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Submission Cover Sheet

Inquiry into Auditor-General Report 8/2021 - Canberra Light Rail Stage 2A: Economic Analysis

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SUBMISSION TO THE STANDING COMMITTEE ON PUBLIC ACCOUNTS – INQUIRY INTO AUDITOR-GENERAL'S REPORT 8/2021 - CANBERRA LIGHT RAIL STAGE 2A – ECONOMIC ANALYSIS

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Dear Mrs Kikkert

Thank you for your invitation to prepare a submission to the inquiry, detailing my 'view of the economic analysis conducted by the ACT Government for Canberra Light Rail Stage 2A, as well as the contents of the Audit Report'.

My comments are based on my experience in economic analysis as a consultant to various Australian governments and international organisations, as an academic teaching at ANZSOG and a Masters level course in Cost-Benefit Analysis at the ANU Crawford School, I have also held senior positions in Commonwealth Government departments including The Treasury, Communications, Transport and Regional Services, and the Bureau of Transport Economics.

A comprehensive, detailed analysis of the Major Projects Canberra (2019) Business Case and the ACT Auditor-General's Report (8/2021) would be unduly time consuming, particularly because of the redacted and opaque presentation of information in the Business Case. My comments are therefore focused on the readily available material relating to economic analysis in chapter 7 of MPC (2019) and the A-G's (2020) comments.

The ACT Government uses the term "light rail", although the distinction between light rail and "tram" is not a fixed one, with different usage in other countries at different times (https://en.wikipedia.org/wiki/Light_rail). Trams are generally associated with at least some travel along road lanes. I have used the term "tram" for brevity, and because the light rail system does not rely on a dedicated way separated from public streets for its entire length (e.g. the west side of London Circuit: section 5.7.1).

Economic Analysis, especially in the form of Social Cost-Benefit Analysis, is not unlike a mathematical proof in its structural presentation. It desirably follows a series of sequential steps that ensure internal analytical consistency and logical flow. The nine steps used below are a standard checklist of issues that a rigorous Cost-Benefit Analysis could be expected to

cover. Further detail is available in Dobes et al. (2016, ch. 4). Most academic texts use a similar classification: for example, Boardman et al. (2018).

1. Specification of the objective of the policy or project

Clarity of the objective of a proposed policy or project is self-evidently essential if the economic analysis is to remain focused throughout on a specific outcome. In the case of a transport project, a broad objective may be to reduce travel times, or increased ease of access to services (etc) by residents. If the benefit to society as a whole is to be maximised, then at least the key feasible alternative projects should be analysed and compared to determine which one yields the greatest difference between social benefits and social costs.

To ensure the realism of the projects being considered in an economic analysis, identification and discussion of geographic, budget, technological, time, legal, or other constraints is also desirable.

The MPC (2019, p.6) Business Case states that it 'has been developed on the basis that light rail is to be developed between the City and Woden as soon as possible', and the "Options Analysis" (section 1.6) only considers several potential tram routes along a 'north-south light rail spine' (p. 10). No alternative modes of transport are considered, despite an overarching project approach by the ACT Government to 'improve transport accessibility by providing more convenient, reliable and high-quality public transport services that better connect Canberrans, while supporting opportunities for urban renewal across the territory' (p. 6).

Lack of analysis of alternative modes means that the Business Case is flawed. This is of particular concern in the light of an ACT Government (2012, Table 12, p. 34) economic study of the City to Gungahlin Transit Corridor found that the Net Present Value of a Bus Rapid Transit solution was $243.3m for a Business as Usual Land Scenario and $939.1m for a Higher Density Land Scenario (in $2011 using a 7 per cent per annum discount rate). The respective Net Present Value results for Light Rail were $10.8m and $701.1m. It would certainly be valid to ask why a similar analysis could not be carried out for the City to Woden link or the entire Woden to Gungahlin link, both with existing buses, and electric buses on an O-Bahn model that made use of the existing concreted median strip on Northbourne Avenue and elsewhere.

