Traffic Signals Safety and Efficiency Project

In 2012 RAC initiated a two year project, in partnership with the State Government, to investigate the use of technology to further improve the performance of Western Australia's traffic signals.

Why did we undertake this project?

Perth is growing at a rapid rate, with our city's population forecast to increase a further 1.5 million, to 3.5 million people, by 2050[1]. Roads in Western Australia (WA) will need to carry more vehicles than ever before and perform an increasingly diverse role, accommodating a wide range of users.

Infrastructure Australia's 2015 Australian Infrastructure Audit predicts that WA will have seven of the nation's ten most congested roads (including the top four) by 2031.

Congestion is already harming the State's economic productivity, and is taking a toll on commuters and their families. A majority (87 per cent) of business respondents to the 2015 RAC BusinessWise-CCI Congestion Survey stated they believe traffic congestion contributed directly to lost productivity (up from 78 per cent in 2013).

Enhancing the effectiveness of Perth's existing arterial road network has never been more important. We cannot simply build our way out of congestion, we need to make better use of the infrastructure we already have. It is therefore essential an appropriate balance is struck between the expansion of our existing road network and the need to make the existing infrastructure work harder and smarter.

Of all traffic management measures, the operation of traffic signals is considered to have the greatest influence on the performance of metropolitan road networks. A well set up and maintained traffic signal system ensures maximum possible performance, and minimises unnecessarily constrained traffic flow and bottlenecks.

WA's Traffic Signal System

There are over 968 sets of traffic lights in operation across WA's road network, managed by Main Roads WA (MRWA). They are controlled by a system known as SCATS – the Sydney Co-ordinated Adaptive Traffic System. Depending on how it is set up, SCATS is able to adjust signal times based on the time of day and traffic demands. It has an adaptive traffic response capability and can adapt to cater for changes in traffic volumes and movements to help keep the traffic moving. It also allows adjacent sets of traffic signals to be coordinated to improve flow along major routes. Manual adjustments can also be made by operators at the State's Traffic Operations Centre (TOC) in response to congestion, traffic incidents or faulty infrastructure for example.

What did the project involve?

The purpose of the project was to test an alternate approach to traffic signal retiming (or signal optimisation), using micro-simulation modelling software as an additional step in the process.

Retiming signals can reduce queuing and delays, and improve traffic flow. Even small changes to signal timings at one or multiple intersections can have substantial benefits for road users.

This project therefore looked at signal retiming as a potential low cost solution to improve the efficiency of the network and provide direct benefits for the commuting public. In addition to efficiency, it also prioritised road safety and considered the broader user experience for all road users including pedestrians.

Micro-simulation modelling

A micro-simulation model is simply a simulation or replica of the traffic conditions on a part of the road network, based on existing and potential future situations. This is a useful tool in aiding more informed decision-making as a range of options can be tested to improve network performance.

[1] WA Planning Commission (2015). Draft Perth and Peel@3.5 million.

The project comprised the following two stages:

Stage One (completed in September 2013)

Selection of two demonstration sites, traffic data collection and development of micro-simulation models to replicate the current signal operation and traffic movements to test a range of potential signal retiming options. The two sites chosen were:

> Kelvin Road and Tonkin Highway intersection, and

> Orrong Road, between Francisco Street and Oats Street (comprising four signalised intersections, which also included Archer Street and Wright Street).

Stage Two (completed in October 2014)

Real-life implementation and testing of the signal timing recommendations from Stage One.

Stage Two focused on the Orrong Road corridor as no civil works were required to implement the recommendations. This was critical to achieving the project objectives as it allowed the benefits of the signal retiming to be determined, demonstrating the effectiveness of this low cost solution. This corridor also provides a key link between the City and Airport and experiences heavy traffic flows and congestion, particularly during peak hours. Thus, improving the operation of this corridor could be expected to deliver significant benefits for road users.

