May 2020

Supplementary Report: Economic Costs of Inaction on Paradise Dam

Report prepared for
Bundaberg Regional Council, Wide Bay Burnett Regional Organisation of Councils, Regional Development Australia Wide Bay Burnett, Bundaberg CANEGROWERS, CANEGROWERS Isis, Bundaberg Fruit and Vegetable Growers, and the Australian Macadamia Society

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Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
BIS	Bundaberg Irrigation Scheme
CAPEX	Capital expenditure
CBA	Cost-benefit analysis
DBC	Detailed business case
DNRME	Department of Natural Resources, Mines and Energy (Queensland)
DPI	Department of Primary Industries (Queensland)
CG	Coordinator General (of the Queensland Government)
FTE	Full-time equivalent (employment)
GRP	Gross regional product
GVAP	Gross value of agricultural production
Ha	Hectare
HP	High Priority (water)
LGA	Local Government Area
MCA	Multi-Criteria Analysis
ML	Megalitre (i.e. 1,000 kilolitres or 1 million litres)
MP	Medium Priority (water)
PV	Present value
ROL	Resource Operating Licence

Summary

State of play

On 25 March 2020, Building Queensland (BQ), the Queensland Government's independent infrastructure adviser, released its *Paradise Dam Options Assessment Summary Report*, accompanied by a study by NCEconomics assessing various options, and NCEconomics' review of the Adept-QEAS report *The Economic Costs of Inaction on Paradise Dam*. Bundaberg Regional Council has commissioned Adept Economics, assisted by QEAS, to respond to these documents through this Supplementary Report.

While NCEconomics has identified several aspects of our economic modelling which it considers contentious, we stand by our finding that there is a substantial benefit from restoring Paradise Dam in the order of $2 billion or more over the next few decades. We note that the economic modelling conducted in our Costs of Inaction Report was underpinned by a major consultation process that included around 300 regional growers and businesses.

We welcome the opportunity to respond and are keen to ensure the development of the Detailed Business Case (DBC) of Paradise Dam options uses the most accurate information available on the likely future demand and use of Paradise Dam water. BQ's DBC will evaluate various options for addressing dam safety concerns, some of which involve substantial reductions in spillway height and dam capacity, with adverse consequences for Bundaberg regional economic development.

Key points

To its credit, BQ has recognised it should keep an open mind on the benefits of the dam, and has decided that a full Paradise Dam capacity option (labelled Option 1a in the reports) is considered in the DBC, despite advice from NCEconomics to the contrary.

Analysis of NCEconomics' supporting analysis, and NCEconomics' review of our *Economic Costs of Inaction* report indicates one major concern with the conclusions of NCEconomics' study. One of the key findings is inconsistent with the extensive consultation that has been conducted by Adept Economics in the preparation of the *Economic Costs of Inaction on Paradise Dam* and follow up stakeholder consultation since then. Specifically, there has been and is anticipated to be net growth in the amount of irrigated agriculture land in use (in

particular greenfield macadamia hectares) that will increase demand for the Paradise Dam's water.

There has and will be additional greenfield macadamia hectares

The NCEconomics report is too pessimistic in its assessment of potential future greenfield development—i.e. development which does not just replace existing cane farms with e.g. new tree crops, primarily macadamias and avocados.

NCEconomics have concluded that their projected growth of high value crops has exclusively been from brownfield development – not greenfield development which is inaccurate for a number of reasons.

Consultation confirms considerable net addition to hectares (greenfield) of macadamias on top of the conversion of sugar cane fields to macadamias (brownfield). This increase in greenfield macadamia hectares has occurred through:

- Conversion of grazing and timber areas on farms;
- Utilisation of farmland that was otherwise fallow; and
- Greater utilisation of existing farmland that was otherwise unsuitable for sugar cane. Stakeholder consultation indicated that sloping land that is unsuitable for cane and small non-symmetrical land on existing farms have had macadamias planted.

The above three sources have led to effectively greenfield macadamia hectares or net increase in irrigated agricultural land. Estimates of the proportion of increase in macadamias from new land are as high as 20% over the past four to five years with median estimates in the order of 5% to 10%.

Adept Economics consultation has indicated macadamia crops are anticipated to triple over the next ten years. The recent and predicted scale of investment in macadamias as indicated by stakeholders is underpinned by the water security provided by the Paradise Dam.

Consultation has indicated that the trend of conversion of existing sugar cane land, conversion of grazing and timber areas on farms, utilisation of fallow land, and greater utilisation of existing farmland that was otherwise unsuitable for sugar cane will continue for only approximately the next 10 years.

It is anticipated that the availability of this land will inevitably run out and further investment in channel infrastructure will be required to expand the reach of water from the Paradise

Dam into non-irrigated areas adjacent to existing irrigated agriculture footprint. This investment will further pave the way for greenfield macadamia crops.

We note also the substantial latent demand for water represented by young tree crops. Recently planted macadamias are still in their infancy and the majority are currently too young for production, requiring less water. As these trees mature an increase in demand will dramatically occur.

In summary, we disagree with NCEconomics' conclusion that nearly all development going forward will be brownfield. If this assumption is carried over into the DBC they will substantially understate the economic benefits of restoring Paradise Dam to its full capacity and bias the assessment. Hence, we welcome NCEconomics' recommendation, accepted by BQ in its summary report, that further analysis of the greenfield vs. brownfields development issue is undertaken for the DBC.

Other comments

While it could be argued some assumptions are on the high-side, others, in our view, could be considered too conservative—i.e. the gross margin for macadamia and avocados and our assumptions regarding the catalytic impact of agricultural development in the region.[1] Moreover, a number of the issues identified by NCEconomics would not have a significant enough impact on the estimated benefit/avoided cost to lead us to question the conclusion that there is substantial benefit from the Dam, which, based on current most likely cost estimates for Option 1a ($800 million), would exceed the cost of repairing it.[2]

While taking information and views in the reports released as part of BQ's Options Assessment into account would change assumptions and possibly lower our overall cost of inaction estimate, we strongly expect a revised cost of inaction estimate would exceed the "more likely" cost estimate of $800 million for Option 1a. In our first report, the central estimate for the total cost of inaction was $2.426 billion.[3] That is, even if the estimated total cost of inaction were only half of that estimated in our first report, it would still exceed the estimated cost of Option 1a by $413 million or by over 50%. Indeed, the estimated cost of

[1] For instance, NCEconomics (2020, p. 65) observes "margins are much higher for avocados…often in excess of $10,000/ha for mature trees".
[2] BQ, 2020, p. 41.
[3] Adept Economics-QEAS, 2020, p. 14. This is a present value (PV) estimate over thirty years, using a 4% real discount rate.

inaction could be reduced by around two-thirds before the cost of Option 1a was equivalent to the cost of inaction.

