Submission No 13

INQUIRY INTO RAIL INFRASTRUCTURE PROJECT COSTING IN NSW

Organisation: Evans & Peck Pty Ltd

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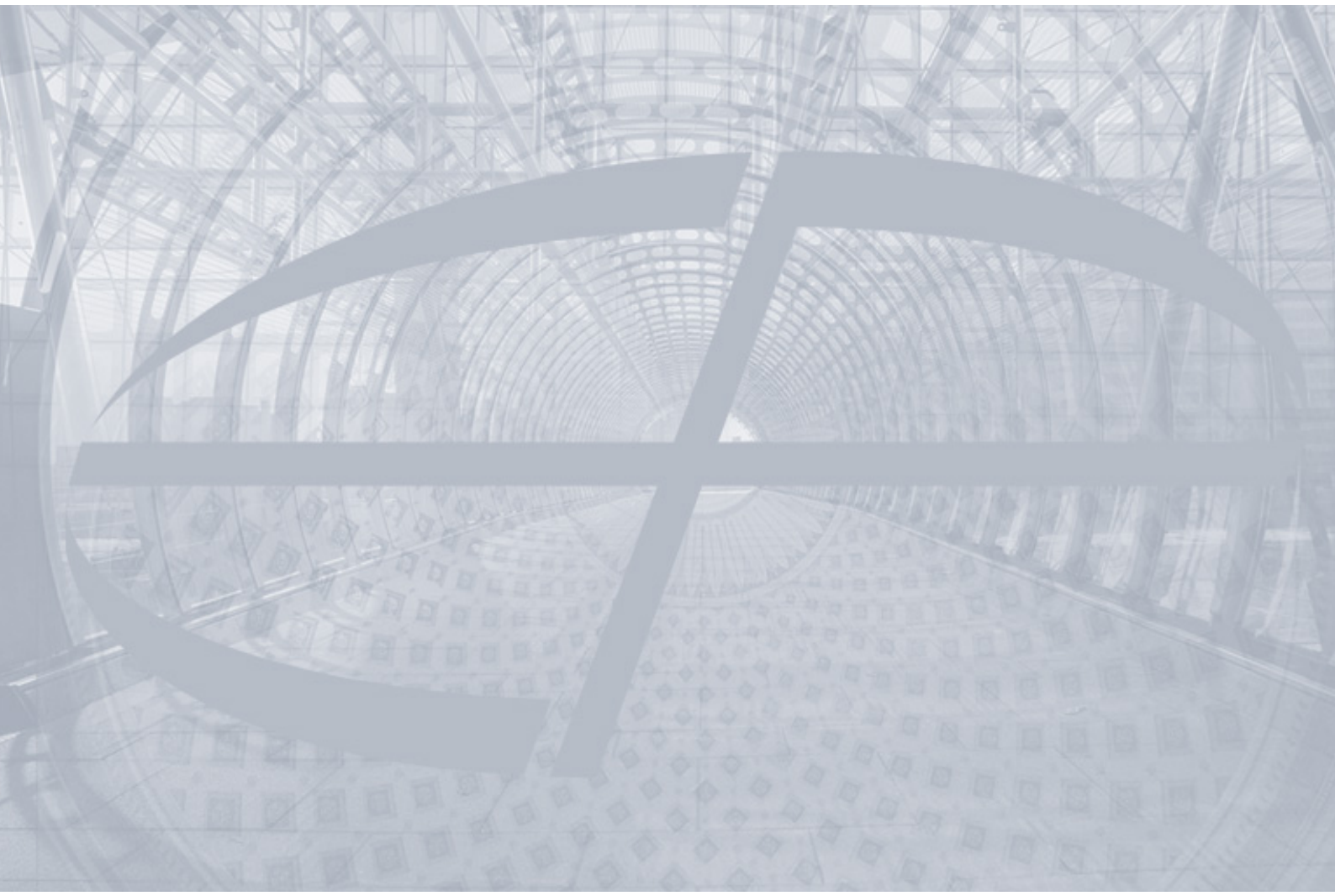

NSW Parliament Legislative Council
General Purpose Standing Committee No. 3

INQUIRY INTO RAIL INFRASTRURE COSTING IN NSW

Submission by Evans & Peck Pty Limited

26 September 2011

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1 INTRODUCTION

1 The Legislative Council General Purpose Standing Committee No 3 has been established by the New South Wales Parliament to investigate the validity of current costing methods used for rail infrastructure project costing by government agencies in NSW.

