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Considerations in Preparing Strategy Options for Deteriorating and Ageing Bridges

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Small Bridges Conference 2017

Outline

- Background
- What is a Preservation Strategy
- Rooney Bridge Case Study
- Development of Preservation Strategies
- Key Messages
- Conclusions

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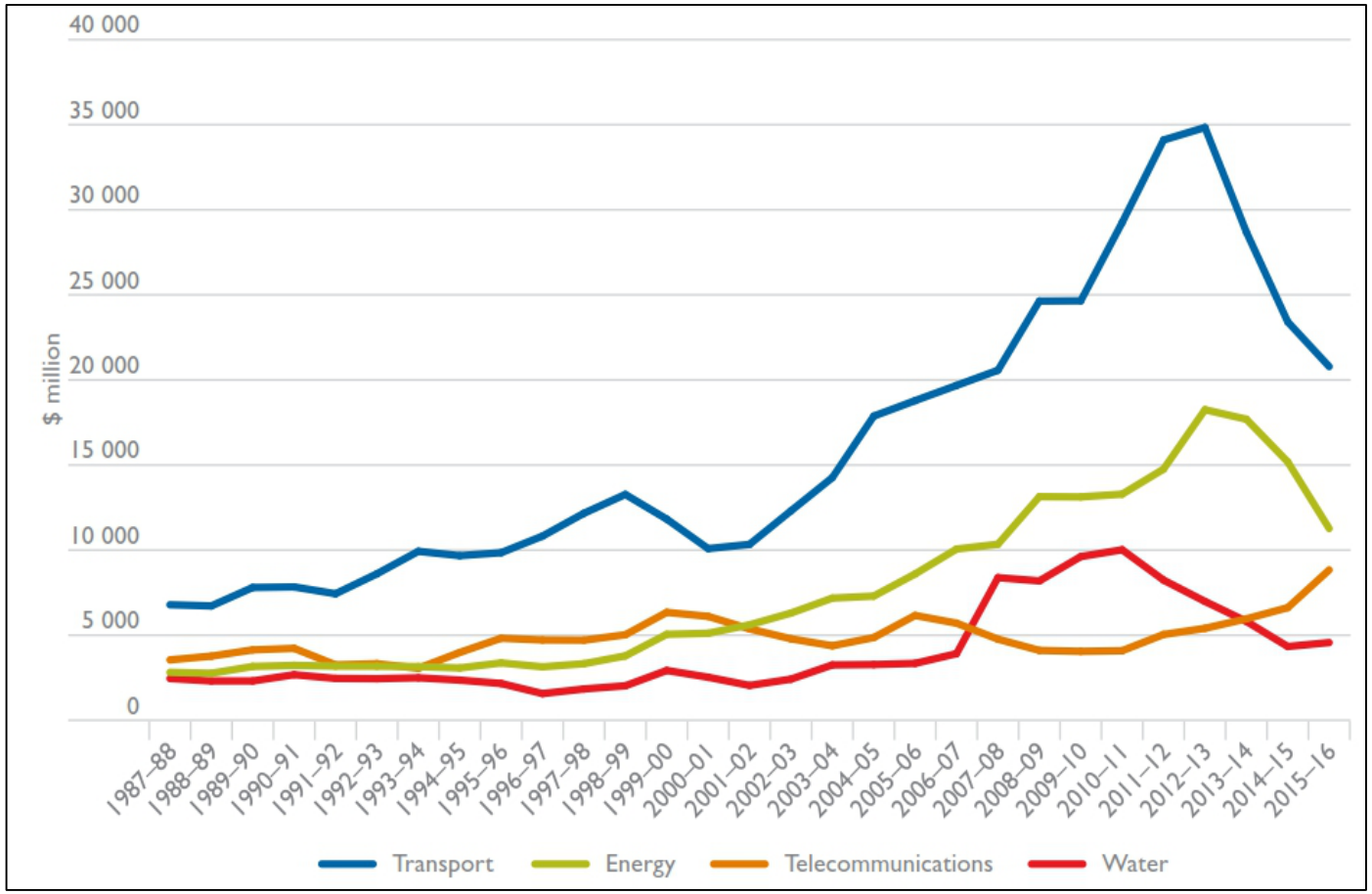
Background