We note that our analysis was conducted in the absence of the full range of data that was available to NCEconomics from Sunwater, and we would welcome further discussions with BQ regarding the economic modelling being conducted for the DBC.

1. Introduction

1.1 Scope of Work

Bundaberg Regional Council, Wide Bay Burnett Regional Organisation of Councils, Regional Development Australia Wide Bay Burnett, Bundaberg CANEGROWERS, CANEGROWERS Isis, Bundaberg Fruit and Vegetable Growers, and the Australian Macadamia Society have commissioned Adept Economics, assisted by QEAS, to respond to:

- Building Queensland's (BQ's) Paradise Dam Options Assessment Summary Report;
- NCEconomics Paradise dam Improvement Project: service needs, demand estimates and options assessment; and
- NCEconomics High level review of the *Economics Costs of Inaction on Paradise Dam*, a reported prepared in February by Adept Economics and QEAS, regarding the economic costs of not restoring Paradise Dam to its full capacity.

1.2 Structure of the supplementary report

The report is structured as follows:

- **Section 2 Background** provides background on the state of play on Paradise Dam and Building Queensland's options assessment process;
- **Section 3 Review of Service Needs, Demand Estimates and Options Assessment** assesses NCEconomics' review of options which underpins the summary report prepared by BQ;
- **Section 4 Response to high level review of previous report** assesses NCEconomics high level review of the *Economics Costs of Inaction on Paradise Dam*
- **Section 5** concludes the Supplementary Report and includes recommendations for next steps.

This supplementary report should be read in conjunction with the Adept-QEAS report *The Economic Costs of Inaction on Paradise Dam* released in February 2020.

2. Background

2.1 Paradise Dam state of play

The Paradise Dam is in the Bundaberg region and was opened in 2005 with a capacity of 300,000 megalitres (ML) of water. Owing to dam safety concerns, capital works need to be undertaken to ensure public safety. Capital works have already commenced to lower the dam wall by 5 metres and Building Queensland is currently preparing a detailed business case (DBC) assessing several options, namely:

- "maintain the primary spillway height at the level of the essential works (nominally 5 metres below existing spillway level prior to the essential works)
- raise the primary spillway height to an optimal level (up to the existing full supply level prior to the essential works)
- lower the primary spillway height to an optimal level (down to a maximum of 10 metres below the existing spillway level prior to the essential works) and explore alternative water supply options."[4]

The detailed business case is intended to determine which of the options is optimal from the Queensland community's perspective. No timeframe is indicated on the BQ website regarding when it is due for completion, with BQ advising, regarding additional demand analysis essential to the DBC, that "These investigations will be undertaken as a matter of priority, allowing the Queensland Government to determine the best options for Paradise Dam."

2.2 Cost of inaction report

The Adept Economics-QEAS (2020) report The Economic Costs of Inaction on Paradise Dam estimated substantial net benefits from restoring Paradise Dam to its full capacity. The executive summary of the study reported:

> *Using Adept Economics' regional economic model, an estimated potential cost of inaction on Paradise Dam has been estimated in the order of $2.4 billion in present value (PV) terms over the next thirty years (2020-21 to 2049-50), relative to the counterfactual in which Paradise Dam is assumed to be maintained in its originally*

[4] BQ website: http://buildingqueensland.qld.gov.au/business-case/paradise-dam-options-assessment/

intended capacity…This is the cost to the Queensland community of a permanent lowering of Paradise Dam by up to 10m.[5]

2.2.1 Views from stakeholders in the Bundaberg region

To inform the economic analysis, Adept Economics and QEAS undertook extensive community consultation within the Bundaberg region with irrigators, supply chain businesses, community groups, and the Council.

Adverse economic impacts on irrigators and broader economy

Feedback from consultation sessions indicated that Paradise Dam was a critical issue for growers in the Bundaberg Region. In general, the Paradise Dam has provided for reliability and in turn water security that has created grower certainty that has underpinned confidence to invest and employ.

According to the views of stakeholders, the potential of Bundaberg irrigated agriculture is enormous, serving as one of Australia's major food bowls. Conversely the permanent loss of capacity of the Paradise Dam was described as a potential "economy killer" given that it is hugely important for Bundaberg growers. Irrigated agriculture in the Bundaberg North Burnett region has been described as now under threat due to loss of reliability and security and in turn certainty and confidence.

There will be an impact on the whole of the irrigated agriculture value chain including nurseries, sugar mills, transport operators, packaging providers, ports, planting and harvesting contractors, fuel distributors, fertiliser and chemical retailers, farm machinery retailers, irrigation equipment suppliers, and accountants and insurance brokers.

Furthermore, if these businesses are impacted their employees will be, too, leading to a reduction in expenditure across the broader community as they will no longer be spending their wages.

Culinary agriculture and agriculture education are also expected to be negatively impacted as a result of a loss in Paradise Dam's storage capacity. Bundaberg Tourism emphasised the foundation that agriculture is providing to Bundaberg's visitor experience.

[5] Adept Economics-QEAS, 2020, p. 13.

A reduction in the supply of water has led to the price of water across the BIS to rise with further rises anticipated, possibly causing it to become too expensive to acquire, pushing it out of the price range of smaller growers.

Why Paradise Dam water was not originally purchased

Consultation indicated that the Government held a view that the water from Paradise Dam had not sold in the quantity originally modelled and accordingly it was not valued by growers. Growers indicated there were several key reasons why only 24,000ML of 124,000ML of Medium Priority water allocations and 2,850ML of 20,000ML of High Priority water allocations are currently committed to customers, including:

1. It is poor planning by Government if a piece of infrastructure such as a Dam, with at least a 50 year asset life, assigns 100% of its allocation within the first 12 years of its construction;
2. Water security provided by the dam has encouraged the transition to higher revenue tree crops such as macadamias. These trees are still in their infancy and the majority are currently too young for production, requiring less water. As these trees mature an increase in demand is anticipated;
3. Of the 12 years since the construction of the Paradise Dam, eight years have had above average rainfall and four below average rainfall including the wettest year on record (2010);
4. Timeframes were quite short and EOI's were required to be lodged within 28 days which was insufficient to secure finance or free up capital to purchase;
5. Sugar prices have been suppressed which acts as a disincentive to plant more cane crop;
6. Water sourced from Paradise Dam had additional charges associated with it and accordingly a premium attached to it, whereas water from elsewhere in the scheme is cheaper for growers. The view commonly held is that Paradise Dam water will eventually sell but it well sell last;
7. Growers knew it was there for future use providing a benefit through reliability, security and certainty;
8. When purchasing a permanent nominal allocation, there is no guarantee that the full nominal entitlement will be announced through the Medium Priority allocation process whereas with temporary transfer the grower receives 100% of the water; and

9. The Scheme design was also referenced with limited peak water volume available in the Woongarra section of the distribution system.