2 The Terms of Reference for the inquiry are:

> *"That General Purpose Standing Committee No 3 inquire into and report on rail infrastructure project costing in New South Wales and in particular:*
>
> *(a) methodologies used by the Transport Construction Authority, NSW Treasury and other government agencies to cost rail projects,*
>
> *(b) 'concept estimates' for rail projects,*
>
> *(c) the differences between rail and road project costs methodologies,*
>
> *(d) cost estimate methodologies applied in other Australian states, by the Australian Rail Track Corporation and internationally,*
>
> *(e) tendering processes, and*
>
> *(f) any other related matter.*
>
> *That the Committee report by Wednesday 29 February 2012."*

3 Evans & Peck Pty Limited ("Evans & Peck") is familiar with construction industry estimating practices, including having worked with a number of Australian and international rail and road agencies. We are pleased to provide this submission to this inquiry and are willing to appear before the inquiry.

4 Consistent with the terms of reference for the inquiry, this submission discusses the estimating methods used to cost rail projects and associated issues that we expect may be of assistance to the inquiry. Comparisons are drawn with the methods used to cost road projects where appropriate.

5 Our submission to the inquiry is limited to costing methods used for fixed rail infrastructure. Our comments are relevant to items (a) to (d) of the Terms of Reference. Whilst Evans & Peck has expertise in tendering processes and many other aspects of the formulation, procurement, delivery, integration and commercial resolution of rail infrastructure projects, our submission is limited to comments on estimates and does not include commentary on tendering processes or other related matters.

2 EVANS & PECK EXPERIENCE

6 Evans & Peck is a multi-disciplinary business with a track record in providing management and advisory services to the engineering and infrastructure sector since its inception in 1985. Its experience has been built over many water, rail, road, marine, mining and resources projects for the public and private sectors.

7 Providing cost advice for major infrastructure projects forms a key part of Evans & Peck business. We provide our clients with the most realistic range of possible project cost outcomes, taking into account:

(a) the phase of project development;
(b) scope of the works;
(c) the required construction methodologies;
(d) project constraints;
(e) the commercial arrangements under which the construction will occur; and
(f) appropriate allowances for risk.

8 The preparation of realistic cost estimates for complex projects is a capability in which Evans & Peck is widely recognised by industry.

9 Our cost estimating experience spans all parts of project planning and delivery, from the initial concept estimates for client bodies and development of detailed estimates to support option selection, through to the assistance in preparation of tenders for contractors. Major government clients for whom Evans & Peck has provided estimates for transport projects include:

(a) The Transport Construction Authority (TCA) and its predecessor organisation Transport Infrastructure Development Corporation (TIDC);
(b) RailCorp;
(c) Roads and Traffic Authority NSW (RTA);
(d) Sydney Ports Corporation;
(e) Road and rail agencies in Australian states other than NSW; and
(f) Road and rail agencies internationally.

3 FEDERAL GOVERNMENT BEST PRACTICE COST ESTIMATION STANDARD

10 Evans & Peck was engaged by the Federal Department of Infrastructure, Transport Regional Development and Local Government in 2008 ("DITRDLG") to undertake the creation of a best practice standard for cost estimating, for road and rail projects for which Australian Government funding was being sought.

11 DITRDLG's key objectives were to improve cost estimation practices for road and rail projects and to ensure that the government received funding requests that were backed by reliable cost estimates, presented in a consistent structure.

12 The research work undertaken in association with DITRDLG highlighted that agencies in all states were experiencing issues in the way estimates for road and rail projects were prepared and recognised the need for improvement.

13 The resultant document, the *Best Practice Cost Estimation for Publicity Funded Road and Rail Construction* (19 June 2008) (the "Standard") was implemented in 2008 across all state road and rail agencies and is still current, until such time as the revised Standard described below is implemented.

14 The current version of the Standard can be found at:

15 http://www.nationbuildingprogram.gov.au/publications/administration/pdf/Best_Practice_Cost_Estimation.pdf

16 Further tasks carried out by Evans & Peck on behalf of DITRDLG included:

(a) Training state-based rail and road agencies in the Standard (2009); and
(b) Reviews of cost estimation practices carried out by various agencies in all states to assess their compliance with the Standard (compliance reviews) (2010).

