ATTACHMENT 8

Dendrobium Extension Project (8194)

Independent Planning Commission's Public Hearing

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Preamble

This report has been prepared in response to an expert brief from the Environmental Defenders Office (EDO) on behalf of Protect Our Water Alliance.

I have read and agree to be bound by Part 31 Division 2 and the Expert Witness Code of Conduct as described in Schedule 7 of the *Uniform Civil Procedure Rules 2005* (UCPR).

Executive summary

- The approval of the Dendrobium Extension Project ('Project') requires that the social benefits outweigh the social costs under the NSW Government's (2015) "Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals" (NSW Guidelines). The NSW Guidelines also require a Local Effects Analysis which estimates the impact of the Project on local jobs, gross regional product and other industries in the region and often utilises computable general equilibrium (CGE) analysis or, more generally, input-output (IO) analysis.
- I make 6 points about the cost benefit analysis performed for the Project and the analysis of supply-chain impacts related to the carbon emission costs, the WaterNSW report and the precautionary principle, the modelling of economic interactions, the benefits to workers, the treatment of offsets, and finally the base case and what I perceive as being an error in the NSW Guidelines.
- With regard to the carbon emission costs, the cost benefit analysis has not used a price that equates to the social cost of carbon emissions. In the economic assessment, the emission reduction fund price is used as an estimate of the social cost of carbon. However, as no cap is placed on carbon emissions in the market, this price has no relationship to the social cost of carbon. Instead, the economic assessment should draw on peer-reviewed estimates of the social cost of carbon.
- In addition, the entire amount of scope 1 and scope 2 emissions should be included in the analysis. In the economic assessment, the total cost of carbon ($111.7 million) is multiplied by the NSW percent of the global population to reduce the costs to $122,000. The global costs should be included because under the NSW Guidelines they are all attributable to the project.
- The WaterNSW submissions suggest that the Project does not meet the neutral or beneficial effect principle and they note the potential irreversible impact on endangered upland swamps and the potential impact on drinking water supply. This suggests that cost benefit analysis is not the appropriate decision making tool and that the precautionary principle should instead be used. The precautionary principle is part of the definition of Ecologically Sustainable Development under Federal and NSW State government legislation and, if applied, would lead to the rejection of the Project.
- The modelling of economic interactions uses IO and CGE modelling and predicts a cascading catastrophe for other industries if the mine is rejected, and the loss of jobs and gross regional product. However, these modelling techniques are not suitable for analysing long-term economic interactions because they are static models, they rely on historical market relationships, and they cannot model new technology or structural changes in the economy.
- The benefits for workers in the economic assessment of some $365 million in present value terms should not be included in the cost-benefit analysis following the NSW Guidelines. The benefits were derived by analysing the difference between predicted mining wages and the average wage in NSW. The NSW Guidelines are very clear that the difference is due to the disutility of work and, as such, workers are not actually receiving any wage premium. The Independent Planning Commission can disregard that part of the cost benefit analysis focussed on worker benefits.
- The way that environmental offsets have been used in the cost benefit analysis does not align with the theory of cost benefit analysis. In the economic assessment, the cost of offsets

are included as a cost of the project and because offsets are assumed to lead to no net loss in biodiversity, no indirect environmental costs are included for biodiversity, endangered upland swamps, or water. However, NSW citizens value the upland swamps and other environmental attributes in their current condition and location. While offsets may be good, they do not compensate citizens for the value of the upland swamps and other environmental attributes being lost. Thus, the WTP to avoid the biodiversity and other environmental losses even when compensation occurs through offsets must be included as an indirect cost of the Project.

- The economic assessment does not include the value of land in the base case. This suggests there is a 'free lunch' which can never be the case in economics. There are alternative uses to the land around the facilities and in the Special Metropolitan Area and this should be valued and included as a benefit in the base case or cost of the Project. The NSW Guidelines are clear that the opportunity cost of land should be included as a cost of the project.
- Also in relation to the concept of a free lunch, the NSW Guidelines are structured in such a way that it is possible to approve a mine without considering the opportunity cost of the land, labour and capital, which does not align with economic theory. This would be the case where a mine is entirely foreign owned, in which case the producer surplus is not included in the cost benefit analysis. If the NSW Guidelines separate out the revenues on the benefit side and the capital and operating costs on the cost side, it would be clear than all the labour, land and environmental costs should be included in the analysis. The Dendrobium project would still include only 15.7% of the revenues and capital costs as this is the proportion of the company owned by NSW citizens. However, cost-benefit analysis theory suggests that all the other NSW resources (land, labour and environmental resources) being allocated to the project should be valued in their entirety. This will substantially change the benefit-cost calculation and ensure there is no free lunch.

1. Economics and the evaluation of a mine expansion

Economics is concerned with the efficient allocation of resources. Economic resources such as land, labour and capital must be allocated in an economic system to particular industries and for particular products or services. Due to unlimited wants for goods and services, economic logic suggests that the land, labour and capital should be allocated to the goods and services most valued by society.

In the case of the Dendrobium Extension Project, land around the pit top site and land subject to subsidence above the mine is being allocated along with the labour and financial capital needed to purchase and develop the technology and machinery and operate the mine. Other resources are also allocated to the mine such as surface and underground water resources, the atmosphere and biodiversity.

To determine whether this allocation of resources is right or efficient, economic theory suggests that the costs and benefits of any project should be assessed and that a project is efficient when the benefits outweigh the costs. This is a fundamental principle of welfare economics. The practical tool of cost-benefit analysis has developed around this theory and is used throughout the world to assess government and private-sector projects, regulations and policies.

It is important to note, however, that economics is not concerned with profits, the financials of the firm, or individual returns. Economists are concerned with the social costs and benefits and analyse whether society's resources are being allocated correctly. Thus, rather than the private costs and benefits of the project to a company, the social costs and benefits must be considered.

