



mainroads
WESTERN AUSTRALIA

SIDRA UGM 18th Oct 2019

Operational Modelling

Guidelines and Auditing Process

Hannah Saunders

Operational Modelling and Visualisation Manager, MRWA





Objectives

SIDRA at Main Roads

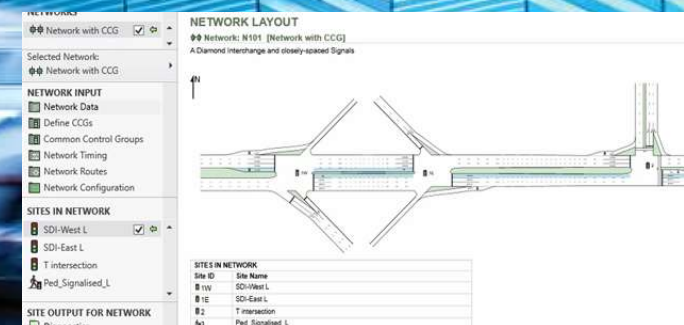
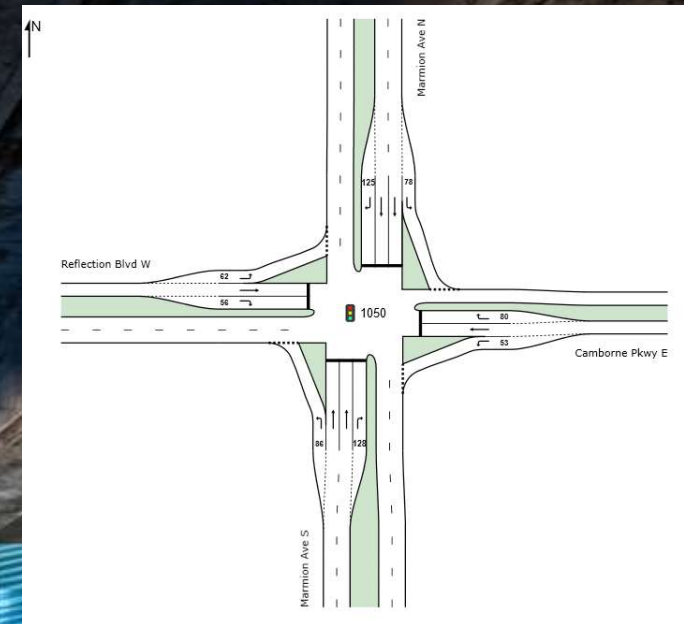
Overview of supporting documents

Food for Thought



SIDRA at Main Roads

Australian software used as an aid for design and evaluation of individual intersections and networks of intersections.





About Us

Main Roads Western Australia manages 18,500km of roads

Responsible for delivery and management of a **safe** and **efficient** road network

Network Operations Directorate (NOD):

- To **optimise the performance** of the existing road network
- To facilitate the movement of people and freight **safely**, **reliably** and **efficiently** throughout Western Australia.



Operational Modelling and Visualisation Team

- Operational modelling **centre of excellence**
- Develop modelling **guidelines** and **provide support**
- **Checks** and **audits** modelling submitted to Main Roads
- Supports **informed decision-making**

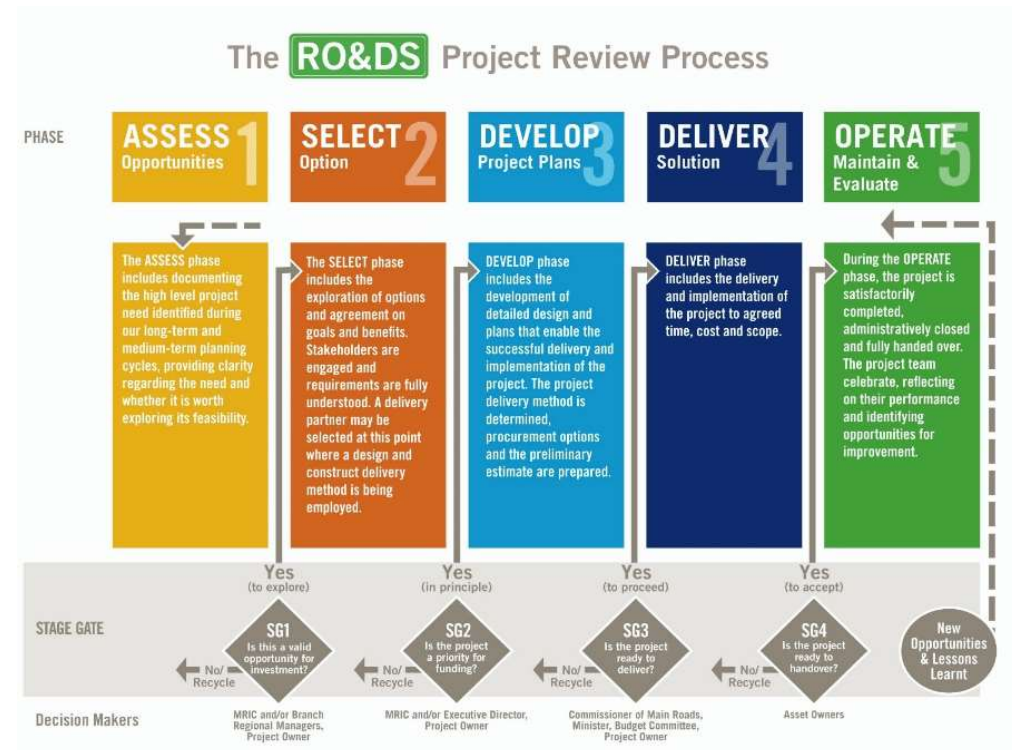




SIDRA

Used at Main Roads for:

- Primarily for assess and select stage of Main Roads RO&DS project lifecycle
- Assessment of traffic impact for Development Applications
- Planning of future corridors
- Project Identification
- Intersection configuration analysis
- Stage 1 of Traffic Signal Approvals
- Traffic management assessment (temporary works)
- Signal Timing optimisation assessment and input into microsimulation models





SIDRA

SIDRA can assess:

- signalised intersections
- pedestrian crossings
- priority intersections
- interchanges
- roundabouts
- networks

SIDRA Outputs:

- Degree of Saturation
- Delay
- Level of service
- Average queues or any percentile queues.