In the absence of any comparison of potential alternatives such as a mini-bus network, expanded services by existing buses, trackless trams, an electric bus O-Bahn network, etc, there can be little confidence that the Business Case (2019) can identify the best possible transport system based on economic analysis. However, given that the ACT Government has already taken a decision to proceed with a tram on a specific route, it may have been more appropriate to simply undertake a Cost-Effectiveness Analysis to determine the financially cheapest means of constructing it.

The Business Case (2019, clearly identifies and discusses the potential constraint of the need to obtain complex planning approvals for a tram route through the Parliamentary zone (p. 11), as well as the need to raise London Circuit and build a new bridge across Parkes Way (p. 15). However, there appears to be no substantive discussion of potential budgetary constraints or opportunity costs to the Canberra community if funds need to be diverted away from other government services such as health or education.

The ACT Auditor-General's Report (8/2021) does not appear to have addressed the need for a comparison of Stage 2A with alternative modes of transport; focusing solely on light rail. However, it does consider constraints such as the need to achieve grade convergence between London Circuit and Commonwealth Avenue.

2. Specification of "Standing" and the scope of the analysis

Definition of the "standing" or jurisdictional perspective of an analysis is an essential step, because it determines whose costs and benefits will be counted.

Most states and territories appear to (implicitly) adopt a local, rather than a national perspective, but this can result in ambiguities and uncertainties that the analyst needs to declare and resolve. In the case of the Stage 2A or 2B tram route, adoption of an ACT perspective may be logical, although it could also be somewhat spuriously argued that the tram's route across the Commonwealth's territory makes it an interstate or national project.

However, if a considerable number of passengers are from Queanbeyan, should their costs and benefits be counted too? If a financial contribution is received from the Commonwealth Government, ACT residents will receive a benefit, but residents of Queanbeyan, as well as those in other states, will effectively bear some of the costs in the form of income tax collected by the Commonwealth. Adoption of a purely ACT perspective would ignore the cost to Queanbeyan residents, but would count any external benefit to the ACT. A national perspective would treat a financial contribution by the Commonwealth as a transfer payment, with no net benefit or cost recorded.

Most commercially produced cost-benefit analyses fail to define from the outset the "standing" or jurisdictional perspective from which the analysis is to be undertaken. Failure to do so can result in non-trivial errors in subsequent sections of the analysis.

For example, the Capital Metro Agency (2014) business case for the Stage 1 tram project from Civic to Gungahlin did not explicitly define the standing adopted, but its implied objective (e.g. p. 69) was greater economic growth and job creation in the ACT itself. Unsurprisingly, this study – in a subsequent step – erroneously included as a benefit the additional tax revenue from an assumed larger workforce (Table 28, p. 102), even though income tax accrues to the Commonwealth Government, rather than to the ACT.

Neither the MPC (2019) Business Case nor the A-Gs Report (8/2021) appear to have explicitly addressed the issue of standing. An implicit recognition is contained in the MPC (2019, p. 131) comment on 'wider Project objectives', which notes that it may be difficult to monetise factors such as improved connectivity and urban fabric which 'do provide a social benefit to the Canberra community'. Confirmation is provided in the statement (p. 123) that the CBA assesses costs and benefits of transport users, operators, the Government 'and the general community'.

It also appears to be implied throughout that the focus is on the welfare of Canberra residents alone, but an explicit statement is highly desirable in order to avoid potential inconsistencies in the subsequent steps of the analysis. Where non-Canberra tourists are included in passenger numbers, for example, the benefit to them may wrongly be counted in the CBA, although this example is likely to be a minor issue.

ACT A-G (2021) does not appear to explicitly address the issue of standing or its ramifications.

3. Establish a basecase as a reference point for costs and benefits

Specification of the basecase is instrumental in determining costs and benefits. Basecases are variously described as "business as usual", "the status quo option", and "do nothing". The rationale for specifying a counterfactual basecase is to establish a reference point from which the additional social costs and the additional social benefits of the proposed policy or project can be estimated.

