

ECONOMICALLY JUSTIFIED TRAFFIC CONTROL SCHEMES

ABSTRACT

Increasingly, our motorways are becoming clogged with traffic; affecting our lives, frustrating drivers and restricting economic growth.

History and overseas experience has shown us that widening and building new roads may not be the optimal solution to reducing congestion in the future — could we manage better what we have? Managed Motorways is a toolbox of techniques which represent a step change in how networks are managed – the application of control techniques based on traffic flow theory to the motorway environment.

These systems are being used more and more overseas. Why? What safety and operational benefit do they bring? Will they work in New Zealand? How can we test their effectiveness and measure their potential economic benefits?

Information from overseas provides a strong guide to the design of these systems, what infrastructure they require, and how they may function.

We can analyse how Managed Motorway systems can be applied to our own motorway networks using a specific form of traffic model; microsimulation. With these models we can directly measure the change in behaviours brought about by the ITS system – how it could improve journey times, reliability, and reduce congestion on an actual New Zealand motorway, and how can traffic be better managed when incidents occur?

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INTRODUCTION

The state highway network is one of New Zealand's most valuable assets, considered to be worth around \$23 billion. Around 200km of this network is motorway; access-controlled, high speed roads which normally have grade-separated intersections. Although less than 2% of the State Highway network, NZTA (2013) state that motorways carry around 10 percent of New Zealand's traffic. Importantly this includes a high volume of freight, commuter, commercial and business traffic. These links support movement around, and access to and from, our largest urban centres, making these sections of highway vital components for both the road network, and the wider New Zealand economy.

Can we Continue to Build, Build, Build?

The benefits of road building schemes can be a contentious topic – some argue that adding capacity to our road network (through widening existing routes or building new routes) simply encourages more vehicular travel which goes against modern sustainable themes. An example of this is described by METZ (2010) who reports that the UK's National Travel Survey shows that the average distance travelled has continued to increase through 1970 - 2010, although average travel time and the number of trips has remained relatively static. This implies that transport project investiture has enacted as an enabler for more travel, rather than a time-saver.

In a recent detailed transportation study, (TDG 2012) investigated the operation of Auckland's Southern Motorway corridor and found that a simple widening of the Mt Wellington interchange overbridge, to remove the physical bottleneck in this location (3-lanes reduction to 2-lanes in each direction), would not offer any significant economic returns. Some benefits were restricted by upstream network performance limiting the demand reaching the widened area. Other benefits were restricted, as releasing traffic demand simply shifted the problem a small distance downstream – actually exacerbating delays and issues in that area.

In 2001, BBC (2001) summarised a political report and quoted that motorways “should be 14 lanes”, noting that a new generation of super motorways would be constructed. This happened just over 10 years ago and is unconceivable in today's transport environment. In 2009 plans to widen London's M25 were scaled back in favour of alternative solutions which aim to manage traffic flow, incidents, and congestion were implemented.

Irrespective of these views, one thing is well known – new road building and widening is expensive. For example, the Waterview Connection part of Auckland's motorway system is quoted as costing \$1.4billion, and the Tauranga Eastern Link as \$455 million – figures which are often quoted proudly; NZTA (2012) states that the Waterview Connection will be New Zealand's “most expensive project to date”.

Objectives

The objectives of this paper are to identify the key components of Managed Motorways; economically justified traffic control systems – describing the necessary infrastructure, traffic control theory, scheme functionality options, likely implementation and operating costs and potential scheme benefits. Commentary is provided with a high level assessment of their suitability to the New Zealand context and identification of mechanisms and the available tools to robustly establish the potential.

THE PROBLEM

The Existing Motorway Network

Sections of the motorway network have been identified as some of our most congested roads. A recent Stuff (2012) article highlighted the worst congestion locations in New Zealand as the Auckland Southern Motorway, Auckland Northwestern Motorway, Wellington's Johnsonville-Porirua Motorway and a section of the Christchurch Southern Motorway.