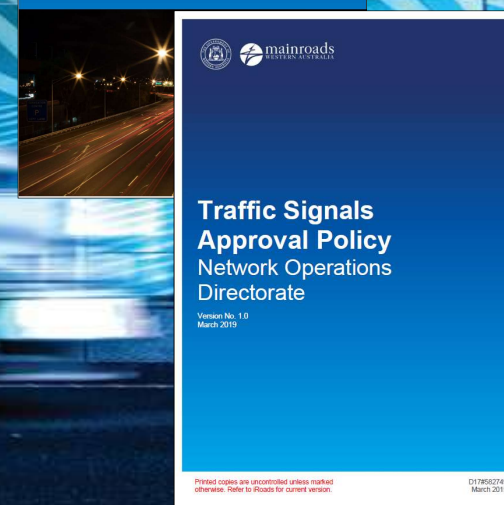
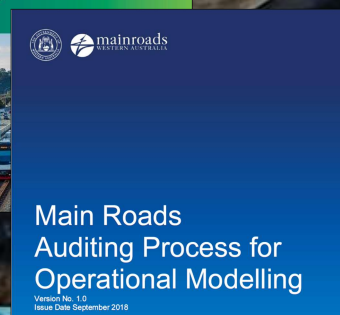
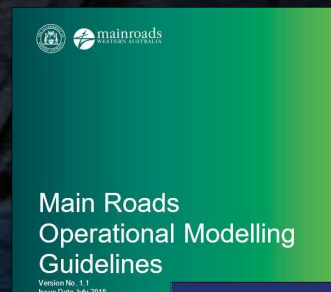
Lane Use and Performance													
	Demand Flows			Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	Cap. veh/h	w/c	%	sec		Veh	Dist m		m	%	%
South: Spine road (S)													
Lane 1 rd	314	14.1	677	0.464	100	5.6	LOS A	2.1	18.4	Full	180	0.0	0.0
Lane 2	209	9.7	541	0.386	83 rd	9.5	LOS A	1.5	12.6	Full	180	0.0	0.0
Approach	523	12.3		0.464		7.2	LOS A	2.1	18.4				
East: Thomas Rd (E)													
Lane 1 rd	368	14.1	1282	0.287	100	5.0	LOS A	1.3	11.3	Full	500	0.0	0.0
Lane 2	268	14.1	936	0.287	100	5.4	LOS A	1.2	10.2	Full	500	0.0	0.0
Lane 3	279	8.9	974	0.287	100	8.6	LOS A	1.2	9.7	Short	200	0.0	NA
Approach	915	12.5		0.287		6.2	LOS A	1.3	11.3				
North: Spine road (N)													
Lane 1 rd	260	2.2	681	0.382	80 rd	4.7	LOS A	1.6	12.4	Full	110	0.0	0.0
Lane 2	248	2.2	519	0.478	100	12.9	LOS B	2.1	15.7	Full	110	0.0	0.0
Approach	508	2.2		0.478		8.7	LOS A	2.1	15.7				
West: Thomas Rd (W)													
Lane 1 rd	693	11.8	1350	0.513	100	5.1	LOS A	3.1	26.5	Full	500	0.0	0.0
Lane 2	514	14.1	1001	0.513	100	5.7	LOS A	2.9	25.7	Full	500	0.0	0.0
Lane 3	158	13.6	1043	0.151	29 rd	13.7	LOS B	0.6	5.2	Short	200	0.0	NA
Approach	1365	12.9		0.513		6.3	LOS A	3.1	26.5				
Intersection	3311	11.1		0.513		6.8	LOS A	3.1	26.5				



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Supporting Documents: An overview

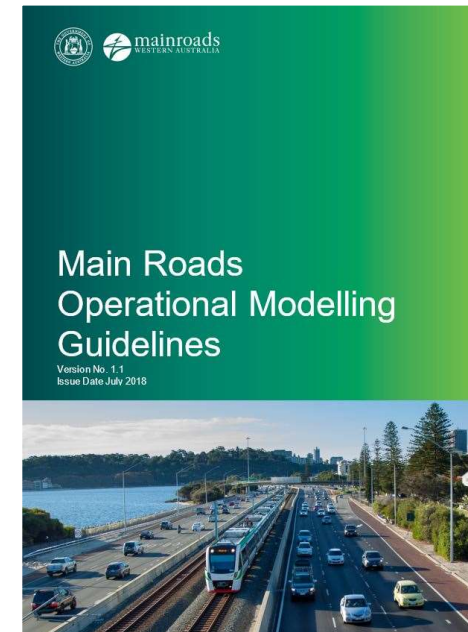
1. Main Roads Operational Modelling Guidelines
2. Main Roads Auditing Process for Operational Modelling
3. Traffic Signal Approval Policy





Operational Modelling Guidelines

- Why develop?
 - Consistency, best practice, WA specific
- What is it used for?
 - Traffic Modelling in WA
- Who should use it?
 - Modellers, Project Managers
- When is it used?
 - Signal Approvals, Traffic Modelling Schemes



Operational Modelling Guidelines (OMG)

Section 1 – Background and Purpose

- Consistency
- Accurate modelling
- High quality project design and assessment



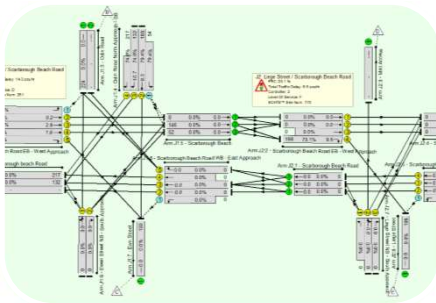
Section 2 – Traffic Modelling Overview

- Data Collection and Analysis
- Signal Data
- Study Area Selection
- Calibration and Validation

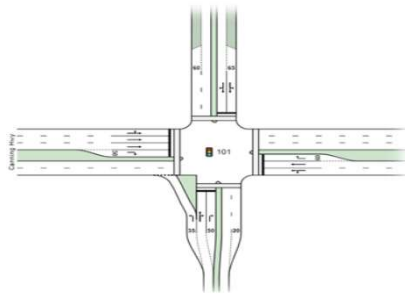
**Modellers and
Project Managers
should know
Sections 1 and 2**

Operational Modelling Guidelines

Section 3 to 6 – Software Guidelines



3. LinSig



4. SIDRA



5. Vissim



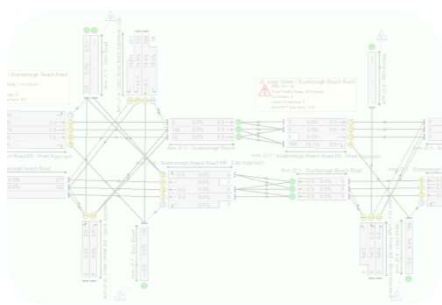
6. Aimsun

- WA settings and modelling parameters
- Modelling techniques and requirements
- Calibration and validation

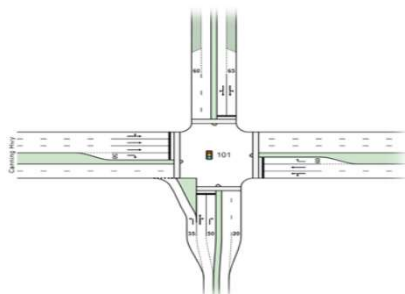
**Modellers
should know
these sections**

