

FINAL REPORT

R108: Review of Road Operations Intervention Levels (2020/21)

ARRB Project No.: 015711

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Prepared for: Queensland Department of Transport and Main Roads

June 2021

SUMMARY

The performance-based management system, as referred to in the Maintenance, Preservation and Operations (MPO) element framework is summarised in the Queensland Road System Performance Plan (QRSPP) (Queensland Department of Transport and Main Roads (TMR) 2020a). It provides the milestones for road system investment to achieve when delivering the Queensland Department of Transport and Main Roads (TMR) outcomes for the state-controlled road network over 4 years.

The operation of the road network is becoming increasingly more important relative to construction and maintenance with intelligent transport systems (ITS) playing an increasing role. Element 34: Traffic management is responsible for funding the activities for operating the road network, including operational systems and assets.

Element 34 is one of the 23 elements under the MPO management framework. It has close linkages to 6 of the other elements. This includes Element 6 – Fire risk management; Element 11 – Vehicle monitoring systems; Element 13 – Other transport infrastructure maintenance; Element 15 – Routine maintenance; Element 30 – Road lighting; and Element 70 – State-wide data collection.

The overall objective of Element 34 is to fund the safe and efficient operation of the state-controlled road network through operational services, maintaining traffic signals and intelligent transport systems (ITS), and traffic management systems. This includes:

- providing road network operational services such as traffic incident management (TIM); network operations (staffing of traffic management centres); and traffic data collection
- maintaining safe-to-use and available ITS assets such as traffic signals and road-function-related ITS assets.

Project Objectives and Findings

Through undertaking a literature review, an initial data review, workshops with districts responsible for delivering the activities at the district level, and cost code financial data analysis and reporting, this project was able to derive the below findings associated with the following key project objectives.

1. Objective 1: Map the existing suite of Element 34 funded activities to the relevant operational services and define how they align to TMR's transport system objectives.
 - a. Activities within Element 34 are critical for TMR in delivering its overall strategic objectives as it funds the operations, maintenance, and deployment of ITS on the road network which are critical to its operation.
 - b. The need to undertake Element 34 activities within districts varies depending on the characteristics of the district.
2. Objective 2: Provide clarity and transparency for delivering the Element 34 program of works into the future.
 - a. Districts would like to move to a proactive planning and management approach, however due to growing needs, they are of the view that they are restricted to delivering activities in a reactive manner.
 - b. The key factors that impact Element 34 funding include available state funds, associated impacts arising from population growth (e.g. increased traffic volume and incidents), growing ITS assets and greater community expectations.
 - c. There is a strong correlation between the number of traffic signals deployed within the district and the total Element 34 funding assigned to it. This is reflective of the traffic operations demand. In addition,

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where traffic signals are deployed, other ITS devices are likely to also be deployed. Responding to incidents is a major contributor to Element 34 funding. The more populated districts and those with higher traffic volumes have a higher Element 34 funding and expenditure.

- d. Many road upgrade projects result in the deployment of ITS. It is perceived by districts that such projects do not lead to an increase in funding for the associated operational and maintenance costs of the new ITS devices.
 - e. Districts tend to focus on activities that relate to safety-critical elements and have an impact on operations, and devices that are public facing. Traffic management centre (TMC), incident management and electrical safety work are priority activities with Element 34 funding directed to them. These are considered by districts to be non-discretionary activities. Activities which are of lower priority are delayed. These are considered by districts to be discretionary activities.
 - f. The most critical ITS devices identified by districts were road condition information signs (RCIS), traffic signals, closed circuit television (CCTV), flood monitoring sites and variable message signs (VMS) along with ITS devices associated with the operation of smart motorways.
 - g. The main activities which may not get undertaken and are delayed due to other priorities are collecting traffic data, end-of-life activities, periodic electrical installation validation, lighting, and pit replacements (including asbestos pit replacement). It also includes work activities associated with vehicle activated signs (VAS) for which the work activity maintenance fall under the Targeted Road Safety Program.
 - h. There is limited application of performance benchmarking for the activities in Element 34 that are applied elsewhere, and which could be applied to this element as well.
 - i. The implementation of Element 34 is significantly different between districts in different regions, but similar for districts within the one region. A classification of the regions and the districts within them is as follows:
 - i. Low population and large geographical area
Western region: South West, Central West, and North West Districts.
 - ii. Mid-level population and mid-sized geographical area
Southern (non-Western) region: Wide Bay/Burnett and Darling Downs Districts
Central and North Queensland coastal region: Mackay/Whitsunday, Fitzroy, Northern and Far North Districts.
 - iii. High population within a small graphical area
North and South Coast region: North Coast and South Coast Districts
Metropolitan region: Metropolitan District.
 - j. There is a need for a clear linkage between the funding profile and corporate policy and guidelines for Element 34 activities, particularly related to incident management.
3. Objective 3: Assist with investment planning optimisation and hence realise further efficiencies and effectiveness gains for TMR.
- a. There is a need to move to a more proactive approach to ITS maintenance and optimisation.
 - b. Expenditure in one year does not reflect expenditure in the next year. Therefore, it can be difficult to plan and budget expenditure.
 - c. There are significant differences between the district grouping in the average expenditure per district for the Element 34 cost codes.

Conclusions

Element 34 comprises a set of complex and diverse activities and tasks. Many are not related to one another (e.g. traffic incident management, ITS maintenance and traffic data collection). Much of the funding within districts is being directed to activities that are perceived by them to absolutely need to be undertaken such as electrical safety inspection and incident management. This results in a deferral of activities which are a

lower priority and restricts the ability to undertake reactive and proactive maintenance. Also, Element 34 expenditure and needs vary significantly across districts in different regions although there can be similar levels of expenditure for districts in the same region.

The need to restructure the program with the activities in Elements 11, 13, 30 and 34 was confirmed. TMR has already proposed that the activities in these elements be reallocated as follows:

1. Element 56: Road network operations services
2. Element 57: Road ITS infrastructure
3. Element 58: Transport infrastructure electricity charges
4. Element 59: Bus transport facility maintenance.

This restructure is being implemented in 2021–22. An overview of the changes resulting from the restructure is provided in Figure 7.1 in the report.

The restructure is appropriate as it better locates work activities in the new groups. This will help with budgeting and expenditure as a clearer focus can be applied to the following activities: bus facility maintenance, ITS maintenance, electricity charges and operational services. It is also proposed that traffic data collection field services are assigned to Element 70 – State-wide data collection.

Once the restructure is implemented, further work on investment policies and principles for the new Road Operations (RO) elements should be undertaken to better determine the funding requirements for each work activity. This would help to establish intervention levels.

It is critical to maintain good data on expenditure within activities along with data on outputs delivered and activities not delivered due to other priorities. This will aid forward planning and expenditure forecasting.

Recommendations

Eight key recommendations have been identified for TMR consideration and implementation.

It may not be necessary to implement the recommendations uniformly across the network. Instead, it may be more appropriate to develop them specifically for districts within regions of similar road network operation challenges.

The first recommendation concerns a restructure of the road operation suite for which Element 34 resides along with Element 11, 13 and 30. The recommendations that follow apply to Element 34 activities. They also apply to the work activities that were in Element 34 and will be redistributed to the new road operations suites following the restructure.

It is recommended that TMR:

1. Continue to finalise the restructure of the road operations suite of elements.
2. Review, refine and develop further investment policies and principles for work activities that were in Element 34.
3. Review, refine and develop further the investment prioritisation approach for work activities that were in Element 34. This includes better articulating what can be afforded and what is really needed. This will help to make sure that the outcome that is expected is in accordance with the Department's priorities.
4. Improves efforts to collect data on the activities that were in Element 34 while progressing recommendations 2 and 3. Data should cover both financial expenditure and non-financial outputs on activities undertaken and not undertaken. Financial expenditure and non-financial outputs data should not only be collected, but also monitored, reviewed, and interrogated to ensure that it accurately reflects the expenditure.
5. Review, refine and develop functional requirements for ITS solutions and capabilities deployed and/or maintained on the road network as part of Element 34.
6. Define what work activities under Element 34 are funded. TMR should also provide clarification on which work activities are not funded where there may be confusion amongst the districts. Funding should be defined in the context of the outcome of recommendations 1 to 5.

7. Establish performance benchmarking and intervention levels for the activities that were in Element 34 and will be redistributed to the new road operations suite following the restructure. This should take into consideration proactive and reactive delivery of work activities.
8. Undertake ongoing reviews of the policy, prioritisation, data collection, funding and performance benchmarking and intervention levels due to the evolution of ITS. This will help to ensure that the Element 34 activities are delivered as required (do the activities that TMR need to do, and do not do the things that TMR do not need to do).

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ACKNOWLEDGEMENTS

The authors would like to acknowledge the contributions to this project from TMR and its officers for without this the project would not have been possible. This includes the TMR project manager Andrew Causley, along with Kym Eldridge and Jade Ryan who provided project management support. Also acknowledged are the district representatives who had an interest in this report and who contributed to it in various ways, with many participating in the teleconference workshops. This included David Willis, Vince Green, Anthony Bougoure, Robin Marston, Adam Palmer, Andrew Wachtel, Kumar Panchal, Devinder Pal, Jason MacPherson, David Hamilton, Kingo Gan, Laxman Gopali, Sugunakar Gogula, Chris Mason, Brad Garrett, Kieran Waters, Manu Hingorani, Stephan Casey, George Schwerin, Leanne Mosch, Cameron Messer, and Prakash Kolarkar.

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1 INTRODUCTION

This document is the final published project report associated with the 'Review of Road Operations Intervention Levels' project undertaken as part of the National Asset Centre of Excellence (NACOE) program between ARRB and the Queensland Department of Transport and Main Roads (TMR).

This section provides background (Section 1.1), the project objectives (Section 1.2) and outlines the report structure (Section 1.3).

1.1 BACKGROUND

The Queensland Department of Transport and Main Roads (TMR) utilises a performance-based management system for the planning and delivery of maintenance, preservation, and operation activities on the state-controlled road network.