If the estimated additional benefits exceed the directly attributable additional costs, then the policy or project is considered to provide a net benefit to the community. Implementation of the project or policy is justifiable, provided that no feasible alternative project or policy would yield a higher net benefit, and there is no relevant budget constraint.

MPC (2019, Table 7-1, p. 126) categorises the development of the Acton Waterfront precinct as part of the basecase. If this is the case, neither the associated additional social costs or additional social benefits of the Acton development should be counted. Somewhat incongruously, p. 127 states that the 'ACT Government has stated that, although the Acton Waterfront development may proceed irrespective of the Project, construction of the Stage 2A light rail will accelerate the completion of commercial and residential developments in the precinct. As such, this CBA captures the incremental benefits that flow from the accelerated development of the Acton Waterfront'.

Given that the Acton Waterfront project can proceed independently of Stage 2A, it is a matter of judgement whether the Acton and tram projects should be assessed separately, or not. Prima facie, it seems that the Stage 2A project should not include any costs or benefits

relevant to the Acton Waterfront project. However, Major Projects Canberra should provide an explicit clarification on the issue, because it will also affect assessment of the Stage 2B analysis and possibly light rail extensions, given the 30-year assessment period specified on p. 134.

Further, it is not clear what additional benefits are to be gained from an accelerated implementation of the Acton Waterfront project if Stage 2A proceeds. Unless there are newly created benefits, the initially projected benefits – as well as amenity costs such as the closure of the south-west cloverleaf to Parkes Way – should simply be treated as occurring at an earlier date. The result may be an increase, or a decrease in the Present Value of the net benefits calculated for the Acton Waterfront project.

Inclusion in the MPC (2019, table 7-1, p. 125) basecase of an assumed London Circuit/Commonwealth Avenue grade connection is difficult to understand. Construction of a ramp or raising London Circuit is essential to allow entry into Commonwealth Avenue from the western part of London Circuit, and its primary purpose is to permit travel by the tram. Even if construction is completed before final work begins on Stage 2 between Civic and Commonwealth Park, the cost is directly attributable to the Stage 2 project. Some justification should also be provided in MPC (2019) as to why the economic modelling assumed an ostensibly cheaper ramp, while the financial analysis was based on raising London Circuit.

Pages 55-56 of Report 8/2021 by the ACT Auditor-General expresses a degree of scepticism about attributing any benefits of the Acton Waterfront development to Stage 2 because it can proceed independently (p. 34), and highlights the paucity of information or justification provided in MPC (2019).

4. Predict the effects of the policy or project over its life cycle

A rigorous Cost-Benefit Analysis would ensure analytical transparency by providing a full list of likely impacts (resources used, benefits gained, and externalities) of all the transport modes considered. A comprehensive list of impacts can be generated by interviewing tram operators, bus operators, construction companies, politicians, as well as focus groups of residents in the ACT and cities such as Melbourne that already have trams. MPC (2019) has not done included a full list in its Business Case, and, in particular, fails to consider the impacts of alternative modes to the proposed tram.

Vague assertions such as ‘Light rail can assist in enhancing the reputation of Canberra as a desirable city in which to live, visit and invest’ (MPC 2019, p. 131) offer little more than political spin. A credible analysis requires explicit specification of the impacts. For example, the phrase ‘in which to live’ suggests that the tram may result in population increase, so an explicit estimate of the expected increase in number of people should be provided. In this case, however, the suggested impact contradicts the modelling assumption

made on p. 129 that the 'Territory-wide population' remains 'constant between the base and project cases'. Given past and projected population growth in the ACT, the assumption of zero population growth is in any case unrealistic.

A period of 30 years has been adopted for the economic analysis by MPC (2019, Table 7-5, p. 134), but no rationale is provided for its choice. It is often the case that consultants, for some inexplicable reason, choose a 30-year period for analysis, but the tram tracks and the way can be expected to last longer than 30 years with regular maintenance. Even with a real discount rate of 7 per cent per annum, a cost or benefit of $1 will still have a present value of five cents 50 years after project commencement.