Operational Modelling Guidelines

Section 3 to 6 – Software Guidelines



3. LinSig



4. SIDRA



5. Vissim



6. Aimsun

- Provides details on what should be considered when building a SIDRA model

SIDRA: What's included in the guidelines

- Program settings
- Heavy Vehicle classes
- Gap Acceptance
- Modelling staged crossing at two-way sign control
- Saturation Flow calibration
- Traffic demand calibration
- Network Modelling





Specific WA SIDRA parameters: Heavy Vehicles

Class	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Heavy Vehicles – Table 4.2*

- Mass
- Power
- Length
- PCE

*Table may be updated

Table 4-2: Recommended Movement Classes by Main Roads

Austroads Vehicle Class	Vehicle Mass (kg)	Power (kw) ¹⁴	Length (m) ¹⁵	PCE (pcu/veh) ¹⁵
1	1600	120	4.85	1
2, 3, 4, and 5	22500	160	12.5	2
6, 7, 8 and 9	42500	350	19	3
10	64000 – 70000 ¹⁶	400	27.5	4
11	80000 – 90000 ¹⁷	450	36.5	4
12	115000	450	53.5	5

Source: Main Roads



Specific WA SIDRA parameters: Heavy Vehicles

Class	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

Heavy Vehicles – Table 4.5

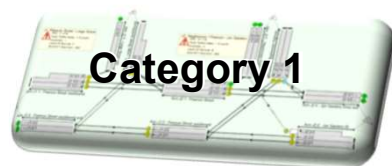
- Gap Acceptance
- Opposing Vehicle Factors

Table 4-5: Gap Acceptance & Opposing Vehicle Factors

Austrroads Class	Gap Acceptance Factor	Opposing Vehicle Factor
1	1	1
2	1.5	1.5
3-5	1.5	1.5
6-9	2	2
10	2.5	2.5
11	2.5	2.5
12	4.5	4.5

Source: Main Roads

Model Categories for Validation



- Single intersection or short corridor model
- Different design layouts or traffic conditions



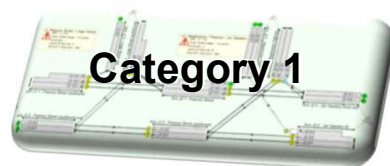
- Small area network
- Different traffic management schemes.



- Large area network
- Network planning, traffic management and road schemes



Model Categories for Validation



- Single intersection or short corridor model
- Different design layouts or traffic conditions



Output	Category 1 (LinSig & SIDRA)
Queue length	✓
Degree of Saturation	✓
Saturation flow	✗
Traffic turning movement and directional link volume	✗
Travel Time	✗
Signal timings	✗
Vehicle speed map	✗

Queue Lengths:

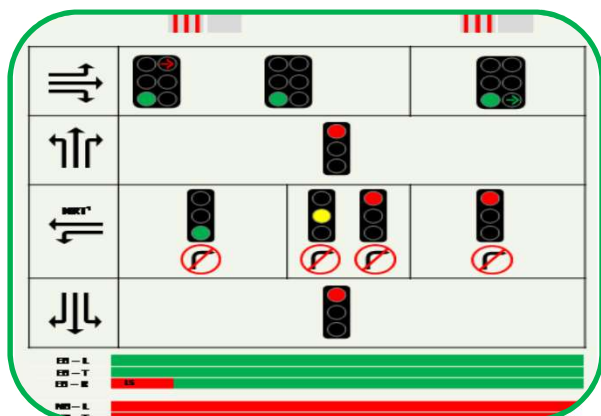
- should be measured at the start of green period for 5-minute intervals over the peak period (min. of 10 samples should be collected across the peak hour)
- should be collected on the same day as the traffic survey

Degree of Saturation:

- the base model should have less than or equal to 100% degree of saturation for all of the movements

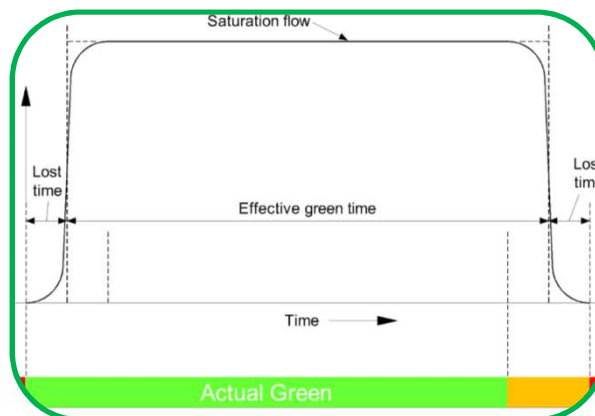
Associated Documents

Appendix A



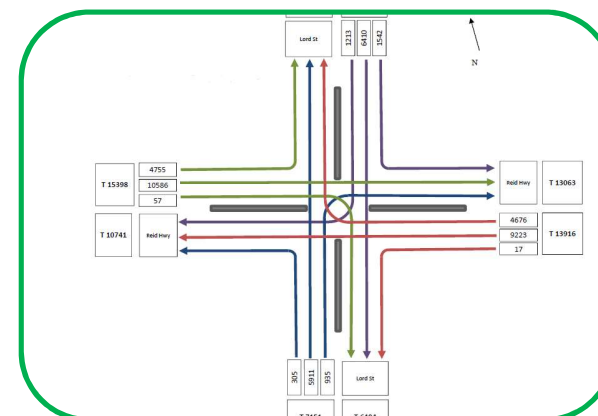
Signal Data
Information for
Modelling

Appendix B



Saturation Flow
Information

Appendix C

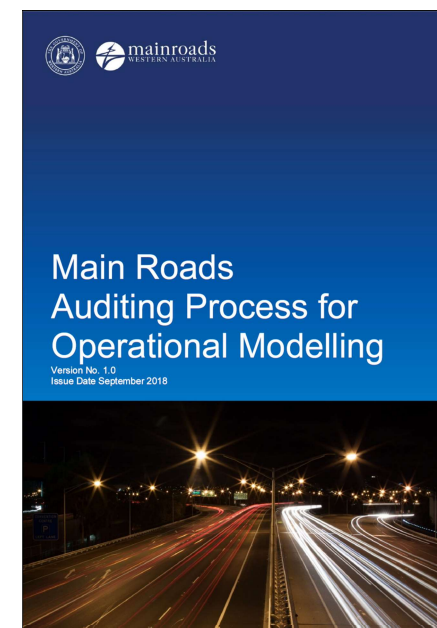


Guidelines for
Calibration of
Traffic Volumes
from ROM24



Auditing Process for Operational Modelling

- Why develop?
 - Consistency, Good Practice and Transparency
- What is the process?
 - Six Stage Process
- Who should use it?
 - Modellers, Project Managers, Auditors
- When is it used?
 - Signal Approvals, Traffic Modelling Schemes