Growers have indicated if the sale process were to occur again then there would be greater take up and several have indicated that they would be prepared to buy allocations as a means of offsetting the expense of the dam rebuild.

Stakeholder feedback indicated that in any case the Paradise Dam had acted as an economic development mechanism providing for new industries to come to the region on the knowledge of the water they could inevitably call upon.

What the Queensland Government should do

The overwhelming feedback indicated the requirement for the Government to either rectify the current dam wall or rebuild it. The challenge, however, is that the cost has to be paid by the Queensland Government, but the benefit accrues to the Bundaberg community.

Stakeholders indicated there is an underlying need to drought-proof the country, yet we are decommissioning a drought-proofing piece of infrastructure. All stakeholders interviewed believed the government's long-term economic benefit will outweigh the short-term financial cost.

2.2.2 Survey results

As part of the preparation of the report a survey was commissioned to canvas both irrigated business and non-irrigated business views on the importance of the Paradise Dam. This survey received nearly 300 responses, reflecting a high level of community concern regarding the potential lowering of Paradise Dam. Key survey findings included the following.

- Nine in ten growers (91.9%) indicated that the Paradise Dam was extremely important to their business and three in four non-irrigated businesses (76.9%) also indicated that it was extremely important to their business. In short growers indicated no water, no crop, no income and that it is the security that Paradise Dam provides is its greatest advantage. Non-irrigated businesses referenced that their turnover is intrinsically linked to grower activity.
- Three in every four growers (75.8%) and three in every five (62.8%) non-irrigated businesses have made investments contingent upon the availability of water from the Paradise Dam. Over $510 million of investments made since the Paradise Dam became operational were identified as part of the survey on land, buildings, equipment and additional hectares of crops planted. Thirty-three growers identified

investments greater than $1 million and ten growers identified investments greater than $10 million.

- The majority of irrigated businesses anticipated either a high impact on their turnover (35%), employment (34.5%) and investment (23.3%) or severe impact on their turnover (46.3%), employment (38.7%) and investment (58.3%) if the Paradise Dam is not restored to its original capacity. The impact for non-irrigated businesses was less, but still profound indicating a prevalence of mutual dependence between the broader business community and irrigated agriculture.
- Virtually all irrigated businesses (99.2%) held the view that Paradise Dam's water resource is extremely important for the Bundaberg Community. This sentiment is also held by non-irrigated businesses (88.5%).
- Significant forward investments were highlighted relating to the ongoing expansion of tree crops together with other projects associated with the Isis Central Mill.
- Only one in ten growers (11.3%) indicated they would be able to mitigate the impact of a permanent reduction in water storage capacity of Paradise Dam.
- As a result of all of the above, virtually all growers (99.2%) and 86.5% of non-irrigated businesses indicated it was extremely important to restore Paradise Dam's capacity.
- In respect to what the Government should do, the overwhelming feedback indicated the need to either rectify the existing Paradise Dam wall or build a new dam as a priority.

BQ commissioned NCEconomics which prepared the services needs assessment to undertake a high-level review of the Adept Economics-QEAS report, and this is considered later in this report. NCEconomics high level review was considered in the options assessment summary report from BQ, discussed in the next sub-section.

2.3 Building Queensland's Options Assessment

BQ's *Paradise Dam Options Assessment Summary Report* is heavily based on NCEconomics (2020) report on service needs and a review of design, cost, and risk of capital works options prepared by Aurecon (2020). The options considered by BQ comprised:

- "Option 1: maximum primary spillway height…
- Option 2: reduce maximum primary spillway height by 5m...
- Option 3: reduce maximum primary spillway height by 10m…
- Option 4: reduce maximum primary spillway height by an optimised level (between 5m and 10m) to maintain water security.
- Option 5: decommission the dam."[6]

These core options were supplemented by two sub-options which were considered by NCEconomics (2020). These sub-options were:

- Option 1a: maximum primary spillway height with "additional risk reduction works on the secondary spillway that may meet the required dam safety assessment criteria"; and
- Option 3a: reduce maximum primary spillway height by 10m…supplemented by alternative water supply options which would meet projected demands and provide water security for the region.

The Summary Report prepared by BQ is an informative and accurate assessment of the evidence presented to it. For instance, BQ effectively acknowledged the uncertainty around future development in the Bundaberg region and the implications for future water demand by deciding that a full-capacity option (1a) should be considered in the DBC, despite NCEconomics recommending that only options involving a permanent lowering of the dam wall be considered. BQ was right not to recommend a specific option at this stage. It noted:

> *The assessment of long-term options identified that Building Queensland is not in a position to provide a recommendation on long-term option(s) because of the preliminary level of design and other information currently available in relation to the various options. Therefore, Building Queensland has recommended further work be*

[6] BQ, 2020, p. 6.

> *undertaken with Sunwater as a matter of priority to support a firm recommendation to government.*[7]

BQ's inclusion for consideration in the DBC of a full-capacity option, which involves some remediation works on the secondary spillway, appears to have been motivated by:

a) the possibility of such an option addressing dam safety concerns; and
b) economic modelling in the *Economic Costs of Inaction* report.

Regarding dam safety, BQ notes:

> *Aurecon's review determined that Option 1A's performance in potentially meeting dam safety requirements relies on the outcomes of the dam foundation assessment (currently underway), RCC assessment and anchoring trials (planned by Sunwater).*[8]

That is, it is possible that Option 1A may not be feasible ultimately due to dam safety considerations, in which case BQ would need to consider another option to restore full capacity.

Regarding the Adept Economics-QEAS report, BQ noted:

> *The further assessment will also give due consideration to the assumptions and findings of the Adept Economics report released in February 2020.*[9]

The major issue to resolve, as will be discussed further below, is the likely future agricultural development of the region in the with-and-without cases for restoring Paradise Dam's full capacity. In our view, the NCEconomics report is too pessimistic in its assessment of potential future greenfield development—i.e. development which does not just replaced existing cane farms with e.g. new tree crops, primarily macadamias and avocados.