Ignoring costs and benefits after 30 years would bias the analysis. The residual value reportedly included in year 30 by MPC (2019, Table 7-5, p. 134 and p. 140) is apparently based on a longer period. But it is not clear what additional period has been included in the residual (so-called "horizon") figure, or what it contains. The lack of transparency on this and other issues precludes an informed assessment of the Business Case.

The following is a partial selection of some of the impacts that could have been usefully explored in detail in the Business Case. The following are examples where greater clarity and evidence-based justification is required:

- It could be argued that constructing a ramp or raising London Circuit is a sunk cost if carried out before a decision is taken on Stage 2A. However, a difference in timing may not be an entirely valid rational if the sole purpose of the ramp or grade convergence is to allow Stage 2A. Moreover, the cost may be at least partially recoverable (e.g. sale of the soil fill used to raise the road level), so only the unrecoverable part (e.g. wages of workers) would be a sunk cost. MPC (2019, pp. 125-127) is perplexing, because the basecase includes the assumption that 'London Circuit/Commonwealth Avenue intersection assumed to be grade separated', but an almost identical entry occurs in the project case, with no additional information of where a ramp from London Circuit to Commonwealth Avenue would be situated.
- Consideration of costs and benefits incurred prior to a formal decision taken to proceed with Stage 2A. General administrative costs such as salaries of public servants that cannot be recovered would be treated as sunk costs and excluded from the analysis. However, administrative costs incurred by the public service or politicians from project implementation do need to be included. It is at least arguable the expenditure on drilling and testing soil and bridge integrity on Commonwealth Avenue and London Circuit: should be fully included as a cost because it has produced knowledge that must be used for project implementation.
- Losses or gains to residents due to cessation or rerouting of bus services need to be analysed in detail, particularly where changes are directly attributable to Stage 2A. Section 7.4.2 (p. 137) seeks to include as a saving benefit the avoided cost of bus

services that are no longer required. Unless the loss in amenity to the bus users is also included as a cost, however, this approach will produce a biased result.

- It is not clear how travel time on the tram, a major component of transport user benefits (section 7.5.1.1), has been treated. The final paragraph on p. 139 appears to suggest that the loss to passengers due to longer travel times compared to buses (presumably between Woden and Civic) can be ignored, because other characteristics of light rail such as (presumably greater) comfort will cancel out the increased travel time cost. Such heroic assumptions have no place in a credible Cost Benefit Analysis unless convincing evidence of monetised costs and benefits is provided. An appropriate tool that could be employed is Choice Modelling.
- Closure of the south-western cloverleaf if the Acton Waterfront project proceeds will entail a cost. Noting that The National Capital Authority in its 30 March 2022 media release approved of the closure of cloverleafs, the loss of benefits to existing users should be included in the analysis.
- Inclusion of the travel time cost of vehicle traffic disruption and congestion, and the cost of traffic management during Stage 2A construction and over the rest of the analytical period.
- Loss of business profits in Civic that are experienced by ACT residents during construction due to lack of access by consumers. Loss of profits by non-ACT residents should not be included if the "standing" of the Cost Benefit Analysis has been defined as ACT only.
- Claimed city shaping benefits are essentially speculative and ill-defined. Their inclusion in a cost-benefit analysis would require unambiguous demonstration of causality with respect to the tram. Developments such as the Acton Waterfront project can obviously proceed without Stage 2A. MPC (2019, p. 132) states that it has avoided double-counting (presumably positive) travel time savings and increased land values near tram routes. However, it appears (p. 133) to include as separate benefits 'land value uplift resulting from an increase in densification and infrastructure cost savings'. It is not clear why increased densification should be attributable to a tram route – rather than the alternative of an O-Bahn, for example – when increased densification can be achieved by rezoning land, as already occurs throughout Canberra. Nor is it clear how an increase in land values would be apportioned between increased densification and the proximity of a tram route.
- The value of land such as the median strip on Commonwealth Avenue, or loss of the amenity of parking spots. A future alternative use of the Commonwealth Avenue median could be development of a treed walkway (as for Northbourne Avenue before Stage 1. There is a non-zero opportunity cost to the Canberra community of using the median strip for the tram, so the loss of potential benefit should be included as a cost.
- When a project is funded through increased taxation, the level of economic activity will be reduced because of the negative effect on consumption and/or investment. The resulting loss of social surplus is a deadweight loss. Appendix 7 of Dobes et al (2016) deals with this issue in detail. At least some, if not all, of the Stage 2A costs will ultimately result in higher land taxes or rates in the ACT. This