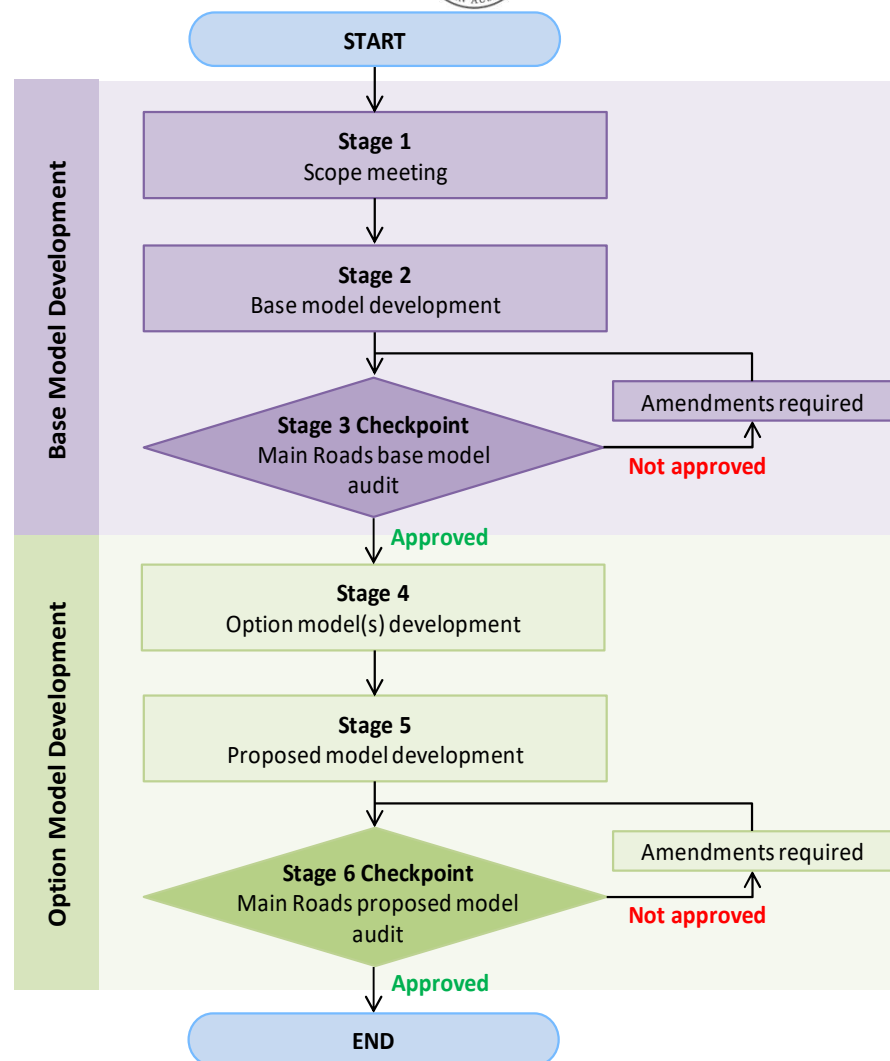


Auditing Process

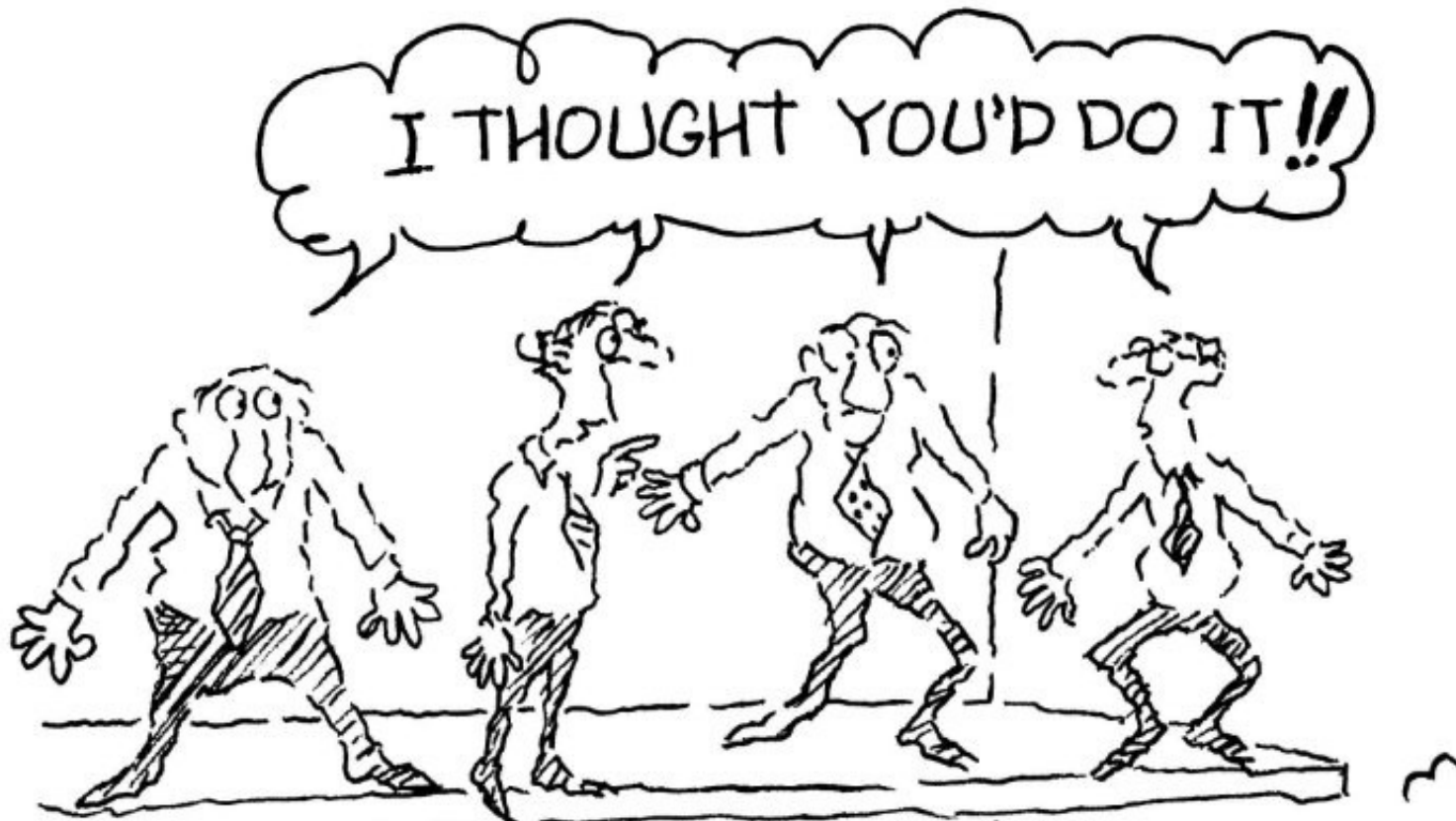
Previously:

- Traffic flows / poor data / incorrect future traffic flow calculations
- Base and Proposed Models submitted. More work to correct the model if the base model is incorrect
- Option Models were not possible (incorrect signal phasing)

Modelling audit approval does not constitute Traffic Signal approval



Roles in Auditing Process





Roles in Auditing Process

	Roles	Responsible Party
Applicant	Applicant	Project Manager (*)
	Modeller	(assigned by Applicant)
Main Roads	Auditing Process Coordinator	TMS (first point of contact)
	Model Auditor	TMS / AP / OMV / PTS
	Traffic Signals Reviewer	SCATS
	Signs and Lines Reviewer	TMS
	Existing Traffic Flow Reviewer	TMS / Area Performance
	Future Traffic Flow Reviewer	PTS



Associated Documents and Forms

Traffic Modelling Instruction Form

General

Title of The Project Wellington Street / Barrack St

Stage Develop Stage

Promoter PTS - Carpline Carabott

Modeller (if known) TBC

Requested by Traffic Signal Approval

Main Roads Reference Number (Requester) 24445878 / 201.05

Main Roads Reference Number (Approver) #00048

Modelling Level Microscopic Software Version

Modelling Objectives

- purpose of the modelling;
- who if it for;
- and, ...

☐ Feasibility Assessment

☐ Intersection Layout Justification Analysis

Proposed Phasing Changes for Safety as identified by the Pinch Point Programme.

Study Area (i.e. Corridor or Intersection/s (TCS Number)) Intersection + adjacent intersection where exit blocking occurs

Study Area Image

SIDRA Model Audit Checklist			
Project Information			
Project			
Model Name			
Site Name			
Site ID (if applicable)			
Promoter (Name & Organisation / MRWA Team)			
Modeller (Name & Consultancy / MRWA Team)			
Modelling Coordinator (Name & MRWA Team)			
Model Auditor (Name & MRWA Team)			
Add Comment/Response			
Spelling (for selection)			
Base Model Checks	Modeller	Model Auditor	Find it in SIDRA so
Supply Information	TBC	TBC	
INTERSECTION	TBC	TBC	INTERSECTION Dia
VEHICLE CLASSES	TBC	TBC	MOVEMENT DEFIN
MOVEMENTS	TBC	TBC	MOVEMENT DEFIN
LANE GEOMETRY	TBC	TBC	LANE GEOMETRY I
Number of lanes	TBC	TBC	Lane Configuration
Lane configuration (Full-length, short lane, short lane with parking, two-segment lane)	TBC	TBC	Lane Configuration
Lane type (Normal, Slip/Bypass - High or Short Angle)	TBC	TBC	Lane Configuration
Lane control (Signals, Give-way/Yield, Stop, Continuous)	TBC	TBC	Lane Configuration
Lane length	TBC	TBC	Lane Configuration



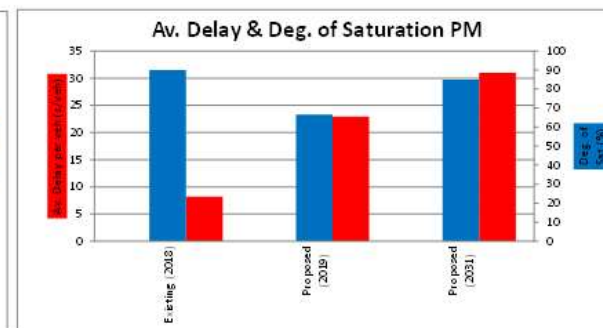
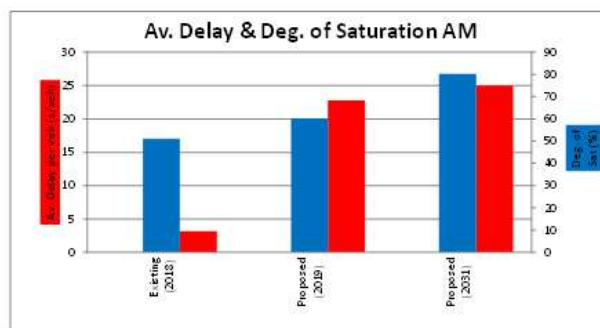
Associated Documents and Forms

SIDRA Model Output

Intersection #3:	Albany Hwy / Davis Rd / Fancote St - Conversion of Priority Control to Signals
Suburb:	Kelmscott
Traffic Flows Date:	SATURN flow outputs used for all scenarios