This is important for mining projects because mining typically leads to what economists refer to as external costs. These are costs which spill over onto third parties; that is, other members of society that are not party to the selling or buying of the product or service being produced (Baumol and Oates 1988, p. 17). For example, when looking at a new or extended mine, the benefits chiefly accrue to the owners, suppliers and workers. Costs such as water, air and noise pollution are incurred by residents near the mine, and those individuals concerned with the impacts on other species or natural ecosystems. Economists stress that the private and social benefits and costs must all be considered for a project to be evaluated correctly and that the social benefits of a project must outweigh the social costs if it is to lead to an improvement in welfare.

In addition to the cost-benefit analysis (CBA), the NSW Government's (2015) "Guidelines for the Economic Assessment of Mining and Coal Seam Gas Proposals" (NSW Guidelines) require a Local Effects Analysis. The local effects analysis estimates the impact of the proposal on local jobs, gross regional product and other industries in the region. This often utilises computable general equilibrium (CGE) analysis or, more generally, input-output (IO) analysis. CGE and IO analyses map the way in which industries are interlinked in an economy and analyse the impact of a change in one industry on other parts of the supply chain. Thus, the full local economic effect of a proposal, or the rejection of a proposal, can be assessed.

It is on the basis of my knowledge in cost-benefit analysis, CGE and IO modelling that I have evaluated the Dendrobium Extension Project's (Project's) environmental impact assessment and particularly Appendix L, the economic assessment (Cadence Economics 2019), as requested by EDO

acting on behalf of Protect Our Water Alliance. I also reviewed the WaterNSW response to the amended project and supplementary information (WaterNSW 2020), South32's original response to the concerns of WaterNSW (South32 2020), and the Department's assessment report with particularly attention paid to the BAEconomics review of the economic assessment (Fisher 2020a) and the BAEconomics review of the key economic interactions (Fisher 2020b).

I would like to make 6 points about the cost benefit analysis performed for the mining project and the analysis of supply-chain impacts related to the carbon emission costs, the WaterNSW report and the precautionary principle, the modelling of economic interactions, the benefits to workers, the treatment of offsets, and finally the base case and what I perceive as being an error in the NSW Guidelines.

2. Carbon emission costs

The pricing of greenhouse emissions in the cost benefit analysis that forms part of the economic assessment is not correct. In a perfectly functioning carbon emission reduction market, the price of carbon emission reductions would be equal to the marginal social cost of carbon emissions, or the marginal damages (MD) of carbon emissions, and the marginal abatement cost (MAC). Environmental economic theory indicates that a limit be placed on a pollutant, or damaging carbon emissions, at the efficient level where MD=MAC for the economy as a whole. When this limit on emissions is applied in a carbon market, emitters abate and use their carbon permits such that the price in the market is equal to their individual MACs. As such, all firm's MACs are equated and equal to the MAC for the economy as a whole. Thus, the price in the perfectly functioning market equals the MD of emissions and the marginal social cost of carbon emissions.

Unfortunately, every carbon market in the world is compromised and the number of permits, or the cap on emissions, has little relationship to the efficient amount of carbon emissions. Instead, the cap and subsequent price of carbon is driven by pragmatic considerations such as the competitiveness of a country's export industry. Thus, the price does not equal the marginal social cost of emissions. This is particularly the case in Australia's emission reduction fund market which was used to establish the social cost of carbon emissions in the economic assessment (Cadence Economics 2019, p. 23). The emission reduction fund uses a reverse auction mechanism to distribute the available funds to the lowest-cost emission reductions. Firms who would like to install emission reduction technology propose a price (subsidy) per tonne of emission reductions and the lowest-priced projects win government support. The price therefore reflects the cost of the new technology, the amount of abatement that it can produce and the available funds in the market. Due to the reverse auction process, and assuming many participants seeking funds, the price is, in theory, reduced to the marginal abatement cost of the new technology, or slightly above this level so that firms benefit from receiving the funding and installing the technology. However, the market can be compromised by a lack of participants who can then "game the system"; that is, they can attempt to use their market power to increase the subsidy they receive well above the actual marginal abatement cost of the new technology. More importantly, even if the resulting price is equal to the marginal abatement cost, the price and marginal abatement cost has no relationship to the marginal damages or marginal social cost of carbon emissions. This is because a limit on the amount of emissions in the economy has never been set at the efficient level of carbon emissions. Thus, using the price in the emission reduction fund as a measure of the social cost of carbon emissions is inaccurate.

The use of the emission reduction fund price also contradicts the NSW Guidelines (NSW Government 2015). In the technical notes that support the NSW Guidelines (Department of Planning and Environment 2018, p. 48) and the NSW Treasury's "Guide to cost-benefit analysis" (The Treasury 2017, p. 61), the point is made that:

> "Market prices should be used as a basis for valuing the costs of carbon emissions, where reliable evidence can demonstrate that those market prices are not significantly biased as a direct consequence of scheme design."

It is clearly the case that the emission reduction fund biases the market price away from the price that would result from an efficient level of emissions because there is no limit on the amount of emissions. When the market is compromised like this, the advice in The Treasury's (2017, p. 61) guide is to use estimates of the damage costs or damage mitigation costs. This involves searching the literature and using a range of prices that are also used by other organisations. For example, the US Environmental Protection Agency (EPA) estimates the cost of carbon based on "a comprehensive estimate of climate change damages and includes changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning" (EPA 2017). It is acknowledged that these costs are not exhaustive but, giving consideration to these costs, the social cost of carbon ranges from $12 (2007 USDs per metric ton of CO_2) to $123 in the year 2020 depending on the discount rate and the climate change impact scenario (EPA 2017). The price then rises through to 2050 because marginal damages are expected to increase as climate change worsens and the range is from $26 to $212. In my opinion, the economic assessment for the Project needs to be adjusted for the use of these peer-reviewed estimates of the social cost of carbon.

The authors of the economic assessment also apportion the cost of emissions to NSW on the basis of NSW's share of global population (Cadence Economics 2019, p. 23). Along with excluding scope 3 emissions, this results in a very small social cost of carbon of $122,000 in present value terms. Even allowing for the exclusion of the scope 3 emissions, NSW is responsible for global carbon emission costs of $111.7 million in present value terms and the NSW Guidelines (NSW Government 2015, p. 15) stipulate that: "In general the total net environmental, social and transport costs will be attributable to NSW." By "attributable", I take this to mean that the total amount caused by NSW should be included regardless of where the damages are felt. Thus, even when using the emission reduction fund price of $13.52, the carbon emission costs of the Project are undervalued.