A small number of significant bottlenecks dominate the operation of our motorway systems – for example the southbound SH1 / SH2 merge in Wellington, and the SEART / Southern Motorway northbound merge in Auckland. These bottlenecks are responsible for introducing significant delay and congestion and often compound smaller, manageable delays within the rest of the network

Problems related to traffic flow and congestion on the Auckland and Wellington motorways network are widely described and it is generally accepted that these routes operate poorly during peak travel times. These particular corridors suffer from breakdown in the traffic flow, incidents, and extensive congestion relative to other areas of the State Highway system. This is most notable across the duration of the weekday commuter traffic peaks.

Poor motorway performance leads to a number of key undesirable outcomes, important examples include;

- Delays to users – commuting, commercial, business, and leisure travel times considerably higher than non-peak (or 'free-flow') travel times
- Unreliable journeys – unpredictable variation in daily trips departing at the same time (day-to-day variation)
- Significant adverse effects resulting from incidents – lack of spare capacity in sections where incidents occur and lack of capacity on adjacent routes which could otherwise carry re-routed traffic.
- Safety issues – increased accident rates due to stop-start conditions
- Emissions – increased vehicle emissions due to slower than optimal speeds, and stop-start conditions

These undesirable outcomes occur as network capacities are reached.

WHAT ARE MANAGED MOTORWAYS?

The operation of Managed Motorways represents a step-change in how road networks are operated. The concept of making best use of the existing infrastructure is fully embraced and there is a shift from reactive management to proactive management of the network.

Managed Motorways are essentially a toolbox of techniques that can be applied to the network to improve performance, notably during peak hours where network demand is particularly significant.

The core component of a Managed Motorway is the implementation of Variable Mandatory Speed Limits (VMsL) in response to real time traffic behaviours. In order to deliver this level

of traffic control, the following infrastructure / systems are required:

- Extensive traffic detection systems measuring speed, occupancy and flow for each traffic lane throughout the Managed Motorway scheme.
- Gantry or verge-mounted variable speed signs on the mainline and inclusive on ramps.
- Speed enforcement systems capable of enforcing variable speeds.
- 'Gateway' static signing advising motorists that they are entering a Managed Motorway environment to indicate the expected behaviours.
- Overarching traffic control system with associated algorithms capable of interpreting the data collected from the traffic detection system and setting signs and signals plans accordingly.
- Dedicated Traffic Operations Centre Operators to interface between the technology systems and the road users.

An optional component of the Managed Motorway toolbox is the dynamic use of the shoulder as a running lane. Whereas VMSL merely manages traffic within the existing traffic lanes, this arrangement physically adds additional capacity to the motorway when traffic volumes dictate that the existing lanes are reaching capacity.

The shoulder can be configured as a 'lane drop' for the next off ramp, or by use of 'through junction running' if the nature and layout of intersections permits. For safety reasons, the dynamic use of the shoulder is not possible without reducing the speed of mainline, and as such, is only possible in conjunction with VMSL. To operate the shoulder dynamically, the following additional infrastructure / systems are required:

- Suitably wide and strengthened shoulder physically capable of operating as a running lane.
- Shoulder monitoring system to determine that the shoulder is free from vehicles and debris prior to it being opened to traffic. This can take the form of a dedicated technology system (cameras, radars etc), be a manual process whereby a visual inspection is undertaken (via existing surveillance CCTV systems or a 'drive-by' inspection) or a combination of the two.
- Emergency Refuge Areas with Emergency Roadside Telephones at an appropriate frequency to enable motorists to stop safely in the event of a breakdown or other emergency.

The key operational states and associated infrastructure and systems have been described above to operate Managed Motorways using VMSL with or without the dynamic use of the shoulder as a running lane. The other components in the Managed Motorway toolbox of techniques provide additional information to the Traffic Operations Centre Operators to enable a more proactive management of the road network and / or additional system functionality. Some of these are described below:

- Surveillance CCTV – pan, tilt and zoom (PTZ) cameras located at a frequency which enables Operators to view the extent of the motorway and swiftly respond to incidents.
- Variable Message Signs (VMS) – to relay text-based messages to motorists about delays, diversions or incidents ahead of them.