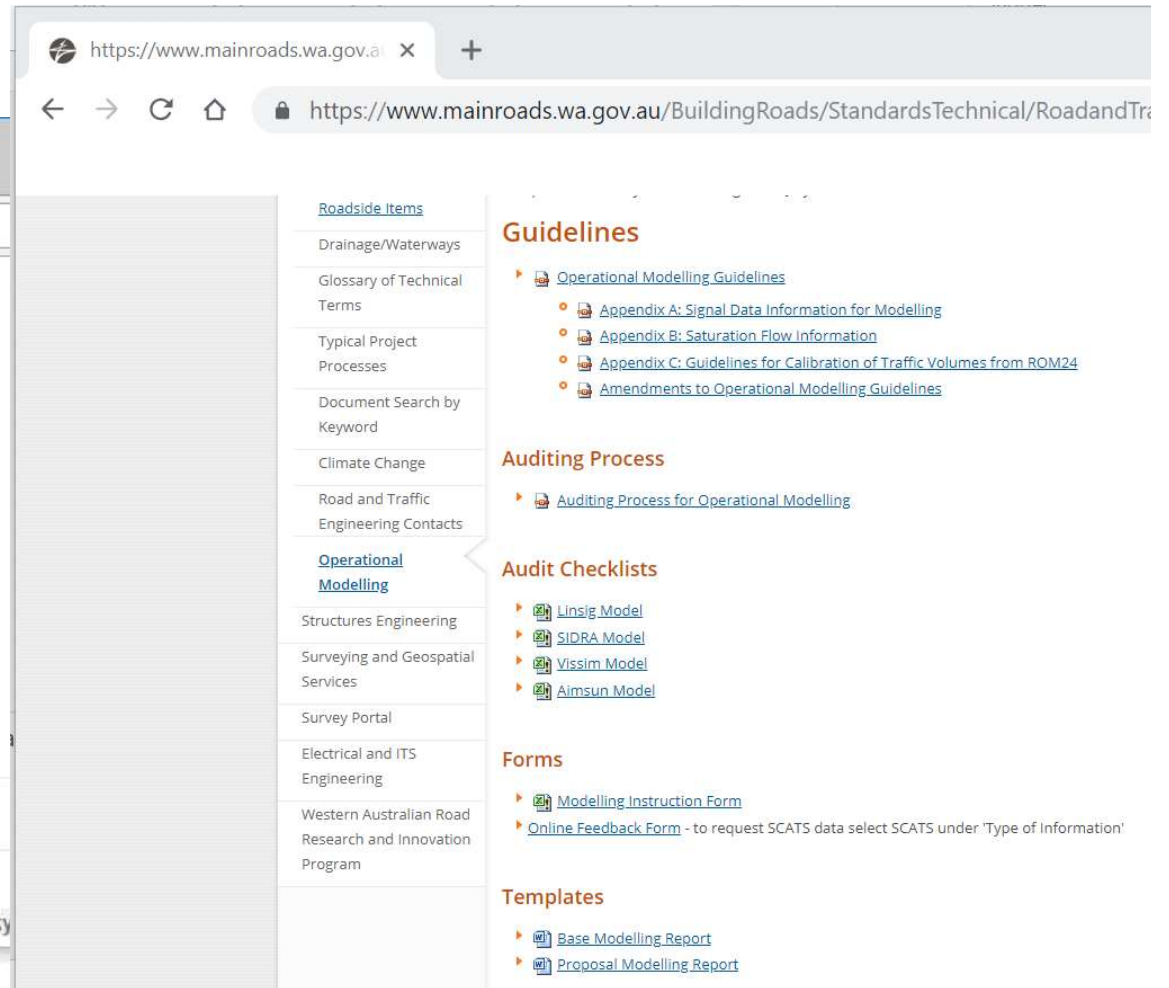
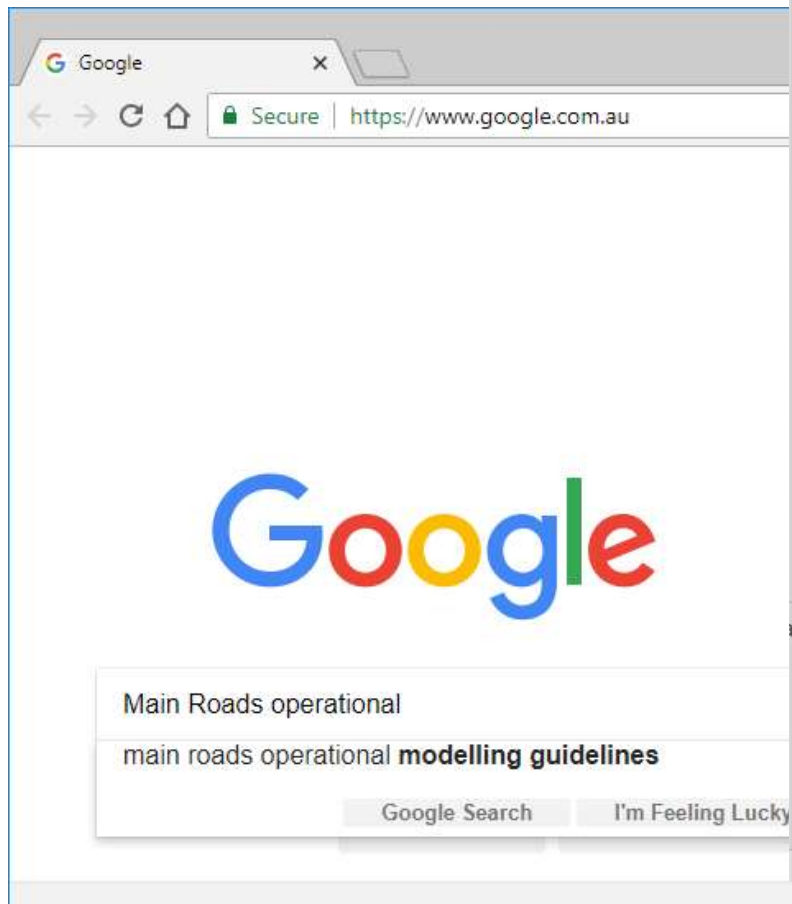
	Approach Name	Road Type	Existing (2018)	Proposed (2019)	Proposed (2031)	Existing (2018)	Proposed (2019)	Proposed (2031)
			AM	AM	AM	PM	PM	PM
Intersection Type			Priority	Signal	Signal	Priority	Signal	Signal
Cycle time (s)			80	80	80	80	80	80
Phase Sequence				ABC	ABC		ABC	ABC
Intersection Level of Service			C	C	C	C	C	C
Intersection Av. Delay per veh (s/veh)			3.2	22.8	25.0	8.2	22.9	31.0
Worst Level of Service			F	C	C	F	C	D
Worst Deg. Of Sat (%) N	Albany Hwy SB	State	25	59	69	38	67	85
Worst Deg. Of Sat (%) S	Albany Hwy NB	State	33	60	74	31	55	73
Worst Deg. Of Sat (%) E	Fancote St	Local	51	6	16	90	26	26
Worst Deg. Of Sat (%) W	Davis Rd	Local	2	60	80	4	66	85
Worst Deg Of Sat (%)			51	60	80	90	67	85
Worst 95%tile Queue (metres)			15	120	160	42	106	194
Worst Approach (Deg. of Sat)			Fancote St	Davis Rd	Davis Rd	Fancote St	Albany Hwy SB	Davis Rd
Corresponding Worst Movement			Left/Through/Right	Through/Right	Through/Right	Left/Through/Right	Left/Through	Through/Right

Existing Phasing
PRIORITY CONTROL





Published Online



SIDRA in the Traffic Signal Approval Process



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Traffic Signals Approval Policy Network Operations Directorate

Version No. 1.0
March 2019

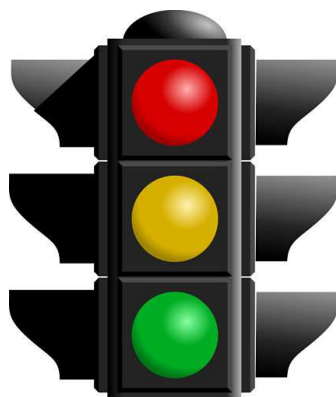
Printed copies are uncontrolled unless marked
otherwise. Refer to iRoads for current version.