3. The precautionary principle and neutral or beneficial effect principle

The WaterNSW submissions are very powerful. They indicate that the proponent has not demonstrated that the Project would meet the neutral or beneficial effect principle and they note the potential irreversible impact on endangered upland swamps and the potential impact on drinking water supply. Specifically, they state (WaterNSW 2020):

> "Uncertainty remains about whether the project would meet the neutral or beneficial effect (NorBE) test for water quality, particularly in relation to post-closure groundwater repressurisation. This is a statutory test that is a pre-condition for approval"; and

> "The proposed mine design and predicted height of free drainage would fundamentally change the hydrological and ecological characteristics and functions of up to 26 endangered Coastal Upland Swamps."

These considerations suggest that CBA is not the appropriate decision making tool. Because the CBA is forward looking and there are many complexities involved in the environmental and water impacts, the economic assessment is analysing the expected, rather than the actual, costs and benefits. As the analysts do not have a complete and perfect model of all the future impacts, the analysis using cost-benefit analysis will "yield inaccurate estimates of the expected benefits of any given course of action" (Quiggin 2005, p. 7). This will lead to a bias in favour of poorly understood courses of action, and errors will increase the greater is the complexity and the more incomplete the model (Quiggin 2005, p. 8). In such situations, the precautionary principle corrects this bias (Quiggin 2005, p.8).

The precautionary principle is entirely in keeping with the definition of Ecologically Sustainable Development adhered to by Federal and NSW State governments (respectively, the *Environmental Protection and Biodiversity Conservation Act 1999* (part 1 3A) and the *Protection of the Environment Administration Act 1991* (Section 6(2)). Thus, the precautionary principle should be used in this case. The precautionary principle states that "if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation" (*Environmental Protection and Biodiversity Conservation Act 1999*, part 1, 3A)). That is, even though we cannot say for sure that irreversible damage is going to occur, we should take action to avoid that damage. Taking action in this case is to reject the mine proposal.

4. The modelling of economic interactions

The BAEconomics review of the key economic interactions (Fisher 2020b) and the economic assessment in the environmental impact assessment (Cadence Economics 2019) make claims about the likely impact of not approving the mine extension for related industries including the Port Kembla Coal Terminal, BlueScope steel, and other mines in the region. It is argued that the rejection of the mine extension could lead to a cataclysmic cascade effect where the coal terminal is not viable if the mine is not approved, and therefore other mines in the Illawarra which rely on the coal terminal are not viable, and then BlueScope Steel is not viable, and this all leads to a massive loss of income and jobs (Fisher 2020b, p. 17).

However, the modelling used to predict this cascading catastrophe is input-output (IO) modelling in the case of BAEconomics (Fisher 2002b) and computable general equilibrium (CGE) modelling in the economic assessment (Cadence Economics 2019). IO analysis in particular is not appropriate for modelling long-term impacts of job losses with no accompanying analysis of how the economy will change in response to these structural changes. While IO analysis is useful for some forms of analysis, it is a static modelling approach and does not include price changes, or the movement of workers to other areas, or changes in input mixes (Australian Bureau of Statistics 2020; West 1995). CGE is slightly better in this regard because it models market changes for inputs and workers based on an historical analysis of markets. However, both models lack an ability to predict technological changes and new shifts in the economy (West 1995, p. 211).

For example, the price of coal from Queensland could fall or new technology could arise that leads to a change in the way steel is produced, or new regulations may change the nature of the port. It is simply impossible to make predictions of a cascading catastrophe and in fact these are very rare and only really occur when private companies and governments fail to transition regions and workers to, in this case, a post-carbon economy.

It should also be noted that while the NSW Guidelines require a Local Effects Analysis, which implies such IO or CGE modelling, the Local Effects Analysis is irrelevant for the economic assessment of the Project. In economics, only the cost-benefit analysis results are significant. Distribution effects should be analysed and arguments can be made to weight the impact of particular impacts on the utility of NSW citizens within a cost benefit analysis. However, the actual impact on jobs and gross regional product is irrelevant to the decision of whether the Project is economically justifiable; that is, whether it passes the benefit-cost test.

5. The benefits to workers

The author and proponent assert in the economic assessment (Cadence Economics 2019, pp. 17-19) that the benefits to workers is some $365 million in present value terms. They state that mining wages are around $195,000 to $200,000 and that without the mine the workers would be earning the average NSW wage of $66,000. Thus, workers get a wage premium. However, the NSW Guidelines are very clear that this wage premium should not be included.[1] The NSW Guidelines state (NSW Government 2015, p. 13): "An appropriate starting assumption should be that workers do not receive a wage premium, even if they will earn more working in the mining sector." The NSW Guidelines do explain that in some cases it might be appropriate to consider a wage premium, but indicate that consideration of a premium requires a good justification (NSW Government 2015, p. 13). The author's only justification is that workers in mining work with a lot of capital (machinery) and the disutility of mining is the same as the disutility of any job (Cadence Economics 2019, p. 18). This is not in accordance with the NSW Guidelines or logic. The NSW Guidelines (NSW Government 2015, p. 13) indicate that any extra wage will be to "compensate for more physically demanding work, tougher conditions" and "the costs associated with greater hardship"; that is, the higher wage compensates for the disutility of working in mining, which by implication is greater than the disutility of working in other professions. In addition, logic indicates that these highly-skilled workers will find high-paying jobs elsewhere in the economy. Thus, the Independent Planning Commission (Commission) can disregard that part of the cost benefit analysis focussed on worker benefits.

6. The treatment of offsets

The way that environmental offsets have been used in the CBA is not in alignment with the theory of cost benefit analysis. I would like the Commission to be aware of the fact that environmental offsets are a relatively new phenomenon and to my knowledge there has not been a formal, peer-reviewed treatment of them in the theory of cost-benefit analysis. How they are treated in cost-benefit analysis is an open book and the Commission can determine how offsets are treated in regards to this mining proposal.