17 Outcomes from the compliance reviews identified key areas for improvement which included:

(a) Project scoping;
(b) Compliance with the Standard for the structure of estimate data (Work Breakdown Structure);
(c) Improved use of historical costs and first principles estimating methods;
(d) Ensuring that the required construction methods and staging constraints were incorporated into estimates;
(e) The inclusion of appropriate contractor and client on-costs;
(f) Greater transparency and better practice around determining appropriate contingencies for risk; and
(g) Calculation of escalation allowances to estimate the cost of projects at completion ("Outturn Cost").

18 In 2011, Evans & Peck was engaged by the Federal Department of Infrastructure and Transport ("DoIT"), formerly DITRLDG, to provide technical input and advice throughout the development of the updated version of the Standard. In particular, Evans & Peck provided additional guidance relating to standard Work Breakdown Structures and the application of contingency assessment, reflecting experience with the use of the Standard since it was developed.

19 The updated Standard has been provided to each jurisdiction as a "Proof Version for Jurisdiction Training". It is the Department's intention to publish the document in final form after consideration of jurisdiction comments on the proof version and further review.

20 The updated Standard maintains the principles contained in the current version, supplemented with additional clarification.

21 A copy of the updated Standard, *"Proof Version for Jurisdiction Training"*, is included as Appendix 1 to this submission. It is due for release in late 2011.

22 The Best Practice cost estimating method set out in the Standard reflects the practice that Evans & Peck adopts when preparing cost estimates for rail and road projects for all government bodies throughout Australia.

23 A significant portion of Evans & Peck's cost estimating work in the rail sector in NSW is for the Transport Construction Authority (TCA). TCA requires that estimates prepared by its service providers comply with the Standard.

4 COST ESTIMATION METHODS

4.1 Generally

24 Each project, whether it is a conventional building project or a unique civil infrastructure project, is constructed using methods and sequences which consider the necessary work activities and the context under which those activities are carried out. For the purpose of this submission, the term "civil infrastructure" includes rail, road, water, marine and power projects.

25 Compared to conventional building projects, civil infrastructure projects differ in many aspects and require a different approach to estimating costs, including careful consideration of the construction methods and more rigorous analysis of risk due to the greater uncertainty in scope definition and construction related risks.

26 Experience shows that civil infrastructure projects have a greater exposure to risk compared to conventional building projects. Accordingly, civil infrastructure projects are likely to experience more significant cost increases between the initial estimates prepared at the inception stage and the final costs at completion.

4.2 Rail and Road Project Types and Impact of Type on Cost Estimating

27 Rail and road projects are best understood by considering them as two distinct types:

(a) Greenfields projects; and

(b) Brownfields projects.

28 **Greenfields projects:** The term "greenfields" applies to those projects which are constructed away from the existing operating infrastructure. In the case of rail projects, a new rail line in a new corridor is substantially greenfields construction. Examples include the South West Rail Link, the Epping to Chatswood Rail Link, the Perth to Mandurah Link, or the Alice Springs to Darwin Link. Put simply, greenfields construction projects are not significantly affected by real or potential constraints from existing operational infrastructure except at the connection or crossing points.

29 **Brownfields projects**: The term "brownfields" applies to those projects which are constructed within or alongside operating infrastructure such that the construction sequence, methods and access within the worksite are significantly constrained in some way. In the case of road projects, this might involve construction staging, traffic management, and temporary side tracks to allow regular traffic operations to continue. Examples include the Pacific Highway Sapphire to Woolgoolga Upgrade and the M2 Upgrade in Sydney.

30 In the case of brownfield rail projects, the operator's objectives may include the continuity of rail operations throughout the construction program. Examples include the Kingsgrove to Revesby Quadruplication, Richmond Line Duplication and Southern Sydney Freight Line.

31 The complexity and constraints imposed because of brownfields construction significantly reduces construction productivity compared to greenfields construction and requires significant additional design, construction and management resources, from both the contractor and the client organisations. The resultant cost per track kilometre for a project constructed under brownfields conditions will be significantly greater than the same project constructed under greenfields conditions.