The management system, as referred to in the Maintenance, Preservation and Operations (MPO) element framework is summarised in the *Queensland Road System Performance Plan (QRSP)* (Queensland Department of Transport and Main Roads (TMR) 2020a). It provides the milestones for road system investment to achieve when delivering the outcomes for the state-controlled road network over 4 years.

Element 34: Traffic management, is managed under the Road Operations Investment Program, which is jointly governed with the Maintenance, Preservation and Environment (MPE) Investment Program under the MPO program.

The 4-year view provides detailed directions for investment in maintenance and preservation activities within the road operations investment program. The plan includes 4-year milestones for the 23 maintenance and preservation elements, and 4-year funding allocations by TMR districts to the 23 elements through state and federal funding sources.

Element 34 is one of the 23-element QRSP framework targeted at traffic management maintenance. Table 1.1 lists all 23 elements of the framework, categorised into relevant groups.

Table 1.1: QRSP 23-element framework

No.	Element group	Element no.	Element name
1	Corridor management	1	Contaminated areas
2		2	Nature conservation
3		3	Degraded areas
4		4	Heritage preservation
5		5	Invasive plants and animals
6		6	Fire risk management
7		7	Road traffic noise management
8	Rehabilitation	18	Pavement rehabilitation
9		19	Bridge and culvert rehabilitation
10		27	Better slope management
11		39	Large traffic signs structure
12	Grids, guidance, and delineation	7	Management of grids
13		23	Roadside signing
14		24	Roadside and surface delineation
15	Programmed maintenance	17	Surfacing treatment
16		29	Skid resistance management
17	Routine maintenance	15	Routine maintenance
18		16	Unsealed road re-sheeting
19		11	Vehicle monitoring systems

No.	Element group	Element no.	Element name
20	Road operations (also referred to as traffic operations)	13	Other transport infrastructure maintenance
21		30	Road lighting
22		34	Traffic management
23	Data collection	70	State-wide data collection

Source: TMR (2020a).

Element 34 provides funding to operate, maintain and enhance the following:

- traffic management devices that reduce congestion and improve the performance of the road network
- system and service capabilities to detect, respond and clear traffic incidents quickly to reduce the impacts on travel reliability and minimise travel delays
- traffic and travel information products to help road users make more informed travel choices
- intelligent transport systems (ITS) and other electrical assets that optimise use of existing infrastructure and improve safety.

The overall objective of Element 34 is to fund the safe and efficient operation of the state-controlled road network through operational services, maintaining traffic signals and ITS, and traffic management systems. This can include the following activities:

- providing road network operational services including
 - traffic incident management (TIM) services
 - network operations services (staffing of traffic management centres (TMC))
 - traffic data collection services.
- maintaining safe-to-use and available ITS assets including
 - traffic signals
 - road-function-related ITS assets.

Funding of Element 34 activities helps to deliver a safe, reliable, and efficient operation of the state-controlled road network:

- by reducing the duration and impact of traffic incidents
- by providing high-quality, fully integrated traveller information services that are accurate, relevant, and timely
- through the operation of more reliable traffic control systems, allowing the movement of people and goods efficiently on the network.

The allocation of funding to Element 34 maintenance activities is undertaken through the following procedures:

- Element planning:
 - Coordinate the element scope with other element leaders, particularly related to routine maintenance to ensure any scope changes do not create gaps or overlaps.
 - Recommend 20-year, network-wide 'vision' target values and affordable 4-year milestones for the element, expressed in terms of performance measures.
 - Negotiate targets and milestones for the element that are aligned with the road system performance measures.
 - Engage all relevant stakeholders in the development of the element management plan (EMP) reflecting current costs and constraints, new and changed influences on element levels of service and innovative operational practices.
 - Develop and maintain EMPs.
- QRSP planning and prioritisation:

- Ensure element leadership activities are funded through the normal business planning processes.
- Assess state-wide element needs, performance and risk.
- Provide element needs forecasts that acknowledge the benefits of current investment plans and identify emerging trends (both reductions and/or increases in element needs) and long-term performance visions.
- Contribute to QRSP development by establishing distributions of funding (both target and aspirational).
- Develop and improve element analysis and management processes.
- Distribute the element prioritised needs list after consultation with reference groups.
- Define element data collection and data storage systems.
- Delivery:
 - Provide advice to element managers on needs, prioritisation and treatment selection and innovations as required.
 - Provide technical advice to TMR districts on element scoping matters, technical solutions, innovation, and delivery.
 - Lead and promote innovation through collaboration, research, and development.
- Performance assessment:
 - Monitor element performance following the delivery of works to identify whether any significant variations have occurred between expected and delivered performance and the factors that may have contributed to the variation.
 - Report performance of elements in the EMP.
 - Gather and disseminate lessons learnt including unit cost data from the project and investment program reviews and reports.

Funding is prioritised to Element 34 activities which maintain capabilities and optimise TMR's due diligence in operating a safe and available-to-use road network. The prioritisation approach considers the threats posed to road user safety in the context of road classification, including available road operational services.

In a constrained financial environment, the current consequences for TMR in not prescribing readily available, defined intervention level targets are as follows:

- Substantial inefficiencies in the delivery of activities (i.e. over or underservicing).
- Inconsistencies in intervention levels between geographical districts, the magnitude of which are noticeable on occasions by road users.
- Intervention levels defined by delivery areas, thus likely to be focussed more on local political needs as opposed to state-wide corporate objectives.

1.2 PROJECT OBJECTIVES

In 2014, work was undertaken on how Element 34 activities were delivered across the state and at what levels. This was documented in the Transoptim Consulting (2014) report prepared on behalf of ARRB and provided to TMR.

This current project is a continuation and evolution of the 2014 work. Due to the growth in ITS solutions over the last 5 years and growth in traffic, there is a need to do an updated review so as to provide insights into:

- what benefits are received or provided by the investment
- whether funding for Element 34 activities is used in the most efficient way possible
- whether the intervention levels are right
- linking the services TMR delivers to its objectives.

Element 34 will change in scope in 2021, therefore there is a need to establish insights that will enable the scope of works to be more concise and clearer.

The 3 objectives of this project were:

1. Objective 1: Map the existing suite of Element 34 funded activities to the relevant operational services and define how they align to TMR's transport system objectives.
2. Objective 2: Provide clarity and transparency for delivering the Element 34 program of works into the future.
3. Objective 3: Assist with investment planning optimisation and hence realise further efficiencies and effectiveness gains for TMR.

1.3 REPORT STRUCTURE

The report has the following structure:

- Introduction: Section 1
- Literature review: Section 2
- Initial data review: Section 3
- Workshops: Section 4
- Cost-code financial data analysis: Section 5
- Discussion: Section 6
- Conclusions and recommendations: Section 7.

2 LITERATURE REVIEW

A literature review was undertaken to provide a high-level overview of:

- the scope and program outcomes funded under the Element 34 program
- the existing Queensland and national intervention targets and benchmarks for program activities.

Reports were reviewed as identified in the following sections and as listed in the references section. Outlined below is a summary of the findings from the literature review, presented under the following sub-sections:

- High-level overview: Section 2.1
- Previous reviews: Section 2.2
- Benchmarks: Section 2.3.

2.1 HIGH-LEVEL OVERVIEW

There are key TMR documents (2015, 2016a, 2016b, 2017a, 2018a, 2020c) that set up the foundation for Element 34 operations. These documents outline:

1. the vision for the road network operations
2. TMR strategic commitments to the road users
3. performance indicators for the key customer delivery areas
4. high-level priorities
5. key service areas
6. action areas
7. measures of success for road operations.

They also outline the road operations investment program and how funding is distributed to the 12 TMR districts for implementation of the Element 34 activities.

The operation of the road network is becoming increasingly more important relative to construction and maintenance with ITS playing an increasing role. Hence there is a need to operate and maintain ITS devices in the field. This is the focus of Element 34 (TMR 2012, 2014 & Transoptim Consulting 2014).

Element 34 covers capital and operational funding. Funding is prioritised to the Element 34 activities that maintain the capabilities that optimise TMR's ability to operate a safe and available-to-use road network (TMR 2020a). TMR (2017b) provides maintenance guidance that assists in developing road maintenance priorities. It includes technical guidance for the maintenance of lighting and traffic signals.

Element 34 in-scope and funded activities are associated with providing road network operational services and maintaining safe-to-use and available ITS assets that can be broadly categorised under operational services, hardware, assets (devices) maintenance, and systems operations and maintenance. Element 34 also includes activities that are not funded through the Element 34 program. These mainly include staff administering activities such as element leader activities, element manager activities, externally identified activities and core businesses such as permit processing and technical assessments (TMR 2018b).

Element 34 has close linkages to 6 of the 23 elements outlined in Table 1.1, including (TMR 2018b):

- Element 6: fire risk management
- Element 11: vehicle monitoring systems
- Element 13: other transport infrastructure maintenance
- Element 15: routine maintenance
- Element 30: road lighting
- Element 70: state-wide data collection.

Element 34 has specific cost codes for each main activity group. In addition, there are cost codes for selected sub-activities of the activity groups (TMR 2015). Specific performance measures and metrics are defined for the Element 34 activities. This is to guide the program towards achieving the objectives (TMR 2018b). Data is required to manage Element 34 processes and performance measures (TMR 2018b).

2.2 PREVIOUS REVIEWS

Previous reviews have been undertaken of the Element 34 program. The Transoptim Consulting (2014) review developed key findings with respect to:

- overall funding pressures
- funding pressures at the district level
- service levels and road operations service standards
- defining activities as being discretionary (including at different levels) or non-discretionary
- funding other activities
- opportunities to improve efficiency
- the road operations focus for different TMR districts and regions.

Key issues have also been identified including:

- The need to shift planning from a one-year outlook to a 4-year outlook (TMR 2020d).
- There is a growing ITS asset base that requires funding for ongoing operation and maintenance (TMR 2020d).
- There is inconsistency in the service-level expectations across Queensland.
- There are challenges with funding traffic data collection, given competing demands for operational services.

Some districts have identified priorities for Element 34 activities including:

- Traffic Management Centre (TMC) operations
- electrical service maintenance
- traffic engineering support and advice, and network optimisation
- ITS communication and hosting charges
- traffic data collection.

