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CIRCULAR TO PROFESSIONAL INSTITUTIONS

Dear Sir/Madam

REVISION TO "GUIDELINES FOR PREPARATION OF TRAFFIC IMPACT ASSESSMENT REPORTS"

1. We are pleased to announce the above revision to the Guidelines. The revised Guidelines will provide greater clarity on the information and requirements in the preparation and submission of Traffic Impact Assessment (TIA) reports as part of Development Clearance (DC).

2. This is the second revision of the Guidelines since it was introduced in 2002. The updates include amendments and additions to ensure that the Guidelines are updated to on-going conditions and took into account feedback from the industry. To elaborate, the purpose of a TIA is to identify the transportation impacts of a new development / redevelopment on the surrounding transport network and recommend necessary and practical measures to mitigate negative impacts. This is important as it helps avoid expensive remedial actions as the transport problems are addressed upfront in tandem with the implementation of the development / redevelopment. The benefit is to those accessing the completed development as well as the community at large. The revision of the Guidelines is to strengthen this objective. A summary of the major enhancements are provided on the last page of the Guidelines.

3. The revised Guidelines can be downloaded freely from LTA's website at the following link (http://www.lta.gov.sg/dbc/index_business_partners.htm).

4. We would appreciate it if you could please convey the contents of this circular to members of your respective organisations. Should you have any queries, please contact the undersigned.

Yours faithfully,

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For Director of Local Planning
Enc.

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Guidelines for Preparation of Traffic Impact Assessment Reports

Revision (2011)

LTA has revised this Guideline to update the information and requirements for the preparation and submission of Traffic Impact Assessment (TIA) reports. The Guideline (i) specifies when a traffic impact study is required to be submitted as part of a development application, and (ii) sets out standards for the preparation of TIA reports.

The following is the second revision to the Guideline since it was introduced in 2002. It includes a number of amendments and additions to ensure that the Guidelines are updated to on-going conditions and took into account feedback from the industry. A summary of major amendments and additions is provided on the last page of the Guidelines.

Purpose of a TIA

The purpose of a TIA is to identify the transportation impacts of a new development / redevelopment on the surrounding transport network and recommend necessary measures to mitigate the negative impacts. The scale of the impacts is dependent on the type, size and location of the development and may vary from localised impacts such as at its access point(s) and nearby road intersections for the smaller developments to regional impacts for the larger ones.

The provision of an adequate transportation network near a proposed development benefits those accessing the development as well as the community at large. Design oversights with regard to site access and circulation can lead to operational challenges if left undetected. Traffic impact studies help in the early identification of such potential problems and can thus help avoid expensive remedial actions if the challenges are addressed upfront in tandem with the implementation of the development. In addition, a TIA assists LTA to better plan and design the transportation system by enabling it to anticipate incremental traffic impacts of each new development on the overall road network.

The purpose of this document is therefore to:

- Assist developers (and transport professionals who are so engaged) by outlining the requirements and the level of detail required for the study; and
- Provide greater clarity, maintain uniformity and consistency in the preparation and evaluation of traffic impact studies to expedite the approval of development applications.

When is a Traffic Impact Study Needed?

In general, a TIA is required to be submitted if the type and size of the proposed development meets one or more of the criteria stipulated in Annex A. The size of the development reflects the level at which the development is likely to generate sufficient additional traffic that is likely to impact on the surrounding road network.

Because of the difference in the type, size and location of a development(s), it is not practical to describe a single scope of work that can be applicable for all proposals. The document is

therefore intended to serve as a guide for developers and consultants who are strongly encouraged to discuss and review their scope of work with the LTA before proceeding with their studies.

Who Prepares a TIA?

The transportation impacts of the development shall be evaluated by a professional transportation firm appointed by the developer. The consultant should ensure (a) accuracy and validity of all information and assumptions to be used in the study and (b) discuss the project scope with LTA in advance of preparing the study.

Scoping Meeting

To assist in determining the extent of the TIA, developers and traffic consultants are required to hold discussions with the LTA on their study scope and any specific requirements that may apply to the development prior to commencing the study. Such a discussion ensures common understanding of relevant issues. Issues discussed may include but not be limited to:

- Study purpose and objectives,
- Proposed methodology and assumptions,
- Existing data intended to be used,
- Size of the study area and traffic intersections to be studied,
- Assessment years,
- Forecast background traffic volumes or growth rate to be adopted,
- Type of surveys to be undertaken e.g. intersection, travel time, origin-destination etc,
- Relevant peak hour(s) and site(s) for the conduct of traffic surveys,
- Derivation of trip generation rates,
- Whether traffic microscopic simulation/network assessment is required and if yes what are the assessment area(s) and assessment scenario(s) required,
- Proposed modelling tool(s) and parameters to be used,
- LTA road and/or junction improvement plans for the study area to be taken into consideration as a base in the analysis for corresponding assessment year(s),
- Intended location of development's access point(s), parking provision and circulation,
- Whether public transport/pedestrian/cyclist analyses and/or development traffic operation plans are required and to what extent,
- Whether there is a need for an Inception Report and/or Interim Report,
- Other requirements if any, that may apply to the proposed development.

A senior level representative of the developer and consultant should attend the Scoping Meeting. This is to facilitate clear understanding of the extent of the TIA to be done. Prior to the Meeting, developers are encouraged to provide LTA the development transport related information and/or consult LTA on the extent of TIA scope required. In addition, developers and/or consultants are also encouraged to conduct a survey of the existing site condition and provide LTA questions/clarifications before the meeting. Developers and/or consultants are advised to submit to LTA the minutes of the Scoping Meeting based on the agreed timeline discussed at the Scoping Meeting.

Requirements of TIA Reports

The following section outlines the information and assumptions that may be used to assist in the preparation of TIA reports. The information should be used in conjunction with Annex B and Figure 1, which illustrate the structure and contents of a standard TIA report.

1. Executive Summary

1.1 The report shall include a technical summary that is concise and clear on the study purpose, major findings, conclusions and recommendations.

1.2 Improvements recommended in the TIA are to be illustrated using appropriate plan(s) with sufficient detail to substantiate their feasibility.