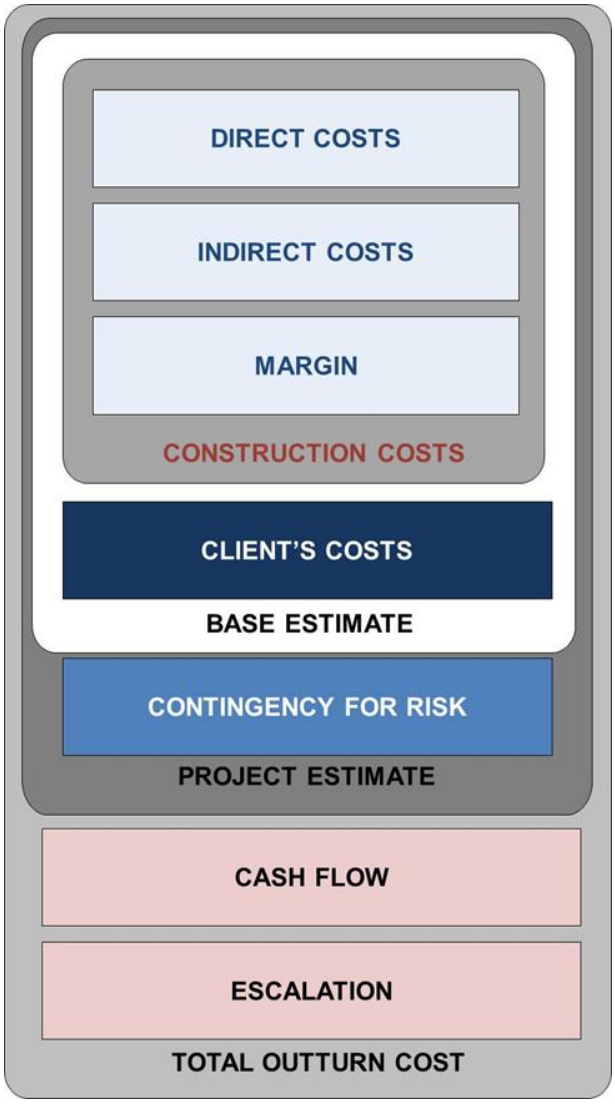
32 All of the Clearways rail projects planned and undertaken to rationalise the Sydney passenger network were required to be constructed under brownfields conditions.

4.3 Estimating Process for Rail and Road Projects

33 The process of preparing cost estimates for rail or road projects is similar. In preparing estimates it is essential to consider the quantity of work required, how the works will be constructed, the works program, the cost of all resources and the risks involved in undertaking the work. Whether it is a rail or a road project, the construction work can range from being reasonably straight-forward as is the case for new greenfield work, to extremely difficult for brownfields work, particularly within built up urban environments, such as construction within the Sydney rail or road network.

34 Cost estimates prepared by delivery agencies are required to be comprehensive and contain all construction and client costs associated with developing and delivering projects.

35 The generic structure required for estimates is illustrated in the following diagram, extracted from the Standard:



36 **Base Estimate**: This diagram sets out the component parts of the estimate in a sequence that separates the Construction Cost and the Client's Costs (including land acquisition). The summation of these two components forms the Base Estimate which is linked to a stated Base Date for estimating purposes.

37 The Base Estimate forms the basis on which the construction risks and client's risks are analysed to determine the project contingency.

38 **Contingency for Risk**: Evan's & Peck's experience is that there is a range of potential issues and unforseen events (risks) that have a significant effect on the construction costs of rail and road projects.

39 These issues and risks need to be thoroughly accounted for in order to achieve realistic estimates. The issues and risks may not be readily foreseeable and therefore it is often difficult to make an accurate assessment of their effects, which highlights the importance of the role that contingency plays in preparing estimates.

40 These issues are not unique to NSW agencies' projects and occur throughout all state and international rail and road projects.

41 **Cash Flow and Escalation**: For major projects, there is normally some years that will elapse between project identification and project completion. The risk and the effect of likely price increases over that time must be estimated, based on the projected project cash flow, to determine an appropriate escalation allowance and therefor the estimated final cost of the project (the "Outturn Cost").

4.4 Key Issues that affect the reliability of Rail Cost Estimates

42 Key issues that affect the reliability of rail cost estimates can be categorised as follows:

(a) Project Scope Issues;
(b) Project Design and Construction Approval Issues;
(c) Construction practice issues; and
(d) Cost certainty issues.

43 Many of those issues are associated with the requirement to develop rail projects under brownfields conditions. Their impact is generally much greater in brownfields projects.