- Ramp signalling – to manage access to the motorway. Managing the volume of traffic entering the mainline at key on ramps will limit disruption to mainline traffic.
- Emergency Refuge Area detection and camera systems – to generate an alarm and automatically patch the appropriate CCTV images to the Operator's workstation for swift action. Dynamic shoulder running may need to be (temporarily) ceased depending on the situation.
- Incident Response Plans – to proactively manage lane use upstream of incidents, road works and / or maintenance activity.
- Automatic Queue Detection and Signalling systems – to detect stationary vehicles and set signal plans on upstream signs to warn of the presence of queues ahead.
- Dedicated on-road Traffic Officers – who are swiftly deployed and responsible for attending to, and ensuring that, issues and incidents are promptly dealt with such that normal service can resume as quickly as possible.

As with all roadside infrastructure and associated systems, the physical location, functionality and specification of the equipment will need to 'fit' the specific motorway and traffic patterns to ensure that the benefits of the Managed Motorway scheme are realised.

TRAFFIC THEORY OF MANAGED MOTORWAYS

The operation of Managed Motorways (VMSL with or without dynamic shoulder running) is based on the established speed-flow curve which represents the performance of a motorway as it exceeds capacity. An example of this, taken from a location just downstream of the Junction 7 southbound merge of the M6 UK motorway, is shown in Figure 1 below with annotations indicating the key operational phases of traffic behaviour.

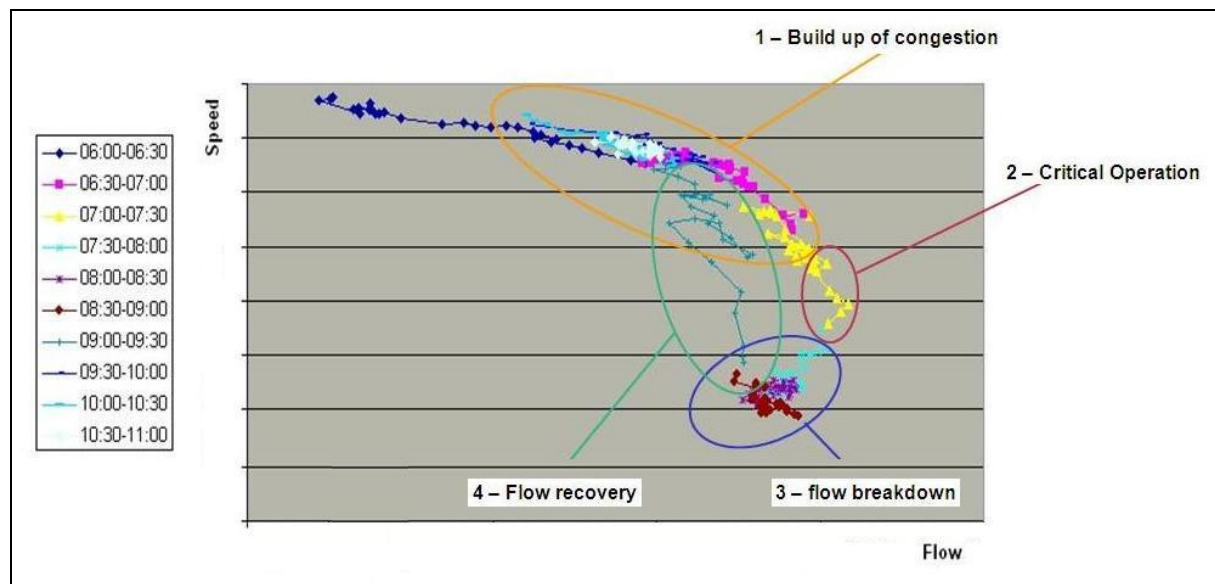


Figure 1 – Speed-Flow Curve

Characteristics of the Operational Phases

- 1 – Build up of congestion: vehicle demand increases as the morning peak sets in and the flow rate (x-axis) continues to increase as the corresponding traffic speeds decrease (y-axis).
- 2 – Critical operation: the maximum flow rate is achieved at a speed less than the speed limit (typically 80kph). Vehicle headways are small and traffic flow is 'smooth' and uninterrupted.
- 3 – Flow breakdown: traffic speeds **and** traffic flow both decrease. Demand may not decrease, and queues may build. Typically caused by lane changing manoeuvres, ramp merges and corresponding vehicle braking. Feels like 'stop-start' conditions to the motorists.
- 4 – Flow recovery: vehicle demand decreases as the peak period begins to end. The 'path' to a recovered motorway delivers a consistently poor flow rate.