D17#582749
March 2019

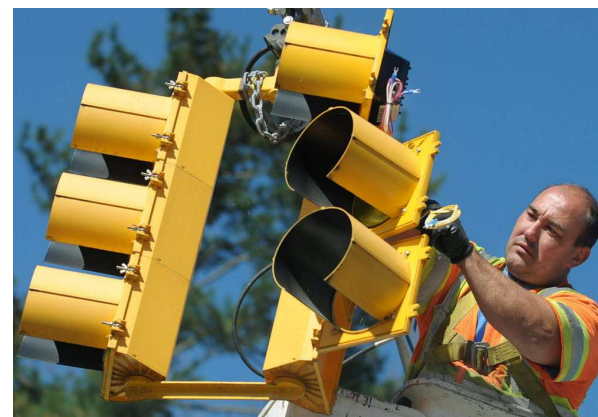
TSAP – What is this for and when to model

Set out the circumstances under which Main Roads will consider approving the modification of existing signals and the provision of new traffic signals on all roads within Western Australia

New Traffic Signals

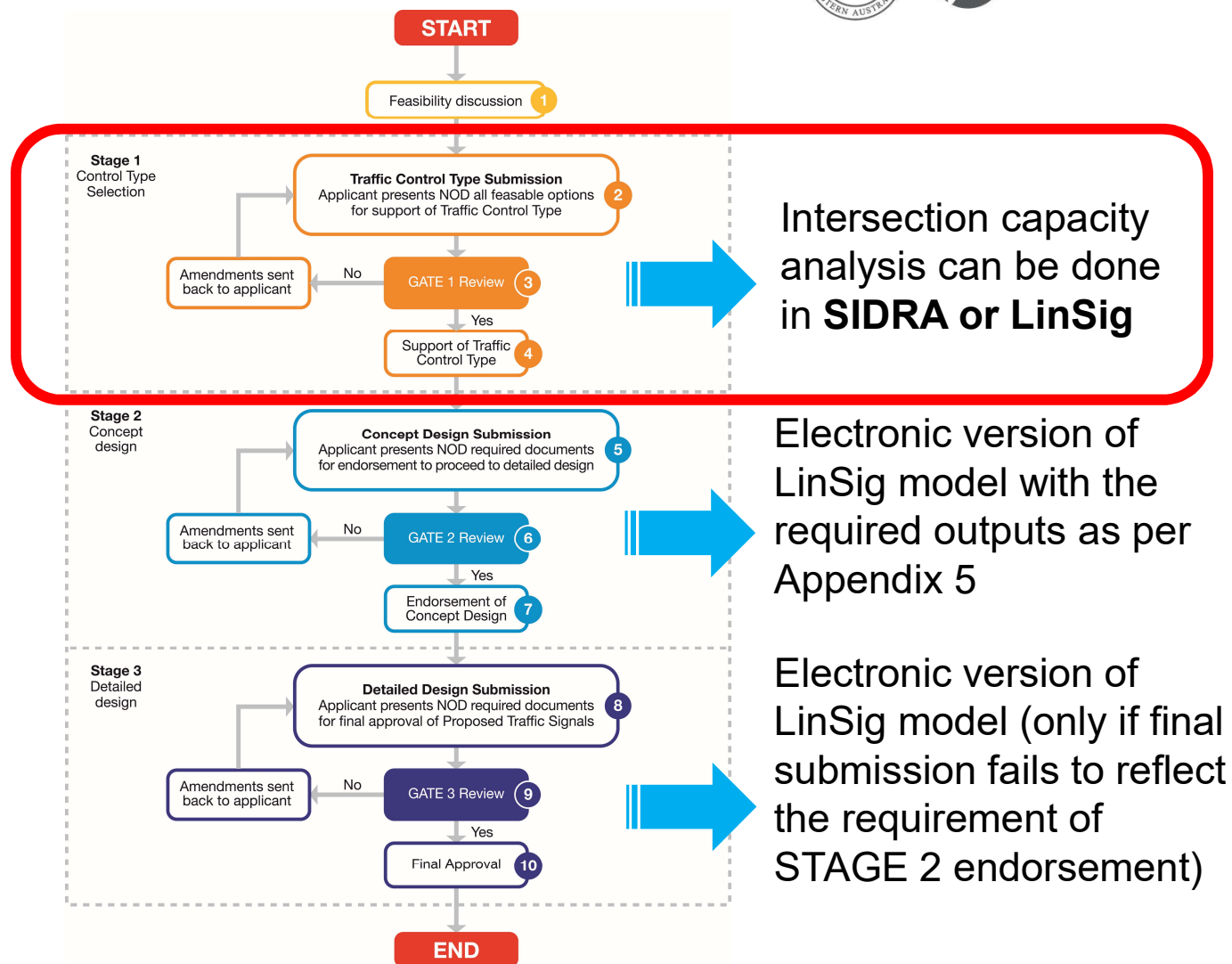


Traffic Signal Modifications



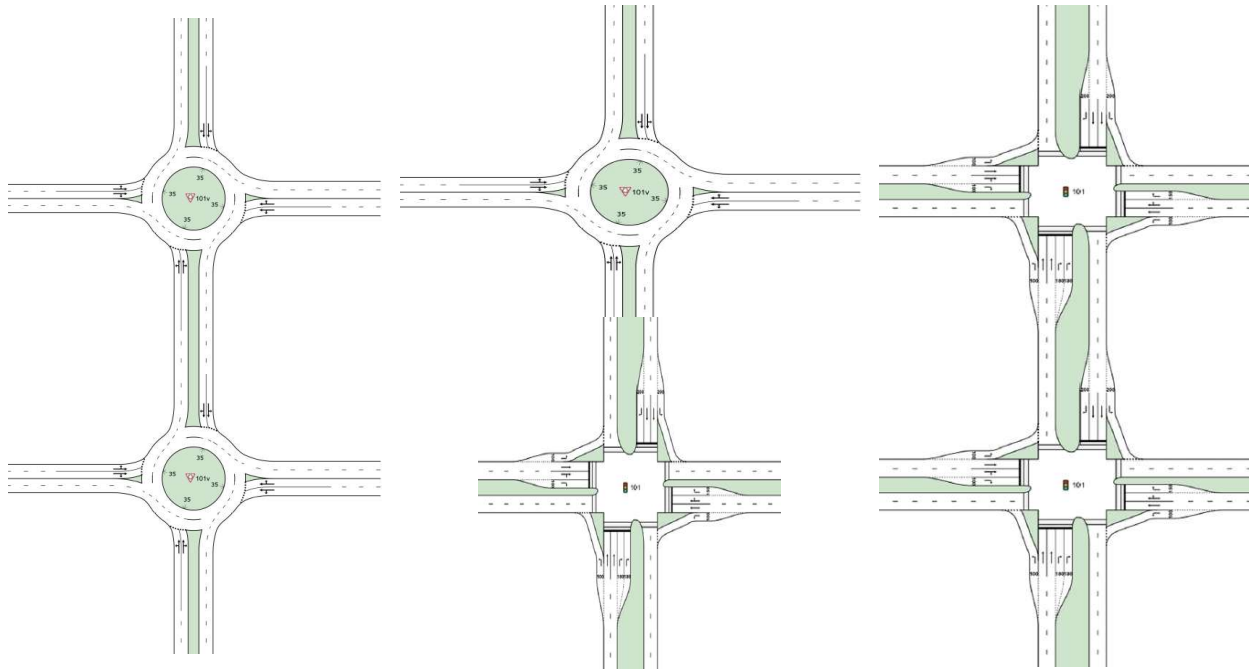


Approval for New Traffic Signals



Stage 1 Purpose

- Intersection configuration confirmation
- Compare Roundabouts vs Signals vs Priority