In addition, other priorities identified include sustained service standards for maintaining road safety ITS devices and responding to traffic incidents; and accelerated state-wide rollout of smart LED road lighting and next-generation traffic signal controller technologies.

Previous work and investigations have been undertaken on improvements to the Element 34 program. This includes adopting a modernised element structure model which restructures the activities undertaken under Elements 11, 13, 30 and 34 as illustrated in Figure 2.1. Figure 2.1 shows how activities within the elements of the road operations element group are restructured into different element groups.

Another improvement identified was the need for a funding prioritisation framework that prioritises funding based on risks. The framework is made up of the following components (Faulkner 2019):

- hazard classification
- hazard scenarios within the realm of road operation control
- operational treatment
- road and ITS classification
- backend capabilities required.

This is outlined in Table 2.1.

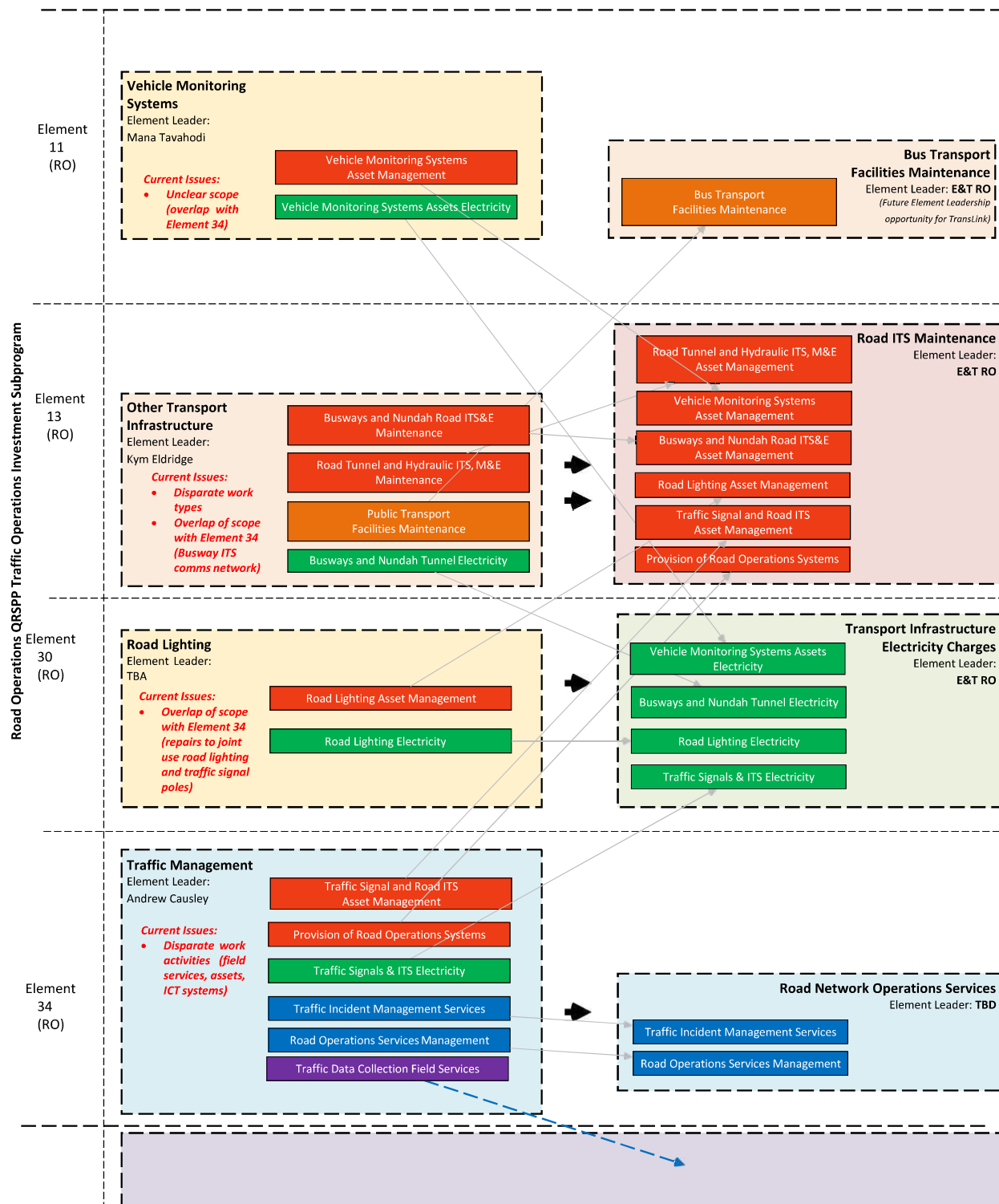
Figure 2.1: Proposed restructure of the Road Operations element group

14/08/2019

QRSP Road Operations Elements – Proposed Future State

Current (2018/19 to 2019/20)

Future (Aspirational Target 2020/21 onwards)



Source: Provided by Causley, A of TMR (2020).

Table 2.1: Possible prioritisation approach to Element 34 funding

Type	Hazard classification	Hazard scenarios with realm of RO control	Operational treatment	Road and ITS classification, and prioritisation				Backend capabilities required
				Motorway	Highway	Urban arterials	Other roads	
Intersections	Priority 1: Vehicles hitting other vehicles	Traffic signal on flash	Available signal installations	- Smart motorway - Partial smart motorway - Basic smart motorway	- Regional highway dual carriageway - Regional highway single carriageway	- Urban arterial high density traffic signals - Urban arterial low density traffic signals	All other roads	Principles: - Required ITS hardware and software (STREAMS) are provided. - A base level of TMC support is included for ITS fault detection and management (including 151940 reports line) - Electricity is included.
Unexpected hazards	Priority 2: Vehicle hitting unexpected objects likely to cause injury	Non frangible debris on travelled path Stationary vehicle on travelled path Emergency vehicle through intersection	Removal of unexpected, immediately injurious hazards Managing of proximity hazards and unexpected congestion	Prioritisation principles: - Utilise the available ITS to effectively manage traffic. - Where dynamic traffic control (access, speed, lane) devices are available, they are to be used as the primary mechanism to manage hazards. - Where dynamic traffic control devices are not available, road monitoring and traveller information ITS should be highly available and use to detect and inform the public. - Traffic incident management service levels should be set somewhat inversely to the level of traffic control ITS. For example, where there is a high level of traffic control ITS, traffic incident management service requirements should be lower. Conversely where there is a low level of traffic control ITS, traffic incident management service requirements should be higher. - Service levels should be prioritised based on hazards exposure risks, considering the level of existing traffic control ITS, speed environment, volume of traffic and road geometry.	Prioritisation principles: - Required ITS hardware and software (STREAMS) are provided. - A high level of TMR support is included for detection and management of hazards. - A low level of network optimisation support is included.			
Unexpected hazards	Priority 3: Vehicle hitting objects in or near the travelled path	Vehicle versus stationary vehicle off travelled path Abnormal traffic congestion Vehicle versus frangible debris on travelled path						

Type	Hazard classification	Hazard scenarios with realm of RO control	Operational treatment	Road and ITS classification, and prioritisation				Backend capabilities required
				Motorway	Highway	Urban arterials	Other roads	
Congestion hazards	Priority 4: Vehicle hitting a reoccurring traffic queue	Recurrent congestion	Management of expected motorway congestion through optimisation of ITS	- Smart motorway - Partial smart motorway - Basic smart motorway	- Reginal highway dual carriageway - Regional highway single carriageway	- Urban arterial high density traffic signals - Urban arterial low density traffic signals	All other roads	Principles: - Included provision of Bluetooth readers for travel time monitoring. - Requires low level of TMC support. - Requires a high level of network optimisation support.
	Priority 5: Vehicle delays through unexpected congestion	Recurrent congestion	Management of expected congestion through optimisation of ITS	Prioritisation principles: - Network optimisation service levels should be informed by network operating plans and quantitative performance gaps. - One network approach should be utilised. - Treatments should show a demonstrable improvement to reducing operating gaps for the priority modes.				

Source: Faulkner (2019).

2.3 BENCHMARKS

Some performance measures and benchmarking with respect to Element 34 activities were identified in the literature.

These include broad Austroads ITS variable speed limit performance measures and benchmarking (Austroads 2016a), reliability-centred maintenance (Austroads 2016b) and European key performance indicators for ITS (Payne et al. 2015).

In addition, experience related to traffic signal reviews (Department of Transport 2021; Transmax 2018; Victorian Auditor-General's Office 2014), incident management (TMR 2009, 2016c, 2020b; PwC 2016; Washington State Department of Transportation 2016, 2017), help phones (ARRB Group 2016) and ITS hosting systems (TMR 2020d & Queensland Government 2020) was also identified.

A request was made to the Austroads Network Task Force representatives for information about intervention targets and benchmarks. Only New Zealand responded. The NZ Transport Agency (2013) specification for the maintenance and repair of traffic signal installation is based on a 13, 26 and 52-weekly cycle. For traffic incident management (TIM), the main benchmarks are with respect to response time to incidents, which is the time from notification and covers both the mobilisation of the response and commencement of work to clear the incident in a specified duration from notification (NZ Transport Agency 2006).

Based on this, very little performance assessment and benchmarking that is relevant to Element 34 and is in use in other Australian jurisdictions was able to be identified as part of this investigation. However, some findings were able to be established. This includes:

- TMR (2019) outlines performance measures for electrical safety operations associated with activities delivered under:
 - Element 34 – traffic management
 - Element 30 – road lighting
 - Element 13 – other transport infrastructure maintenance.
- While the performance measures and benchmarking description could be uniformly applied, reporting and the actual acceptable measure should be based on road type or area. Furthermore, the performance measure and benchmarks should be developed specifically for TMR, taking into consideration specific needs and requirements.
- The review highlighted the importance of regular traffic signal reviews and optimisation across the traffic signal network. In addition, the review identified the importance of rolling out technology such as Bluetooth readers to assist and expedite this process.
- The review highlighted the need for traffic incident management (TIM) and to achieve TIM targets associated with the removal of a stationary vehicle. To achieve this TMR requires the ability to be able to identify the incident soon after it occurs and deploy sufficient traffic response units (TRU). The ability to monitor, detect, respond, and inform are critical elements in the management of on-road incidents. This requires the deployment of measures that fall under the Element 34 program, such as closed-circuit television (CCTV), traffic detectors, roadside help phones where there is no cell-phone coverage, and 13 19 40 phone calls into the TMC. There is also a need to measure the specific aspects associated with an incident such as notification time, response time, incident clearance time, extraordinary incidents, roadway clearance time and secondary incidents.
- The issue of help phones and their need, given the uptake and use of mobile phones, was covered as help phone maintenance is an Element 34 activity. The ARRB Group (2016) investigation identified that help phones should only be installed on a road that carries 40,000 vehicles per day and there is no mobile coverage, or a 'special feature' exists which requires a help phone treatment. Based on this, the investigation recommended the removal of all help phones, except for 10 help phones identified.