The data shown in Figure 1 above has been taken from a single longitudinal point within the motorway. The speed-flow curve at locations upstream and downstream of this location will take a different form. The shape of the curve indicates the 'type' of congestion experienced at that particular site. Where the curve is well rounded and 'complete', this indicates that the traffic behaviours at this location are causing congestion (i.e., a congestion seed point). Where the 'curve' is flatter, separated and has no apex, it indicates that a congestion shockwave is propagating back from an upstream location (i.e., a congestion seed point), meaning there is no cause of delay at this location. If the 'curve' is merely a straight line, this indicates that the motorway is not reaching capacity and therefore its performance does not become degraded.

Figure 2 below shows speed-flow curves which have been extracted from a microsimulation model of Wellington's Urban Motorway in the southbound direction between a location downstream of the Aotea Quay off ramp (to the south) and upstream of the SH1/SH2 merge (to the north). The varying shapes of the speed-flow curves along the route demonstrate the patterns described above.

The image illustrates the speed-flow curves at locations throughout the corridor in the morning peak period. The speed-flow curves tell the following story (starting from the most southern end, downstream of the Aotea Quay off ramp):

- Site 1370B – downstream of the Aotea Quay off ramp the motorway remains free-flowing throughout the peak period (speed-flow curve is represented as a straight line).
- Site 1270B and Site 1230B (located 400m apart) – weaving traffic upstream of the Aotea Quay off ramp is causing a congestion seed point (rounded apex on the speed flow curves). The bottleneck will actually move around within the peak periods as a result of shockwave generation.
- Site 1170B – minor congestion shockwaves propagate back from the Aotea Quay weaving problem which causes a lowered performance in this area but the motorway remains free flowing and does not enter flow breakdown (speed-flow curve can be described as a widened straight line).
- Site 1125M (located on SH1 upstream of the SH1/SH2 merge) and Site 2125B (located on SH2 upstream of the SH1/SH2 merge) – show significant congestion with an 'immediate' transition between free-flow conditions and flow breakdown. These locations are suffering significantly from a downstream bottleneck / congestion seed point (speed-flow curve is flat, separated and has no apex) and the rate of flow is low.

