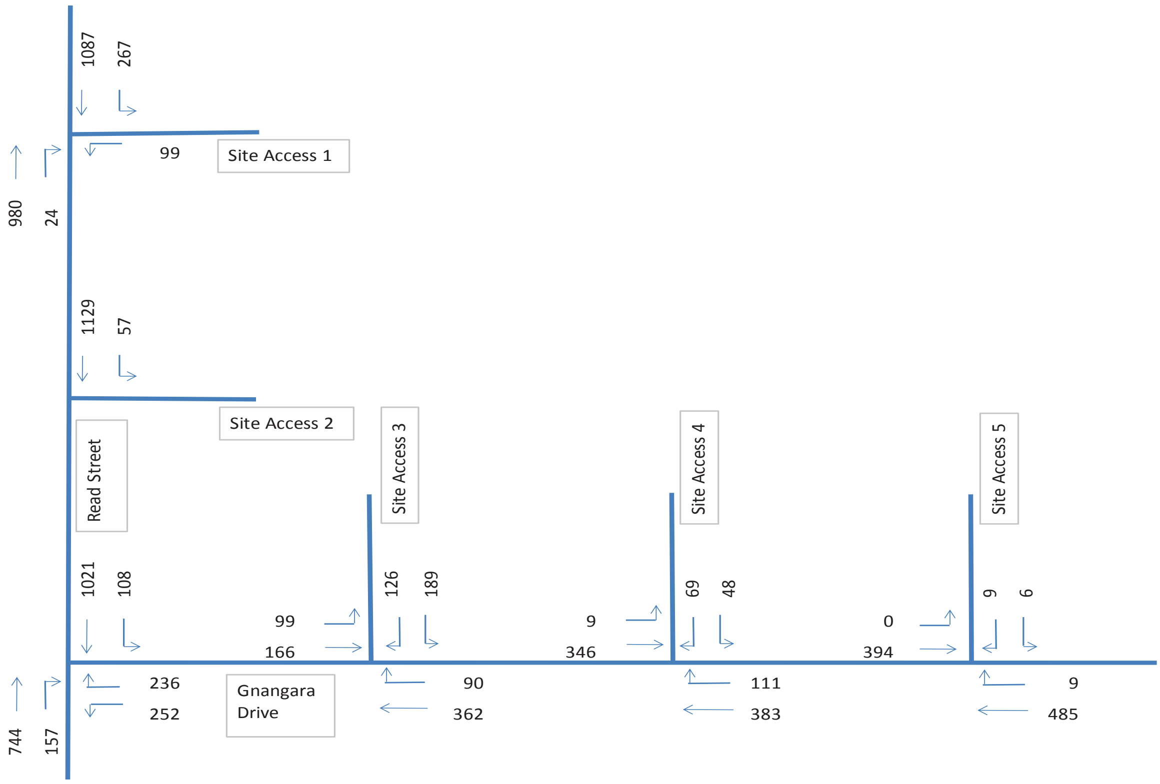


Figure 2: Directional distribution