- There is potential for TMR to centrally host applications and associated communications. This would enable applications to be delivered more consistently and affordably in the future and potentially enable more harmonised intervention levels for maintaining application capability.

3 INITIAL DATA REVIEW

A review of initial data available at the state level was undertaken to understand the scope of activities delivered as part of the Element 34 work program. There is no such thing as business as usual. Data can be skewed and may be different across the years depending on events (for example cyclones and COVID-19 can skew funding in one year). Where possible, multiple years of data were reviewed.

There are some traditional Element 34 activities that in some instances may be funded separately. For example, where ITS maintenance needs to be undertaken in response to extreme weather events such as cyclones, the activity may get funded under the Disaster Recovery Funding Arrangements (DRFA) and/or Natural Disaster Relief and Recovery Arrangements (NDRRA). Therefore, activities performed under the DRFA and/or NDRRA funding will not be captured in the Element 34 data.

Outlined below is a summary of the findings associated with the initial data analysis, presented in the following sections:

- Road network, ITS devices and incident data: Section 3.1
- Element 34 funding: Section 3.2
- Element 34 (and Element 30) employees by type: Section 3.3
- Electrical safety performance: Section 3.4.

3.1 ROAD NETWORK, ITS DEVICES AND INCIDENT DATA

The districts in western Queensland have the most road length while those in South East Queensland (SEQ) have the least. However, most of the vehicle kilometres travelled are in SEQ. This is reflected in the need for traffic management and therefore Element 34 funding undertaken for this purpose.

Districts within SEQ have the most traffic signal sites. The Metropolitan District has the most CCTV (licences) and help phones deployed by a significant amount compared to other districts. Interestingly, the North Coast District has significantly more permanent counting sites compared to other districts. The North Coast and MacKay/Whitsunday Districts have also utilised temporary counting sites more than other districts, although the difference is not as significant as with the permanent counting sites. Flood monitoring is primarily deployed in the Darling Downs and Wide Bay/Burnett Districts.

Hazards and congestion make up a significant proportion of the causes of incidents reported to TMR. The Metropolitan District reported significantly more incidents than the other districts. Flooding is the main contributor to incidents in the districts within the western region, but not so much in the districts in SEQ. In addition, roadworks and hazards are the main contributors to incidents in the districts within the coastal region. While hazards are a key contributor to incidents in the districts in SEQ, congestion is also a key contributor. Congestion is not a key contributor to incidents within the districts of the western and coastal regions.

3.2 ELEMENT 34 FUNDING

Most Element 34 funding comes from the state, mainly directed to operational purposes rather than capital investment. The total funding is slightly increasing.

In addition to district funding, there is funding allocated to state-wide activities. This is a pool of funds that is outside district funding. It does not represent total funding. Rather it comprises funding that cannot be attributed to a district but applies to the whole state. This includes aspects such as the payment of electricity supply authority charges as well as providing traffic system applications such as STREAMS.

While the districts in the SEQ region have the least road length, they receive a substantial amount of the Element 34 funding. It was observed that there is a strong correlation between the number of traffic signals deployed within the district and the total Element 34 funding assigned to it.

Element 34 makes up a significant amount of the road operations element group funding (i.e. funding associated with Element 11 (vehicle monitoring systems), Element 13 (other transport infrastructure), Element 30 (road lighting) and Element 34 (traffic management)). For example, for nearly all districts, Element 34 makes up at least 70% of the funding for the road operations element group, while for the Metropolitan District it amounts to 53%.

Road lighting, which is funded from another element, makes up a significant component (43%) of the state-wide funding under the Road Operations elements. This is likely due to it including the payment for electricity for road lighting.

Element 13 comprises the maintenance of ITS and electrical (ITS&E) equipment along busway and associated infrastructure. This also includes buildings. As these will mainly be deployed within districts in the SEQ region, funding of Element 13 activities is low in districts beyond the SEQ region.

3.3 ELEMENT 34 (AND ELEMENT 30) EMPLOYEES BY TYPE

Compared to the 2021–22 financial year, there is a scheduled decrease in full-time equivalent employees assigned to Element 34 (and Element 30) activities for 2022–23 and 2023–24.

3.4 ELECTRICAL SAFETY PERFORMANCE

Most of the traffic signal and ITS electrical safety inspections occur within the districts located in SEQ. In addition, there are a significant number of ITS assets that have not had an electrical safety inspection within the last 5 years. This is not as evident for traffic signals.

4 WORKSHOPS

Teleconference workshops were undertaken with the TMR districts to obtain an understanding of:

- the technical levels of service undertaken within the district
- the intervention levels used to initiate activities
- how well the intervention levels meet the demand and local priorities
- activities not undertaken by districts that could be funded under Element 34.

The 12 districts were combined into 5 groups as shown in Table 4.1. The managers for Element 34 for each of the 12 districts were invited to participate in the workshop.

Table 4.1: Workshops – groupings

No.	Group name	Districts within the group
1	Southern (non-Western) region	1. Wide Bay/Burnett 2. Darling Downs
2	North and South Coast regions	3. North Coast 4. South Coast
3	Western regions	5. South West 6. Central West 7. North West
4	Central and North Queensland coastal region	8. Mackay/Whitsunday 9. Fitzroy 10. Northern 11. Far North
5	Metropolitan region	12. Metropolitan

Each workshop went for approximately 2 hours and followed a structured questionnaire. A summary of the findings is outlined in the sections listed below:

- General: Section 4.1
- Service-level definition and performance targets: Section 4.2
- Key factors that influence Element 34 funding: Section 4.3
- Five most critical ITS devices: Section 4.4
- Activities that get delayed due to competing priorities: Section 4.5
- Specific Element 34 activities: Section 4.6.

4.1 GENERAL

Overall, it was noted that the Element 34 program is complex, made up of a mix of physical resources and activities (e.g. staffing and attending to incidents in the field) and management of ITS devices.

4.2 SERVICE-LEVEL DEFINITION AND PERFORMANCE TARGETS

The need to undertake Element 34 activities varies significantly between districts in different regions, but there are similarities between districts within the same region. Districts with similar road network challenges, categorised into regions are as follows:

1. Low population and large geographical area
 - a. Western region:
South West, Central West, and North West Districts.

2. Mid-level population and mid-sized geographical area
 - a. Southern (non-Western) region:
Wide Bay/Burnett and Darling Downs Districts
 - b. Central and North Queensland coastal region:
Mackay/Whitsunday, Fitzroy, Northern and Far North Districts.
3. High population within a small graphical area
 - a. North and South Coast region: North Coast and South Coast Districts
 - b. Metropolitan region: Metropolitan District.

There is a need for a clear linkage between the funding profile and corporate policy and guidelines for Element 34 activities, particularly related to incident management. This may require consideration for the movement and place framework in some instances (e.g. urban arterial road corridors).

The movement and place framework provides a framework in which to view a road within a road network in the context of its role as in catering for a movement and its role as a place. Movement can be people and goods and can be car and non-car based. While places are key destinations and activity centres where people congregate. Roads and off-road environments can be either movement corridors, places, or a hybrid of the two. The movement and place framework is outlined in *Austrroads Guide to Traffic Management Part 4: Network Management Strategies* (Austrroads 2020). The movement and place framework will likely overlap with network planning functions within TMR.

Districts would like to move to a proactive planning and management approach, however due to growing needs, they are of the view that they are restricted to delivering activities in a reactive manner.

Incident management is taking up a lot of the program funds. This results in other activities getting delayed or funded through savings from another program.

The workshops justified the need to restructure the road operations suites of elements (i.e. Elements 11, 13, 30 and 34). This includes Element 34. TMR (2021) outlines the proposed restructure. Within it, the road operations suites of elements is proposed to be redistributed across the following newly developed 4 elements in 2021:

1. Element 56: Road network operations services
2. Element 57: Road ITS infrastructure
3. Element 58: Transport infrastructure electricity charges
4. Element 59: Bus transport facility maintenance.

Most districts noted that there are contracts that specify timeframes for contractors to address problems with ITS assets. Many districts set up maintenance contracts with RoadTek and in some cases councils, with the intervention levels managed by the respective contract.

TMC incident response activities are well defined as all contracts are measured and have KPIs associated with them. However, for many districts the crash rate has increased and therefore the number of incidents to respond to has increased.

4.3 KEY FACTORS THAT INFLUENCE ELEMENT 34 FUNDING

The key factors that impact Element 34 funding include:

- available state funds
- associated impacts arising from population growth (e.g. increased traffic volume and incidents)
- growing ITS assets
- growing community expectations.

With respect to growing ITS assets, many road upgrade projects result in the deployment of ITS. It is perceived by districts that such projects do not lead to an increase in Element 34 funding for the associated operational and maintenance costs of the new devices.

There is a need to move to a more proactive approach to ITS maintenance and optimisation. However, the challenge is prioritising the funding of such an approach, in a fiscally constrained environment particularly with operational expenditure.

For the mid to high-level populated districts, the focus is on incident management and electrical safety. This is a major factor influencing Element 34 management and funding. After that, activities get undertaken based on risk. For ITS maintenance, the districts can have different and unique issues to deal with. This can range from the number of devices, remoteness, availability of qualified resources to undertake the work, damage to devices and/or equipment associated with the device (damage can range from theft, vandalism and crashes involving the device).

Element 34 activities can be categorised into the following 3 groups:

1. Operational services:

Traffic incident field services and TMC operations, traffic incident management, traffic management and network optimisation.