- Diverse range of infrastructure assets
- Increasing level of new infrastructure
- Increasing pressure is being exerted to ensure assets are safe and reliable
- Budgets for capital and operational costs are increasing but are still limited
- New assets are also being created which will add to the future budget required for infrastructure maintenance
- Maintenance budgets for bridges up to $550M per annum in 2015/16
- Bridge Maintenance backlog rising: >$100M (WA, 2012)



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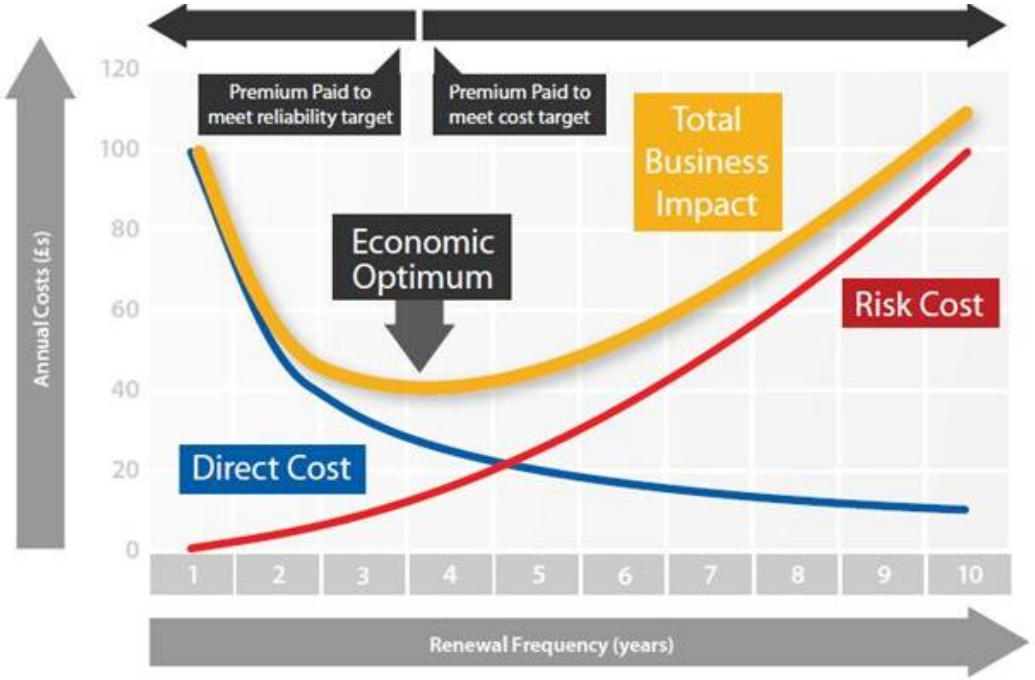
What is a Preservation Strategy?

- Balance of required service levels and maintenance budgets
- Pressure is being exerted on existing assets (and asset managers) to exceed the original design life
- Increased focus required to prioritise maintenance: strategic approach to move away from condition to functionality
- Preservation Strategies becoming increasingly significant
- Objective: to employ cost effective treatments at appropriate time to maximise useful life
- Challenge: TMR manage approx. 3,000 bridges (circa 1960-70)



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Case Study – Rooney Bridge

- Located on key residential and commercial route from Ring Road to Townsville CBD
- Rooney's Bridge – 16 span (200 metres long), steel and concrete construction
- Constructed 1950, major refurbishment in 1976 and 2002
- Level 2 Inspection (2016) – Poor condition assessment:
  - protective coating failure and significant corrosion
  - severe cracking, spalling, reinforcement corrosion

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Rooney Bridge – Steelwork Condition

- Corrosion was identified in the steel girders, bearings, and headstocks
- Steel girders – onset of corrosion observed but good overall condition
- Steel headstock – corrosion concentrated at the ends of the headstock and section loss of the stiffeners
- Steel bearings – Significant levels of corrosion at expansion joint bearings: leaking water main