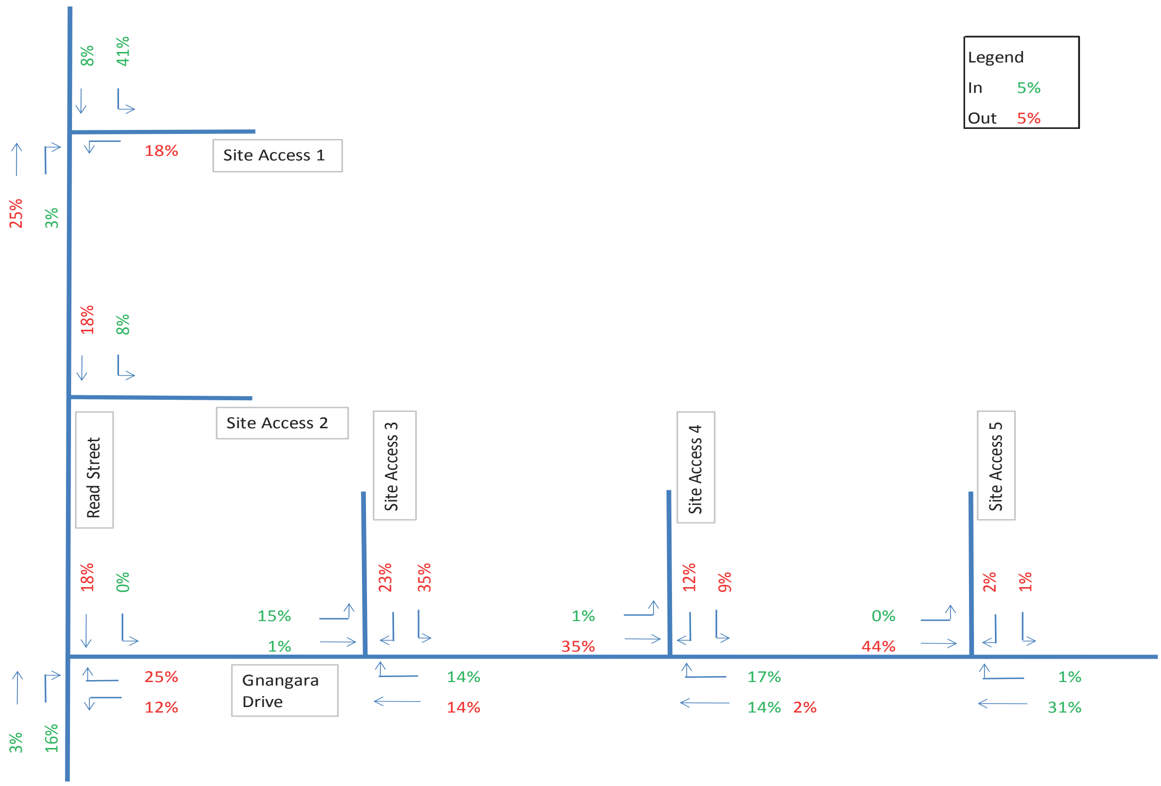
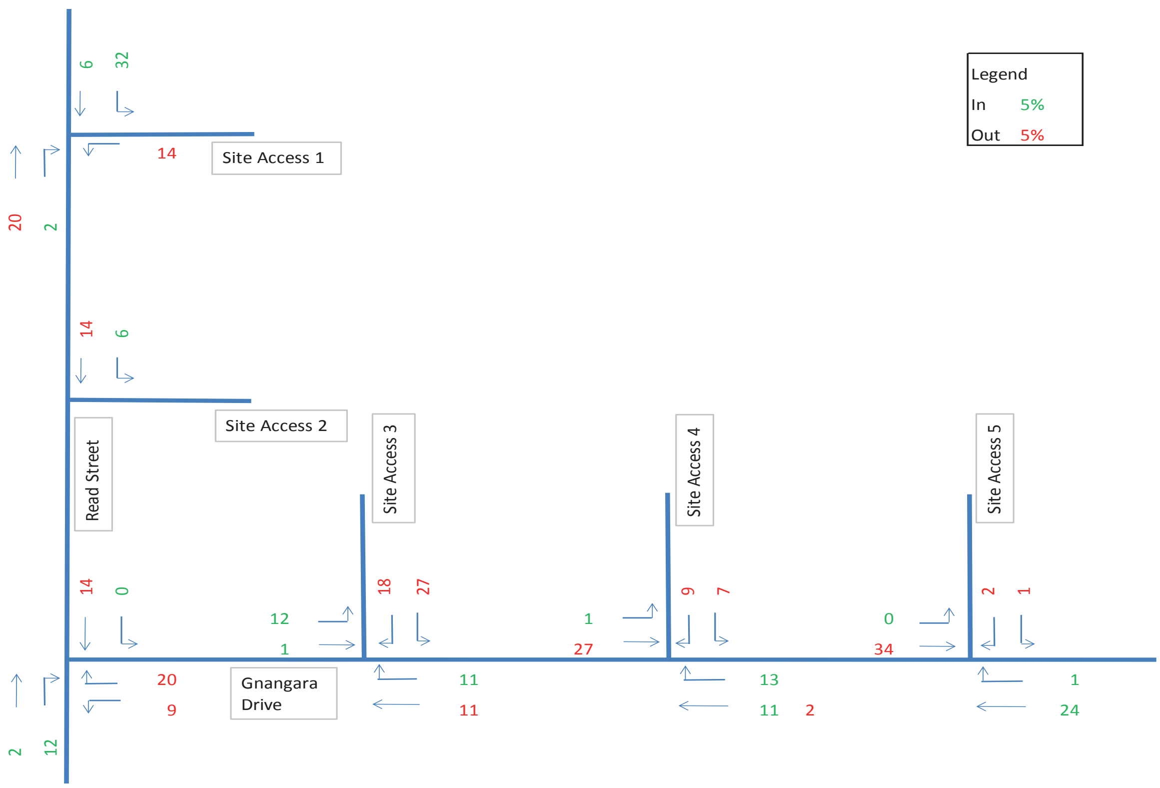