Modelling requirements – Stage 1

Modelling Scenarios to be submitted:

- Base model – Existing layout
- Proposed layout - Opening year
- Proposed layout – Opening year + 5 (short term horizon, STH)
- Proposed layout – Opening year +10 (medium term horizon, MTH)

- Traffic data should not be older than 12 months
- Applicant should consult with Main Roads to confirm forecast traffic flows
- Nearby Intersections (linked) – Optimum cycle time for the network
- Minimum cycle times (accepted performance requirements)
- Microsimulation requested if necessary
- Phase & Phase sequences – approved by SCATS & Electrical Services Team



Modelling requirements – Stage 1

Modelling output comparison:

- Overall degree of saturation
- Overall level of service
- Overall weighted average delay
- Cycle times

	Approach Name	Road Type	Existing (2018)	Proposed (2019)	Proposed (2031)	Existing (2018)	Proposed (2019)	Proposed (2031)
			AM	AM	AM	PM	PM	PM
Intersection Type			Priority	Signal	Signal	Priority	Signal	Signal
Cycle time (s)				80	80		80	80
Phase Sequence				ABC	ABC		ABC	ABC
Intersection Level of Service				C	C		C	C
Intersection Av. Delay per veh (s/veh)			3.2	22.8	25.0	8.2	22.9	31.0
Worst Level of Service			F	C	C	F	C	D
Worst Deg. Of Sat (%) N	Albany Hwy SB	State	25	59	69	38	67	85
Worst Deg. Of Sat (%) S	Albany Hwy NB	State	33	60	74	31	55	73
Worst Deg. Of Sat (%) E	Fancote St	Local	51	8	18	90	28	28
Worst Deg. Of Sat (%) W	Davis Rd	Local	2	60	80	4	66	86
Worst Deg Of Sat (%)			51	60	80	90	67	85
Worst 95%ile Queue (metres)			15	120	160	42	105	194
Worst Approach (Deg. of Sat)			Fancote St	Davis Rd	Davis Rd	Fancote St	Albany Hwy SB	Davis Rd
Corresponding Worst Movement			Le/Through/Right	Through/Right	Through/Right	Le/Through/Right	Le/Through	Through/Right

Performance Requirements:

- Opening Year ➡ 80% DoS ➡ LoS D or better
- STH ➡ 85% DoS ➡ LoS D or better
- MTH ➡ < 100% DoS ➡ LoS E or better



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Food for Thought:

- Heavy Vehicle Research Findings
- Sidra Model Audits – Issue
- Lessons Learnt / Challenges





Heavy Vehicle Research Findings

- Working with Austroads to improve modelling parameters
- Light and heavy default vehicle lengths and Queue Space should not be used
- Survey supports the lengths recommended
- Need to consider heavy vehicles

Vehicle type	Queue space, m		
	SIDRA default	MRWA (maximum) ¹	Survey (average)
Rigid truck	13	15.0	12.3
Single articulated truck	13	21.5	19.8
B-double	25	30.0	27.3
Double road train	25	39.0	31.6
Triple road train	25	56.0	54.3

Vehicle type	Vehicle length, m		
	SIDRA default (maximum)	MRWA (maximum)	Survey (average)
Rigid truck	10	12.5	9.5
Single articulated truck	10	19.0	17.1
B-double	22	27.5	24.6
Double road train	22	36.5	28.9
Triple road train	22	53.5	51.6

Sidra Stage 1 Audits



MRWA Sidra Model Audit

- Local Roads – Traffic Management Services (Base and Proposed)
- State Roads – Operational Modelling and Visualisation Team (Base)
- State Roads – Area Performance Team (Proposed)
- General – Planning and Technical Services

Issues found when auditing Sidra Roundabouts



The environment factor

- adjusted without proper justification
- confusion on the starting value before calibration
- its application for 'greenfield' sites



Sidra Stage 1 Audits

Common issues found when auditing Sidra Models in general

- No council expertise
- Incomplete information and reporting of modelling assumptions
- Guidelines not being referred to
- Incorrect data used
- Incorrect scenarios modelled
- Models are not updated correctly after an audit
- Two-stage modelling methodology modelled incorrectly
- Heavy vehicles classified incorrectly
- Default values (vehicle lengths / gap acceptance) used
- How pedestrian protection / pedestrian demand should be modelled
- Confusion between underutilised green time or lost green time
- Misinterpretation of SCATS timings



Lessons Learnt / Challenges

- Checklists long / time consuming?
- Calibration methodology – simpler way to do saturation flows?
- Heavy Vehicles – knowing what data to use
- Correct roundabout calibration (through the environment factor and not manually through critical gap and follow-up headway)
- Modelling for Greenfield sites
- How well calibrated and validated is the base model for Stage 1 Signal Approvals (purpose of model – design or lane configuration)
- Transition between planning and operational traffic models – use of different outputs i.e. back of queue and 95% percentile
- Governance of model reviews: Scenarios > MTH (+10 yrs)

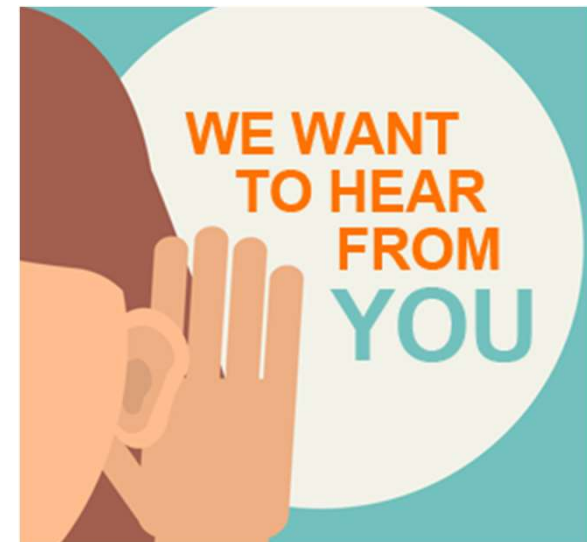


Summary

- Sidra at Main Roads
- Recap Sidra modelling related documentation
- Food for thought:
 - Research
 - Audit issues
 - Lessons learnt and challenges

What's Next?

- Guidelines / APOM Update
- Is the document right for you?
- How can these documents be improved?
- December Survey



The background of the slide is a photograph of a highway underpass. The concrete beams of the overpass are visible at the top. Below them, a wall with a blue and white wavy pattern separates the road from the underpass. A white car is blurred in motion on the road. A dark blue rectangular overlay covers the left side of the image, containing the text.

Thank You!

OMV@mainroads.wa.gov.au