44 In Evans & Peck's experience, these issues are common to rail projects in all other Australian capital cities and internationally.

45 Each of these issues is discussed in more detail in sections 4.4.1 to 4.4.3 below.

4.4.1 Project Scope Issues

46 **Lack of clear objectives and user requirements:** It is not uncommon for rail projects to be identified and costed without clear, documented, operational objectives and user requirements. In the absence of clear objectives, the project scope, procurement methods, design, construction methods, sequences and durations are often developed without the necessary controls in place, leading to cost overruns.

47 **Insufficiently specific or evolving scoping of projects**: It is not uncommon for the scope of rail projects to evolve as the cost of the projects is being estimated. The scoping of projects tends to focus on the key "visible" items that are essential to the functionality of the project. There is often insufficient information, time or resources available to properly investigate the less visible or tangible scope items, such as in-ground services, drainage requirements, ground conditions and temporary works, or to fully define the requirements of rail systems (such as signalling). This can result in estimates that understate the cost of these items or that do not take into account the impact of the associated activities.

48 Particularly in brownfields rail projects, scope often evolves throughout the life of the project.

49 Experienced cost estimators are mindful of these issues and endeavour to either make specific allowances where scoping gaps are clearly evident or to include a contingency for items that may be required.

50 **Design standards**: Particularly in rail projects, the operators' design standards are constantly under review and are periodically revised to achieve improved outcomes. The design standards cover a wide range of issues such as environmental, acoustic, safety, performance, durability and maintenance requirements. Design standard changes can occur at any stage, and they generally result in increased costs. An allowance for potential changes to design standards needs to be considered in the contingency allowance. Alternatively, projects should be quarantined from changes in design standards after the design has been approved, as is common practice in major road projects.

4.4.2 Design and Construction Approval Issues

51 **Design and construction approval process**: Delays by the operator in the design and construction approval process can lead to substantial delays, prolongation and/or disruption to projects during the construction phase with associated increases in cost. Causes of approval process delays include:

(a) a shortage of the rail operator's resources to process applications;
(b) lack of clarity around user requirements, scope and/or applicable design standards;
(c) uncertainty on whether a waiver will be granted or whether a significant upgrade will be required to meet current standards;
(d) delays incurred for each designer to receive Engineering Design Authority from the operator to work on a particular project;
(e) the process of gaining approval from all stakeholders within the operator organisation, which can involve multiple iterations of a detailed design over a number of monthly review periods and can result in options being rejected without direction towards an acceptable solution; and
(f) approved designs which can be later revoked, resulting in costly delays through redesign and new approvals.

52 Evans & Peck considers that reform of the design and construction approval process would result in project cost savings.

4.4.3 Construction Practice Issues

53 Estimates need to reflect the construction practices that are integral to delivering the particular projects. The issues identified in this section reflect the practices that drive costs and time on rail projects. There is potential to improve the practices, and thereby reduce the costs, with appropriate collaboration between stakeholders.

54 **Track possessions and bussing costs**: Brownfields rail projects require to be undertaken with minimal impact on existing operations. Therefore construction elements

that impact on operational rail infrastructure require a shut-down of the track or a 'track possession'. Track possessions are usually restricted to a weekend but occasionally can be for one or more weeks. A number of track possessions will be required throughout any major brownfields project, particularly to interface new work with existing infrastructure. These possessions are normally scheduled 12 months in advance of the works occurring. If the programmed works are not completed within the scheduled track possession, a 3 to 6 month delay will likely occur before another track possession is available, incurring the associated costs of project overheads for the delay. In addition, track possessions often change significantly depending on the requirements or preferences of the rail operator.

55 While contractors will endeavour to minimise the critical works that need to be carried out during track possessions, there are significant extra costs for these works due to reduced productivity, overtime, additional stand-by resources, overheads in planning the possession works and costs associated with providing alternative bussing to passengers. The cost estimate therefore ought to include realistic allowances for track possessions and bussing costs and the associated loss of productivity in carrying out the work under those conditions.

56 **Construction methods**: Rail projects often include elements which are difficult to construct, particularly under brownfields construction. It is essential that an understanding of viable construction methods is developed during the design development phase so that workable designs are produced. It is equally essential that the methods of construction, including temporary works, are taken into account in the estimate.