1.3 Examples of summary tables with illustrated plan(s) that may be used in TIA reports are provided in Annex C.

2. Study Purpose and Objectives

2.1 The objectives and purpose of the study are to be clearly stated. In addition, key issues, methodology, study schedule and scope of work shall also be included. Where appropriate, LTA may require the submission of an Inception Report. The Inception Report may include but not be limited to the following:

- Study objectives and scope of work,
- Description of the proposed development, size, location of access points, parking provision and intended circulation,
- Study area, roads and intersections,
- Existing landuse/transport network nearby,
- Assessment years,
- Study methodology and assumptions,
- Survey plan,
- Historical data / overseas data intended for use.

2.2 The consultant is required to obtain LTA's endorsement of the Inception Report prior to commencing the study.

3. Description of Site and Study Area

3.1 Description of the proposed development including quantum, use and timeframe.

3.2 The size of the study area will depend on the type, size and traffic condition in the vicinity of the development. Generally, small developments that do not generate high volume of traffic are likely to have localised impacts so the area to be studied may include own access point(s) and the nearby major intersections. In contrast, larger developments with higher volume of additional traffic may impact the road network for a considerable distance from the site so a wider study area that may include already critical intersections would be

needed. As a guide, the study area may be based on the extent of the impact of the development's traffic using preliminary estimation of traffic generation and assignment of development's traffic onto the road network up to major road/expressway or a point where development's traffic contribution becomes less than 100pcu[1] either to or from the site in the peak hour or alternatively experiences 10% or more increase in traffic on any approach leg to a junction due to the development's traffic. This is provided as a guide and consultants are advised to confirm the extent of the study area with LTA prior to commencing the study.

3.3 Analysis of contextual site issues e.g. size, current use, access points etc.

3.4 Description of the road geometry, pedestrian routes, cycling paths, bus stops and MRT/LRT stations near the development.

3.5 Appreciation of surrounding landuse and environs.

3.6 A map with the location of the proposed development in relation to its surrounding road network and the overall study area is to be included.

4. Existing Traffic Conditions in the Area of Development

4.1 An assessment of all roads and junctions likely to be affected by traffic from the development during the peak hours is to be undertaken. The junctions and peak hours to be assessed should be determined in consultation with LTA during the Scoping Meeting. Identifications of existing traffic problems are to be supported by site survey and photos.

4.2 In circumstances where the development's peak traffic generation occurs outside of regular commuting peak hours then periods to be surveyed should include both the adjacent road network peaks as well as the development's peak period(s) which may occur in the off-peak or during the weekend. This is to ensure that the access points are able to accommodate the peak traffic generated by the development during its busiest period(s).

4.3 Generally, for commercial, industrial and residential developments, surveys are conducted in the morning and evening weekday peak periods. Retail developments may require surveys during the weekend as well as weekday. Traffic surveys are commonly carried out in 15 minute intervals and classified by vehicle type to determine the profile of traffic changes within the peak hour. Traffic surveys should be undertaken on a typical weekday excluding Mondays and Fridays unless specified or weekend (where applicable) and not be affected by inclement weather or a public or school holiday period. The results of the surveys should be summarised with the peak hours identified and graphically illustrated (in pcu/hr) within the main body of the report. Consultants shall agree with the LTA on the intended survey location(s), period(s) and date(s), at least 3 working days prior to the survey. Consultant is to seek LTA's agreement on any change to the plan at least 1 working day prior to the survey date, unless

[1] Passenger car unit (pcu) equalises the impact of different vehicle sizes on traffic flow by converting vehicle classes to a common passenger car.

the change is due to unexpected incidents such as inclement weather or the occurrence of a traffic accident at the survey site(s). During the intended survey period(s), LTA officers may selectively undertake survey observations.

4.4 The LTA may request for raw traffic survey data conducted by consultants. Consultants are to ensure that the survey data are appropriately formatted and the raw data are to be kept for at least six months for LTA's possible audit purpose.

5. Assessment Years

5.1 The assessment years generally include the opening year when the development is expected to be fully operational and the design year which is typically five years thereafter. LTA may propose a different design year from the typical definition according to respective study needs. For developments that are expected to be open in phases, a separate assessment representing the expected completion date of each major phase may be required. Consultants are to seek LTA's advice on the assessment years to adopt for case specific development proposals.

Table 1 Assessment Years for New Developments

Type	Assessment Year
Single phase developments	- Anticipated opening year assuming full occupation - Anticipated design year
Multiple-phase developments	- Anticipated major phases of completion of the development including the first and the last phase - Anticipated design year

6. Background Traffic Forecast

6.1 In general, the background traffic volume can be estimated using the growth factor method for forecasts of up to five years from the current year. Typical growth factors between 0.5% and 1.5% per annum may be considered appropriate. Notwithstanding this, the location and proximity of the development to other major new developments and/or new roads are likely to influence the extent of background traffic. Thus, other growth rates may be more applicable in some circumstances. Consultants are required to consult with LTA to confirm on appropriate growth rate(s) to be adopted for the estimation of background traffic.

6.2 Where applicable (e.g. longer future year forecasts, or, areas to have significant changes in landuse and/or infrastructure), LTA may advise on the methodology to estimate the future background traffic.

7. Development Trip Generation

7.1 Trip generation rates are to be based on survey(s) of similar development(s) agreeable to LTA. Such survey(s) data shall have a maximum validity of not more than two years prior to the date of the TIA study. The survey information including site(s), location(s), date(s) and time period(s) is to be included in the TIA report to substantiate similarities.

7.2 For developments where a comparable site may not exist, trip generation may be estimated from first principles e.g. employer numbers, number of visitors etc. based on the methodology agreeable to LTA.

7.3 For mixed developments such as retail/office or retail/residential where there may be interaction between various land uses, a portion of the trips will be generated from within the development. The total traffic generation of the development is likely to be lower than the sum of individual uses if the rates were derived from stand-alone developments. A reduction in the development's trip generation rate may be warranted when estimating additional traffic on external roads.