[1] Note that a similar point was made in *Gloucester Resources Limited v Minister for Planning* [2019] NSWLEC 7, [paragraph 587-606].

CBA is about the willingness to pay (WTP) for, say, a new national park or a new bridge or road and the opportunity cost of providing that park, bridge or road. The opportunity cost is the value of the resources, such as land, labour and capital in their alternative uses. In the CBA, biodiversity offsets and water offsets are included in the costs of the Project and the environmental impacts themselves are not therefore considered in the indirect costs of the Project. However, even when a mining company pays for an offset, there is still a WTP to avoid the original loss of the upland swamps and potential water impacts. As such, this WTP needs to be investigated and included in the indirect costs of the Project and they are likely to be substantial. They will be substantial because even though offsets may be good, they are nothing like the original. NSW citizens value the upland swamps as they are in their original state and we are willing to pay for them to be maintained even when the offset occurs.

The problem here derives from the no net loss assumption that underpins NSW's biodiversity offset policy (NSW *Biodiversity Conservation Act 2016*, Part 6, Division 2, Section 6.7). Because of the no net loss assumption, the proponent can argue that since they have offset in accordance with that policy, there is no biodiversity lost. They can also argue that they have taken the cost of offsets into account in the costs of the project and have internalised the environmental externality. However, the no net loss assumption is only ever correct in terms of biodiversity attributes and not the values or WTP with regard to biodiversity. That is, even if the offset includes all the attributes of the original upland swamp, NSW citizens still value the upland swamp in its original condition and are willing to pay to avoid that loss. In addition, in reality, the no net loss assumption is debatable because the policy allows for offsets to occur by securing existing biodiversity. No, or very little, new biodiversity attributes need to be created in this situation. Thus, the WTP to avoid the biodiversity and other environmental losses even when compensation occurs through offsets must be included as an indirect cost of the Project.

7. The base case

The author of the economic assessment and the proponent has not attributed any value in the base case of no mining to the land around the facility and in the Metropolitan Special Area. This suggests there is a 'free lunch' which can never be the case in economics (McConnell and Brue 2005, p. 3). There are alternative uses to that land and this should be valued and included as a benefit in the base case, or a cost of the Project. As the company currently has mining rights out to the year 2030, the alternative use of the land would commence from that period onwards in the base case or in some case after mitigation and restoration has been completed.

The NSW Guidelines are clear that:

> "Direct impacts reflect the revenues of the project less the opportunity cost of resources (such as land, labour and capital) used for the project" (NSW Government 2015, p. 4); and
>
> "The base case should reflect the existing use of the land (based on current and committed policy settings) where the project is proposed" (NSW Government 2015, p. 7)

Clearly the area above the mine is a special case due to its designation as a Metropolitan Special Area. That area is not going to be used for agriculture or extensive recreation. However, it still has an

alternative use as a site of biodiversity and the delivery of quality drinking water. While the impacts have been offset, the value of the land in these alternative uses has not been included in the costs of the project. In addition, the land around the pit top, the loading facilities, the train line and the ventilation shafts all have alternative uses from the year 2030 onwards. After all, the proponent pays and will pay land tax (Cadence Economics 2019) so they must be using land and this land has an alternative use. The Treasury's (2017, p. 32) guide to cost-benefit analysis is very clear that this land should be valued at its "highest opportunity cost equivalent to its maximum market value under current or likely land-use zoning". In contrast, the proponent is effectively saying that they receive NSW resources for free.

Further to this point about a 'free lunch', I am not convinced that the NSW Guidelines (NSW Government 2015) are correct in the way they present some aspects of the requirements for a cost-benefit analysis. Essentially, as long as a mining proposal is financially profitable, the benefit-cost ratio will be above 1 using the NSW Guidelines. Financial viability means that producer surplus is positive, to which we add royalties and other taxes as benefits less any remaining indirect costs after offsets. Consider instead a situation where a mining proposal was not financially viable. At first glance the proposal could still be approved because royalties and taxes could be enough to ensure the benefits exceed the costs. However, the company will not proceed with the mining proposal due to the lack of producer surplus. Given that social benefits exceed social costs, economics suggests that the government should step in and provide the mine extension. However, government provision of the mine would negate the royalty and tax benefits as they represent a transfer. That is, the government 'owner' of the mine would be paying another government agency royalties and taxes. In CBA, transfers are not included in the analysis (The Treasury 2017, p. 13). Thus, the benefit-cost ratio would then fall below 1 indicating that the mine should not be approved. There is a logical problem here; the mine should be approved on the basis of social efficiency, but given the non-provision of the private sector due to a lack of financial viability, once approved it ceases to be socially efficient.

From my knowledge of cost benefit analysis, I believe the problem results from the way the NSW Guidelines (NSW Government 2015) stipulate that the net producer surplus is a benefit rather than separating out revenue and costs. In the Dendrobium case, a percentage of the net producer surplus (15.7%) is included as a benefit because the NSW ownership of the company is 15.7% (Cadence Economics 2019, p. 15). However, this effectively means that only 15.7% of the costs are considered relevant as well, including the internalised environmental costs. To take this approach to its logical conclusion, if the mine was 100% foreign owned, the producer surplus is irrelevant and no costs would be considered in the analysis except for the remaining indirect costs after offsets. This corresponds to an impossible free lunch with all local resources provided for free.

As mentioned, CBA is about resource allocation. The land, biodiversity, water and labour have an alternative use in NSW and all of those costs should be included in the CBA. For capital costs, 15.7% of which are owned by NSW residents, including only 15.7% seems appropriate, as with the revenue. However, the labour, raw material, land and environment costs should be included in total because they have alternative uses in NSW. If the NSW Guidelines separated revenues on the benefit side and operating and capital costs on the cost side, 15.7% of revenue and capital costs would be included. However, all other operating costs would need to be included in total; that is, 100% of all other operating costs would need to be included. This will change the benefit cost equation substantially and ensure that there is no free lunch. It would also ensure that a project could be financially viable but not socially beneficial with the cost of using local resources exceeding the financial benefits.