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Rooney Bridge - RC piles

- Cracking and spalling
- Exposed corroding reinforcement
- Previous history of similar issues:
  - pile encasements
  - crack injection
- Saltwater environment
- Underwater inspection

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Rooney Bridge - Preservation Strategies

- Historic deterioration rates
- Structural assessment identified critical components
  - Girders have sufficient capacity
  - Corrosion of ends headstocks not part of direct load path from the superstructure
  - Piles: sufficient for vertical loads; sensitive to corrosion losses in bending
- Corrosion reinforcement at headstock connection potential to compromise pile integrity
- The most severe cases of corrosion were found to coincide with water leakages

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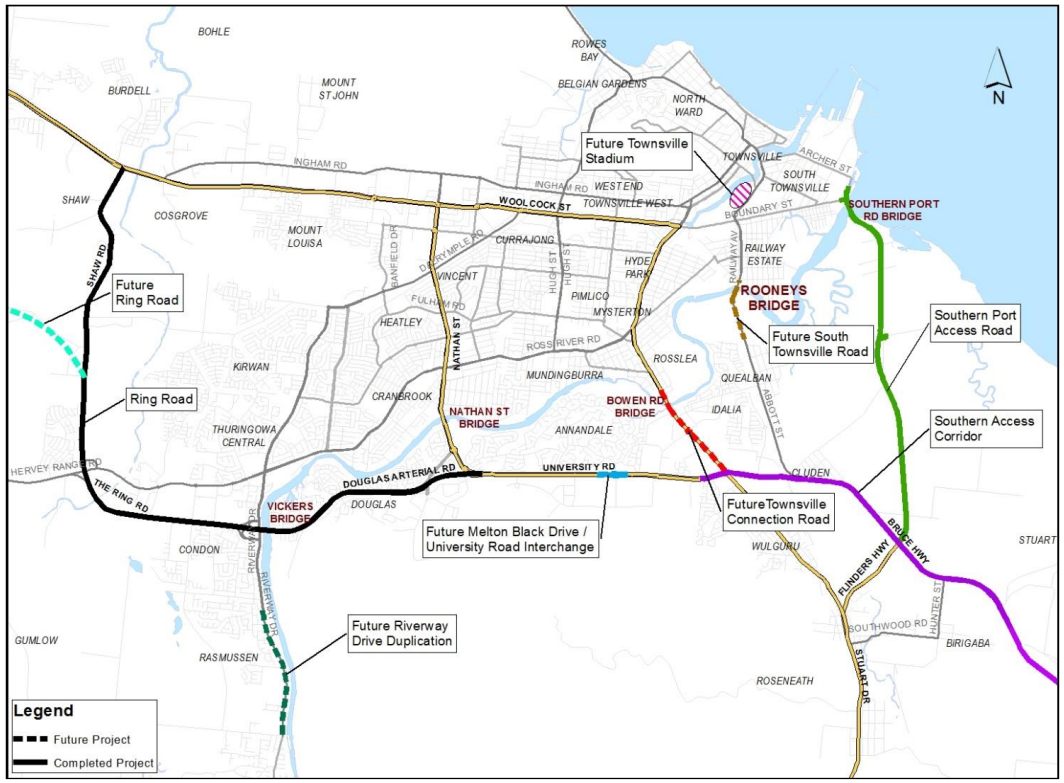
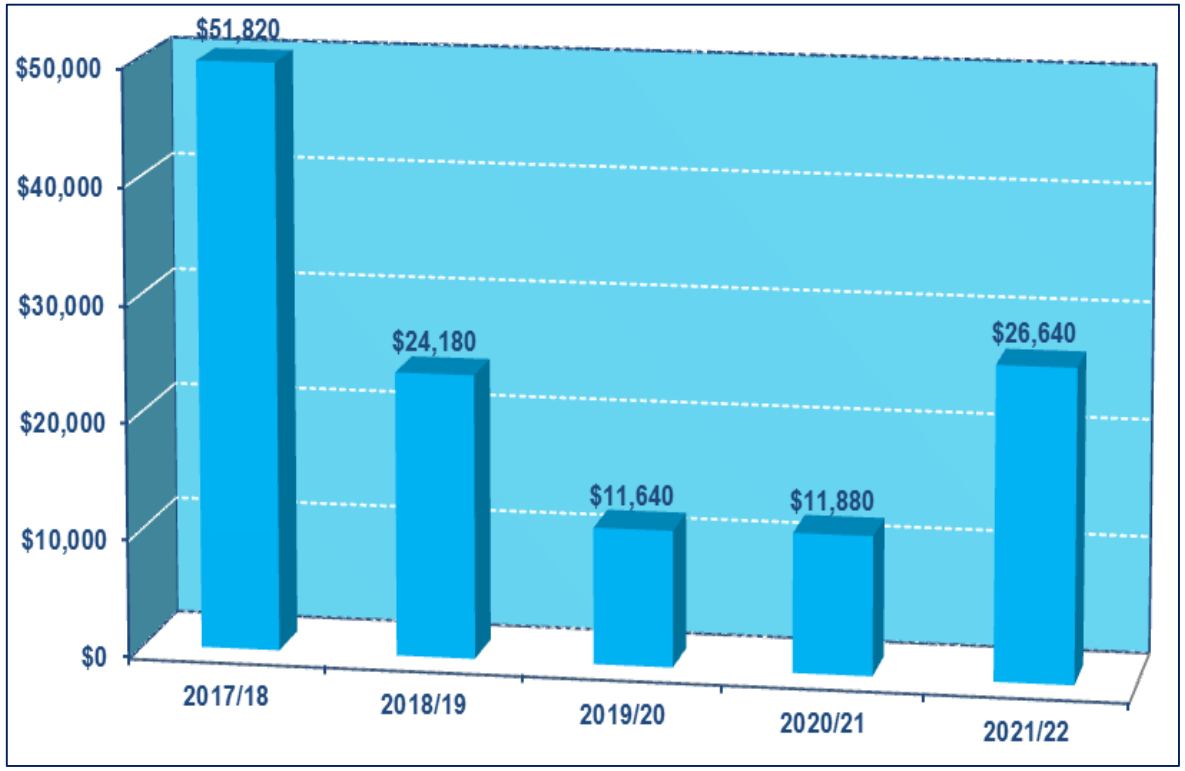
Rooney Bridge – TMR Objectives