7.4 The choice of site(s) and the time of survey(s) to obtain trip generation survey rates, or the intent to use historical trip/traffic generation survey data, shall be discussed at the Scoping Meeting and agreed by LTA prior to commencing the study.

8. Development Trip Distribution

8.1 A description of the methodology used to distribute traffic is to be provided for LTA's review. For most developments, the distribution of development traffic may be based on the survey of an existing nearby development that is similar to the proposed development. Where such development is unavailable, current travel patterns on nearby links and intersections may be used to distribute traffic to/from the development onto the road network. For larger developments or those likely to attract traffic from further afield, traffic distribution may be based on the area of influence of the development e.g. retail centre catchment area or from an origin and destination study to assign the development's traffic to the appropriate routes.

8.2 Diagrams are to be included with clear indications of directional and turning distributions (in percentage) of the proposed development trips onto the road network.

8.3 For mixed developments, different trip distribution for different components of the development may need to be adopted to account for different travel behaviour of users.

9. Modal Split of Development Trips

9.1 Developments located away from major public transport nodes are likely to have higher vehicular generation compared to those nearer to public transport facilities. The trip generation rates shall therefore account for the differences in level of public transport accessibility to ensure relevance. Adjustments to the trip rates would be required where level of public transport accessibility is significantly different. Modal split of a similar development in a similarly located site with similar level of public transport service would provide useful information and should be used wherever possible.

9.2 The TIA shall address alternative modes of travel and the provisions to cater for pedestrians and cyclists' needs (refer to Sections 14 and 15).

10. Development Traffic Assignment and Traffic Forecast Results

10.1 The assignment of traffic from the development shall be based on shortest travel time/cost in the peak periods (where appropriate, LTA may request the inclusion of weekend peak period) and shortest travel distance/cost in the off-peak periods. For larger developments, traffic assignment accounting for travel condition on available routes needs to be considered. The appropriate methodology is first to be accepted by LTA.

10.2 On routes with ERP, the applicable rate is to be converted to generalised time and added to the travel time for that route. LTA will provide the appropriate values of time for private and public vehicles.

10.3 LTA may require the consultant to substantiate the routes chosen for the assignment using field travel time and/or origin-destination surveys.

10.4 A diagram with the routes and the assigned volumes (in pcu/hr) is to be included in the report.

10.5 The methodology, assumptions and data adopted at each step of traffic forecasting shall be clearly reported. Where appropriate, LTA may require the submission of an Interim Report. The Interim Report may include but not be limited to the following:

- Traffic survey(s) conducted and results,
- Assessment of the existing traffic conditions,
- Background traffic forecasts for the assessment years,
- Development trip / traffic generation,
- Trip distribution (including diagrams as specified in Section 8.2),
- Modal split as applicable,
- Traffic assignment (including diagrams as specified in Section 10.4).

10.6 The consultant is required to obtain LTA's endorsement of the Interim Report before further processing of the study.

11. Assessment of Development Traffic Impact

11.1 The performance of the affected junctions shall be assessed using a commercially available intersection modelling program. LTA uses the latest version of the aaSIDRA software. Consultants are advised to adopt the "*Delay & v/c (HCM 2010)*" method to determine the level of service (LOS) for aaSIDRA intersection analysis. The performance standards are shown in Table 2. In general, LTA will not accept intersection assessment outcomes produced by an outdated version of the software, given that a newer version(s) has been available to users for more than two years. The use of other types of software for analysis is acceptable provided that it can produce results comparable to aaSIDRA. Consultants are advised to seek LTA's approval on the suitable software to be used at the Scoping Meeting.

Table 2 LOS Definition for Intersections

LOS for $v/c \leq 1.0$	Average delay per vehicle in seconds (d)		LOS for $v/c > 1.0$
	Signalised junctions	Give way / Stop sign junctions & Roundabouts	All intersection types
A	$d \leq 10$	$d \leq 10$	F
B	$10 < d \leq 20$	$10 < d \leq 15$	
C	$20 < d \leq 35$	$15 < d \leq 25$	
D	$35 < d \leq 55$	$25 < d \leq 35$	
E	$55 < d \leq 80$	$35 < d \leq 50$	
F	$80 < d$	$50 < d$	

Source: Highway Capacity Manual 2010, Transport Research Board

11.2 For areas where queues from closely spaced junctions are likely to interact and significantly affect traffic, suitable modelling software is strongly encouraged to be used for assessing traffic performance at the network level. This could include conducting microscopic traffic simulation for the study area or parts of the study area where queue blocking effects become a concern. For larger developments, LTA may impose consultants to undertake such an evaluation. At the Scoping Meeting, consultants shall propose and seek LTA's approval on the suitable software to be used as well as the extent of the study area to be included in the microscopic traffic simulation model.

11.3 In some situations, LTA may request consultants to assess the impact of the development traffic on the affected roads. The performance standards to determine the LOS of arterial roads and expressways are shown in Table 3. The travel speed for arterial roads should include the running times plus delays at the intersections along the route. Where applicable, LTA will require weaving, on-ramp, and/or link capacity analyses using the latest Highway Capacity Manual (HCM) methodology to be included in the study.

Table 3 LOS Definitions for Links

LOS	Expressway – weighted density (pcu/km/lane)	Arterial road – travel speed as a percentage of link base free-flow speed (%)	
		for critical $v/c^{*} \leq 1.0$	for critical $v/c^{*} > 1.0$
A	< 7	> 85	F
B	7 – 11	67 – 85	
C	11 – 16	50 – 67	
D	16 – 22	40 – 50	
E	22 – 28	30 – 40	
F	> 28	≤ 30	

Noted: * The critical v/c ratio is based on consideration of the through movement v/c ratio at each boundary intersection in the subject direction of travel. The critical v/c ratio is the largest ratio of those considered.

Source: Highway Capacity Manual 2010, Transport Research Board

11.4 The LTA road and/or junction improvement plans (if any) for the study area shall be taken into consideration as a base in the analysis for corresponding

year(s) assessment. The TIA report shall include intersection and road analyses for each year of assessment, with separate analysis for the scenarios of with and without the development traffic. Changes in the average delay for all vehicles at each of the affected intersections as well as the average travel speed along each of the affected roads (where applicable) due to traffic associated with the proposed development shall be analysed and clearly stated in the report.

