International Experiences Driving Managed Mobility

GOOD ONYA, AUSTRALIA!

Darren Henderson, WSP USA
MANAGED FREEWAYS

The most important transportation strategy you’ve probably never heard of!
Managed Freeways provides a comprehensive approach to fully control freeway operations

- Managed Freeways rethinks the way we manage freeways
  - Builds upon ITS, ATM, ICM and dynamic demand management tools of managed lanes.
  - Provides a comprehensive package of strategies to fully control freeway access to manage demand and optimize traffic flows.

Source: VicRoads
M1, Melbourne, VIC
Managed Freeways follows a holistic policy framework

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Managed freeways components can include:

- Extensive highly precise vehicle detection and data collection devices.
- Coordinated dynamic ramp metering.
- Lane-use management:
  - Variable speed limits.
  - Variable lane control.
  - Shoulder running.
- Incident detection and closed circuit television surveillance.
- Traveler information.

Highly precise data and advanced system management tools are key to Managed Freeways.
Strategic design considerations are integral to Managed Freeways effectiveness

- Managed freeways components can include:
  - Strategic design considerations for on ramp queue storage and discharge, merge lanes and off ramp discharge.
  - Priority vehicle lanes and ramp queue bypass.
  - Potential for applying pricing elements
  - Potential for integration of connected vehicle capabilities

Source: VicRoads M1, Melbourne, VIC
Managed Freeways have been deployed on multiple corridors in Australia

- Managed freeways was initially deployed as an integral element of the Monash-CityLink-West Gate (M1) Motorway Upgrade in Melbourne:
  - 47-mile urban freeway linking downtown to suburbs and port.
  - Facility carries over 160,000 vehicles per day.
  - AU$102 million invested in Smart Freeway Management System components.
M1 Managed Freeway system integrates 1,100+ detection, signal and communication devices

- Coordinated dynamic ramp metering at 62 locations.
- Strategic ramp improvements at over 30 locations.
- Priority ramp bypass for transit, HOV and trucks at ramp locations.
- Fiber optic network and integrated control system.
- Lane use management system covering 12.1 miles of freeway.

Source: VicRoads, M1, Melbourne, VIC
Managed Freeways applies contemporary traffic flow theory

- Freeway planning, monitoring and performance evaluation has typically been based on aggregated corridor volumes or theoretical design volumes
  - For the effective management of freeway traffic it is not aggregated volumes or the design flows that are important
Managed Freeways applies contemporary traffic flow theory

- Traffic flows are very volatile and can fluctuate greatly in very short periods of time
  - To effectively manage the freeway, traffic control must balance out the fluctuations whenever they occur
  - Managed freeways optimizes traffic flows along the freeway to match these fluctuations and avoid traffic flow breakdown
Understanding the nature of traffic flow is key to managing freeway operations

Unmanaged freeway:
- Flow breakdown
- Reduced throughput
- Reduced speed
- Congestion
- Lost productivity

Managed freeway:
- Prevents flow breakdown
- Maintains optimum throughput
- Automates flow recovery

Note: actual data values for occupancy will differ for varying detector types
Managing freeway operations applies control engineering

- Applies the fundamentals of **feed-back** control logic in a **closed loop** system
- Requires precise data to complete real-time **statistical analysis** and **data smoothing** to quickly identify and respond to problems
  - Data is measured at the 20 second interval, and is processed to respond within 5 seconds
Traditional ramp metering uses feed-forward logic in an open loop control system:

- The upstream freeway mainline volume ($q_{in}$) is measured to determine ramp flow ($q_r$):
  - Typically assumes an historic or theoretical value of freeway capacity ($q_{cap}$)
  - Downstream conditions are not typically monitored and therefore cannot provide feedback
  - A downstream problem may not be detected until congestion reaches the detector upstream of the ramp

Coordinated closed loop ramp metering is the foundation of Managed Freeways.
Coordinated closed loop ramp metering is the foundation of Managed Freeways

Managed freeways uses feed-back logic in a closed loop control system:

- Traffic conditions are measured at downstream bottlenecks to determine critical occupancy and how much traffic can enter upstream:
  - Downstream flow conditions are known in real time providing feedback to determine ramp flow ($q_r$)
  - Optimal occupancy ($q_{capN}$) is determined in real time
- Applied on a holistic, coordinated, system-wide basis:
  - All ramps continuously “talk” to each other to resolve complex traffic challenges
Managed Freeways is the only proven strategy to reliably control freeway operations

- Managed freeways has enabled VicRoads to gain full control of traffic flows on M1 and M80 to prevent breakdown and congestion at critical bottlenecks
  - Throughput on the M1 has increased by up to 25% during the peak periods
  - That’s the equivalent of one additional lane on the four lane freeway

Source: VicRoads
Managed Freeways is the only proven strategy to reliably control freeway operations

- M1 volume and speeds have increased
  - Data compares October 2010 to October 2013 covering a 16 mile segment of freeway for all weekdays including incidents and inclement weather

Source: VicRoads
Managed Freeways is the only proven strategy to reliably control freeways operations

- M1 crash rates have declined by over 30%
  - M1 had zero fatalities in 2013, and only 1 fatality in 2012 and 2014

Source: VicRoads
Managed Freeways is the only proven strategy to reliably control freeway operations

- Private toll concessionaire has promoted benefits of managed freeways to customers
  - Reduced travel times prompted a 7-10% increase in traffic volumes
  - Higher traffic volumes resulted in higher revenues
- Toll concessionaire is now partnering with VicRoads to implement the latest Managed Freeway as part of the CityLink Tulla (M2) project
Forecasts developed for I-15 in Salt Lake City show the potential for managed freeways to eliminate recurring congestion:

- Total trip times (including meter delay) estimated to improve 11%
- Total delay (including meter delay) estimated to be reduced 37%
- Metering freeway to freeway connector with I-215 was determined to be critical to achieving these results.

Initial evaluation shows potential for Managed Freeways in the United States
The CDOT SMART 25 project will be the first demonstration of the Australian Managed Freeways concept in the U.S.

- SMART 25 will implement the coordinated ramp metering elements of managed freeways
- Upgraded vehicle detection systems and traffic control software will be installed on northbound I-25 consistent with VicRoads standards
- The effectiveness of the system will be evaluated during a demonstration period
“Managed Freeways is not a trivial matter”
Markos Papageorgiou 2007

- Managed Freeways is not a small stepwise change to existing ITS or ramp metering systems
  - It requires embracing a new holistic approach to managing freeway traffic operations

- Managed freeways is a multi-faceted solution that involves new skill sets, communication systems, control systems, control engineering and optimization strategies
  - These skills are not typically associated with DOT’s traditional functions

- The full benefits of Managed Freeways can be achieved with a commitment to following a holistic policy framework addressing all of the critical elements
Questions

Darren Henderson
WSP USA
(951) 833-7763
darren.henderson@wsp.com

Source: VicRoads