8. Conclusion

Giving consideration to the points made in this submission, the Project cannot be argued to pass the benefit-cost test. The cost of carbon emissions has been underestimated due to the use of the emission reduction fund price as an indicator of the social cost of carbon, and due to the decision to apportion the costs on the basis of NSW's share of global population. The worker benefits in the economic assessment are incorrectly calculated and should be zero under the NSW Guidelines. The indirect environmental costs have not been included in the cost-benefit analysis due to the application of environmental offsets, which does not align with economic theory. The alternative use of the land has not been included in the cost-benefit analysis, which does not align with the NSW Guidelines. In addition, the NSW Guidelines do not align with the theory of cost benefit analysis because mining projects can be approved without any consideration to the opportunity cost of resources. An alternative approach has been suggested whereby all the land, labour and environmental costs are included as costs of the project rather than 15.7% of those costs, and this would substantially change the cost-benefit ratio.

The hypothesised supply-chain effects on other industries are irrelevant for the cost benefit analysis and the predictions cannot be relied upon because they use models that are unable to model structural change in the economy and changes in technology, which will be extensive over the life of the Project. Moreover, the irreversible impacts on upland swamps and water supply suggests that the precautionary principle is a more appropriate decision-making approach and the application of this approach would lead to the rejection of the Project.

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Appendix A – Neil Perry's Qualifications and Experience

I am a Senior Research Lecturer in Corporate Social Responsibility and Sustainability in the School of Business at Western Sydney University where I have been employed since 2011, and a member of the Institute for Culture and Society at the University. Previously, I held an Associate Professor position at Lebanon Valley College in Pennsylvania, USA (2004-2010), a Lecturer position at La Trobe University (1997-2002), and a tutoring position at the University of Melbourne. I attained my PhD in Economics from La Trobe University in 2006 and I have also graduated with a Master of Commerce (with Honours) (University of Melbourne), a Graduate Diploma in Advanced Economics (La Trobe University), and a Bachelor of Business (University of Technology, Sydney).

My speciality is Environmental and Natural Resource Economics and I have published extensively in the field in international journals such as *Ecological Economics*, the *Journal of Economic Perspectives*, and *Wildlife Research* as well as in edited volumes published by respected publishers such as the Oxford University Press. I have 23 years of experience analysing environmental policy and the utilisation of natural resources in Australia, the USA and globally. I have led cost-benefit analysis projects for government agencies and non-profit organisations, I have qualifications in cost- benefit analysis from the Institute of Public Administration Australia, and I designed and teach the cost-benefit analysis undergraduate unit at Western Sydney University. I have also performed input-output analysis for regional economic development studies and published peer-reviewed research analysing computable general equilibrium analysis.

Staff profile:

https://www.westernsydney.edu.au/staff_profiles/uws_profiles/doctor_neil_perry

NEIL PERRY

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1. Education

2006 Doctor of Philosophy. La Trobe University.
1995 Master of Commerce (with Honours) (Economics). University of Melbourne.
1994 Graduate Diploma in Advanced Economics. La Trobe University.
1993 Bachelor of Business (Finance & Economics/Accounting). University of Technology, Sydney

2. Employment History

2011- Senior Research Lecturer/Research Lecturer in Corporate Social Responsibility and Sustainability. Academic Course Advisor. School of Business. Western Sydney University.

2004-10 Associate Professor/Assistant Professor of Economics. Department of Business and Economics. Lebanon Valley College, Pennsylvania, USA.

2002-4 Visiting Instructor. Department of Economics. Franklin and Marshall College, Pennsylvania, USA.

1997-2 Lecturer/Associate Lecturer. Department of Economics and Finance, School of Business. La Trobe University.

1995-6 Tutor. Department of Economics and Finance. La Trobe University.

1996 Research Assistant/Tutor. Department of Economics. University of Melbourne.

1992-3 Native Garden Designer and Small Business Manager. Conscious Native Gardeners, Sydney.

1989 Trainee Accountant. Court & Co., Chartered Accountants. Sydney.

3. Journal articles

Crabtree, L., McNeill, J., Perry, N. and Grimstad, S. 2019. "Impediments and opportunities for growing the cooperative housing sector: An Australian case study." *International Journal of Housing Policy*. Available online. DOI: 10.1080/19491247.2019.1658916.

Perry, N. and Shankar, S. 2017. "The state-contingent approach to the Noah's Ark problem." *Ecological Economics* 134: 65–72.

Boronyak-Vasco, L. and Perry, N. 2015. "Using tradeable permits to improve efficiency, equity and animal protection in the commercial kangaroo harvest." *Ecological Economics* 114: 159-167.

Perry, N. and Primrose, D. 2015. "Heterodox economics and the biodiversity crisis." *Journal of Australian Political Economy* 75: 11-31.

Perry, N 2013. "The precautionary principle, uncertainty, and the Noah's Ark problem." *Wildlife Research*, 40(2): 117-125.

Perry, N., Rosewarne, S. and White, G. 2013. “Australia’s clean energy future policy: taxing carbon and the illusion of the equity objective.” *Ecological Economics* 90: 104-113.

Perry, N., 2012. “A post-Keynesian perspective on industry assistance and Australia’s carbon pricing policy.” *Economic and Labour Relations Review* 23(1): 47-66.

Perry, N. and Twomey, P. 2012. “Carbon markets: Inherent limitations and complementary policies.” *Economic and Labour Relations Review* 23(1): 1-6.

Perry, N. 2010. “The ecological importance of species and the Noah’s Ark problem.” *Ecological Economics* 69(3): 478-485.

Perry, N. 1999. “Biodiversity preservation.” *Journal of Economic Perspectives* 13(3): 238-239.

4. Book chapters

Perry, N. 2017. “Environmental economics and policy,” in Louis-Philippe Rochon and Sergio Rossi (eds), *Post-Keynesian Economics*. The International Library of Critical Writings in Economics Series. Cheltenham, UK and Northampton, MA: Edward Elgar.