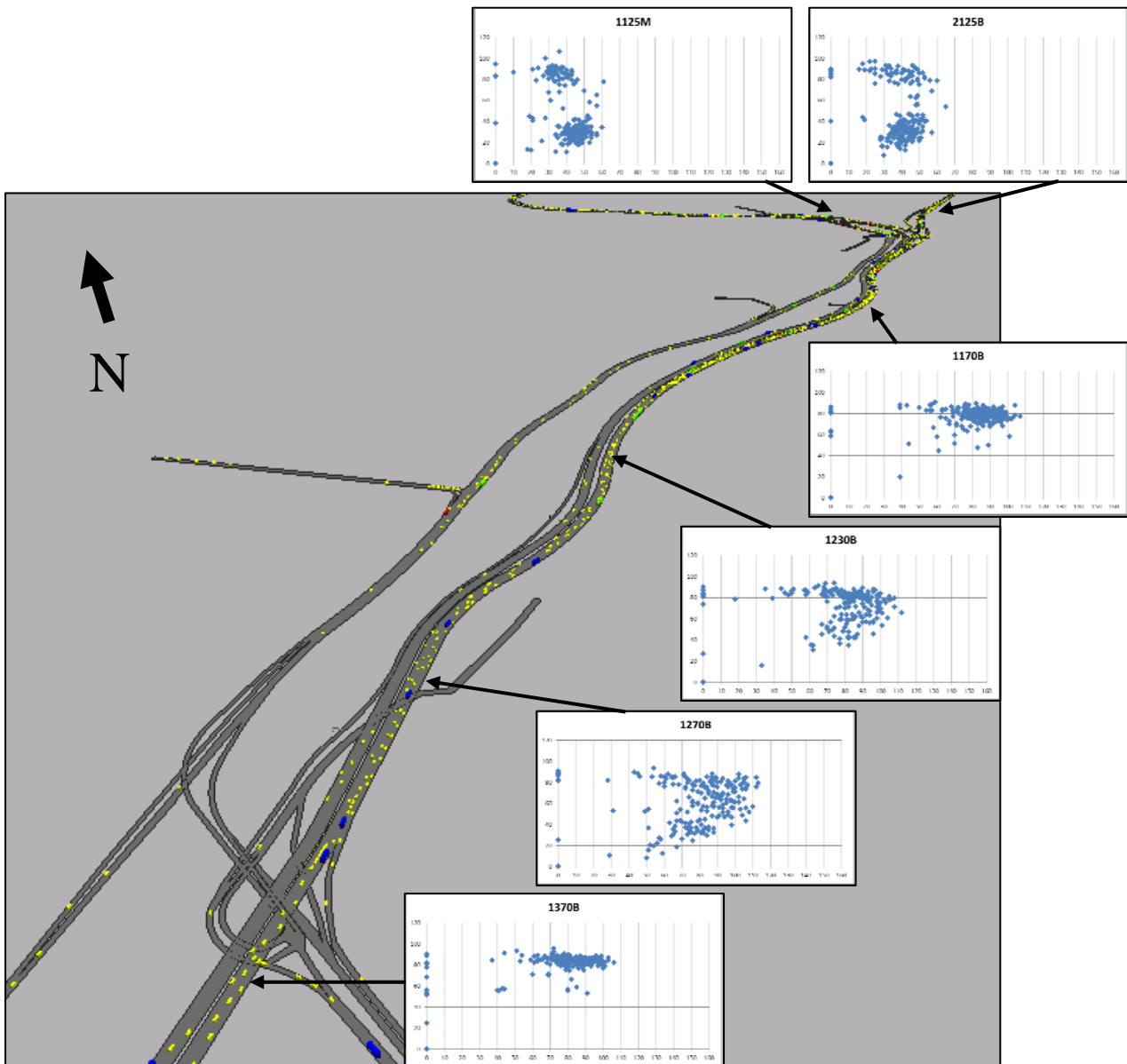


Figure 2: Wellington Urban Motorway Performance

- The 'missing part' of the story is that the SH1/SH2 merge (the most significant congestion seed point in the Wellington region (the Aotea Quay weaving congestion seed point is less severe)) occurs *between* the detection sites 1170B and 1125M/2125B. In conjunction with intermittent shockwaves from the Aotea Quay weaving congestion, site 1170B is recording the traffic behaviours where vehicles are accelerating onwards after being significantly slowed as they negotiate the SH1/SH2 merge.

So How do Managed Motorways Work?

Operations

Within a transport network, flow breakdown will consistently occur at the same locations (bottlenecks) as networks reach their capacity. Typical causes of flow breakdown are:

- Excessive ramp flow 'forcing' its way into the mainline with inadequate capacity for the mainline to 'absorb' the additional volume of traffic.

- High frequency of lane-changing movements in preparation for downstream off ramps, particularly when concentrated within a limited length of carriageway.
- Physical network constraints such as steep gradients, tunnels, lane reductions, and to some extent, where limited forward visibility exists due to horizontal alignment.

These constraints listed above can be considered as 'events' which cause flow breakdown at times when vehicle headways are reasonably low and traffic speeds are reasonably high; when the motorway is at, or nearing, capacity. The motorway is just about stable, but minor fluctuations will cause instant and unrecoverable instability.

Rather than permitting traffic conditions at these bottleneck locations to continue to traverse through the apex of the speed-flow curve, the Managed Motorway control system will introduce an upstream speed restriction at a critical point. Assuming reasonably constant vehicle headways, the upstream speed restriction essentially restricts the flow of vehicles towards these sensitive bottleneck locations such that the capacity of those links is never met (in an optimal system).

Introducing the speed restrictions creates an environment where more vehicles are travelling at a uniform speed, whereby the desire to switch lanes to travel more quickly is suppressed as all traffic lanes are limited to the same speed. This creates a calmer environment which permits high traffic volumes in more stable conditions.

As vehicle demand continues to increase through higher volumes of traffic accessing the network from the on ramps (metered or unmetered), the shoulder may be opened as a running lane (if the scheme permits dynamic shoulder running) and / or further speed reductions may be required. Compliance with the variable speed restrictions is essential – Managed Motorways will not function if motorists do not behave as required. For this reason, speed enforcement in the UK and other locations operating Managed Motorways is mandatory.