11.5 Where possible, it is aimed to provide for a desired LOS "D" or better in the peak periods for intersections and roads affected by the development traffic. Consultants shall recommend junction/road improvement measures and include them in the TIA report, to mitigate traffic impact to achieve the desired LOS. Traditional at-grade widening of roads/junctions within the safeguard road reserve lines are to be considered prior to considering/proposing other infrastructure improvements. In areas where the desired LOS are not achievable with traditional road/junction widening within the safeguarded road reserve lines, LTA may request the consultant to conduct further scenario tests and/or sensitivity analysis as appropriate. Consultants should also consider and report on practical transport solutions to support the proposed development, to ensure that its traffic impacts are kept to a minimum.

11.6 The TIA report shall include tables to clearly explain the summarised assessment of results, including traffic volume, delay, LOS, degree of saturation (DOS), 95% back of queue, stop rate and travel speed as appropriate, of individual transport facilities pertaining to each assessment year. The summary tables shall include separate results for the scenarios with and without the development traffic. If road/intersection improvements and/or additional scenario tests or sensitivity analyses are required, the report shall also incorporate tables with a separate summary of the assessment results. Relevant proposals/assumptions for each scenario are to be clearly listed in the tables.

11.7 LTA generally requires the submission of softcopies of all data files for verification of results.

12. Junction Analysis Parameters

12.1 The values listed below are provided as a guide for the evaluation of isolated signalised junctions.

(a) Cycle time: Existing cycle time in peak period for existing junctions, or an optimised cycle time within the range of 90-150 seconds to determine a new or future traffic signal along arterial roads,

(b) Peak flow factor: 0.95 in general. Lower values are to be used for areas with significant demand peaks e.g. areas for schools, cinema, stadium,

(c) Basic lane saturation flow rate: 2,000pcu/hr/lane (or 1,950tcu/hr/lane) for arterial roads. Lower values are to be used for residential streets and environment with high roadside friction e.g. CBD,

(d) Queue definition: 95% back of queue. When necessary LTA may request consultants to assess the queue length based on other specified definitions,

(e) Passenger Car Unit (PCU) factors: as shown in Table 4.

Table 4 Passenger Car Equivalent Unit Factors

Vehicle Type	Passenger Car Unit Equivalent (pcu/veh)
Passenger cars & vans	1.0
Single unit trucks: - LGV - HGV	 1.3 2.25 - 2.75
Buses - Small - Large - Articulated	 1.6 2.5 2.9
Motorcycles	0.7

LGV: Light good vehicles with laden weights up to 3 tonnes
HGV: Heavy goods vehicle with laden weights more than 3 tonnes or with 3 or more axles
HGV: Lower pcu value appropriate for arterial roads higher value for expressways
Bus: Small bus includes up to 30 seats. Large bus more than 30 seats

12.2 Subject to consultants' justification and LTA's approval, other values for the above parameters can be adopted if they are considered more appropriate to the circumstances. For other parameters which are not defined above, consultants shall justify the parameter values adopted if they are different from their defaults provided in the intersection analysis software. For simulating existing traffic situation, the outputs of mean back of queue shall be comparable to the observed average queues or the difference between the two shall be justifiable.

13. Public Transport

13.1 For larger developments, consultants are to estimate the proposed development's public transport demand and evaluate the accessibility and adequacy in the provision of the public transport system in the study area with the additional development demand. Consultants are encouraged to investigate the need for the development to provide private bus service.

13.2 Where applicable, LTA may request consultants to review and if necessary to propose suitable/optimal locations for new/relocated public transport facilities such as bus stops and taxi stands within the study area, especially those near to/within the proposed development site.

13.3 Consultants shall review the development internal layout design and location of development accesses to avoid creating traffic conflicts. Consultants are to review and if necessary to propose improvement solutions to minimise traffic conflict between the different modes of transport including public buses, taxis, goods vehicles, private vehicles, pedestrians and cyclists, along the roads surrounding the development boundary and within the development site.

14. Pedestrians

14.1 For proposed developments that can generate major pedestrian numbers such as large retail centres, schools, etc, an assessment of pedestrian movement associated with the development is to be carried out in the TIA. The assessment shall include:

(a) Major pedestrian desire lines between the development and its

connectivity to nearby public transport facilities,

(b) Assessment of nearby pedestrian facilities including covered footpaths to public transport nodes, capacity of footpaths, stairways, crossings and their adequacy to cater to forecast demand,

(c) Pedestrian safety e.g. adequacy of sight distances at crossing facilities, conflict at driveways, provision of slow points etc.

14.2 The TIA needs to identify major desire lines to/from the development to MRT/LRT stations or bus stops based on shortest and most convenient travel distance. Site plans with the desired pedestrian walk lines (and barrier-free walk lines if different from the desired ones) shall be provided in the report. The location of crossing facilities, footbridges etc, are to match pedestrian movement needs with minimal deviation from the most convenient line. Justifications would be required on why a proposed facility cannot be provided on the desired line.

14.3 The TIA shall also address pedestrian safety in terms of visibility and sight distances at intersections, entry/exit points to the development and road crossings.

14.4 Where the development is expected to generate high pedestrian volumes, the TIA is to include an assessment of pedestrian numbers, capacity and performance of the facilities to substantiate the adequacy of the design to accommodate the expected pedestrian demand.

15. Cyclists

15.1 The provision of cycling facilities is encouraged where possible. Consultants are to review and propose the provision of cycling tracks linking the proposed development to existing/planned cycling tracks and/or MRT/LRT stations nearby. For larger developments, consultants are also encouraged to investigate the need and feasibility to provide cycling parking facilities at the development.

16. Parking and Pick-up/Drop-off Provision

16.1 The consultant shall document the analysis for parking provisions to ensure that parking requirements for the development have been adequately catered for. The number of parking spaces and access arrangement of new developments shall comply with the requirements stipulated in “Code of Practice for Vehicle Parking Provision in Developments” and “Street Works Proposals Relating to Development Works”.