57 **Temporary works and staging**: The construction around track possessions can add significantly to a project's cost and time. In some instances, the temporary works required to keep the existing rail lines operational can be so extensive that in effect, portions of the project may need to be constructed twice, once for temporary use while an element of the permanent infrastructure is completed and a second time as part of the final works. The estimate needs to reflect the full extent of these works.

58 **Utilities within and adjacent to the rail corridor**: Rail corridors usually have a large number of in-ground, on-ground and above-ground utility services. These services include signalling, compressed air, power, communications, drainage, water, gas and sewer services. The services may be owned by the operator or by the various utility service providers. In the case of brownfields projects, a number of utilities are likely to require relocation. It is also common that existing utilities do not meet current standards and require upgrading.

59 Safely locating and identifying the underground services requires extensive site investigations prior to commencing any relocation work or construction, adding time to programs, which in turn adds costs.

60 The cost and time for the relocation of utilities is a difficult area for the estimator to predict with a reasonable level of certainty at an early stage, when minimal investigation has occurred. Generally, this has the effect of increasing contingency levels in estimates.

61 **Signalling systems**: Signalling costs represent a significant portion of the estimate for rail projects, particularly brownfields rail projects. The impact on the existing signalling cannot be assessed early in a project with any certainty due to such factors as the condition and technology of the existing installation, the changes required to achieve the necessary operational functionality and the extent of staging and adjustments to support the construction work. Furthermore, a shortage of specialist signalling engineers and installers can affect the ability to perform critical activities when scheduled, resulting in loss of productivity, potential delays to program and risks of increased costs.

62 **Protection officers**: Cost estimates need to include the rail safety requirements for protection officers to be present to monitor all work activities within the rail corridor.

63 **Environmental and community impacts**: Environmental requirements and community considerations have increased over the past two decades, particularly for works close to residential areas. These issues are factors in the design and construction of projects, resulting in measures including significant protection of flora and fauna, provision of noise mitigation walls and constraints on construction hours, which limits productivity and increases costs.

64 **Ground Conditions:** Ground conditions have a significant impact on the cost of all civil projects. Uncertainty in ground conditions, through the lack of geotechnical investigation, is also a key issue in the preparation of cost estimates at the early stage of a project. The geotechnical investigation work is generally more difficult for brownfields rail projects compared to greenfield rail projects and most road projects due to the constraints imposed on gaining site access within an operating rail corridor. When geotechnical information does becomes available, it is often the case that the assumptions underpinning the initial design, construction methods, plans and estimates are not adequate, resulting in significant, additional costs. These ground conditions issues generally have a material impact on both the estimates and contingency allowances.

65 **Disposal of contaminated spoil**: Until a thorough site investigation is carried out, there is uncertainty regarding the amount and severity of contaminated soil in a rail corridor. If the spoil is classified as contaminated, which is often the case for the surface layers within the rail corridor, the costs of proper disposal are amplified significantly. Generally, contamination costs can be allowed for with a reasonable degree of accuracy provided a thorough investigation has been conducted.

4.4.4 Cost Certainty Issues

66 **Risk assessment and contingencies**: Rail projects, particularly brownfields rail projects, often lack a well-defined scope at the planning stages and carry significant uncertainties (risks) which can lead to significant cost and time overruns.

67 In order to establish a reasonable budget that will be adequate, without being overly conservative, a contingency allowance is necessary. The level of contingency should reduce as the project scope is better defined and developed and as project delivery progresses.

68 The revised Standard provides guidance to agencies on how risk assessments should be undertaken and how to consider project risks. To quantify an appropriate contingency allowance, a structured risk assessment process should be undertaken. This process focuses on the residual risks, i.e. those risks which are still present after measures have been taken in the design and delivery planning to avoid or mitigate risks.

69 The Standard sets out the principles for establishing both the expected cost and the more conservative (worst case) cost estimate, based on an analysis of the identified risks. Over the life of the project, the amount of contingency required for the expected and worst case levels should reduce as the risks are realised (and become a part of the actual or forecast final cost), are mitigated or are avoided.

70 Appendix 11 of the Standard contains an extract of the report "Procedures for Dealing with Optimism Bias in Transport Planning" (June 2004) prepared by Professor Bent Flyvbjerg for the British Department for Transport which highlights the need for significant contingencies at the early planning stage of most infrastructure projects. According to the report, the uplift (contingency) on conventional rail projects is 40% to 57% at the 50% and 80% level of confidence respectively. The report has been used by the British Department for Transport in formulating its estimating policies.