will induce a deadweight loss which should be included because it will be directly attributable to the project.

- Inclusion of so-called Wider Economic Benefits as a benefit category is highly contentious. The category was initially proposed for large-scale projects such as high-speed rail that would increase the effective workday density of metropolitan cities by affording easier access to workers in exurbs and satellite towns. The increased density is posited to increase the range of job opportunities that better suit each worker's skills, provide employers with greater choice of worker skills, and result in greater exchange of views and information in coffee shops, etc. A detailed analysis is available in Dobes & Leung (2015). It would be stretching credulity well beyond reason to believe that Stage 2A can deliver a large WEB benefit. If it is included, then Major Projects Canberra should disclose fully its methodology and calculations. Moreover, Major Projects Canberra should demonstrate with evidence what Wider Economic Benefits have been generated by Stage 1, to provide a better basis for estimating benefits for extensions of the tramway southwards from Civic.

The MPC (2019) economic analysis fails not only because alternative modes to the proposed tram are not considered, but because it lacks analytical transparency in not providing a full list of impacts (resource use, externalities and benefits generated), with discussion of their relevance and value.

Discussion of the rationale in MPC (2019) for choosing a 30-year analysis period is inadequate. If the tram tracks and the tramway, as well as assumed city-shaping benefits, are longer lasting, a longer period may have been more appropriate. It is likely that the residual value included in year 30 (Table 7-5) and p. 140 takes at least some of this into account, but specific information has not been provided regarding the additional residual period assumed beyond 30 years, or its content in terms of specific costs and benefits.

The ACT Auditor-General's (2021, p. 22) further points out that MPC (2019) has not included the additional cost of providing wire-free vehicles and dual electrical energy infrastructure (p. 33) for Stage 2A and route extensions because of a later decision by the Commonwealth. It rightly considers it to be appropriate (p. 26) for the capital costs to be revised and published by Major Projects Canberra. Inclusion of Wider Economic Benefits by the ACT Auditor-General rightly receives a rather negative appraisal (pp. 56-58), and claimed city-shaping benefits of developing the Acton Waterfront is considered 'not conditional on Light Rail Stage 2a' (p. 56) .

5. Estimate the economic value of the costs and benefits

Economic analysis measures costs in terms of opportunity cost, whereas benefits are generally measured as social surplus accruing to consumers, operators and the government. It is important to note that consumer surplus, for example, is not equal to the fare paid for a trip on the tram. Consumer surplus is the difference between the consumer's willingness to

pay for a trip and the actual fare paid. Seminal texts such as Mishan (1988), Pearce and Nash (1981), Sugden and Williams (1978), Pearce et al. (2006), and Boardman et al. (2018) provide useful guidance.

There are various methods for estimating intangible values such as noise generated by transport vehicles, and "willingness to pay" can be estimated using stated preference techniques such as Choice Modelling. Bateman et al. (2002) provide a comprehensive manual.

Optimism bias is a frequent source of error in Cost Benefit Analysis, both in underestimating costs and in overestimating benefits (see for example Flyvbjerg, 2009). Sensitivity analysis can be useful in identifying potential optimism bias, but it is equally important that care be taken and peer review be used to avoid it. It is equally important to ensure full disclosure of the methods used to generate estimates and to provide access to the data used to permit replicability of results, just as for any scientific investigation.