16.2 The consultant shall also consider the potential traffic impacts and externalities that may arise as a result of car parking operations, and provide appropriate mitigation measures as necessary. If any proposal is unable to meet the access provision and arrangement requirements or LTA considers that the development access point warrants detailed evaluation, the consultant shall demonstrate the viability of the proposed arrangement.

16.3 Consultants shall assess whether there is a need to provide pick-up/drop-off

bays and to estimate the number of bays required and to propose suitable location(s). If the development design is carried out as the TIA is in progress, the consultant is to comment on the layout, identify potential traffic problems associated with the proposed pick-up/drop-off bays and recommend necessary improvements to the plan.

17. Site Access and Traffic Circulation

17.1 Provision of good site access and circulation for all users whether for motorists, public transport commuters or pedestrians help towards the success of a development. The ease with which users move to/from the development and nearby areas, roads and public transport facilities is important to the long-term success of the development.

17.2 The proposals (access, lay-by, pick-up/drop-off point, pedestrian facility etc) shall take into consideration the following requirements:

(a) Safety – The location and configuration of the access, lay-by, pick-up/drop-off point, pedestrian facilities etc shall not pose a danger to motorists and pedestrians. Generally, the proposal to locate the development access at major arterial roads will not be supported when there are alternative feasible option(s) available.

(b) Capacity of road – This shall be considered when designing the configuration of the access. For example, a Left-In-Left-Out (LILO) arrangement for an access connecting to a road with heavy traffic volumes may be more appropriate.

(c) Queuing Length – Sufficient queue space within the development shall be provided at the proposed access, lay-by or pick-up/drop-off point(s) to prevent queues encroaching onto main road carriageways which can obstruct traffic. The TIA shall include an assessment of entry barrier capacity and queue length to demonstrate that the distance between the development boundary line and the car-park barrier is sufficient to accommodate the expected queue length.

(d) Traffic Conflicts – Proposals shall not create conflicts of traffic. Access points shall not be located opposite to each other, near bus stops or traffic junctions.

(e) Obstruction to traffic – Vehicles manoeuvring into the access(es) shall not obstruct traffic along the road carriageway. All vehicles shall enter and exit the site in a forward direction. Reversing of vehicles is not allowed onto a public road.

(f) Pedestrian/commuter facilities – Should a pedestrian crossing facility be proposed, analysis of its impact on traffic flow is to be done. Depending on pedestrian/traffic volumes, other facilities such as an overhead bridge or underpass are to be considered if more appropriate.

17.3 Generally, proposals to signal the junction of the access of the development on arterial roads will not be favoured unless it can be justified. If a new traffic signal is proposed, the impact of the traffic signal on the traffic flow along affected roads is to be evaluated as described in Sections 11 and 12 of this Guideline. This is to demonstrate that the proposed traffic signal will not

significantly affect the traffic flow or reduce the travel speeds along the roads.

17.4 Access, road carriageway and junction improvements shall be in accordance with appropriate LTA design standards and specifications and take into consideration site constraints.

18. Development Traffic Operation Plan

18.1 For developments expected to have significant surge in traffic (e.g., shopping mall opening stage, school morning arrival peaks, development major events, etc), consultants may be required to:

(a) Establish the traffic surge profile;

(b) Estimate the traffic volume during the peak hours of the surge periods;

(c) Assess the impacts of traffic within the proposed development as well as on surrounding public roads during the peaks;

(d) Develop conceptual traffic operation plans to mitigate the negative impacts. The plans shall cover transport facilities which can potentially create significant traffic problems due to overwhelming traffic demand such as car-park accesses, lay-bys, pick-up/drop-off points, pedestrian crossings, immediate junctions with traffic approaching the proposed development, pedestrian holding areas, etc.

(e) Recommend whether it is necessary to engage Auxiliary Police Officers (APO) to implement the proposed traffic operation plans.

18.2 A diagram indicating the proposed traffic control measures at relevant locations is to be included in the report.

19. Traffic Management during Construction

19.1 For very large developments, an assessment of the impact of traffic during the construction period may be required as a separate assessment/ submission (not part of the TIA study). LTA will advise whether such a study/evaluation is required to be submitted.