2. Hardware and assets maintenance:

Maintenance of traffic signals and ITS hardware assets, smart motorway assets, CCTV and web cameras, flood monitoring, variable message signs (VMS), help phones, electrical switchboards, ITS field cabinets and telecommunication equipment and cabling.

3. Systems operations and maintenance (related to traffic operations and traffic management):

Traveller information, traffic management, incident management, traffic data and network performance, video, and asset management systems.

The key factors that have influenced Element 34 funding in the last 5 years include:

- growth in traffic volume
- customer expectations with respect to managing congestion
- increase in disruptive events (natural and manmade)
- increased ITS assets and network communication requirements
- increased vandalism, theft, and damage to ITS assets
- the need to upgrade traffic signals and address end-of-life for existing ITS assets.

It is expected that the issues that have impacted Element 34 funding over the past 5 years will continue into the next 5 years. With increasing tasks, it is anticipated that there will be more activities leading to higher work output, productivity, or alternatively higher staffing costs. In addition, future cooperative ITS applications will require the deployment of the necessary devices.

The districts in the western region that do not have a significant number of ITS devices deployed have been converting operational funds to capital funds to enable the greater deployment of more ITS devices, for example, flood monitoring signs. This enables districts to manage their natural disaster disruption-prone road networks more efficiently. These are typically lifeline links to remote communities.

The Metropolitan District noted that funding optimisation of arterial and motorway corridor activities becomes increasingly difficult as volumes continue to increase, and assets continue to age. Clarity on movement and place framework classification will provide the network optimisers details on where the compromises must be made to the program. If priority is to be given to alternative modes during certain times of day, the ability to detect, track and therefore accommodate their movements is required. This will cater for the funding to install appropriate sensors (for pedestrians, cyclists, heavy vehicle (HV), public transport (PT)) and system enhancements to optimise these modes.

4.4 FIVE MOST CRITICAL ITS DEVICES

The 5 most critical ITS devices identified by districts were as follows:

1. road condition information signs (RCIS) (panels displaying road conditions such as open, closed or caution)
2. traffic signals
3. CCTV
4. flood monitoring sites
5. VMS.

Not all districts have every type of ITS deployed, for example, smart motorways. If these are in the districts, it is likely that the system and the ITS devices making it up would be one of their most critical devices.

4.5 ACTIVITIES THAT GET DELAYED DUE TO COMPETING PRIORITIES

There were activities identified which get delayed or may not get undertaken due to competing priorities. Decisions on whether to proceed with the activity are based on a needs assessment. The districts tend to focus on activities that relate to safety-critical elements and have an impact on operations, and devices that are public-facing. TMC, incident management and electrical safety works are priority activities with Element 34 funding directed to them. Other activities are identified as being a lower priority and are subsequently delayed.

Districts focus on the must-do activities and carry over the non-critical activities or those that can be put off. They also look to reallocate funds from savings in other element funding.

The top 5 key activities which were identified as often not getting undertaken due to competing priorities are as follows:

1. collecting traffic data
2. end-of-life activities
3. periodic electrical installation validation
4. lighting and vehicle activated signs (VAS) inspection
5. pit replacements, including asbestos pit replacement.

Some interesting points that were identified which could influence Element 34 activities delivered within the districts include:

- Expenditure one year does not reflect expenditure in the next year. Therefore, it can be difficult to plan and budget expenditure.
- Some regional districts that undertake periodic inspections and verifications can be constrained by the lack of suitably qualified officers.
- The design of ITS in the industry is not consistent, both in price and quality. This makes it hard for the districts to assess tenders in accordance with procurement processes, as assessors need to consider the quality of the product along with the cost.
- Incident management contracts are under pressure and districts may bring forward allocations from future years.
- There is a need for clarification on the safety policy from a movement and place framework perspective.
- There is a need to articulate what can be afforded and what is really needed to make sure that the outcome that is expected is in accordance with the Department's priorities.

4.6 SPECIFIC ELEMENT 34 ACTIVITIES

Districts were asked 3 questions with respect to the following 5 Element 34 activities:

1. TIM field services
2. traffic signal and ITS field infrastructure maintenance (routine and non-routine servicing)
3. traffic data collection
4. traffic signal timing reviews and optimisation
5. TMC operational responses.

The questions related to levels of service and intervention levels, data on outputs and on activities not undertaken. Key findings are discussed below.

4.6.1 LEVELS OF SERVICE AND INTERVENTION LEVELS

TIM field services

TIM field services are non-negotiable.

The services are managed by the operations team and set up in the road maintenance performance contract (RMPC) contract. Response times are determined under the RMPC.

Districts have different TIM demands which are linked to the traffic demand and geographical area. Some pick up the TIM field services for other districts. Some use the state-wide TMC to do many activities that other districts may do in house.

Traffic signals and ITS field infrastructure maintenance (routine and non-routine servicing)

Specifications are set up with the contractors delivering the services within the district. Some use maintenance crews that are based in other districts.

Generally, components are replaced or repaired as required. End-of-life treatments are programmed and funded through operational and capital budgets.

Reactive maintenance requirements are set out in the RMPC.

Traffic data collection

Districts have a mixture of permanent and temporary traffic data collection sites. Often the deployment of temporary traffic counters is un- or under-funded and deemed a lower priority to other activities. If a permanent site is faulty and counts are required, the district may need to pay a contractor to collect data or apply work arounds such as using STREAMS sites. The use of temporary counting sites on busy corridors may become more difficult for safety reasons.

Surveys can be more expensive in some areas compared to others within a district, depending on local circumstances (e.g. remoteness, vandalism and theft, environmental conditions).

Traffic data collection is important as many activities rely on this information including transport planning and asset management of aging assets. Planning departments often fund their own counts and/or work with old data. Where data collection is funded by the districts under the Element 34 program there is a need to understand the minimum levels of data collection that are required, especially for national corridors where there is a requirement for 12-bin classification.

Traffic signal timing reviews and optimisation

There are no intervention levels set for traffic signal timing reviews and optimisation.

Most districts reported that reviews are undertaken in an ad hoc and reactive manner, often driven by the community and complaints.

Some districts noted that there are several critical sites where signal reviews are undertaken periodically or there are some elements that are periodically reviewed (e.g. filtered turns).

The Western region districts either do not have traffic signals or have a very limited number of them. Therefore, signal reviews are not undertaken or undertaken only as required.

Districts would like to do a lot more signal timing reviews and optimisation; however, resourcing is a limitation.

TMC operational responses

There are no defined service and intervention levels.

The operational responses include setting up strategies to minimise secondary incidents, managing the incident and arranging repair to infrastructure if any.

At present there are a variety of arrangements across the state for some districts with a TMC providing services for districts with no TMC and/or limited resources. For example, the South Coast District provides a state-wide TMC service to the state, except for the metropolitan region. This district also provides part-time TMC support for the North Coast, Wide Bay/Burnett, Far North, Northern, North West, Darling Downs and South West Districts. Each region and district should outline its ability in relation to operating hours, key performance areas and key performance indicators to provide TMC support.

There does not seem to be a clear linkage between the funding profile and corporate policy and guidelines for these activities.

4.6.2 DATA ON OUTPUTS

With respect to data on outputs for the 5 specific Element 34 activities of interest it was found that data, information, and records are kept by districts on the outputs or delivery of activities but are not in a ready form that could be used for analysis as part of this project.

A record is kept on traffic incident management call-outs; however, it is not entered into a database.

For traffic signal and ITS maintenance, STREAMS Incident Management System (SIMS) captures all RMPC activities, and maintenance data is captured through invoicing. Although RMPC activity data is available, it may not be comprehensive. Traffic signal site files on STREAMS may have information on past activities undertaken at the site. In addition, the road operations asset management system may also contain information on activities undertaken.

TMR has an asset database, not an asset management database system. The system is maintained by the contractor engaged to manage the maintenance of the assets.

Traffic count data is available within the traffic surveys and data management system but as a count rather than an activity record.

For traffic signal timing reviews and optimisation, most districts do not keep records on when signal reviews and optimisation are done in a database. However, most districts keep notes within STREAMS on the file for the applicable traffic signal site where the review was undertaken.

It is time consuming to keep databases up to date and therefore limited databases are maintained. For TMC operational responses, some districts outsource the TMC operational response to other districts to administer and therefore do not keep records.

4.6.3 DATA ON ACTIVITIES NOT UNDERTAKEN

There is limited data on activities not undertaken and depending on the district there are activities that do not get fully addressed due to insufficient funding. The following key points were noted:

- TIM field services and TMC operational responses are a non-negotiable activity and therefore are undertaken with high priority over other Element 34 activities.

- There is increasing cost pressure on incident management, with it becoming a growing issue.
- There is a need to re-evaluate the policy requirement for stationary vehicle management and ensure processes match policy.
- There may be a need for TMR to look at the motorways in a similar manner to the way toll-road operators look at the toll road (i.e. put a monetary value on not clearing the road quickly).
- The policy development needs to clarify the warrants for the removal of stationary vehicles.

5 COST-CODE FINANCIAL DATA ANALYSIS

A review of the available cost code financial data was undertaken following the workshops. The review examined three key areas, with the findings outlined in the sections listed below:

- Priority of Element 34 cost codes: Section 5.1
- Financial year 2019–20 expenditure: Section 5.2
- Four-year allocation forecast: Section 5.3.

5.1 PRIORITY OF ELEMENT 34 COST CODES

The top priority items are associated with the safety of traffic signal and ITS maintenance along with TIM services. The low priority items are associated with traffic data collection, emergency phone maintenance and network optimisation.

5.2 FINANCIAL YEAR 2019–20 EXPENDITURE

There are significant differences between the district grouping in the average expenditure per district for the Element 34 cost codes. The North and South Coast Districts dominate expenditure in TIM services, ITS maintenance and, to a lesser extent, network operations. The Metropolitan District dominates funding in end-of-life replacement or upgrade of ITS field infrastructure.

Across the cost codes, the more populated districts had the most expenditure. The districts within the western region had the least expenditure.