Resort is often had to so-called "plug-in values" generated by different studies here relevant data are not readily available. This can reduce costs of analysis, but it can also generate seriously erroneous results if the plug-in values used are inappropriate. In this context, it is important to use data that match as closely as possible the project being analysed.

Estimating economic values of costs and benefits is difficult and potentially subject to errors such as optimism bias or use of non-economic approaches. MPC (2019) should provide detailed explanations, backed with data used, to provide confidence in its estimates. In particular, a stated preference technique such as Choice Modelling should be used to estimate the likely patronage for the Stage 2A tram.

One area where Major Projects Canberra could, and should provide factual evidence for asserted benefits is the contentious category of Wider Economic Benefits. (The Capital Metro Agency (2014, Table 29, p. 103) Business Case claimed a present value of $198m – about 20 per cent of total benefits – contribution from Wider Economic Impacts.)

If claimed Wider Economic Benefits are of material value, then they are likely to have been produced in the Stage 1 section of the tram from Civic to Gungahlin, so their actual effect should now be identified and estimated to assist future Cost-Benefit Analyses for extensions of tram routes in Canberra.

ACT A-G (2021, p. 4) identifies an inappropriate use of plug-in values. Patronage and demand forecasts by a Major Projects Canberra consultant were apparently 'based on Household Travel Survey data from South East Queensland, Sydney and Melbourne'. Canberra-based data for Light Rail Stage 1 were not available in 2019 when the MPC economic report was being prepared, so Douglas Economics has reportedly advised that the demand forecasts should be revised using Stage 1 data.

6. Calculate the Net Present Value

It is not clear why so-called "indicative blended Benefit Cost Ratios" that include costs and benefits of the City to Gungahlin route are presented by MPC (2019, p. 123) in the Key Messages box for stages 2A and (2A plus 2B). Combining the results of an existing route with the additional costs and benefits of an extension constitutes the elementary error of confusing average and incremental results, so its purpose in the economic analysis section is not clear.

As Brealey et al (2006, p. 114) point out, it would be risky to invest a large sum in a 20-year old racehorse, simply because it had won highly remunerative prizes, or sired champions at a much younger age. Its winnings over its lifetime are a furphy – what is important is the comparison between the purchase price of the 20-year old horse and its future earning power.

Results in MPC (2019) showing so-called "indicative blended Benefit Cost Ratios" that include costs and benefits of the City to Gungahlin route for stages 2A and (2A and 2B) should be studiously ignored because they are irrelevant to the estimation of social costs and social benefits for Stage 2A. The ACT A-G (2021, p. 37) is more circumspect about blended Benefit Cost Ratios, simply quoting the quaintly diplomatic formulation by Douglas Economics that 'blended BCR is novel'.

Choice of discount rate is always a contentious issue. However, there is no practicable way of determining a "correct" value. An advantage of choosing the 7 per cent per annum real rate by MPC (2019, p. 131) is that it is consistent with usage by other Australian governments, so that different projects can be compared. (However, if different periods are used for similar projects, resort may be required to calculation of Equivalent Annual Values.) Further, the precise choice of discount rate may not be critical if uncertainties associated with estimated or projected costs and benefits are so large that they dominate the analysis.

Use by MPC (2019) of a real 7 per cent per annum discount rate is arguably reasonable because it is consistent with usage by various Australian governments, but ACT A-G (2021, p. 25) reports that Douglas Economics advised that it was 'high by international standards'.

Use of Benefit-Cost Ratios (BCR) can be misleading because they are ratios, and do not therefore reveal the magnitude of a net benefit. Projects 1 and 2 have identical BCRs, but Project 2 delivers a greater social benefit because its Net Present Value (NPV) of 100 is much larger than that of Project 1. Project 3 is similar to Project 1 although its costs are lower, but it has the highest BCR of 1.2 even though its NPV is far smaller than that of Project 2. If the figures presented in the table were expressed in $million, Projects 1 and 3 would probably be of marginal value compared to Project 2.