71 **Budget management**: A cost estimate is the key supporting document to establish the budget for a project. Budget management, supported by updated estimates, commences at project inception and continues through to project completion.

72 It is important that the project is managed within the 'expected' level of cost. The expected cost will be materially lower than the worst case which is generally (and should be) used for financial provisioning for the project. The expected cost will generally be approximately the "P50" forecast, that is the cost which has 50% probability of not being exceeded. The Standard recognises that the "P90" forecast, that is the cost which has a 90 per cent probability of not being exceeded, is often used for the establishment of the budget. The difference between this P90 figure and the expected cost accounts for risk events, but it is often used as a fund for additional scope. This is inappropriate and potentially renders the expected cost figure and the P90 figure non-conservative.

73 **Escalation**: The pricing for rail projects is sensitive to escalation in the unit costs of resources and market volatility influenced by the volume of proposed or actual construction activity in the market.

74 The impact of escalation depends directly on the timing of the cost estimating work relative to the planned and actual timing of the project. The longer the delay, the higher the escalation. For a project that will take over 5 years to deliver, it is not uncommon for

escalation to add up to 25 per cent to the overall cost of the project relative to cost calculated based on market costs at the time of preparation of the estimate.

75 Increases in resource costs, including labour, materials and plant, contribute to incremental increases in costs during the life of a project. Such increases are unavoidable.

76 The number of projects in the marketplace that are in the tendering and construction phase can also have a marked effect on the ultimate price and cost. The market demand can have a significant positive or negative effect on tender pricing. Agencies need to be mindful of spreading the tendering and construction of projects over a period of time, if possible in balance with the available resources to mitigate the risks of inflated prices. It is difficult to make accurate escalation allowances for the effect of market forces on pricing.

77 Funding of projects relies on budgets which include for the estimated cost at completion. This means that the effect of potential price increases needs to be assessed. The Standard sets out a recommended practice for agencies for the assessment of escalation.

78 **Lack of empirical cost data**: A key part of preparing reliable cost estimates is to have ready access to empirical cost and productivity data from recent projects. In the last 10 years, there has been an increase in the number and diversity of rail projects.

79 Current performance data is still emerging and there is only limited useful data available to estimators to assist in preparing estimates for new projects. It is beneficial to have access to empirical cost data from previous projects in NSW, other states and overseas, against which to benchmark newly prepared project estimates.

80 The Standard requires that estimates are presented in accordance with a standard Work Breakdown Structure which will form the basis of high level cost comparisons as more projects are estimated in compliance with the Standard.

5 RECOMMENDATIONS

81 The issues discussed in this submission are based on observations made by Evans & Peck through its involvement with a number of agencies and their rail projects. While the identified issues cannot be eliminated or ignored, the role of the cost estimation process is to reflect the industry practices under which projects are delivered. Improvement to industry practices should result in improvements in the estimates for projects and also can potentially reduce costs.

82 In order to improve the certainty in cost estimates and/or potentially reduce project costs, Evans & Peck makes the following recommendations:

1. Ensure that the business case for each project is supported by a defined set of objectives, user requirements and performance criteria, agreed between the operator and the delivery agency, that are adhered to by both parties throughout the design and delivery phases.
2. Ensure that the scope of works is complete, defines the operational and environmental constraints under which the project will be delivered, and as far as practicable is not varied.
3. Carry out a review of the design and construction approval process for rail projects to identify ways of expediting the process.
4. For each project, carry out an economic and construction cost analysis to compare the options of constructing under live rail operations or under a temporary line closure.
5. Ensure that cost estimates are prepared in accordance with the *Australian Government Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction.*
6. Monitor estimating performance through benchmarking of expected costs against actual costs to support ongoing improvement of cost estimate accuracy.
7. Govern and manage contingency amounts in the project budget more rigorously. In particular, ensure that the difference between the overall budget and the expected cost is not used as a fund for scope change.
8. Given that the issues are common to many jurisdictions in the developed world, benchmark estimates and actual costs against other jurisdictions to assess value for money and project cost performance in NSW.

Appendix 1 Australian Government Department of Infrastructure and Transport: Best Practice Cost Estimation Standard – *Proof Version for Jurisdiction Training (May 2011)*