There are significant differences between the actual expenditure and both the funding needs as identified by the element manager at the district level, and the funding allocated by the element leader. For 2019–20 the total funds requested across the districts totalled \$90m. The total allocated was \$61m with the total spent being \$99m, with districts bringing forward funds from future years to make up the difference.

5.3 FOUR-YEAR ALLOCATION FORECAST

Funding allocation for TIM services across the districts is declining. Those with the most funding forecast are the Metropolitan, South Coast and North Coast Districts. Funding for the other districts is low in comparison. The district element managers identified a greater need for funding of TIM services than what is being allocated by the element leader.

Funding allocation for traffic signal and ITS maintenance is increasing. Those with the most funding forecast are the Metropolitan, South Coast and North Coast Districts. Funding for districts in the western region is low in comparison. The element leader identified a greater need for funding of traffic signal and ITS maintenance than what is being requested by the district element managers.

Funding allocation for traffic data collection is decreasing. Those with the most funding forecast are the Mackay/Whitsunday and Wide Bay Burnett Districts. Funding for the western region districts is relatively high compared to other districts but not as high as that for Mackay/Whitsunday and Wide Bay Burnett. Except for a few districts, the element leader funding allocation for traffic data collection is generally in line with that being requested by the district element managers.

Trends in funding allocation for network optimisation are varied. There is a spike in network optimisation funding for the South Coast District forecast for 2022–23. Those with the most funding forecast are the Metropolitan, South Coast and North Coast Districts. There is no funding for districts in the western region as network optimisation is not an issue there. Most district element managers identified a greater need for funding of network optimisation than what is being allocated by the element leader.

Trends in funding allocation for network operations varies, with some districts anticipated to have their funds grow, while others are expected to reduce in funding. Those with the most funding forecast are the South Coast and Metropolitan Districts. The North Coast and Northern Districts closely follow. The other districts are not as well funded in comparison. Some district element managers have identified a greater need for funding than what the element leader has allocated.

6 DISCUSSION

This section discusses the key points from the investigation. It focuses on the key findings relevant to the project objectives (Section 6.1) along with key recommendations for TMR consideration and implementation (Section 6.2).

Overall, the findings are based on a review of TMR literature and consultation with TMR officers. This is despite undertaking a review of Austroads published material, and the experience of other Austroads jurisdictions and internationally. The review found that there was limited application of performance measures and benchmarking for ITS devices beyond variable speed limit benchmarks, reliability centred maintenance, and European key performance indicators for ITS. In addition, the experience identified mainly related to traffic signal reviews, incident management, help phones and ITS hosting systems.

6.1 MAPPING PROJECT FINDINGS TO PROJECT OBJECTIVES

The 3 objectives of this project were:

1. Objective 1:
Map the existing suite of Element 34 funded activities to the relevant operational services and define how they align to TMR's transport system objectives.
2. Objective 2:
Provide clarity and transparency for delivering the Element 34 program of works into the future.
3. Objective 3:
Assist with investment planning optimisation and hence realise further efficiencies and effectiveness gains for TMR.

Key findings relating to each of the objectives are outlined below.

6.1.1 OBJECTIVE 1

The project confirmed that the activities in Element 34 are critical for TMR in delivering its overall strategic objectives. This is because it funds the operations, maintenance, and deployment of ITS which are critical to the operation of the road network.

The need to undertake Element 34 activities within districts varies depending on the district. While the districts within the SEQ region have the shortest road network, they comprise a significant proportion of the Element 34 funding with a strong correlation between the number of traffic signals deployed within districts and the total Element 34 funding assigned to the district.

There is a need for a clear linkage between the funding profile and corporate policy and guidelines for Element 34 activities, particularly related to incident management. This may require consideration of the movement and place framework (refer to Section 4.2 for further discussion) in some instances (urban arterial road corridors) which is likely to overlap with network planning functions within TMR.

There are no defined service and intervention levels for TIM field services and TMC operational responses. This need is considered by districts as a must do. There are no intervention levels established for traffic signal timing reviews and optimisation. Most districts reported that reviews are undertaken in an ad hoc and reactive manner. Critical traffic data collection is undertaken while additional traffic data collection can often be delayed due to other priorities. Electrical safety associated with ITS assets is undertaken while nonelectrical safety maintenance is undertaken in a reactive manner.

6.1.2 OBJECTIVE 2

The project confirmed that compared to the 2021–22 financial year, the funding for staffing needs for Element 34 (and Element 30) is earmarked to be less for 2022–23 and 2023–24. That is, there is a forecast decrease in full-time equivalent employees assigned to Element 34 (and Element 30) activities for the two years.

Districts would like to move to a proactive planning and management approach, however due to growing needs, they are of the view that they are restricted to delivering activities in a reactive manner. Incident management is also taking up a lot of the program funds within the districts.

The key factors that impact Element 34 funding include available state funds, associated impacts arising from population growth (e.g. increased traffic volume and incidents), growing ITS assets and growing community expectations.

Many road upgrade projects result in the deployment of ITS. Districts consider that such projects do not lead to an increase in Element 34 funding for the associated operational and maintenance costs of the new ITS devices.

The most critical ITS devices in total that were identified by districts were RCIS, traffic signals, CCTV, flood monitoring sites and VMS along with ITS devices associated with the operation of smart motorways.

The main activities which may not get undertaken and/or are delayed due to other priorities are collecting traffic data, end-of-life activities, periodic electrical installation validation, lighting, and pit replacements (including asbestos pit replacement). It also includes work activities associated with VAS for which the work activity maintenance falls under the Targeted Road Safety Program.

6.1.3 OBJECTIVE 3

The project confirmed that there is a need to move to a more proactive approach to ITS maintenance and optimisation. However, the challenge is prioritising funding of such an approach, in a fiscally constrained environment, particularly with operational expenditure.

Expenditure in one year does not reflect that in the next year. Therefore, it can be difficult to plan and budget expenditure.

There is a need to restructure the program with activities in Elements 11, 13, 30 and 34. Once this is done, policy and principles should be developed along with determining available funding for each activity. It is critical to maintain good data on expenditure within activities along with data on outputs delivered in addition to data on activities not delivered due to other priorities. This will aid forward planning and expenditure forecasting.

There are significant differences between the district groupings in the average expenditure per district for the Element 34 cost codes. The North and South Coast Districts dominate expenditure in TIM services, ITS maintenance and to a lesser extent, network operations. The Metropolitan District dominates funding in end-of-life replacement or upgrade to ITS field infrastructure. Across the Element 34 cost codes, the more populated districts had the most expenditure, while those within the western region had the least expenditure. There are significant differences between the actual expenditure and both the funding needs as identified by the element manager at the district, and the funding allocated by the element leader. For the 2019–20 the total funds requested across the districts totalled \$90m. The total allocated was \$61m with the total spent being \$99m, with districts bringing forward funds from future years to make up the difference. With respect to funding allocation the following issues were noted:

1. Funding allocation for TIM services across the districts is declining. Those with the most funding forecast are the Metropolitan, South Coast and North Coast Districts.
2. Funding allocation for traffic signal and ITS maintenance across the districts is increasing. Those with the most funding forecast are the Metropolitan, South Coast and North Coast Districts.

3. Funding allocation for traffic data collection across the districts is decreasing. Those with the most funding forecast are Mackay/Whitsunday and Wide Bay Burnett Districts.
4. Trends in funding allocation for network optimisation across the districts are varied. There is an anticipated spike in network optimisation funding forecast for the South Coast District in 2022–23. Those with the most funding forecast are the Metropolitan, South Coast and North Coast Districts. There is no funding for districts in the western region as network optimisation is not an issue.
5. Trends in funding allocation for network operations vary across the districts, with some anticipated to increase, while others are expected to reduce in funding. Those with the most funding forecast are the South Coast and Metropolitan Districts. The North Coast and Northern Districts closely follow.

6.2 RECOMMENDATIONS

The investigation identified 8 key recommendations as outlined in Section 6.2.1 through to Section 6.2.8. The first recommendation is associated with a restructure of Element 34. The subsequent recommendations apply to Element 34 itself. They also apply to the work activities that were in Element 34 and will be redistributed to the new road operations suites following the restructure.

It may not be necessary to implement the recommendations uniformly across the TMR network. Instead, it may be more appropriate to apply them specifically for districts within regions with similar road network operation challenges. Possible grouping of districts into regions could include:

1. Low population and large geographical area
 - a. Western region:
South West, Central West, and North West Districts.
2. Mid-level population and mid-sized geographical area
 - a. Southern (non-Western) region:
Wide Bay / Burnett and Darling Downs Districts
 - b. Central and North Queensland coastal region:
Mackay/Whitsunday, Fitzroy, Northern and Far North Districts.
3. High population within a small graphical area
 - a. North and South Coast region:
North Coast and South Coast Districts
 - b. Metropolitan region:
Metropolitan District.

6.2.1 RESTRUCTURE OF ROAD OPERATIONS SUITES OF ELEMENTS

Recommendation

It is recommended that TMR continue to finalise the restructure of the road operations suites of elements.

Justification

There is a proposed restructure of the road operations suites of elements (i.e. Elements 11, 13, 30 and 34) currently underway. This will mean that components of each element are reallocated, and new alternative elements created that better group activities and reduce duplication. This will provide a more streamlined and clearer definition of the activities. Figure 2.1 shows how the road operations suites of elements are proposed to be redistributed across the following newly developed 4 elements:

1. Element 56: Road network operations services
2. Element 57: Road ITS infrastructure
3. Element 58: Transport infrastructure electricity charges

4. Element 59: Bus transport facility maintenance.

Findings derived through this investigation and independent of the consideration of the restructure have found that this is an appropriate move. It is felt that through the restructure, planning for the delivery of activities can be better undertaken as they will be grouped into similar work activities and types rather than combining a mix of different types. This should allow element managers at the districts to better focus on similar work activities rather than being spread across a wide variety. It should also result in more logical control between elements, which will avoid funds being diverted from activities that may be deemed a lower priority to unplanned activities of a higher priority. It will not absolutely prevent funds being transferred at the district level but to achieve a funds transfer would require agreement between the respective element managers at the district level, or alternatively a decision by a higher-rank TMR representative. This should help with better aligning element managers needs to element manager expenditure for the activities.