	Project 1	Project 2	Project 3
Present value of benefits	11	1100	11
Present value of all costs	10	1000	9
Benefit-cost ratio	1.1	1.1	1.2
Net Present Value: net benefit	1	100	2

Source: Dobes et al. (2016, Table 5.2)

In order to present an accurate assessment of the results of its economic analysis, MPC (2019) should ensure that any BCR values that are quoted should be accompanied by the associated Net Present Value. ACT A-G (2021) has separately sourced Present Value figures, and does not appear to have commented on the hazards of relying solely on Benefit Cost Ratios in presenting results to decision-makers.

7. Include risk analysis

It is unclear whether the second dot point 'Subject to P50 contingencies' in MPC (2019, section 7.4, p. 137) indicates inclusion in the economic analysis of a particular cost category. (The preceding financial analysis does allow for contingencies.) It is not correct to include cost contingencies – which are arbitrary, even if based on claimed experience of project cost overruns – in a cost-benefit analysis. Greater effort should instead be applied to estimating the expected level of each cost component, rather than adding a "just in case" lump sum to total costs.

Estimates of the values of individual variables are generally subject to error, often because of imprecise measurement or lack of information, or lack of current data. A risk therefore exists that the overall result for a Net Present Value will be inaccurate. Monte Carlo analysis can be used to take the risk into account. Rather than relying on single values that have been estimated for each variable, the estimates are combined with a probability distribution that reflects the probability with which other values of the variable could occur. Multiple samples from each of the probability distributions results in a derived probability distribution of Net Present Values. Instead of producing a single NPV, the Monte Carlo approach allows decision-makers to assess the probability with which different NPV values will be achieved.

Best practice for incorporating risk in a Cost Benefit Analysis is to employ Monte Carlo analysis. The financial analysis undertaken states that Monte Carlo analysis was conducted (p. 111), but there is no mention of a similar approach in the economic analysis of MPC (2019). ACT A-G (2021, p. 26) discusses contingencies applied in MPC (2019), but does not appear to discuss risk analysis or Monte Carlo analysis per se.

8. Conduct sensitivity analysis

The purpose of sensitivity analysis is to determine whether Net Present Value (NPV) changes significantly when relatively small changes are made to individual variables used to calculate

the NPV. If NPV is significantly changed by a relatively small change (e.g. 5 per cent) in a particular variable, it is considered to be sensitive to the estimated value of that variable. This provides a signal to the analyst to check the robustness of the estimates being used for that specific variable. An NPV value may be sensitive to more than one variable, so sensitivity analysis should be applied reasonably broadly. In the context of Stage 2A, for example, it is likely that NPV will be particularly sensitive to estimates of passenger numbers, the cost of raising London Circuit, and the cost of congestion to cars and trucks.

The sensitivity analysis presented in MPC (2019, Table 7.5.5, p. 145) is either misguided, or deliberately devoid of underlying results for specific cost and benefit variables. To increase or decrease total benefits or total costs by 20 per cent will simply increase or decrease a Benefit Cost Ratio by the same proportion. Table 7.5.5 therefore provides no useful information at all. Further, there appears to be no obvious reason for a need to redact Net Present Values.

9. Conclusions and recommendations

Conclusions and recommendations obviously need to be consistent with the economic analysis undertaken. Where decision-makers wish to take into account other external factors such as job creation or political preferences, they should be discussed separately.

ACT A-G (2021, ch. 4) recommends that 'The Chief Minister, Treasury and Economic Development Directorate (ACT Treasury), in cooperation with Major Projects Canberra and the Transport Canberra and City Services Directorate, should develop a Benefits Realisation Plan for Light Rail Stage 2A'. This is a commendable recommendation because it is an important tool of effective project management.

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21 April 2022

APPENDIX A: Select Bibliography

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