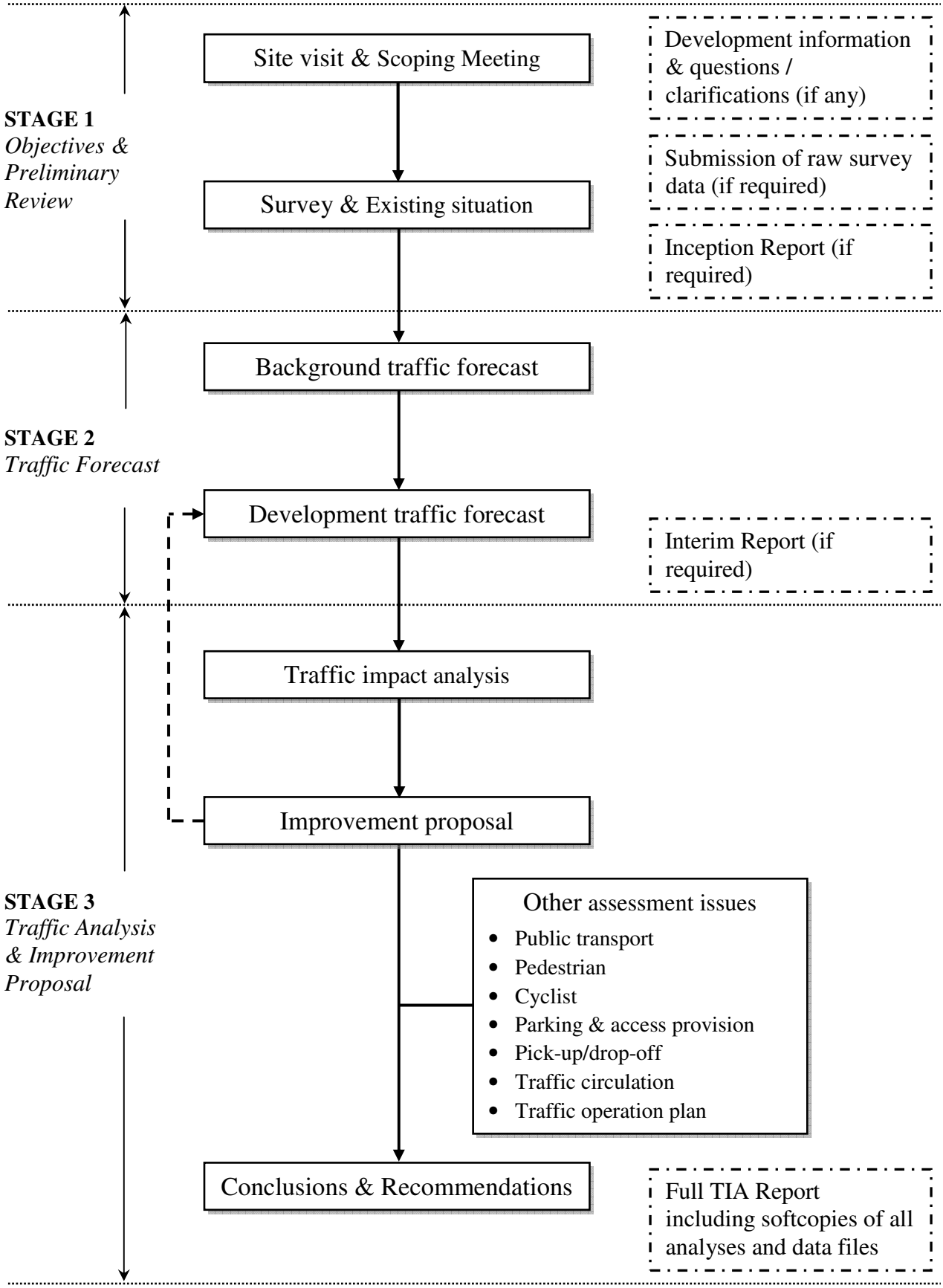
General Comments

- The report shall be set out logically with clear conclusions and recommendations. All assumptions and sources of information shall be clearly documented.
- Ambiguities and validity/lack of information shall be resolved with LTA as soon as possible. Inadequate reports will be returned to the consultant for completion or modification as required.
- This Guideline sets the general technical requirements for the preparation and submission of TIA reports. Some requirements stated in this document may not be imposed for a particular TIA when they are not the most suitable. Consultant is to follow the LTA officers' instructions during the course of TIA preparation.

Summary of Major Amendments to the Guidelines

Section	Amendments
Revision (2011)	Reasons for the revision
Scoping Meeting	- Further specification on who should attend; - Specify what consultants should do at this stage.
4. Existing Traffic Conditions in the Area of Development	- Justification of existing traffic conditions - Further specifications of traffic surveys - Survey notification and data submission
5. Assessment Years	Anticipated design year was added for multi-phase development evaluation
6. Background Traffic Forecast	Typical growth rates revised
7. Development Trip Generation	Validity period for historical trip rate data added
11. Assessment of Development Traffic Impact	- Further specifications on software usage - LOS definition updated - Network assessment added - Impact on expressway traffic and link capacity analysis added - Further specifications on impact analysis; - Further specifications for proposals to mitigate development traffic impacts
12. Junction Analysis Parameters	Some revisions to key parameters
13. Public Transport	New section on public transport analysis added
14. Pedestrians	Some revisions to the assessment requirements
15. Cyclists	New section on cycling analysis added
16. Parking and Pick-up/drop-off Provision	- Documentation of proposed parking provision required - Requirements on pick-up/drop-off assessment added
18. Development Traffic Operation Plan	New section for traffic operation plan to address traffic surge issue added
Figure 1	Submission requirements added
Annex B	Updated with respect to the revised requirements
Annex C	Examples of tables provided for incorporating concise summary of TIA results

Figure 1 Typical TIA Process and Submissions (For Developments)



ANNEX A
Conditions When a Traffic Impact Assessment (TIA) is Required

A TIA is required to be prepared at the Development Control stage if one or more of the following conditions apply to the development.

A-1. Developments exceeding the scales specified in the following table:

Type of Development	Scale of Development
1. Residential	
1.1. Landed properties / Condominiums / Executive HDB housing	1.1. >= 600 units
1.2. HDB housing	1.2. >= 800 units
2. Retail	
Shopping centre	>= 10,000m² GFA
3. Commercial	
Office development	>= 20,000m² GFA
4. Industrial	
4.1. General industry	4.1. >= 50,000m² GFA
4.2. Warehousing / Distribution	4.2. >= 40,000m² GFA
4.3. Science park / High tech park	4.3. >= 40,000m² GFA
5. Educational	
5.1. Primary school	5.1. >= 1,500 students (single-session) or >= 2,000 students (double-session)
5.2. Secondary school	5.2. >= 2,000 students
5.3. International school	5.3. >= 2,000 students
5.4. Junior college	5.4. >= 2,000 students
5.5. University, polytechnic, ITE campus	5.5. TIA required
6. Medical	
Hospital	>= 200 car parking spaces
7. Hotel	
Business & tourist	>= 600 rooms
8. Recreational	
Exhibition centre & major tourist attraction	>= 200 car parking spaces

Note:
Generally, for mixed-use residential/retail developments, a TIA is required if the total trip generation of the development exceeds 200pcu/hr either inbound or outbound. However, if the development is located in an area with already high traffic volume, LTA will advise the applicant on whether a TIA is required.

A-2. For types of developments not listed in table above and for temporary developments with leases of over 5 years or more that may have significant impact to traffic within the surrounding area or be located within a densely developed area, LTA may require the submission of a TIA.

A-3. A TIA is applicable for any development seeking direct access either via a dedicated driveway or a new service/access road onto a Category 2 (major arterial) or above type road.

ANNEX B
Key Issues to be addressed in a TIA Report

A comprehensive TIA report shall cover the following issues. The sequence and headings may not be necessarily the same as those suggested here.