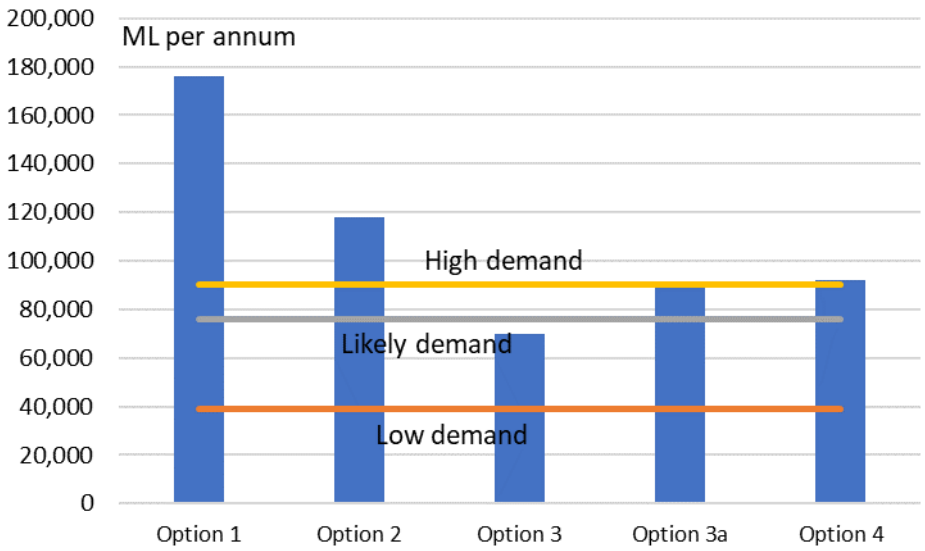
2.4 NCEconomics' Service Needs, Demand Estimates, and Options Assessment

NCEconomics undertook an assessment of scenarios for future water demand in the Bundaberg region, producing low, likely, and high scenarios. In none of the scenarios was a restoration of full capacity of Paradise Dam necessary to meet demand (Figure 1). Except for option 3, a 10m spillway reduction (without any boost to capacity elsewhere), all options

[7] BQ, 2020, p. 5.
[8] BQ, 2020, p. 8.
[9] Ibid, p. 15.

meet NCEconomics high demand estimate in 2050. Note that, based on its service needs assessment, NCEconomics did not recommend further consideration of option 5, the decommissioning of the dam. Incidentally, it is striking that there is a much greater difference between water demand in the low demand scenario and the likely scenario than between the high demand scenario and the likely scenario.

Figure 1.NCEconomics estimates of water demand versus Paradise Dam supply under various scenarios in 2050, ML per annum (blended MP and HP water)



Source: BQ and NCEconomics, 2020. Note that values in the figure are approximate as they have been determined by visual inspection of Figure 1 in the BQ Summary Report.

NCEconomics recognises a lot of downside risk, but little upside potential. As discussed below, in our view, NCEconomics has not recognised the huge potential upside for agricultural production and water demand in the region.

NCEconomics compared the options it assesses using a Multi-Criteria Analysis (MCA) and found that restoring the full supply level (Option 1a) had the lowest ranking, with the highest ranking given to Option 3a, lowering the dam by 10m but with alternative supplies being developed to provide water security. As noted earlier, NCEconomics recommended only options 2, 3a, and 4 proceed to the DBC, and not Option 1a which would see restoration of full capacity.

Overall, the NCEconomics report draws on a wide range of data and limited stakeholder consultations, some of which from Sunwater are not publicly available (and hence was unavailable to Adept Economics-QEAS to scrutinise). Based on our own consultations and

data analysis, including of original survey data from regional irrigators and other businesses, we disagree with NCEconomics' assumptions informing its analysis and findings. We also question the use of MCA to rank options on capital projects, as discussed in the next section.

3. Review of Service Needs, Demand Estimates and Options Assessment for Paradise Dam

3.1 Review of methodology

The NCEconomics report:

a) presents Paradise Dam water demand estimates; and
b) assesses the different options for Paradise Dam partly based on the extent to which they meet the water demand estimates.

The methodology in the NCEconomics report is discussed for these two separate components in the two sub-sections below.

3.1.1 Demand estimates

Analysis of NCEconomics' *Paradise Dam Improvement Project: service needs, demand estimates and options assessment* indicates one major concern with its findings. One key finding of NCEconomics is inconsistent with the extensive consultation that has been conducted by Adept Economics in the preparation of the *Economic Costs of Inaction on Paradise Dam* and follow up stakeholder consultation since then. Specifically, there has been and is anticipated to be net growth in the amount of irrigated agriculture land in use that has and will significantly increase demand for the Paradise Dam's water.

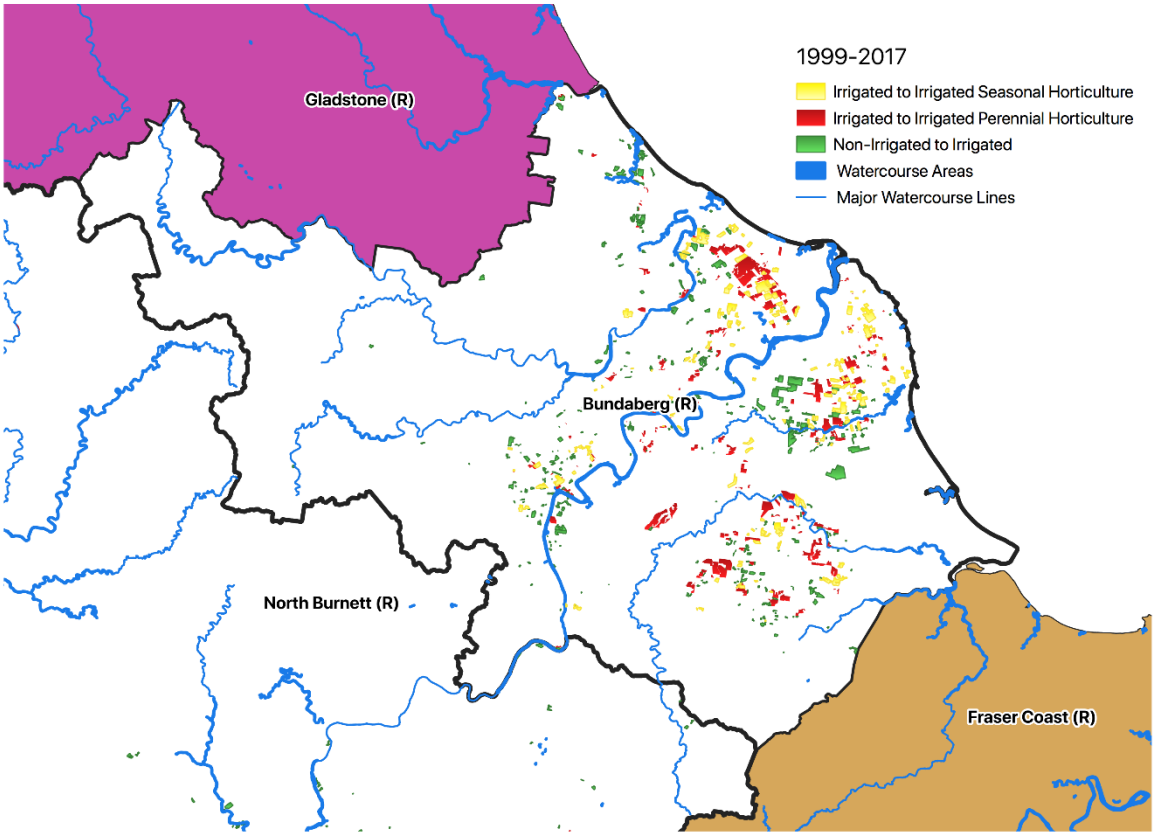
The critical assumptions that are of major difference between the NCEconomics and the Adept Economics-QEAS studies relate to projected future land use. Such assumptions require a large amount of judgment. Historical trends in land use patterns are only useful to a limited extent, and have to be supplemented with information gleaned by stakeholder consultations. NCEconomics has undertaken consultations in the region, but, in its opinion, consultations supported its view that new agricultural developments, particularly in tree crops such as macadamia and avocados, would primarily occur on existing agricultural land, continuing the trend of conversions of cane farms to these crops. As discussed below, we have reached a different conclusion regarding the potential for greenfield development than NCEconomics.