The on-site trial commenced on 5 May 2014. Pre and post-implementation data collection comprised three days of traffic surveys to allow evaluation against key performance measures such as journey times, queues and delay. A two-week 'bedding' period was allowed for prior to the collection of post-implementation data.

What were the key findings?

The project confirmed the importance of using micro-simulation modelling as an additional step in the signal retiming process. It allowed a number of options to be tested, and the best performing (or optimal) solution to be implemented on the ground, to maximise the benefits for road users.

The following changes to the way SCATS was used were demonstrated to reduce queuing and delays, and improve journey times:

> **reducing the signal cycle times[2]** – shortening cycle times by up to 50 seconds meant each approach at an intersection received a green light more frequently and queuing and delays to road users were reduced;

> **switching to incremental split selection (ISS)[3]** – ISS allowed the signals to be more adaptive to changing traffic volumes, improving the signal performance compared to using fixed signal plans which gives movements a certain amount of time each cycle even if there are no vehicles waiting;

> **refinement of the corridor coordination** – this improved travel times by allowing traffic to move through multiple sets of traffic signals in bunches (referred to as platoons), reducing the likelihood of vehicles having to stop at each successive set of lights; and

> additional tweaks to the way functions within the SCATS system could be utilised.

The following efficiencies were achieved as a result of the recommended signal changes being implemented:

> average vehicle queue lengths at the four intersections along the corridor were reduced on average by 30 per cent during the AM peak period and 34 per cent during the PM peak period;

> journey times were up to 20 per cent faster in the peak direction (towards the Perth Hills) during the PM period; and

> the volume of vehicles which could pass through the trial area in the peak direction of travel (towards the Perth CBD) during the AM peak increased by up to 10 per cent.

Signal retiming can also have the added benefit of contributing towards a reduction in emissions from traffic, for example by reducing idling time associated with queuing and delays. The changes implemented were shown to have a positive impact by reducing carbon emissions.

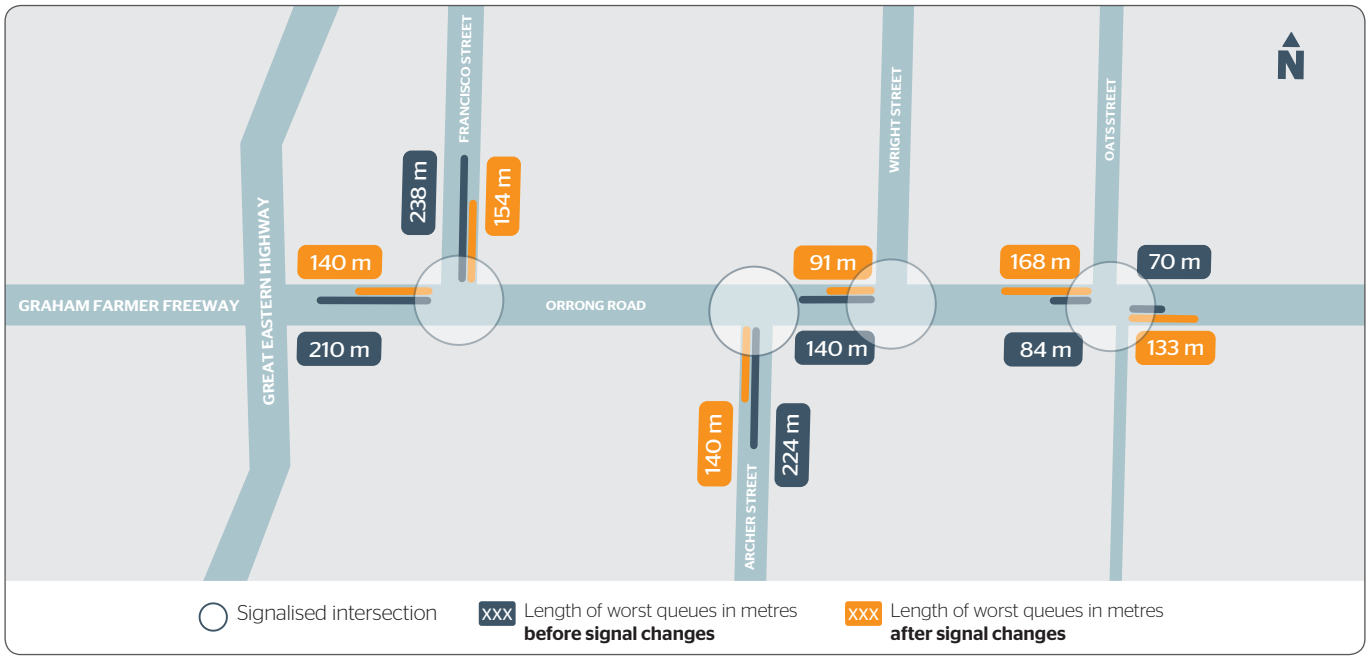
Whilst signal timings will differ from location to location, the approach adopted for this project can be applied more widely to help improve traffic conditions across the network.