Figure 3: Additional generated traffic – PM Peak (veh/h)



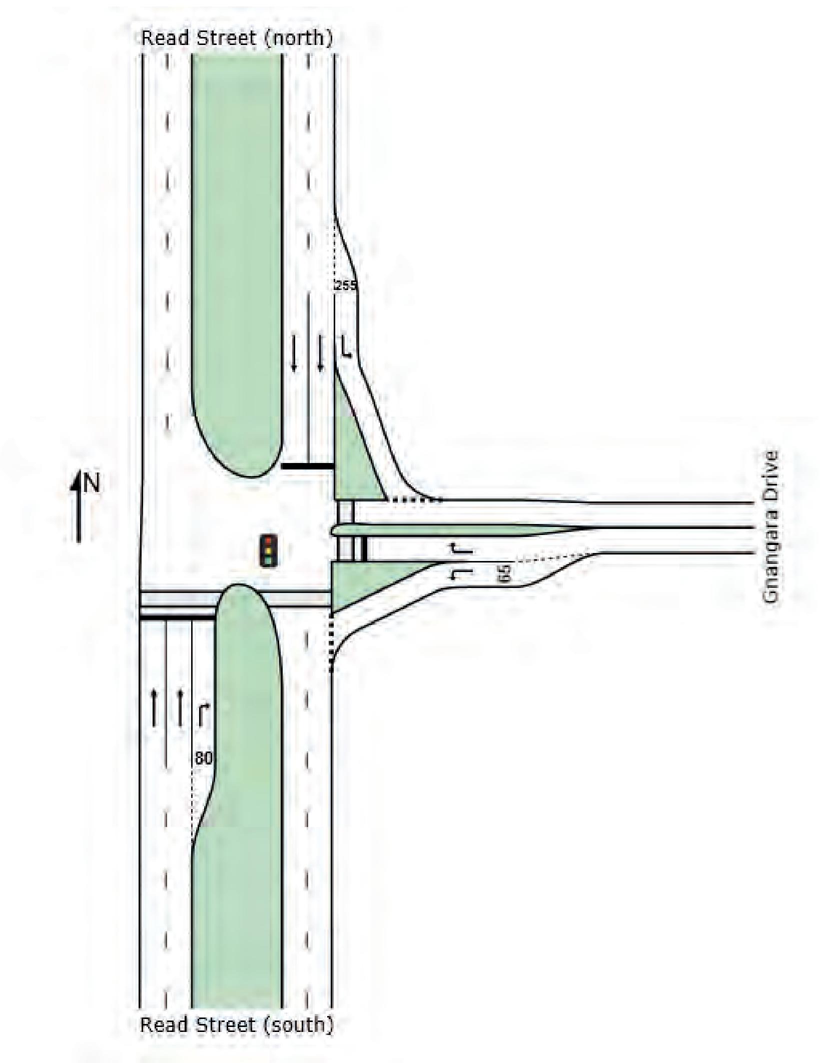
2 Intersection layouts

The lane configurations of intersections being analysed using SIDRA or other software should be shown, both for existing and proposed situations. These can generally be extracted directly from the software.