Land use

Both the Adept Economics and NCEconomics reports confirm the diversification of irrigated agriculture, particularly into perennial horticulture more specifically macadamia tree crops and resultant changing nature of land use in the Bundaberg region.

Adept Economics has provided the changes in land use over the last two decades in the Bundaberg region in Figure 5 of the *Economic Costs of Inaction on Paradise Dam report* (Figure 2).

Figure 2. Changes in land use in Bundaberg region, 1999 to 2017



Source: Queensland Government Land Use Mapping Program data.

We have used the Queensland Land Use Mapping Program (QLUMP) spatial dataset to understand changes in land use since 1999 and this is summarised in Figure 5 of the report (above). Analysis clearly shows a substitution from irrigated to irrigated seasonal horticulture and irrigated to irrigated perennial horticulture. However, analysis also indicates a conversion from non-irrigated to irrigated land over the period.

The University of New England's Industry Engagement Web App that presents mapping of commercial horticulture tree crops across Australia confirms the existence of both brownfield and greenfield macadamia projects in the region (Figure 3).

Figure 3. Australian Tree Crop Rapid Response Map

Source: University of New England.

The Australian Tree Crop Rapid Response Map is part of the 'Multi-scale Monitoring Tools for Managing Australian Tree Crops - Industry Meets Innovation: Phase 2' project, led by the University of New England and funded by the Australian Government Rural Research and Development for Profit program.[10]

Additionally, extensive stakeholder consultation confirmed the considerable additional hectares of macadamias that have been planted. This increase in greenfield macadamia hectares has occurred due to:

- Conversion of grazing and timber areas on farms to macadamia growing;
- Utilisation of farmland that was otherwise fallow; and

[10] For more information about this project, visit: AARSC current projects and the National Tree Project.

- Greater utilisation of existing farmland that was otherwise unsuitable for sugar cane. Stakeholder consultation indicated that sloping land that is unsuitable for cane and small non-symmetrical land on existing farms have had macadamias planted.

The above three sources have led to a net increase in irrigated agricultural land in the Bundaberg region and greenfield macadamia hectares). Estimates of the amount of increase in macadamias that originates from new irrigated land range as high as 20% over the past four to five years however median estimates are in the order of 5% to 10%. A result the Bundaberg region has now surpassed other macadamia capitals to become Australia's largest macadamia growing region.

Accordingly, we disagree with the follow statements by NCEconomics:

> *One of the key findings from the analysis was that, despite significant recent growth in high value crops (particularly macadamia and avocados), this growth is occurring on former sugarcane farms. In effect, the growth in water demand is the net impact of requirements for perennial tree crops less the water requirements previously used for producing sugar.*[11]
>
> *The nature of irrigated agriculture in the region is changing as the economic viability of some crops is reduced through market pressures, while other opportunities emerge. Consultation in the region indicated that the actual expansion of irrigation areas in recent years has been negligible. Rather, the trend is for existing irrigated sugarcane land within the BWSS to be converted to higher value crops.*[12]
>
> *Much of the growth in demand for high value crops is not significantly increasing water demand as this development is occurring in areas that were previously irrigated sugarcane. Hence only the net change between crop requirements per ha impacts on aggregate water demand.* [13]

Our analysis and consultations have revealed that NCEconomics is far too pessimistic in its assessment of future water demand in the region.

[11] Source: NCEconomics - Paradise Dam Improvement Project: service needs, demand estimates and options assessment, p. 26.
[12] Ibid, p. 63.
[13] Ibid, p. 11.

Future Demand

Increases in future water consumption over the next 10 years will be from further conversion of predominantly sugar cane land but also from new land and additional utilisation of existing farm footprints.

Adept Economics consultation has indicated the enormous potential of macadamia crops that are anticipated to triple over the next ten years. The recent and predicted scale of investment in macadamias as indicated by stakeholders is underpinned by the water security provided by the Paradise Dam. Conversely, the erosion of water security provided by the Paradise Dam is anticipated to seriously erode future investment in macadamia planting and greenfield sites. As we noted in the *Costs of Inaction* report:

> *There is concern that a loss in Paradise Dam storage capacity will not allow for growth. Proposed greenfield sites particularly in the macadamia industry are in jeopardy with investment attraction now seriously impeded. For growers, feedback indicated that the only investment going forward will be in trying to reinforce water security on existing land and investments.*[14]

Furthermore, we reported numerous comments from macadamia growers on major projects planned for the region contingent upon Paradise Dam's water resource (Box 1).

Box 1. Comments regarding dependence of projects on Paradise Dam

"There are major Nut projects that have stalled because of the debacle that is Paradise dam. There are several projects to plant orchards in this area that are on hold until this all plays out, I'm lead to believe their value is counted in the 100's of millions." Grower

"Numerous Macadamia development projects are now on hold. 2 of my customers of 20000 trees p/a have indicated postponing plantings until the dam outcome is known." Nursery owner

"Significant investment in further major macadamia nut plantations will not go ahead without water security." Grower

"Further investment in our own business has ceased for now - we had plans to purchase more land. We are considering the possibilities of not developing some of the land we have purchased. I am aware of other macadamia, avocado and citrus projects that are on hold or ready to press the stop button depending on the future capacity of Paradise Dam. I was also

[14] Adept Economics-QEAS, 2020, p. 58.

advised today of a large commercial development on the West side of town that has been shelved until further certainty about the future of the dam is known." Grower

"The nut industry is growing at a rapid rate in the region that has already attracted 2 processing plants to be built, 1 only half completed. And if no more processing plants are built there will be receival depots built." Grower

"I am a horticultural consultant and without the water the business will not be able to afford my services and I will be effectively unemployed. In addition, I am currently involved with two external investors who want to have $43 million to invest into establishing new macadamia orchards within the Bundaberg region. Without the water this investment will not go ahead." Horticulture consultant

"We have presently ceased negotiations on a number of properties south of the Burnett." Grower

Source: Adept Economics - Economic Costs of Inaction on Paradise Dam

Adept Economics consultation has indicated that the trend of conversion of existing sugar cane land, conversion of grazing and timber areas on farms, utilisation of fallow land; and greater utilisation of existing farmland that was otherwise unsuitable for sugar cane will continue for the next 10 years at rates experienced in the past four to five years.