Heading	Description of What to Include
EXECUTIVE SUMMARY	A technical summary that is concise and clear on the study purpose, major findings, conclusions and recommendations
1.0 INTRODUCTION	
1.1 Background	Description of the development proposal, previous submissions if relevant and the study schedule
1.2 Study Objectives and Key Issues	A statement of the key objective(s), with a summary of key issues to be covered
1.3 Outline of Report	A report structure, with short description of the main purpose of each section
2.0 EXISTING TRANSPORT NETWORK & TRAFFIC SITUATION	
2.1 Site Location	Current landuse characteristic, site location & boundary, and planned developments/redevelopments in the vicinity
2.2 Study Area	A map with description identifying the study area including study of intersections and roads agreed with the LTA at the TIA inception stage
2.3 Existing Transport Network	Description of the existing road geometry, on-street parking, MRT/LRT station(s), bus stop(s), taxi stand(s), pedestrian route(s) and cycling facilities
2.4 Survey & Existing Traffic Flow	Traffic (count) survey required, including the survey method, location(s), date(s), period(s) and summary of the existing traffic flows
2.5 Observation of Existing Traffic Conditions	Description of existing traffic condition for each assessment period required. Existing traffic concerns shall be highlighted, supported by site photos
2.6 Assessment of Existing Traffic Conditions	Assessment of the traffic situation at existing intersections, including delays, LOS, DOS, queue length, stop rate, etc. If required, evaluation of the traffic situation at existing road(s), including the average travel speed(s) along the road(s)

3.0 PROPOSED DEVELOPMENT	
3.1 The Development	Nature & size e.g. projected number of residential units / GFA of each component / number of students, hours & days of operation, staging of opening
3.2 Access Location	Access locations, sight distance of access points, desirable minimum sight distances
3.3 Development Traffic Generation	Estimated peak hour traffic generation, based on surveys of similar sites, historical data or method agreed with LTA during the TIA inception stage
4.0 FUTURE TRANSPORT NETWORK & TRAFFIC FORECAST	
4.1 Future Transport Network	Description of relevant transport improvement plans for the corresponding years as agreed by LTA (a statement shall be included if LTA confirms that there is no future improvement plan to the existing transport network)
4.2 Future Background Traffic	Forecast of background traffic volumes corresponding to each future assessment year, based on a method agreed with LTA during the TIA inception stage
4.3 Development Traffic Distribution & Assignment	Assignment of development traffic to the road system based on the method agreed by LTA
4.4 Future Traffic Flows	Separate diagrams to illustrate the forecast background traffic flows (without development traffic) and the total traffic flows (with development traffic)
5.0 IMPACT OF PROPOSED DEVELOPMENT	
5.1 Future Traffic Conditions without the Proposed Development	Assessment of the future traffic situations, including affected intersections and roads, based on the forecast background traffic flows
5.2 Future Traffic Conditions with the Proposed Development	Assessment of the future traffic situations, including affected intersections and roads, based on the forecast total traffic flows
5.3 Development Traffic Impact	Analysis on the impact of the additional traffic associated with the proposed development, with a comparison of the traffic situations with and without the proposed development
5.4 Improvement Proposal	<If Traffic Situation is Unacceptable> Investigation of practical improvement measures to mitigate the development traffic impacts. These may include local improvements to intersection(s) and road(s), site access and circulation, and development traffic demand management measures.

5.5 Traffic Conditions with Proposed Improvements	<As Applicable> Assessment of the future traffic situations with the proposed improvement(s). Sensitivity analysis and/or scenario testing may be required.
6.0 OTHER ASSESSMENT ISSUES	
6.1 Public Transport	<If Required> Estimation of the proposed development's public transport demand, accessibility and adequacy of provision, the need to provide private bus service, optimised traffic layout to minimise traffic conflicts between different modes of transport, etc
6.2 Pedestrians	Review of pedestrian facilities & proposal of necessary improvements
6.3 Cyclists	<If Required> Possible provision of cycling tracks and parking facilities
6.4 Parking Provision	Proposed parking provision and required parking provision by standard
6.5 Loading & Unloading Facilities	<As applicable> Provision and operation of service vehicle area
6.6 Pick-up / Drop-off Facilities	<As applicable> Suitable location for pick-up/drop-off activities and number of bays required
6.7 Access & Traffic Circulation	Traffic circulation pattern & internal road layout, type of traffic control at development entrances and projected queue lengths at entrances, and if necessary proposal to improve the traffic layout
6.8 Traffic Operation Plan	<If Required> Estimation of traffic surge demand and conceptual proposal of traffic operation plans to mitigate the traffic surge impact
6.9 Traffic Management during Construction	<If Required> Assessment of traffic impact during the development construction period
7.0 RECOMMENDATIONS AND CONCLUSION	
7.1 Findings	Summary of the key study issues & findings
7.2 Recommendations	Summary of improvement recommendations
7.3 Conclusion	Overall conclusion of the TIA

ANNEX C
Contents to be included in the Executive Summary of a TIA Report

The Executive Summary of a TIA report shall include the following contents, in summarised tables or in other formats which are easy for reference.

Table C-1 – Summary of TIA Report Information

Information Type	Details required
Developer / Agency	Name(s) of the developer / agency and the representative of the developer / agency as applicable.
TIA consultant	Name(s) of the TIA consultant firm and the TIA project manager
Schedule	Include Scoping Meeting date, submission dates of all notes and reports submitted during the course of the TIA study.

Table C-2 – Summary of Development and Traffic Forecast Information

Information Type	Details required
Type and Scale of Development (1)	For mixed developments, include different component type and scale by land use type.
Assessment years	List the assessment years agreed with LTA. For multi-phase developments, describe the development quantum to be operational corresponding to each assessment year.
Assessment periods	Describe the day (i.e., weekday, Saturday or Sunday) and time period (e.g., 7am–9am) of each assessment period as agreed with LTA.
Traffic / transport surveys	Include information of the survey type (e.g., OD survey), site, methodology (e.g., licence plate matching), date and time period of when the data had been collected of the survey data used.
Resource of vehicular trip rate(s) used	Describe where the trip rate(s) are taken from and how they are applicable to the proposed development.
Trip generation	Include directional vehicular trips (in pcu/h) by assessment period and assessment year (for multi-phase development).
Intended vehicular access points	Indicate the location (name of street) of each vehicular access point (including carpark entrance and/or exit, pick-up /drop-off and loading/unloading as per applicable).
Intended parking provision	List the proposed numbers of parking lots by vehicle type/purpose (i.e., car, motorcycle, loading/unloading, etc).
Background traffic Prediction	Describe the methodology used to forecast the future background traffic and provide the growth rate(s) adopted if applicable.
Other issues	Include findings of other transport related issues such as public transport, pedestrians, cyclists, traffic operation plans, etc. and any other issues / factors that may significantly affect the traffic forecast, as applicable.