- Planned further development in area:
  - residential
  - commercial
- Increased traffic volumes – route upgrade
- Reported in poor condition:
  - full re-paint
  - pile encasement
- Understand potential options:
  - replace as part of upgrade
  - retain within upgrade and replace at later date



Rooney Bridge - Preservation Strategies

- Short-term (5 year) preservation strategy
  - replace bridge in future upgrade
  - minimal capital expenditure
  - inspection & monitoring focus
  - heavy vehicle management



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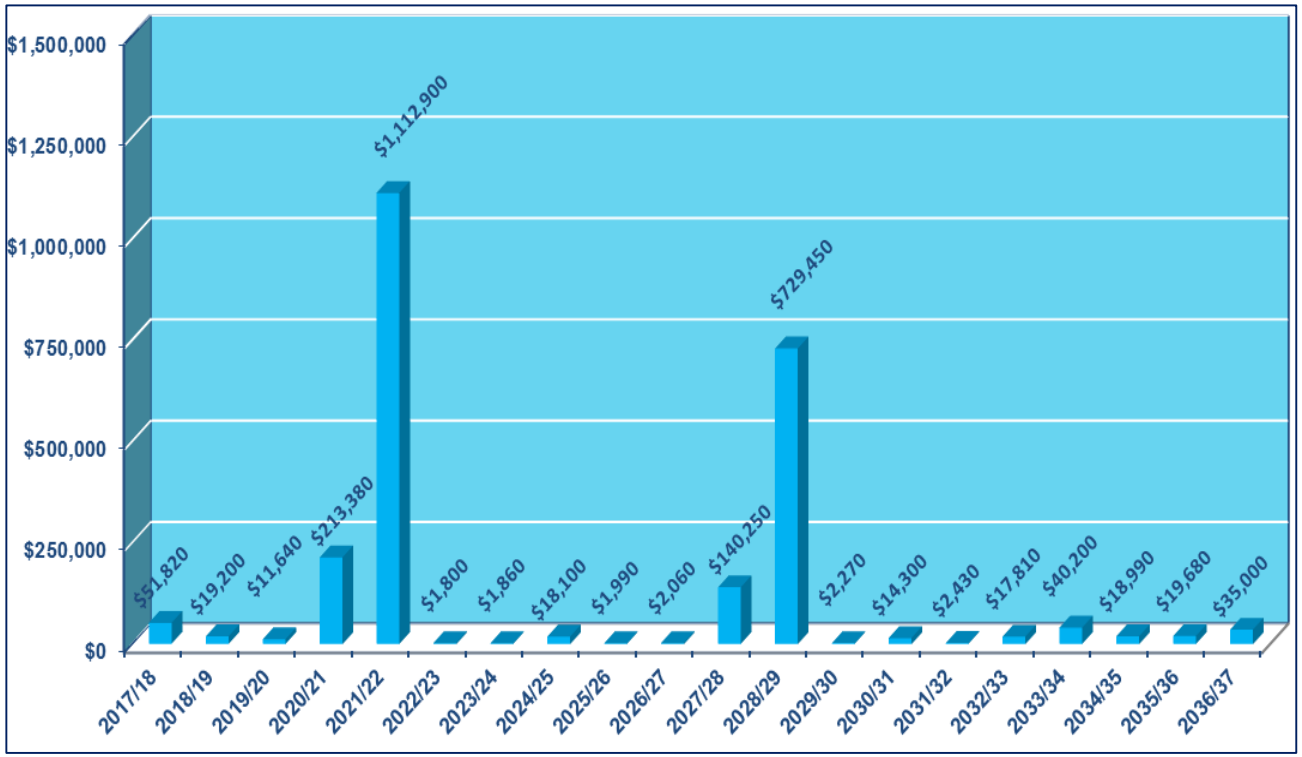
Rooney Bridge - Preservation Strategies

- Long Term (20 year) preservation strategy
  - retain bridge in future upgrade, replace after 20 years
  - deterioration predictions
  - decisions based on functionality rather than reported condition
  - defect prioritisation
  - targeted maintenance focus
  - two large scale interventions, to reinstate condition-poor critical elements and then other elements



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Rooney Bridge – Multi Criteria Analysis

- Purpose: to establish the optimum maintenance solution
- Comparative assessment across a number of criteria:
  - Potential life of repair
  - Need for any ongoing works
  - Relative cost
  - Environmental issues
  - Constructability
  - Reliability of repair
  - Effect on level of service

Description	Rating	Rank
Do Nothing	40%	4
Full blast and re-paint	66%	2
Blast and re-paint steel girders	62%	3
Targeted blast and re-paint at piers	72%	1
Clean and over-paint existing (all steel)	35%	6
Targeted clean and over-paint	39%	5

Description	Rating	Rank
Do Nothing	42%	5
Pile Encasements	62%	2
Crack Injection	40%	6
Concrete Repairs	68%	1
Cathodic Protection	57%	3
Silane Treatment	45%	4

- Various options for superstructure and substructure considered

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Development of Preservation Strategies

- As an asset owner, what do you need to know?
  - Route and network priorities
  - OPEX budget
  - How to maintain asset at current level of service
  - Required service life
- As an asset owner, what information do you need to answer this?
  - Accurate historical data
  - Condition: current and projected
  - Current level of service
  - Environmental factors, i.e. durability
  - Deterioration rates
  - Function of asset
  - Load capacity
  - Higher risk components

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Key Messages

- Understand the significance of condition on level of service
- Optimisation of budget against priorities
- Prioritisation to inform repair recommendations
- Know the critical components
- Establish the required service life
- Know the structure, risks and constraints
- Use engineering judgement

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Conclusions

- A wide variety of strategies can be used for the design and management of assets
- For new assets, balance of CAPEX and OPEX needs to be considered
- For existing assets, maintenance costs need to be optimised against priorities
- Understand impact of deterioration on structural capacity
- Understand what defects can lead to a decrease in levels of service
- Optimise extent of future intervention

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Thank you on behalf of
Dr. Torill Pape (AECOM)
and
Dr. Shunqing Cai (TMR)

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