Managed Motorway systems are sensitive. Introduction of the speed restrictions too early or holding them on for too long will unnecessarily increase vehicle travel times and erode a portion of the system's benefits.

One of the final features of the Managed Motorway operation is associated with a swifter flow recovery process. By managing the speed of vehicles throughout the exit-shoulder of the peak period, speed differentials are minimised and the 'return path' of the speed flow curve is able to be shifted to the right to deliver higher flow rates.

Safety

Reducing vehicle speeds, speed differentials and creating a calmer environment has a significant impact on the number of accidents that might occur. Reducing accidents directly reduces the delays and congestion caused by blocked traffic lanes and rubber-necking motorists. The occurrence of stop-start traffic conditions are also reduced leading to fewer secondary accidents.

In conjunction with this simple concept, the Managed Motorway systems can also detect conditions which may lead to an accident, such as a broken down vehicle or an excessive off

ramp queue. Specific queue detection algorithms monitor all traffic detection systems to identify stationary vehicles. Automatic signalling plans are activated on detection of these conditions and upstream motorists are warned of downstream hazards. The Managed Motorway system can:

- Inform motorists;
- Slow vehicles approaching the incident to reduce the chances of further accidents;
- Notify vehicles of the location of the accident in advance;
- Move vehicles in / out of specific lanes to improve flow around the incident;
- Warn the Traffic Operations Centre Operators of the network conditions, and the likely location of the incident.

These systems and abilities lead directly to reductions in delays through the improvement of traffic flows during the period of the incident and / or from reducing incident clearance times.

System Design and Commissioning

The design of a Managed Motorway is crucial to the success of the scheme. The most important aspect of the design process is to understanding the traffic problem which the Managed Motorway scheme is attempting to solve. As demonstrated by the Wellington Urban Motorway Performance graphs in Figure 2 above, where the SH1/SH2 merge is just upstream of a traffic detection site and therefore the performance of the bottleneck is not 'observed' until it is too late. A detailed understanding of the traffic behaviours within the extents of the scheme is essential.

It is not acceptable to arbitrarily locate traffic detection systems; these must be placed at the network bottleneck locations. Traffic detection sites located beyond those bottlenecks (further downstream) limits the ability of the system to recognise a deteriorated motorway performance in a timely manner. In instances like these, the control system will only be aware of the issues once congestion has propagated back to the nearest upstream site; by which point it will be too late to take preventative, proactive action.

This detailed understanding about the traffic behaviours will enable the identification of when the Managed Motorway signals should operate, which speed limits to display and the number of upstream signals required. Importantly, this knowledge will also inform the point at which the signals should be switched off.

ECONOMICS

Economic Appraisal Overview

In the current framework, Cost Benefit Analysis (CBA) remains an important aspect in support for road schemes. This balances the cost of the scheme, in terms of construction and maintenance, with the estimated benefits of the scheme, measured according to the Economic Evaluation Manual (EEM) in terms of travel time savings, vehicle operating costs, congestion, reliability, emissions and accident savings. This information is commonly presented as a Benefit to Cost Ratio (BCR), with funding levels defined by NZTA's project feasibility standard as >4 High, 2-4 is Medium, <1 is low.

NZTA is currently delivering its seven Roads of National Significance (RoNS) programme.

This sets out key road building and widening schemes to be implemented over the next 10 years. SAHA (2010) reported that the combined BCR for all RoNS schemes has been estimated as 1.8 under the conventional CBA framework.

Managed Motorway Costs

The cost of a Managed Motorway will vary depending on the level of infrastructure required and the functionality of the traffic control systems. The length of the scheme is assumed to be directly proportional to the cost. The inclusion or otherwise of dynamic shoulder running (and the subsequent shoulder strengthening, and potentially the monitoring systems), the extent of variable message signs, traffic detection systems, and the use of overhead gantries or verge mounted signals will be the key design decisions that will impact the final cost most significantly.

Design variations aside, TDG (2011) developed cost estimates for specific components of Managed Motorway systems for a single direction of travel as identified in Table 1 below.