Perry, N. 2013. “Environmental economics and policy,” in Geoffrey C. Harcourt and Peter Kriesler (eds), *The Oxford Handbook of Post-Keynesian Economics. Volume 2: Critiques and Methodology,* New York: Oxford University Press.

Perry, N., 2012. “Environmental policy,” in John E. King (ed.), *The Elgar Companion to Post Keynesian Economics*, 2nd edn, Cheltenham, UK and Northampton, MA: Edward Elgar.

5. Research Reports

Perry, N. and Hewitson, G. 2019. “Weathering the storm: The case for transforming the Hunter”. January. Available at: https://www.lockthegate.org.au/weathering_the_storm_transforming_the_hunter_valley

Crabtree, L., Grimstad, S., McNeill, J. Perry, N. and Power, E. 2019. “Articulating value in cooperative housing: International and methodological review”. January. Available at: https://www.westernsydney.edu.au/__data/assets/pdf_file/0004/1494058/articulating_value_in_cooperative_housing_20190125.pdf

Perry, N., Varua, M. and Hewitson, G. 2018. “The social benefits of better-practice waste management for multi-unit dwellings in Penrith LGA”. April. Available at: https://researchdirect.westernsydney.edu.au/islandora/object/uws%3A47264/datastream/PDF/view

Holmes, S., Perry, N., Varua, M., Farrel, J. and Bakry, W. 2017. “Therapeutic Health Corporation: Business Report.” May. Commercial in Confidence. Not online.

Perry, N. 2015. “Russell Vale Colliery Underground Expansion Project – Submission to the Planning Assessment Commission Public Hearing.” January. Available at: https://live.ipcn.nsw.gov.au/resources/pac/media/files/pac/projects/2014/12/russell-vale-colliery-underground-expansion-project-review/submissions--presentations/russell-vale-expert-report-economicsredactedpdf.pdf

6. Other publications

2017 "What's the economic value of the great barrier reef? It's priceless." *The Conversation*. June 29.

2016 "The NSW government is choosing to undermine native vegetation and biodiversity." *The Conversation*. May 9.

2015 "Kanganomics: it's not worth killing kangaroos." *The Conversation*. July 9. (With Louise Boronyak).

2015 "Key environment policy still unknown in the NSW election." *The Conversation*. March 23.

2014 "Palmer deal gives green light to Direct Action - experts react." *The Conversation*. October 29. (With Frank Jotzo, Alan Pears, Caroline Sullivan, Jemma Green, John Quiggin, Ken Coghill).

2013 "The Australian government's Direct Action policy for meeting carbon emission reduction targets". *Journal of the Economics and Business Educators New South Wales*, 2013(2): 51-6.

2013 "The Coalition reveals a willingness to undermine environmental targets." *The Conversation*. September 5.

2013 "Labor keeps ETS compensation for big power users - why?" *The Conversation*. July 16.

2013 "Queensland government opens up common resources to private interests." *The Conversation*. May 25.

2013 "'Direct action': The coalition's voluntary approach to environmental policy." *The Conversation*. May 10.

2013 "Australian companies will be able to offset their emissions from coal-fired energy by financing new coal-fired energy projects." *The Conversation*. October 14.

2012 "The renewable energy target may be breaking our fossil-fuel path dependence." *The Conversation*. October 2.

2012 "In defence of renewable energy targets." *The Conversation*. August 8.

2012 "Carbon pricing: a minor shock compared to recent electricity price increases." *The Conversation*. July 6.

2012 "Carbon lock-in: social-technological inertias increasing our addiction to coal-fired energy." *The Conversation*. June 21.

2012 "Shooters and Fishers gaining influence over environmental policy in NSW." *The Conversation*. June 4.

2012 "Federal budget 2012: a surplus won't help renewable energy." *The Conversation*. May 9.

2012 "The clean energy finance corporation: the purpose and the hypocrisy of industry." *The Conversation*. April 23.

2012 "Attacks on the constitutionality of the carbon tax reinforce the need for complementary policies." *The Conversation*. April 12.

2012 "Disinformation, no information." *The Conversation*. April 3.

2012 "The mineral resources rent tax and the commons." *The Conversation*. March 27.

2012 "Not a level playing field for wind power." *The Conversation*. February 29.

2011 "Renewable energy tariffs, subsidies, targets: are such policies needed under a carbon price?" *The Conversation*.

2011 "Federal Budget 2011: Missed opportunities for a carbon-smart Australia." *The Conversation*.

2000 "Review of 'Environmental Economics: Individual Incentives and Public Choices' by Ian Hodge." *Australian Journal of Agricultural and Resource Economics* 44(2): 325-8.

7. Conference Papers, Seminars, and Public Lectures

2019 "Conservation decision-making under uncertainty and the state-contingent approach." Ecological Society of America Annual Conference 2019. August 11-16. Louisville, Kentucky.

2019 "Having our biodiversity cake and eating it too: The role of biodiversity in agricultural productivity." Presented at the International Workshop on Strengthening International Agribusiness Trade. November 14-15. TERI School of Advanced Studies, New Delhi, India. (Invited)

2019 "The innovation economy and Australia." ICOSTART 19, International Research Conference on Innovations, Startups and Investments. 16-17 December, Rajkot, India. (Keynote)

2019 "Weathering the storm: The case for transforming the Hunter." Presented at the Hunter Renewal Summit. February 20. Singleton. (Keynote)

2016 "State-contingent conservation and the precautionary principle." Presented at Hawkesbury Institute for the Environment. October.

2013 "Heterodox economics and the biodiversity crisis?" Presented at the Institute for Sustainable Futures, University of Technology, Sydney, February. (Invited)

2012 "Can heterodox economics help us understand the economic-environment-energy crisis?" Paper presented at the 11th Australian Society of Heterodox Economics Conference, UNSW, NSW, December 3-4. (Invited)

2012 "The state-contingent approach to the Noah's Ark problem." Paper presented at 2nd Oceania Congress of the Society for Conservation Biology, Darwin, September 20-23.