Output results from the software can also be extracted graphically, showing various data for either existing or future year scenarios. These might include:

- Levels of Service for each movement;
- Queuing lengths;
- Degree of Saturation;
- Average delays, etc.

Figure 4: Read Street/Gnangara Drive – existing layout



3 Public transport

Bus stop locations and public transport routes can also be shown graphically, using extracts from the TransPerth website, or manually generated drawings.

Figure 5: Bus services in the vicinity of the development site

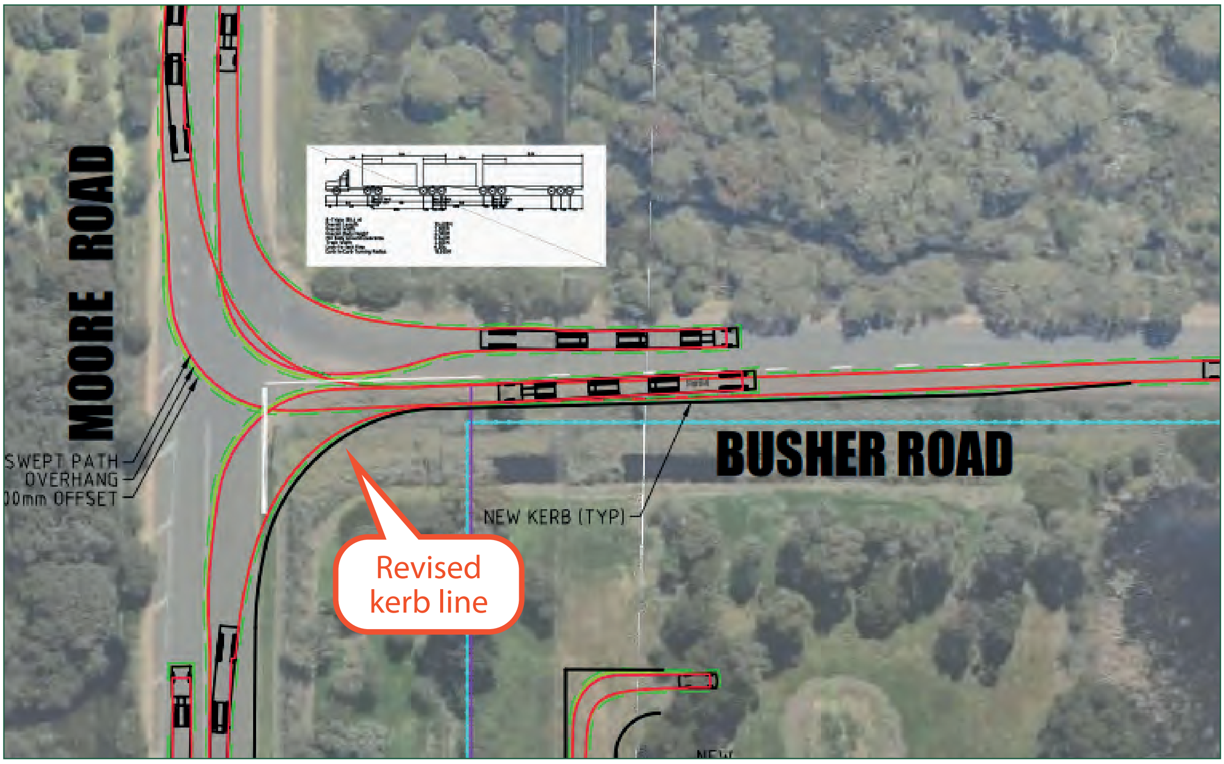
Source: TransPerth

Figure 6: Bus stop locations

4 Vehicular swept paths

Outputs from software packages such as Auto Track or Auto Turn can be used to show the manoeuvring of cars and service vehicles associated with the development.