Table 1: Managed Motorways Component Cost Estimate

COMPONENT	COST PER KM
Shoulder pavement strengthening, mill 250mm down, replace and remark	\$0.7M
VMS signage, say 4/km @ \$50K each, commissioned	\$0.2M
Gantries, signals only, span should + median, \$450K each @ 2/km	\$0.9M
Combined VSL/LCS roundels, \$8K each * 4 lanes (each direction) @ 2/km	\$0.7M
Civil works	\$1.0M
Traffic Management Plans	\$0.5M
Design and supervision	\$0.4M
Operations and maintenance assumed to be 2.5% of capital cost	\$0.1M

This gives a total cost estimate of approximately \$4.5M per km per direction of travel where dynamic shoulder running is incorporated.

The UK's M42 Managed Motorway Pilot Scheme (between junction 3a and J7, which is approximately 17km in each direction) cost an estimated £105M (~NZ\$200M), which is equivalent to approximately £3.08M (~NZ\$5.7M) per km. Whilst this value is higher than the estimates provided above, today's currency exchange rate widens this gap and the M42 was over-designed and over-engineered to mitigate the uncertainty and potential safety risks associated with the country's first dynamic shoulder running operation.

It is also worth noting that a large proportion of the 'back office systems' were already in place prior to the Pilot scheme and as such are not included within those costs.

Since the success of the M42 Pilot Scheme, the UK Highways Agency has released design guidance which minimises network infrastructure, particularly in terms of the quantity and spacing of overhead portal / superspan gantries. Reducing these big-ticket items is having a significant impact on the costs of current and planned schemes.

Options to widen the M42 instead of utilising Managed Motorway systems were estimated to cost between £18-25M per km.

Managed Motorways Benefits

UK Experience

The UK's M42 Pilot Scheme was under formal evaluation for 3 full years between 2006 and 2009. The evaluation report concluded the following benefits and statistics:

- Capacity increases of between 7 to 9 %
- Journey time reductions of 24% (northbound) and 9% (southbound)
- Journey time reliability improvements of 22%
- Number of users who experienced no congestion increased by 7%
- Speed compliance was greater than 93%
- Personal injury accidents reduced by 65% (against a national reduction of 21% in the same period)
- Vehicle emissions reduced by 4 to 10%
- Fuel consumption reduced by 4%
- Noise levels reduced by 1.8 to 2.4 dB

Based on the £105M price tag, the scheme delivered a BCR of 5.6.

New Zealand Forecast

TDG (2011) undertook an assessment of the current congestion and accident figures experienced on Auckland's Southern Motorway between Mt Wellington and Market Road. Through the application of their cost estimates and the likely benefits from other Managed Motorway schemes, a BCR of 4.7 was derived. The review was purposely brief and at a high level, but demonstrates the initial potential for a Managed Motorway environment to exist within New Zealand.

ASSESSMENT TOOLS

Background

The understanding of how New Zealand's motorways currently perform and the evidence gathered from overseas Managed Motorways schemes brings great potential to deliver economically justified traffic control systems to the New Zealand motorway environment.

Despite their low implementation and operational costs (compared to the alternative of road widening), the introduction of automated Managed Motorway systems still presents a significant investment of Government funding.

Whilst there are similarities between UK and New Zealand traffic behaviours, there are also subtle differences which may affect the application, operation or configuration of Managed

Motorway algorithms in the New Zealand traffic environment.

The relevant key differences are:

- New Zealand's motorway speed limit is 12kph lower than the UK
- Driver behaviour on a New Zealand motorway system is likely to differ to that of the UK
- Constructed motorway environment in the UK tends to be of a higher standard (due to higher speeds)
- UK speed enforcement systems are more widely used and therefore 'accepted' by motorists

Given the levels of sophistication in today's traffic modelling tools, it would be prudent to assess the concept on the desktop prior to committing funds to implementation.

Traffic Modelling

Very broadly there are two forms of traffic models: (i) macroscopic models which deal with aggregate traffic flows, often hourly volumes across the network (SIDRA and SATURN are common examples) and (ii) microsimulation models which deal with individual vehicles in small time increments (commonly less than 1 second).