The restructure will result in the establishment of Element 56: Road network operations services, whose scope is exclusively road operation services. This will enable districts to have a dedicated element for TMC funding. It will make it easier for TMR as a whole and the individual districts to more clearly plan for and see how much they are allocating and spending on TMC services. TMC services may be both delivered within each district, and/or where required delivered by the state TMC on behalf of individual districts. State TMC services for individual districts may be undertaken as either full-time or part-time arrangements depending on the district.

6.2.2 POLICY TO DEFINE ACTIVITIES

Recommendation

It is recommended that TMR review, refine and develop further investment policies and principles for work activities that were in Element 34.

Justification

Policy needs to be reviewed, refined and/or developed for the activities within Element 34. For each activity there should be a clear policy that provides a linkage between the available funding and activities expected to be delivered.

In doing so, consideration should be given to the overarching guidelines and frameworks related to the operation of the road network such as the Safe System and Movement and Place. To help with shaping policy, TMR should look at its strategic roads in a similar manner to the way toll road operators look at their roads (i.e. put a monetary value on not addressing the issue).

A clear policy will help shape the prioritisation of activities. This would also help to define how the activity is undertaken. This will influence both funding and expenditure associated with the activity. The policy should determine the following:

- How extensively proactive activities are undertaken versus reactive.
Policy should define how extensively an activity needs to be undertaken and its timing for the components of the activity. For example, a policy for traffic signal reviews could prioritise and categorise traffic signals across the road network based on their strategic importance and then outline how often they should be reviewed over a specified period.
- How activities are undertaken.
This would outline the key steps and functions that are needed when delivering the activity as this will influence the cost per output for the activity. For example, a policy on the deployment of TMCs across the road network is needed to define the extent to which TMCs are deployed and operated by the 12 districts. As of 2020 there were 7 TMCs being operated across the state. This includes the state-wide and Brisbane Metropolitan TMCs, in addition to those in the North Coast, Wide Bay/Burnett, Far North, Northern and Darling Downs Districts. A policy on TMCs that defines the quality of service that needs to be maintained across the districts against the funding would help to determine whether more or less than

the current 7 TMCs are required. This would include consideration on how much the state-wide TMC can cover operations across other districts.

- What the activity should comprise.

In addition to outlining how activities are undertaken, there is a need to outline what the activity comprises. For example, a policy on traffic incident management may need to define to what extent the activity is undertaken and when. This may include removing the stationary vehicle to the nearest safest location.

- Transparency on services requiring work activities.

There is a need for transparency on services that are dependent on Element 34 work activities. This can be undertaken through mapping all work activities that are required to deliver the road network services. For example, the service of providing operational and safe-to-use traffic signals requires work activities such as maintenance of the assets, network optimisation (i.e. regular timing reviews), payment for telecommunications and provisioning of traffic system applications. Mapping all the required work activities will provide the needed transparency. This will become more important with the restructure of the road operations suite of elements as road network services will require work activities across other elements. For example, ITS infrastructure will require work activities under Element 57 in addition to electricity charges which are covered under Element 58.

The policy should be developed uniformly for all districts so that there is consistency in application. The policy for each activity will vary in complexity, depending on needs. It should not be site-specific but generalised so that it can be applied if required by other districts. Its application may be different depending on the district and the extent of Element 34 activities undertaken. Similarities may be achieved across the districts or at the very least districts in regions as specified in Section 6.2.

6.2.3 PRIORITISATION OF ACTIVITIES

Recommendation

It is recommended that TMR review, refine and develop further the investment prioritisation approach for work activities that were in Element 34. This includes better articulating what can be afforded and what is really needed. This will help to make sure that the outcome that is expected is in accordance with the Department's priorities.

Justification

The districts tend to focus on activities that relate to safety-critical elements and/or have an impact on operations and devices that are public facing. TMC, incident management and electrical safety work are priority activities with Element 34 funding directed to them. These are considered by districts to be non-discretionary activities. On the other hand, other activities which are of lower priority, but are of very high strategic importance and value to TMR are delayed. These are considered by districts to be discretionary activities by many districts. Districts focus on the must do activities and carry over the non-critical activities or those that can be put off. They also look to reallocate funds from savings in other element funding.

There is a need for prioritisation of activities as some are being delayed. As outlined in Section 6.2.1, the restructure currently being undertaken will help to address this as it will better group separate activities into similar categories. This will help in the planning for funding of activities that would have similar levels of priority within the road operations suites of elements. This will mean that low priority activities are not competing with high priority activities within the one element. For example, incident management would no longer be competing with traffic data collection within the one element.

While the restructure will assist in this, there is a need to prioritise activities within Element 34 and more broadly within the road operations suites of elements. TMR (2021) outlines the principles for prioritisation of funding. These are outlined in Figure 6.1. Prioritisation can be based on these principles along with the overall policy governing the delivery of the activity. Discussion on the need for policy is outlined in Section 6.2.2.

The prioritisation of activities may need to be undertaken on a district-by-district basis, although Similarities may be achieved across the districts or at the very least districts in regions as specified in Section 6.2.

Figure 6.1 Principles for prioritisation

1. Road network outcome preferences.
Invest in safety treatments first, ahead of journey reliability, then efficiency and productivity treatments.
2. Risks before performance.
Ensure that network and agency-level risks are acceptably managed, ahead of investing in additional network performance treatments.
3. Consider whole-of-life asset cost implications.
 - a. Consider whole-of-life implications of investment approaches.
 - b. Ensure existing and new capabilities can be sustained now, and into the future.
4. Apply due diligence to existing asset portfolio.
 - a. Ensure corporate due diligence is realised in all investment decisions (legislative and reputational).
 - b. Ensure expected value of past transport infrastructure investments is realised.
 - c. Always preference non-discretionary investments ahead of discretionary investments.
5. Apply systems approach to investment prioritisation.
Consider spatial and temporal limits of value creation:
 - a. Investment Priority 1: Wide area network solutions (coverage: every place and every time).
 - i. Payment of electricity supply charges.
 - ii. Maintaining traffic system applications, including the core ITS information communication and technology telecommunications network.
 - b. Investment Priority 2: Local area network solutions (specific places and every time).
 - i. Maintaining ITS field devices.
 - c. Investment Priority 3: Network operational service solutions (specific places and specific times only).
 - i. Provision of TIM field services.

Source: TMR (2021).

6.2.4 NEED FOR DATA

Recommendation

It is recommended that TMR improves efforts to collect data associated with the activities that were in Element 34 while progressing recommendations 2 and 3. Data should cover both financial expenditure and non-financial outputs on activities undertaken and not undertaken. Financial expenditure and non-financial outputs data should not only be collected, but also monitored, reviewed, and interrogated to ensure that it accurately reflects expenditure.

Justification

It was observed that the element manager for each district proposes that Element 34 funding allocation is based on the activities. The element leader reviews the element manager's proposed funding allocation and assigns their own allocation for the activities. This makes up Element 34 funding for the district and takes into consideration overall Element 34 funding for all districts. Once the funding is allocated to the district, the element manager decides how the Element 34 funds are spent, taking into consideration the needs of the transport network.

To aid future planning, key data is needed. The investigation identified the need to keep data on expenditure, the activities undertaken and those not undertaken. Expenditure and activities undertaken in one year may not apply in the following year. It would be appropriate to collect data over 4 years (in line with a 4-year outlook) to establish averages and trends.

As there is potential for financial data to be incorrectly assigned to cost codes, financial and expenditure data should not only be collected but also monitored, reviewed, and interrogated to ensure that it accurately reflects expenditure.

This will help shape policy for Element 34 activities both in the initial policy set-up and ongoing review (refer to Section 6.2.2). It would also help to establish and review prioritisation settings (refer to Section 6.2.3). Ultimately this will help to ascertain how much funding should be allocated to Element 34.

Consideration needs to be given to assuring that the funding needs for districts that are responsible for the provision of services to other districts continue to be reviewed and where appropriate are properly allocated. For example, the needs and allocation process for Network Operations funding needs to consider the value of providing TMC services to the entire state, which are delivered by the South Coast District.

6.2.5 ITS FUNCTIONAL REQUIREMENTS

Recommendation

It is recommended that TMR review, refine and develop functional requirements for ITS solutions and capabilities deployed and maintained on the road network as part of Element 34.

Justification

The design of ITS in the industry is not consistent, including in price, quality, and capability. This makes it hard for the districts to assess tenders in accordance with procurement processes, as assessors need to consider the quality and capability of the product along with the cost.

There is a need for TMR to review, define and develop functional requirements for ITS equipment deployed and/or maintained on the road network as part of Element 34.

In addition, TMR needs to define how ITS devices and their capabilities contribute to the overall ITS solution, and what value the solutions provide to the road network and its users. This needs to take into consideration the benefits and the risks. For example, the rollout of ITS solutions may assist with solving a traffic congestion issue but the introduction of additional electrical assets on the road corridor provides a maintenance and safety liability (to both road maintenance personnel and road users) if not appropriately maintained, designed, and installed within and/or above the road and/or roadside environment.

Consideration should be given to the unique requirements, including environmental, the remoteness of districts and the potential for vandalism. It may be appropriate to establish base functional requirements for TMR but modify them for district groupings per region, for the regions specified in Section 6.2.

6.2.6 DEFINE FUNDING

Recommendation

It is recommended that TMR define what work activities under Element 34 are funded. It should also provide clarification on which work activities are not funded where there may be confusion amongst the districts. Funding should be defined in the context of the outcomes of recommendations 1 to 5.

Justification

Before determining performance benchmarks and intervention levels for Element 34 activities there is a need to define how much TMR is prepared to assign to the activities. That is, funding should be defined in the context of the policy that defines activities, the prioritisation of activities, data associated with the activities undertaken and not undertaken, and the ITS functional requirements. The available funding will influence the performance benchmarking and intervention levels assigned.

With the new restructure being roll out in 2021–22, as outlined in Section 6.2.1, funding should be allocated per element and per district.