It is anticipated that after the next decade the availability of this land will inevitably run out and further investment in channel infrastructure will be required to expand the reach of water from the Paradise Dam into non irrigated areas adjacent to existing irrigated agriculture footprint.

Accordingly, NCEconomics are inaccurate to suggest that Adept assumptions on most development going forward will be greenfield is wrong and this in turn has material implications for their own demand assessments.

Latent demand

We note also the substantial latent demand for water represented by young tree crops.[15] Recently planted macadamias are still in their infancy and the majority are currently too young for production, requiring less water. As these trees mature an increase in demand will dramatically occur.

[15] See Section 4.5.2 in Adept Economics-QEAS, 2020, p. 53.

Feedback from the consultation that was conducted by Adept Economics in January and February 2020 indicates macadamia grower concern that there is minimal opportunity to reduce water application to the macadamia tree without jeopardising its long-term yield.

This in effect creates a legacy commitment of continued water application for the duration of the tree's lifespan. Feedback indicates that as a result of this there exists a significant prospect of increased water demand as recently planted macadamia trees reach maturity (estimated at 12 years) when their water requirement is at its highest.

3.1.2 Implications for the NCEconomics Report

As we did in our study, NCEconomics has analysed Queensland Government geospatial information for the Bundaberg region, and based on changes observed over time, as well as partly on stakeholder consultations, it has developed assumptions for land use change which imply a massive reduction in hectares of land used by sugar cane farmers over the next three decades (Table 1).

Table 1. NCEconomics assumptions regarding future land use changes p.a. for low, medium, and high-change scenarios

Crop type	Low (ha/per annum)	Medium (ha/per annum)	High (ha/per annum)
Irrigated sugar	-359	-589	-846
Macadamias	236	337	438
Avocados	31	62	124
Citrus	1	7	9
Other fruits	40	80	120
Vegetables	43	86	129
Pasture, fodder and broadacre	9	17	26
Total	**1**	**0**	**0**

Source: NCEconomics, 2020, tables 19 to 25.

In our view, it is problematic to assume zero (or only infinitesimal) change in aggregate land use over the projection period, as NCEconomics does. Ideally, to get a true sense of the potential range of outcomes, NCEconomics should have had the total agricultural land vary significantly across their scenarios. Given the growing global middle class, and positive trends for agricultural produce demand as discussed in Section 2.5 of our previous report, it would make sense to consider the possibility of total agricultural land expanding in the Bundaberg region.

The future change in agricultural land use are extremely important in understanding the future demand for water from Paradise Dam's and its economic value, and presupposing there will be no (or only negligible) expansion in agricultural land would limit the robustness of the results. It would certainly appear contrary to what we have determined in our

stakeholder consultations—including additional consultations conducted for this supplementary report—and regional survey.

3.1.3 Multi-criteria analysis

To rank the various options, NCEconomics used an MCA where it scored each option according to a range of criteria and using a range of techniques, many relying on subjective assessments (Table 2). This established a rank ordering of options, with Option 3a (less 10m plus supply enhancements elsewhere) number one and Option 1a (Full supply level) last in fourth place.

Table 2. NCEconomics MCA of Paradise Dam options

Item	Option 1a (Score)	Option 2 (Score)	Option 3a (Score)	Option 4 (Score)
Dam safety	0.000	0.000	0.300	0.150
Meets future water requirements	0.300	0.290	0.082	0.000
Recreation use opportunities	0.050	0.025	0.000	0.025
Environmental risks	0.040	0.050	0.000	0.050
Social and cultural risks	0.050	0.050	0.000	0.050
Cost	0.000	0.193	0.250	0.235
Total (maximum = 1)	0.440	0.609	0.632	0.510
Ranking	**4**	**2**	**1**	**3**

Source: NCEconomics, 2020, p. 22.

It is unclear why Option 1a is scored 0.000 compared with 0.3000 for Option 3a and 0.150 on dam safety when, as noted above, Option 1a may well meet the required dam safety assessment criteria. In this case, the option should not be penalised relative to the other options in the assessment. Option 1a would score higher than Option 3a and Option 4 if it were not penalised on the dam safety criterion, and it would possibly rank above Option 2 if a criterion were included for economic impact, rather than simply “Meets future water requirements.” Adept Economics-QEAS received the clear message from consultations that

simply meeting projected water requirements is not enough. The fact Paradise Dam has a great deal of capacity provides room for future growth and gives confidence to irrigators and other businesses (e.g. downstream processors) to invest in the region.

MCA may have some value for a preliminary assessment of options but it is less rigorous and useful than a comprehensive cost-benefit analysis (CBA) which attempts to compare all items in a common metric, dollars, and which does not rely on subjective scoring rules.

Ultimately, it is expected the options will be assessed using CBA in the DBC so the MCA rankings may be irrelevant to the final decision.

3.2 Assessment and implications for Building Queensland's Options Assessment

Overall, NCEconomics has adopted a sound methodology, although as noted above we have some substantial reservations about:

- assumptions around future land use, which do not consider any significant upside in agricultural land use in the region, which appears likely given the rapidly expanding global middle class and growing demand for agricultural produce;
- the scoring of dam safety in the MCA which, in our view, wrongly penalises Option 1a on dam safety in the ranking of options and relegates it to last place, whereas it is either in first or second place; and
- the lack of an economic impact criterion in the MCA, which would enable a consideration of the relative economic contributions of the dam at different supply levels.

That said, NCEconomics analysis can be readily extended and revised as the DBC is being prepared. As noted by BQ in its Summary Report, an additional detailed demand assessment is being prepared for the DBC, and in our view this additional assessment should contain much more optimistic about the potential for future agricultural expansion in the Bundaberg region than is assumed in the NCEconomics analysis to date.