To assess the potential for Managed Motorways in New Zealand, microsimulation traffic modelling is by far the most appropriate tool. There are many reasons for this – overridingly this is because the real-time simulation of individual vehicles and distribution of driver behaviours is crucial in understanding how a VMSL system may influence motorway performance and hence the impact on travel time, emissions, fuel use, and reliability savings. This is described further below.

A related interesting point is that macroscopic models require speed-flow curves to be specified as an **input** – these are generally pre-determined (i.e. not measured locally), or calibrated (i.e. adjusted iteratively until the model aligns with observation) to provide a representation of on-street performance. This form of modelling will not naturally predict the varying shapes of the speed flow curves through a route, as described in Figure 2 which shows the **output** curves from a microsimulation model (i.e. curves are not pre-determined). Macroscopic models therefore struggle to inform on the performance of a congested interactive system such as a motorway. It would not be possible to determine how the speed-flow curves would change if the SH1/SH2 merge bottleneck was released.

Microsimulation traffic models are constructed to represent the physical road environment, how vehicles travel through this network is governed by 'rules' –the road rules and the laws of physics. This information is used along with behaviour distributions. For example, one rule is the speed limit - when the microsimulation model runs, there will be a distribution of traffic travelling around this specified speed. As in reality, some drivers are willing to exceed the speed limit and others are more conservative. The distributions narrow and widen depending on the on-street speed limit and road environment, e.g. a 100kph motorway tends to have a wider speed distribution than a 50kph urban route.

The microsimulation model can interrogate traffic behaviours (speed, flow and occupancy) at locations within the model – this can be done using detectors which sample the individual vehicles as they pass, very much in the same manner in which on-street loops detect traffic. Sophisticated ITS controllers can utilise this information and ‘talk’ to the model - the ITS controller can then respond to predefined traffic behaviour thresholds and, essentially, impose a new speed limit along the route. This can be carried through to a full implementation of the Managed Motorway system and algorithms within the modelled environment.

The ITS controller also has the ability to vary the compliance with the VMSL in a number of ways and with some flexibility. Compliance with the signals can be set as a basic percentage (1-100), or by adjusting the driver behaviour target speed distribution, or a combination of the two. Understanding this issue will enable NZTA to establish the resources required for network compliance and enforcement activities.

In conjunction with incident rate data, the ITS controller can also be used to extrapolate the delays caused by incidents and the savings induced due to incident management systems. Some sensitivity testing can be used to establish the potential economic returns of improved incident management strategies.

Managed Motorways Modelling Summary

Over and above the established benefits of using microsimulation modelling to investigate transport schemes, the sophistication of the ITS controller enables the ability to:

- Fully understand the traffic characteristics within the network and the location and severity of flow breakdown. This will identify why flow breakdown is occurring, how long it lasts for and the extent of the impacts on the rest of the network.
- Provide input to the infrastructure design process, namely, the optimal location and quantity of traffic detection sites and signal configurations.
- Establish the economic benefits of introducing VMSL (with or without dynamic shoulder running) in response to ‘real time’ traffic behaviours.
- Enable high level testing of the thresholds in the VMSL algorithms, e.g. speed thresholds which will differ in New Zealand to the UK
- Sensitivity-test the effects of varying degrees of compliance with the VMSL. This will enable the measurement of the benefits associated with speed compliance.
- Measure the benefits of implementing sign and signal plans during traffic incidents and establish the magnitude of savings from quicker incident response times.
- Measure other, more complex, outputs which result in changes to stop-start conditions (effecting vehicle acceleration, not just average speed) such as emissions, fuel-use, and travel time reliability

CONCLUSIONS

New Zealand’s motorways are becoming increasingly more congested and responsible for generating delays to freight and businesses which are damaging the economy. There comes

a point where construction of additional traffic lanes is no longer feasible and the only option is to better manage the resources we currently have.

Overseas experience tells us that Managed Motorways are cost effective solutions, they maximise the use of existing resources and they deliver additional capacity / control only when sufficient network demand exists.

The translation of these techniques into the New Zealand context remains slightly uncertain in some areas. However, the tools, technologies and knowledge exist to close out some of these uncertainties and robustly establish the benefits of such system in New Zealand. The question is: what are we waiting for?

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