There is a need for greater transparency of what is and is not funded under the Element 34 program and ultimately the new road operations element suite following the restructure. Collecting data (refer to recommendation 4) and making it available and accessible for all districts can assist in providing transparency on what work activities are being funded across the districts as part of Element 34. Funding across the districts should continue to be categorised for all in-scope work activities. TMR should continue to review and interrogate the data to identify anomalies and provide clarification on work activities which are not funded under Element 34. This is where there may be confusion amongst the districts and where work activities may be mistakenly funded under Element 34 which may fall under another funding scheme.

6.2.7 PERFORMANCE BENCHMARKING

Recommendation

It is recommended that TMR establish performance benchmarking and intervention levels for the activities that were in Element 34 and will be redistributed to the new road operations suites following the restructure. This should take into consideration proactive and reactive delivery of work activities.

Justification

Once the policy, prioritisation, data on activities and defined funding have been established as outlined in Sections 6.2.2 to 6.2.6, performance benchmarking can then be determined. It is important that this is done at this stage as the policy, prioritisation, data on activities and defined funding all influence how extensively activities can be undertaken within the district. Available annual funding determines how much of the activity can be undertaken within a year. This in turn influences the performance benchmarking and intervention levels for the delivery of the Element 34 activities.

Establishing performance benchmarking and intervention levels should take into consideration proactive and reactive delivery of activities. Reliability-centred maintenance, which is the application of engineering principles to manage the consequences of failure under a constrained maintenance budget, will assist with this. In addition, the outcome of the following 2 NACOE projects may provide insights on proactive maintenance of ITS devices:

- Project A35 – Identification of residual risk for each element and development of a funding allocation methodology of elements (Year 3).
- Project A41 – Benchmarking asset management practices and developing improvement actions.

6.2.8 ONGOING REVIEWS

Recommendation

It is recommended that TMR undertake ongoing reviews of the associated policy, prioritisation, data collection, funding and performance benchmarking and intervention levels due to the evolution of ITS. This will help to ensure that the Element 34 activities are delivered as required (do the activities that TMR need to do, and do not do the things that TMR do not need to do).

Justification

There is a need to undertake ongoing reviews of the policy, prioritisation, the defined funding, and the assigned performance benchmarking. This is because activities can be altered with respect to their cost and risk profile, and the benefits and performance associated with the delivery of activities within Element 34.

The ongoing reviews will help to focus Element 34 funding and help to ensure that TMR delivers the required Element 34 activities. For example, review of policy prioritisation, the defined funding and the assigned performance benchmarking associated with help phones. This includes consideration of the removal of help phones where mobile phone coverage is good and the maintenance of those installed in locations with poor mobile coverage. The collection of data will assist in the reviews.

A key impetus to continually undertake such reviews is that technology associated with Element 34 evolves and therefore the cost profiles, risks and assigned performance benchmarking will change. Some of the key technologies that are expected to evolve and impact Element 34 funding include the following:

- Smart LED street lighting – may have an overall positive impact on electricity charging and maintenance.
- Next-generation traffic signal controller rollout – may have an impact on network optimisation and is expected to reduce the cost of maintenance of traffic signal controllers.
- Connected road users – may have an impact on the need to deploy, operate and maintain many ITS devices on the road network such as VMS.

For the emerging technologies, the review needs to take into consideration:

- availability of the technology
- uptake of the technology by the public (for technology such as entities associated with connected road users)
- deployment of technologies by TMR (for technologies such as smart LED street lighting and next-generation traffic signal controllers)
- resource implications of new and more complex (i.e. increasingly integrated) ITS solutions.

Ongoing reviews will identify the status of such evolutions and provide an appreciation of the impact of Element 34 funding in the future.

7 CONCLUSIONS AND RECOMMENDATIONS

TMR utilises a performance-based management system for the planning and delivery of maintenance, preservation, and operation activities on the state-controlled road network.

Element 34 is one of the 23 elements under the MPO element management framework. It is responsible for funding the activities for operating the road network, including funding for operational systems and assets.

The overall objective of Element 34 is to fund the safe and efficient operation of the state-controlled road network through operational services, maintaining traffic signals and intelligent transport systems, and operating traffic systems.

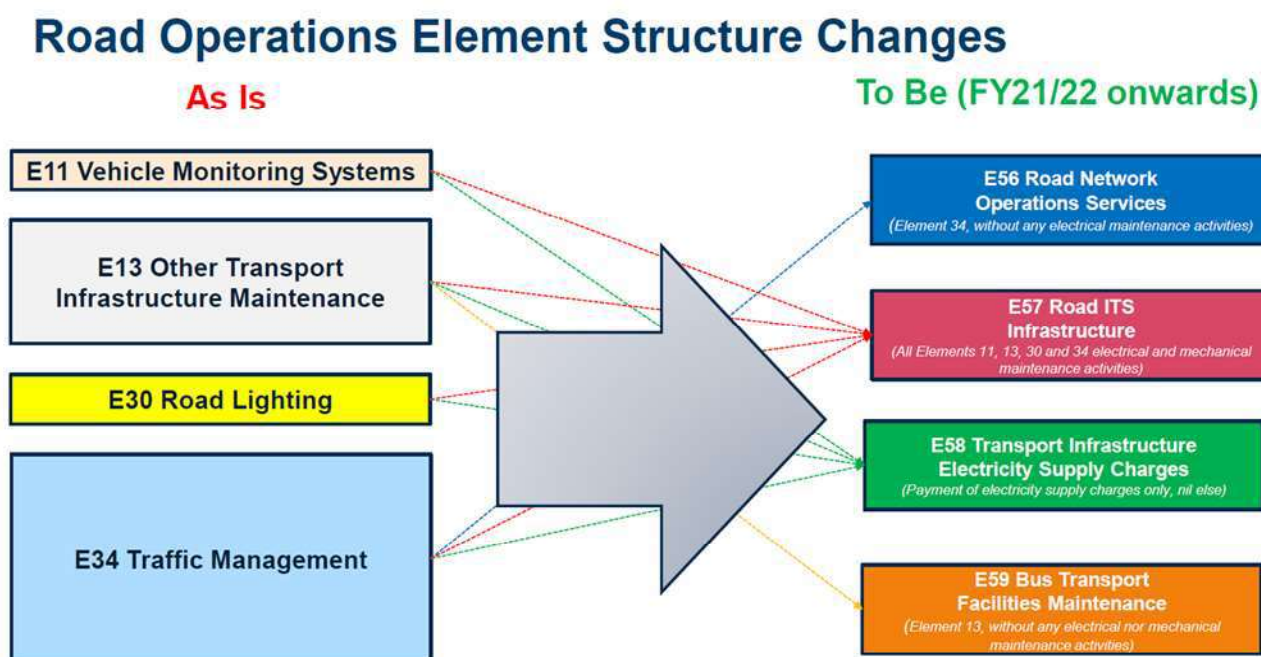
Overall, the project has found that Element 34 comprises a set of complex and diverse activities and tasks. Many are not related to one another (e.g. traffic incident management, ITS maintenance and traffic data collection). Much of the funding within districts is being directed to activities that are perceived by them to be imperative such as electrical safety inspection and incident management. This results in a deferral of activities that are of a lower priority and restricts the ability to undertake reactive and proactive maintenance. Also, Element 34 expenditure and needs vary significantly across districts.

This project confirmed the need to restructure the program with activities that are currently in Elements 11, 13, 30 and 34. TMR has already proposed that the activities be reallocated as follows:

1. Element 56: Road network operations services
2. Element 57: Road ITS infrastructure
3. Element 58: Transport infrastructure electricity charges
4. Element 59: Bus transport facility maintenance.

Figure 7.1 shows in broad terms how the restructure may work. A more detailed illustration is shown in Figure 2.1.

Figure 7.1 Overview of the road operations element restructure



Source: Causley (2021).

The project has confirmed that the restructure would be appropriate as it better locates similar activities into the element groups. This would make budgeting and expenditure more effective as a clearer focus can be applied to activities such as bus facility maintenance, ITS maintenance, electricity charges and operational

services. It is also proposed that traffic data collection field services are located in the state-wide data collection Element 70.

Once the restructure is implemented, further work on investment policies and principles for the new elements should be undertaken to better determine the funding requirements for each work activity. This would help to establish intervention levels.

It is critical to maintain good data on expenditure within activities along with data on outputs delivered and activities not delivered due to other priorities. This will aid forward planning and expenditure forecasting.

7.1 RECOMMENDATIONS

The investigation identified 8 key recommendations for TMR's consideration and implementation.

It may not be necessary to implement the recommendations uniformly across the TMR network. Instead, it may be more appropriate to apply them specifically for districts within regions with similar road network operation challenges.

The first recommendation is associated with a restructure of Element 34. The subsequent recommendations apply to Element 34 itself. They also apply to the work activities that were in Element 34 and will be redistributed to the new road operations suite following the restructure. It is recommended that TMR:

1. Continue to finalise the restructure of the road operations suite of elements.
2. Review, refine and develop further investment policies and principles for work activities that were in Element 34.
3. Review, refine and develop further the investment prioritisation approach for work activities that were in Element 34. This includes better articulating what can be afforded and what is really needed. This will help to make sure that the outcome that is expected is in accordance with the Department's priorities.
4. Improves efforts to collect data on the activities that were in Element 34 while progressing recommendations 2 and 3. Data should cover both financial expenditure and non-financial outputs on activities undertaken and not undertaken. Financial expenditure and non-financial outputs data should not only be collected, but also monitored, reviewed, and interrogated to ensure that it accurately reflects the expenditure.
5. Review, refine and develop functional requirements for ITS solutions and capabilities deployed and/or maintained on the road network as part of Element 34.
6. Define what work activities under Element 34 are funded. TMR should also provide clarification on which work activities are not funded where there may be confusion amongst the districts. Funding should be defined in the context of the outcome of recommendations 1 to 5.
7. Establish performance benchmarking and intervention levels for the activities that were in Element 34 and will be redistributed to the new road operations suite following the restructure. This should take into consideration proactive and reactive delivery of work activities.
8. Undertake ongoing reviews of the policy, prioritisation, data collection, funding and performance benchmarking and intervention levels due to the evolution of ITS. This will help to ensure that the Element 34 activities are delivered as required (do the activities that TMR need to do, and do not do the things that TMR do not need to do).

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