4. Response to High Level Review of Costs of Inaction report

4.1 Overview of High Level Review

NCEconomics (2020) review of the Adept Economics-QEAS Economic Costs of *Inaction on Paradise Dam* report noted that:

> *The Adept report includes significant contextual information that will prove useful for the Detailed Business Case (DBC). The report concludes (as expected) that there is a significant cost of a permanent reduction in the dam by 10 metres (present value range of between $1,451 and $2,426 million).*[16]

It is pleasing that NCEconomics has recognised the extensive research, including via stakeholder consultations and a survey of regional farms and other businesses, that provide context for BQ's decision—i.e. that Paradise Dam is considered of high importance to the regional economy. It is also a positive finding that NCEconomics recognises that "there is a significant cost of a permanent reduction in the dam by 10 metres"—although it queries the magnitude of our estimates.

NCEconomics (2020) review of our report identified what, in its view, were two key issues:

- assumptions regarding future changes in land use, particularly the extent to which future development is on greenfield or brownfield sites; and
- other assumptions and input parameters which, in its view, are unclear or questionable, and lead to a too high estimate of the forgone benefits arising from BQ's Option 3.[17]

Our responses to NCEconomics' views on these key issues are presented in sub-section 4.2 and 4.3. Regarding greenfield versus brownfield development, NCEconomics appears to concede the uncertainty around the land use change assumptions—uncertainty which is also relevant to their own arguably too pessimistic assumptions—by recommending that "BQ should ensure the demand estimates undertaken for the DBC include detailed analysis of the likely configuration of greenfield vs. brownfield irrigation development."[18] We concur with

[16] NCEconomics, 2020b, p. 3.
[17] Ibid. NCEconomics also noted that "Where assumptions and input parameters were clear, NCEconomics was unable to accurately replicate the estimates." Without seeing NCEconomics spreadsheets attempting to replicate the analysis it is not possible to respond to this point.
[18] NCEconomics, 2020, p. 3.

this recommendation as land use change assumptions are the most critical in determining projected future water demand and economic benefits of Paradise Dam's water resource.

4.2 Potential for greenfield development

NCEconomics are inaccurate to suggest that Adept Economics assumptions are wrong that most development going forward will be greenfield and this in turn has material implications for their own demand assessments. NCE Economics writes:

> *"Adept's simple assumption that future development is primarily greenfield is inconsistent with recent history, current trends, and statements in their own report. This assumption has a profound impact on water demand and could result in demand outstripping FSL yields in as little as 20 years."*[19]

However Adept Economics contends that this is reasonable particularly in the medium to long term. As indicated in Section 3, a net increase in irrigated agricultural land and an increase in macadamia greenfield hectares has occurred in recent years through:

- Conversion of grazing and timber areas on farms to macadamia growing;
- Utilisation of farmland that was otherwise fallow; and
- Greater utilisation of existing farmland that was otherwise unsuitable for sugar cane. Stakeholder consultation indicated that sloping land that is unsuitable for cane and small non-symmetrical land on existing farms have had macadamias planted.

Further analysis will be required to quantify this precisely and we expect this will be done in the DBC.

Furthermore consultation has indicated that the trend of conversion of existing sugar cane land, conversion of grazing and timber areas on farms, utilisation of fallow land, and greater utilisation of existing farmland that was otherwise unsuitable for sugar cane will continue for the next 10 years at rates similar to that in the past four to five years. After this time greenfield sites will accelerate as the availability of land expires and further investment in channel infrastructure occurs to expand the reach of water from the Paradise Dam into non-irrigated areas adjacent to existing irrigated agriculture footprint.

[19] NCEconomics, *High Level Review,* 2020, p. 6.

4.3 Other issues

4.3.1 Alleged inconsistency in the report

NCEconomics observes:

> *The inconsistencies between Adept's statements regarding crop substitution and the parameters used to develop their scenarios (that indicate very low level of substitution) are not resolved in their report.*[20]

The alleged inconsistency is resolved by recognising that, based on our stakeholder consultations, we consider future greenfield development will be stronger than the historical experience. That said, see section 4.2 above which presents a fuller analysis and acknowledges our assumed greenfield development may be too high based on additional consultations.

4.3.2 Water utilisation in high growth scenario

Regarding the high growth scenario (i.e. where non-sugar cane land use expands by 5% p.a.) presented in the report, NCEconomics notes:

> *In effect, under Adept's high growth scenario, all water available from the current FSL [Full Supply Level] would be exhausted in approximately 20 years.*[21]

This may be a fair point, although we would respond:

- NCEconomics' Figure 1 (2020b, p. 6) demonstrates that our central demand estimate does not ever exceed the FSL and it is the central demand estimate which underpins the central estimate of the report—the $2.426 billion cost of inaction; and
- There may be scope for demand to exceed the FSL if irrigators use on-farm storages to store excess rainfall during high rainfall years and use it boost water applied to crops in other years.

Overall, the point by NCEconomics indicates the need for the DBC to consider highly detailed water demand and supply estimates.

[20] NCEconomics, 2020b, p. 6
[21] NCEconomics 2020b, p. 5-6

4.3.3 Replicability of results and information regarding assumptions

NCEconomics (2020b) makes several assertions regarding the replicability of results and information regarding our assumptions. Regarding replicability, without seeing NCEconomics calculations or exposition of its attempt to replicate our estimates, it is impossible for us to judge where any potential difference lies or what additional information we need to provide. In our view, we disclosed sufficient information regarding our methodology and assumptions in the report. Also, NCEconomics argues our estimates are higher than they would estimate based on our assumptions, but it is unclear how much higher and whether any difference would affect the overall conclusions of our report.

Regarding assumptions which NCEconomics has questioned:

- the explanations for our investment cost estimates are presented in the notes to Table 12 on p. 90 of our report;
- regarding GRP impacts, our assumptions are presented in Tables 9 and 14 on pages 86 and 94 respectively of our first report, and we note these are considered to be indicative of the catalytic impact that additional agricultural development could have on the regional economy rather than as precise estimates; and
- our assumptions for the social cost estimates are explained in section 6.2.5 and are based on research by Deloitte Access Economics (2016).

4.3.4 Tomatoes as representative crop for other crops

Regarding our gross margins assumptions, NCEconomics (2020b) makes the point that:

> *Tomatoes are used as the representative vegetable crop. This is an unrealistic assumption, and given the very high gross margins for tomatoes, overall costs are over-stated.*[22]

Adept Economics-QEAS used tomatoes instead of another crop based on advice from the study's Advisory Group, which included regional irrigators who considered tomatoes would be a reasonable representative crop to use in the analysis.