Figure 7: Proposed improvements to the intersection



Reference list

Austroads 2009, *Guide to road design*, Austroads (http://www.austroads.com.au)
- *Part 4: Intersections and crossing - general*
- *Part 4A: Unsignalised and signalised intersection*
- *Part 4B: Roundabouts*

Austroads 2009, *Guide to road safety*, Austroads (http://www.austroads.com.au)

Austroads 2009, *Guide to traffic management*, Austroads (http://www.austroads.com.au)
- *Part 3: Traffic studies and analysis;*
- *Part 4: Network management*
- *Part 6: Intersections, interchanges and crossings;*
- *Part 9: Traffic operations*
- *Part 10: Traffic control and communication devices*

Data Analysis Australia 2006, Perth and regions travel survey (PARTS), *Data Analysis Australia* (http://www.daa.com.au/case-studies/parts/)

Department of Transport 2015, *Transport modelling guidelines for developments in activity centres* (Draft 2015) Department of Transport

Director General of Transport 1987, *Land use traffic generation guidelines*, Director General of Transport, South Australia

Institute of Transportation Engineers edition 9 2012, *Trip generation manual*, Institute of Transportation Engineers, Washington

Main Roads WA 2006, *Guidelines for assessing cycling level of service*, Main Roads WA (https://www.mainroads.wa.gov.au/Documents/los_guidelines_cycling.RCN-D06%5E2347971.PDF)

Main Roads WA 2006, *Guidelines for assessing pedestrian level of service*, Main Roads WA (https://www.mainroads.wa.gov.au/Documents/e80529_20060518140840511.u_1240822r_1n_D06%5E2347977.pdf)

Main Roads WA 2015, *Statewide Traffic Digest 2008/09-2013/14*, Main Roads WA (https://www.mainroads.wa.gov.au/OurRoads/Facts/TrafficData)

NSW Transport Road and Maritime Services (RMS) 2013, *Guide to traffic generating developments 2013/04a updated traffic surveys*, NSW Transport Road and Maritime Services (RMS)

Planning and Transport Research Centre (PATREC) 2014, *Congestion abatement through travel demand management report A*, PATREC (http://www.patrec.uwa.edu.au/announcements/congestion-abatement-through-travel-demand-management)

Public Transport Authority 2015, *Bus planning and design for efficient people movement*, Public Transport Authority

Public Transport Authority 2015, *Public Transport Authority annual report 2014/15*, Public Transport Authority

Roads and Traffic Authority, New South Wales 2002, *Guide to traffic generating developments version 2.2, October 2002*, Roads and Traffic Authority, New South Wales

Transportation Research Board of the National Academy of Sciences 2010, *Highway capacity manual*, Transportation Research Board of the National Academy of Sciences (http://hcm.trb.org/)

Victoria Transport Policy Institute 2014, *Online TDM encyclopaedia*, Victoria Transport Policy Institute (http://www.vtpi.org/tdm/)

Western Australian Planning Commission 1988, *DC4.1 Industrial subdivision,* Western Australian Planning Commission

Western Australian Planning Commission 1998, *DC1.5 Bicycle planning*, Western Australian Planning Commission

Western Australian Planning Commission 1998, *DC1.7 General road planning*, Western Australian Planning Commission

Western Australian Planning Commission 1998, *DC2.6 Residential road planning*, Western Australian Planning Commission

Western Australian Planning Commission 1998, *DC5.1 Regional roads (Vehicular access)*, Western Australian Planning Commission

Western Australian Planning Commission 2001, *DC 1.10 (Service Stations)*, Western Australian Planning Commission