2011 "Using functional diversity to prioritise biodiversity projects." Paper presented at 25th International Congress for Conservation Biology, Auckland, NZ, December 5-9. (Invited)

2011 "A post-Keynesian perspective on the carbon pricing debate and industry assistance." Paper presented at La Trobe University, School of Economics and Finance Seminar, August 5. (Invited)

2011 "Economics and environmental sustainability: the case of carbon taxes." Paper presented to the Economics and Business Educators NSW Annual Conference, May 27. (Invited)

2010 "A post-Keynesian theory of environmental taxes." Proceedings of the 9th Australian Society of Heterodox Economics Conference, Coogee Bay Hotel, Coogee, NSW, December 6-7.

2010 "Research in ecological economics." Presentation given for Lebanon Valley College Colloquium, April 8. (Invited)

2010 "Jobs won't go to China and India if the US acts on climate change." Public lecture for Lebanon Valley College Earth Day Celebration, April 22. (Invited)

2009 "Greenhouse gas reduction strategies on campus." Presentation for the Pennsylvanian Environmental Resource Consortium 2009 Annual Meeting: Greenhouse Gas Inventories and Strategies Workshop, Harrisburg PA, October 2. (Invited)

2009 "Climate change in Pennsylvania: impacts and solutions for the keystone state." Delivered on behalf of the Union of Concerned Scientists to the Tri-County Regional Planning Commission, Harrisburg PA, April 23.

2008 "Reducing a municipality's carbon footprint: motivation and method." Seminar presented as part of the Energy Workshop at the Lebanon County (PA) Supervisor's Convention, October 16.

2006 "Difference, value and the Noah's Ark problem." Presentation given for Lebanon Valley College Colloquium, April 30. (Invited)

2005 "The economics of global warming and the Kyoto protocol." Public lecture sponsored by the Student Action for the Environment (SAFE) group and the History, Political Science and Economics student group, Lebanon Valley College, September 23. (Invited)

2004 "The marginal value of species, ecological importance and endangered species legislation." Paper presented at the University of Maryland, Ecological Economics Student Group Seminar, July 20.

2001 "A Post-Keynesian reconsideration of environmental taxation." Paper presented at the 30th Conference of Economists, University of Western Australia, September 23-26.

2000 "Functional diversity and the Noah's Ark problem." Paper presented at the PhD Conference in Economics and Business, Australian National University, November 15-17.

2000 "The importance of concept mapping for first year transition." Paper presented at the OOICTL – Business International Conference, Shreveport, Louisiana, September 22-23.

1999 "The double dividend effect of carbon taxes in a Kaleckian model of growth and distribution." Paper presented at the 43rd Conference of the Australian Agricultural and Resource Economics Society, Christchurch, NZ, January 20-22. *Discussion Paper*, School of Business, La Trobe University, Series A – 99.08, 1999.

1999 "Biodiversity preservation: Weitzman's model, problems." La Trobe University, Department of Economics Seminar, July 12.

1999 "Three easy ways to improve teaching outcomes." La Trobe University, Department of Economics Seminar, March 11.

1998 "A post-Keynesian interpretation of the double dividend effect of carbon taxes." Paper presented at the Resource and Environmental Economics Group of the Economic Society of Australia, Melbourne, April 9.

1997 "Production and on-farm soil depletion choices for a risk averse farmer." Paper presented at the 26th Conference of Economists, University of Tasmania, September 12-14. *Discussion Paper*, School of Business, La Trobe University, Series A – 99.09, 1999.

8. Research Grants

2020-22 "Articulating value in housing cooperatives". Funder: Australian Research Council (ARC Linkage) and Australian Cooperative Network. Amount: $594,268. (With Louise Crabtree, Emma Power, Wendy Stone and Sidsel Grimstad).

2020-23 "Metro North West - Evaluating land use, place making and wider economic benefits". Funder: Transport for NSW. Amount: $190,000. (With Rae Dufty-Jones).

2020 "Evidence Bank Development for the Two Priority Vulnerable Groups". Funder: NSW Department of Communities and Justice. Amount: $150,000. (With Brian Stout, Pru Goward, Ann Dadich and Rebekah Grace).

2019 "NSW manufacturing strengths and opportunities". Funder: NSW Government – Innovation and Productivity Council. Amount: $54,714. (With Donald McNeill).

2019-20 "Infrastructure asset management and reporting in preparation for regional growth". Funder: Camden Council. Amount: $20,000. (With Dorothea Bowyer, Ayda Succarie, Connie Vitale and Donald McNeill)

2018-9 "Benefits of strategic conservation planning". Funder: UTS. Amount: $8,400.

2018-9 “Creating the City We Want”. Funder: Landcom. Amount: $50,658. (With Louise Crabtree).
2018 “The Hunter region's economic profile and opportunities”. Funder: Lock The Gate Alliance Limited. Amount: $17,000.
2018 “Co-operative Housing Research: Literature Review & ARC Linkage.” Funder: Australian Cooperative Network. Amount: $ 22,727. (With Louise Crabtree and Emma Power).
2017 “The social benefits of better-practice waste management for multi-unit dwellings in Penrith LGA.” Funder: Penrith City Council. Amount: $25,000. (With Maria Estela Varua).
2016-7 “Business Plan for [medicinal cannabis company].” Funder: [Medicinal Cannabis Company]. Amount: $169,000. (With Scott Holmes).
2016-7 “Bulldogs EOI response to the NSW NRL Centres of Excellence Program.” Funder: Bulldogs Rugby Leagues Club. Amount: $23,000. (With Warren Day, Tim Hall, Keith Parry).

9. Teaching

Cost benefit analysis; Globalisation and Sustainability; Economic Controversies, Theories and Policies; Economics (post graduate); Ethical Enterprise Practice; Institutional Economics and the Environment; Environmental and Natural Resource Economics; Sustainability (multidisciplinary); Energy (multidisciplinary); Ecological Economics; Global Environmental Issues; Introductory Microeconomics; Intermediate Microeconomics; Introductory Macroeconomics; Intermediate Macroeconomics; Principles of Economics; Agriculture in the Australian Economy; Game Theory: Economic Applications; Applied Econometric Research; Financial Economics.