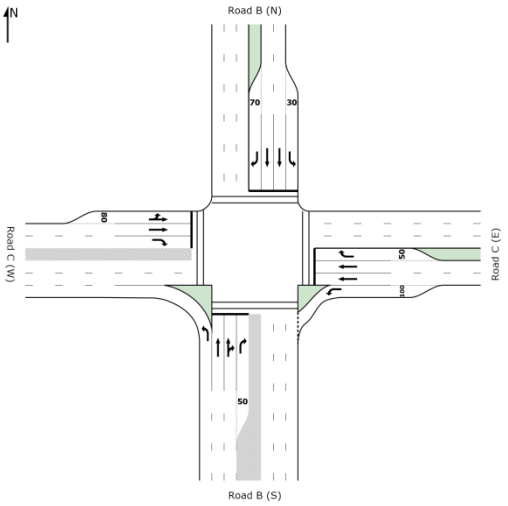
Note: (1) Please refer to Table A-1 for the definition of Type and Scale of Development.

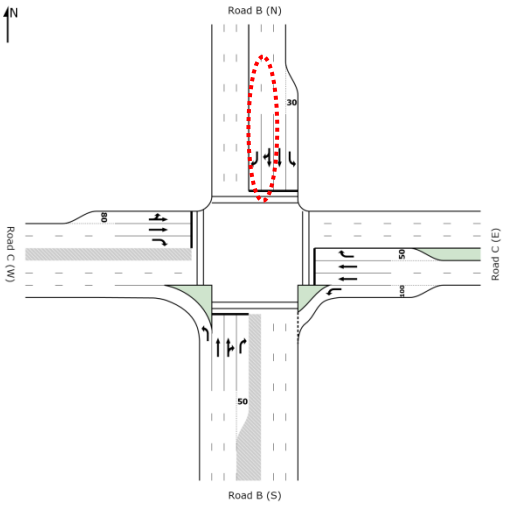
Table C-3 – Summary of Traffic Impact Assessment Results (Example)

Assessment Year and Location	**Assessment conclusion & Highlights of traffic issues**		
	Without development	**With development**	**Impact on average delay**
Year 2015	*(Refer to Table 4.4 at Page 51)*	*(Refer to Table 4.5 at Page 52)*	
• Junction 1 (Road A / Road B)	AM: • Average delay: 41 sec • DOS: 0.73 • LOS: D • 95% Back of queue: 262m • Stop rate: 0.70 PM: • Average delay: 39 sec • DOS: 0.71 • LOS: D • 95% Back of queue: 198m • Stop rate: 0.67 Highlight of traffic issues: • Nil.	AM: • Average delay: 50 sec • DOS: 0.80 • LOS: D • 95% Back of queue: 348m • Stop rate: 0.78 PM: • Average delay: 45 sec • DOS: 0.76 • LOS: D • 95% Back of queue: 319m • Stop rate: 0.76 Highlight of traffic issues: • Nil.	AM: ↑ 22% PM: ↑ 15%
• Junction 2 (Road B / Road C)	AM: • Average delay: 69 sec • DOS: 0.91 • LOS: E • 95% Back of queue: 402m • Stop rate: 0.78 PM: • Average delay: 51 sec • DOS: 0.82 • LOS: D • 95% Back of queue: 269m • Stop rate: 0.56 Highlight of traffic issues: • Nil.	AM: • Average delay: 97 sec • DOS: 1.74 • LOS: F • 95% Back of queue: 552m • Stop rate: 0.92 PM: • Average delay: 82 sec • DOS: 1.30 • LOS: F • 95% Back of queue: 457m • Stop rate: 0.88 Highlight of traffic issues: • Right-turn from North Approach is over capacity, at both AM & PM peaks.	AM: ↑ 41% PM: ↑ 61%
…	…	…	…
Year 2020	*(Refer to Table 4.6 at Page 53)*	*(Refer to Table 4.7 at Page 55)*	
• Junction 1	…	…	…
• Junction 2	…	…	…
…	…	…	…

Table C-4 – Summary of Recommendations (Example)

<table>
<tr><th>Assessment Year and Location</th><th colspan="2">Improvement proposal & results</th></tr>
<tr><td>Year 2015</td><td>(Refer to Table 4.8 at Page 56)</td><td>(Refer to Table 4.9 at Page 58)</td></tr>
<tr><td>• Junction 1 (Road A / Road B)</td><td colspan="2">No improvement required.</td></tr>
<tr><td>• Junction 2 (Road B / Road C)</td><td colspan="2">Proposed mitigation measures:
• Convert the right-turn short lane at the North approach from 70m to a full lane;
• Convert a through lane to a shared lane with right-turn at the North approach;
• Optimise the traffic signal timing.

Layout without proposed improvements:
 

Layout with proposed improvements:
 

Assessment results with the proposed improvements:

AM:
• Average delay: 75 sec
• DOS: 0.93
• LOS: E
• 95% Back of queue: 385m
• Stop rate: 0.80

PM:
• Average delay: 63 sec
• DOS: 0.85
• LOS: E
• 95% Back of queue: 330m
• Stop rate: 0.75

Conclusion: Satisfactory performance achieved.</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>Year 2020</td><td>(Refer to Table 4.10 at Page 60)</td><td>(Refer to Table 4.11 at Page 61)</td></tr>
<tr><td>• Junction 1</td><td>…</td><td>…</td></tr>
<tr><td>• Junction 2</td><td>…</td><td>…</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
</table>