Western Australian Planning Commission 2004, *DC1.1 Subdivision of land – General principles*, Western Australian Planning Commission

Western Australian Planning Commission 2004, *DC1.2 Development control – General principles*, Western Australian Planning Commission

Western Australian Planning Commission 2006, *DC1.6 Planning to support transit use and transit oriented development*, Western Australian Planning Commission

Western Australian Planning Commission 2006, *State planning policy 1 state planning framework (Variation No 2)*, Western Australian Planning Commission

Western Australian Planning Commission 2006, T*ransport assessment guidelines "version for trial and evaluation"*, Western Australian Planning Commission

Western Australian Planning Commission 2009, *Liveable neighbourhoods*, Western Australian Planning Commission

Western Australian Planning Commission 2009, *State planning policy 5.4 road and rail transport noise and freight considerations in land use planning*, Western Australian Planning Commission

Western Australian Planning Commission 2010, *State planning policy 4.2 activity centres for Perth and Peel*, Western Australian Planning Commission

Western Australian Planning Commission 2012, *DC3.4 Subdivision of rural land*, Western Australian Planning Commission

Western Australian Planning Commission 2012, *Guidelines for preparartion of integrated transport plans*, Western Australian Planning Commission

Western Australian Planning Commission 2013, *DC2.2 Residential subdivision*, Western Australian Planning Commission

Western Australian Planning Commission 2013, *State planning policy 3.1 residential design codes*, Western Australian Planning Commission

Western Australian Planning Commission 2014, *State planning policy 5.4 road and rail transport noise and freight considerations in land use planning-implementation guidelines for SPP 5.4*, Western Australian Planning Commission

Western Australian Planning Commission 2015, *Liveable neighbourhoods* (Draft 2015), Western Australian Planning Commission

Western Australian Planning Commission 2015, *Perth and Peel @3.5Million* (Draft 2015), Western Australian Planning Commission

Western Australian Planning Commission 2015, *Planning and development (Local planning schemes) regulations, structure plan framework*, Western Australian Planning Commission

Western Australian Planning Commission 2015, *Planning and development (Local planning schemes) regulations*, Western Australian Planning Commission

Western Australian Planning Commission 2015, *State planning policy 3.6 developers contributions for infrastructure*, Western Australian Planning Commission

Useful Links

Main Roads WA Statewide Traffic Digest
https://www.mainroads.wa.gov.au/OurRoads/Facts/TrafficData

Online TDM encyclopaedia http://www.vtpi.org/tdm/

TravelSmart Australia (2009) http://www.travelsmart.gov.au/

TRICS Bureau Service www.trics.org

Trips Database Bureau (2007-2016) www.tdbonline.org

Appendix A:
List of contacts

The following table provides a summary of the suggested sources of data required for a TIA:

DATA	SOURCE
Existing traffic flows	MRWA Asset and Network Information Branch Tel: 08 9323 4621 (Customer service officer) Email: roadinfo@mainroads.wa.gov.au Daily data is available in *Statewide and Regional Digests* at https://www.mainroads.wa.gov.au/OurRoads/Facts/TrafficData/Pages/default.aspx#digest MRWA website: www.mainroads.wa.gov.au Local councils may also have some data
Public transport services	Public Transit Authority (PTA) Tel: 08 9326 2600 Website: www.pta.wa.gov.au Email: enquire@pta.wa.gov.au
Cycle routes/ facilities	Local councils Department of Transport Tel: 08 9216 8000 Website: www.transport.wa.gov.au/cycling Email cycling@transport.wa.gov.au
Crash data	MRWA Asset and Network Information Branch Tel: 08 9323 4111 Data is available through the CARS system via the MRWA website www.mainroads.wa.gov.au
Other proposed developments	Local councils Department of Planning – Statutory Planning Tel: 08 6551 9000 Email: corporate@planning.wa.gov.au
Other transport proposals	MRWA Tel: 08 9323 4111 Local councils PTA (for public transport proposals – see above)