By using technology better we can make our road network work harder and smarter, squeezing more out of our existing infrastructure, to help manage congestion across the network.

[2] The signal cycle time is the total time for all approaches at a set of signals to receive a green light. Shorter cycle times mean that, on average, vehicles will experience less delay. This is because the vehicles will get the green light more frequently - resulting in shorter queue lengths and delays to vehicles as they are not waiting at the lights so long.

[3] ISS is a SCATS function that allows the system to be more responsive to the varying traffic volumes in real-time. For example, if there is a long queue of vehicles on a particular approach the signals will adjust to better cater for this demand.

Figure 1 » 'Before' and 'after' AM peak hour queues



What's next?

Looking forward, emerging technologies in the field of Intelligent Transport Systems (ITS) will have implications for the way roads, and other transport networks, are managed.

To deliver a smarter road network, RAC is calling for the State Government to:

> increase funding to better resource traffic signal operations, including enabling increased active traffic management to improve real time road management, i.e. using technology to better cater for varying traffic demands, which can increase capacity, smooth traffic flow and improve safety; and

> provide funding to enable the implementation of initiatives under the MRWA Traffic Congestion Management Program, including the deployment of (ITS) solutions and improving real-time traveller information.

MRWA Traffic Signal Timing Improvement Project

In 2014/15, MRWA reviewed 93 sets of traffic signals along nine key routes across the Perth metropolitan area, relating to 58km of arterial road, as part of the Traffic Congestion Management Program. The results have been very positive and MRWA is reviewing an additional 201 intersections in 2015/16 to achieve further efficiencies for road users.

About RAC

RAC works collaboratively with Government and other organisations to ensure our members and the community can move around our State safely, easily and in a more sustainable way.

We give back by reinvesting our profits for the benefit of our members through projects aligned to RAC's Mobility Agenda, such as the Traffic Signals Safety and Efficiency Project.

Supporting smart transport and mobility

In early 2016, RAC joined with a range of national organisations, research institutions and Government departments to be part of the iMOVE Collaborative Research Centre (CRC) bid to the Commonwealth Government.

Subject to Commonwealth funding (a decision about which is expected in December 2016), the **iMOVE CRC** would seek to take advantage of emerging technologies to help our transport system become more efficient, intelligent and data driven. The ultimate aim is to ensure a connected and competitive Australia.

The research agenda of the iMOVE CRC, which is industry-led, currently falls into three broad themes:

> Intelligent Transportation Systems and infrastructure (encompassing all modes of transport);

> creating effective end-to-end freight solutions; and

> enhanced personal mobility / travel experiences for people.

RAC is supporting the iMOVE CRC to progress the development and deployment of technology solutions to manage congestion, improve mobility and save lives.

For further information about this project
please contact advocacy@rac.com.au

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