10. University governance and professional development

2017- Work Load Committee. School of Business. Western Sydney University. (Appointed).
2012-9 Research Committee. School of Business. Western Sydney University. (Appointed).
2015-8 Academic Course Advisor (Undergraduate). School of Business. Western Sydney University. (Competitive Appointment).
2014-5 BBC Core Review Requirements Committee. School of Business. Western Sydney University. (Appointed).
2013-5 Academic Literacies Advisory Group. Senate Education Committee. Western Sydney University. (Appointed).
2008-10 Campus Sustainability Working Group. Lebanon Valley College. (Appointed).
2008-10 Academic Evaluations and Policies Committee. Lebanon Valley College. (Elected).
2006-8 Curriculum Committee. Lebanon Valley College. (Elected).

11. Professional Activities

2019- Member. Institute for Culture and Society. WSU.
2019- Academic Associate. Global Centre for Land Based Innovation. WSU.
2016- Academic Associate. Centre for Compassionate Conversation. UTS.
2016- Core member. International Centre for Ocean Governance. WSU.
2014 Member of organising committee, Society of Heterodox Economics Annual Conference.
2011-2 Guest co-editor Symposium on “Carbon markets: inherent limitations and complementary policies,” *Economic and Labour Relations Review*. Volume 23, Issue 1, February, 2012. (with Paul Twomey).

2012-7 Review submissions for scholarly journals including *Environment and Resource Economics*, *Ecological Economics*, *Journal of Environmental Management*, *Environmental Conservation*, *Journal of Australian Political Economy*, *Review of Political Economy*, *Journal of Environmental Economics and Policy*, *Economic Papers* and *Economic and Labour Relations Review*.

1997- Membership of Learned and Professional Associations including Ecological Society of America (2019-20). International Society for Ecological Economists (2017-20, 1990-2000); Society for Conservation Biology (2012); Union of Radical Political Economists (2012); Society for Heterodox Economists (2010, 2014); Pennsylvania Environmental Resource Consortium, Executive Committee member and Treasurer (2009-11); American Economic Association (2003-5, 1998-9); Australian Agricultural and Resource Economics Society (2000-2002); Economic Society of Australia (1997-02).

12. Environmental Advocacy

2015-9 Volunteer economic consultant for the Environmental Defender's Office

- SREBA SREBA Framework Consultation Draft – Review of the Guidance Note for Social, Cultural and Economic Studies. February 2020.
- Sepik Sepik Development Project Environmental Impact Statement: Expert Brief. December 14, 2019
- NSW Biodiversity Legislation Review. Assisted on the EDO's submissions to the NSW government. Attended briefing sessions on Offset Calculator. 2017.
- Russell Vale Colliery Underground Expansion Project – Submission to the Planning Assessment Commission Public Hearing. January. May. December. 2015.

2013-5 Volunteer economic consultant for the Institute for Sustainable Futures at the University of Technology, Sydney.

- Provide economic analysis to support a report into the social costs and benefits of the Kangaroo industry in Australia.

2005-9 Volunteer lectures for environmental organisations and community groups.

- For Hawkesbury Climate Forum: "The cost of climate action versus the cost of doing nothing". Sydney. August 2019.
- For Greater Sydney Landcare Network: "Biodiversity Forum". June. 2016
- For NSW Retired Teachers Federation: "Where to now for climate policies in Australia?" Sydney. April. 2014
- For Politics in the Pub: "Where to now for climate policies in Australia?" Sydney, September. 2013
- For Friends of the Earth: "Beyond carbon pricing: where to from here? Equity and distribution issues." Sydney, August 2011.
- For Climate Action Network and Forest Alliance: "The carbon pricing debate and the struggle over income shares." Katoomba, August. 2011
- For Union of Concerned Scientists: "Climate change in Pennsylvania: impacts and solutions for the keystone state." Harrisburg, PA, April. 2009
- For Student Action for the Environment (SAFE): "The economics of global warming and the Kyoto protocol." Lebanon Valley College, PA, September. 2005

2011 Volunteer work for the United Voice.

- Analysed the Treasury's modelling of the impact of Australia's carbon pricing scheme on low income earners (with Stuart Rosewarne and Graham White).

2010 Economic consultant for the Union of Concerned Scientists (UCS). 2010.

- Analytically deconstructed any public commentary on U.S. climate change legislation. Reworked the analyses into talking points to be used by the UCS and their volunteers in media contexts. Provided explanations for UCS staff of the economic arguments for and against climate change legislation.

2008-10 Volunteer work for the Union of Concerned Scientists (UCS).

- Lobby Pennsylvania Congress representatives and Senators regarding *The American Clean Energy and Security Act (H.R. 2454)*.
- Assisted UCS staff to write "Pennsylvania Scientists and Economists' Call for Action on Climate Change" signed by economists and scientists in Pennsylvania and delivered to members of Congress.
- Organised a meeting between Pennsylvanian Scientists and Economists and UCS staff.

2007-10. Volunteer work for the Pennsylvania Environmental Resource Consortium (PERC).

- Lebanon Valley College Representative.
- Member of the Executive Committee, and Treasurer.

2004-10 Faculty advisor for the student environmental group, Student Action for the Environment (SAFE).

- Led the student activist group in lobbying administrators at Lebanon Valley College to become of the Pennsylvania Environmental Resource Consortium.
- Provided analytical support for a proposal to install a wind-power generator at Lebanon Valley College.
- Attended meetings and events. Delivered presentations. Approved budgets.

2008-10 Carbon inventories and measuring sustainable outcomes

- Performed carbon inventories for Lebanon Valley College.
- Led students in an analysis of the sustainability performance of Annville Municipality.
- Volunteered to assist three municipalities in Lebanon County to devise a grant application for the Pennsylvania Department of Environmental Protection's Local Government Greenhouse Gas Pilot Grant Program.