4.3.5 Sensitivity analysis

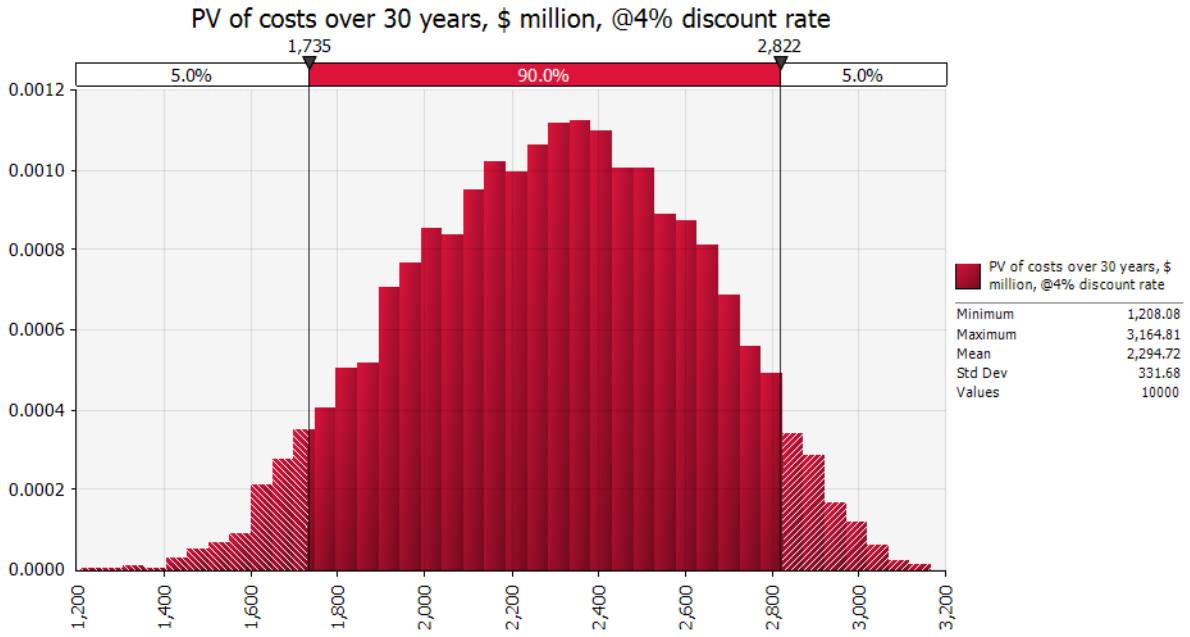
Regarding the sensitivity analysis, Adept Economics-QEAS presented in the first report (Section 6.3.2, pp. 96-97), NCEconomics comments:

[22] NCEconomics 2020b, p. 7.

> *…only partial results of the sensitivity analysis were presented, and it is not possible to elicit insight on which input parameters drive the variability on the cost estimates. Furthermore, the range of estimates is relatively narrow given the paucity and variability of input data presented. This reinforces the need to treat the estimates with extreme caution.*[23]

Regarding the "relatively narrow" range of estimates, inadvertently, the sensitivity analysis presented in the report did not allow for variation in all the parameters and is not the full sensitivity analysis it should have been. Running the sensitivity analysis to reflect all the parameter ranges indicated in the first report yields a wider range of estimates which we expect should allay NCEconomics' concerns in this regard (Figure 1). The sensitivity analysis still shows a likely range for the cost of inaction ($1.735 billion to $2.822 billion) in excess of the cost of Option 1a (up to $1.381 billion with $800 million more likely).[24] The largest contributors to the variance in the estimated cost of inaction in the sensitivity analysis are the land use change assumptions and the productivity uplift assumption.

Figure 4. Updated sensitivity analysis for Present Value (PV) of total cost of Paradise Dam inaction, @RISK Monte Carlo simulation



Source: Adept Economics estimates using the @RISK add-in to Excel.

[23] NCEconomics, 2020b, p. 7.
[24] BQ, 2020, p. 41.

4.4 Implications for magnitude of costs of inaction

In light of the high level review from NCEconomics (2020b), if we were to develop a new regional economic model for the purposes of the costs of inaction on Paradise Dam, it is possible we would settle on assumptions which imply less greenfield development than in our previous report, but not zero or negligible greenfield development as assumed by NCEconomics. We might also adjust some other assumptions, although they would have much less impact on the overall results than changes to the land use assumptions.

While changes to the assumptions to take into account information and views in the reports released as part of BQ's Options Assessment would possibly lower our overall cost of inaction estimate, we expect a revised cost of inaction estimate would exceed the "more likely" cost estimate of $800 million for Option 1a. In our first report, the central estimate for the total cost of inaction was $2.426 billion.[25] That is, even if the estimated total cost of inaction were only half of that estimated in our first report, it would still exceed the estimated cost of Option 1a by $413 million or by over 50%. Indeed, the estimated cost of inaction could be reduced by around two-thirds before the cost of Option 1a was equivalent to the cost of inaction.

Given that we expect further useful information will be forthcoming from the work undertaken by the DBC, we do not consider it useful to add a new estimated cost of inaction/benefit of Option 1a figure into the public debate. Instead, we would conclude that our estimates are sufficiently in excess of the cost of Option 1a that even with revisions they suggest Option 1a should seriously be considered by BQ in the interests of Bundaberg regional economic development.

[25] Adept Economics-QEAS, 2020, p. 14. This is a present value (PV) estimate over thirty years, using a 4% real discount rate.

5. Conclusions

On basis of the above and the extensive feedback that was gathered in the preparation of the Adept Economics' *Costs of Inaction Report* and since then we feel sufficiently confident with the findings and conclusions of this report (Box 2) and commend it for consideration by Building Queensland and the Queensland Government. We understand that the analysis of the DBC may result in a different estimate of the cost of inaction, but for the reasons outlined above, we expect such an estimate would very likely exceed the cost of proceeding with Option 1a to restore full capacity.

In terms of next steps, we recognise the importance of the analysis BQ will be commissioning for the DBC, and we would make ourselves available to assist BQ's consultants with any queries they have regarding our analysis and findings.

Box 2. Conclusions of Adept Economics' Costs of Inaction on Paradise Dam Report

This study has revealed potentially large costs to the Bundaberg community of a permanent reduction in Paradise Dam's water storage capacity. There are also implications for the state economy, given Bundaberg's substantial contribution to Queensland agricultural activity in total. In making its final decision on Paradise Dam, the Queensland Government needs to take full account of these economic and social costs. The Government is rightly concerned about the costs of any mitigation measures relating to Paradise Dam, but it needs to consider the full magnitude of the avoided costs which would result from such mitigation measures.

Finally, while difficult to quantify, the Queensland Government should note that it sends a negative signal to investors, both domestic and foreign, when governments unexpectedly reverse previous policy and infrastructure commitments. Previous Queensland Governments saw Paradise Dam as an essential part of the economic development of the Bundaberg region, and based on our stakeholder consultations and survey results, that view is widely shared in the Bundaberg community.

Source: Economic Costs of Inaction on Paradise Dam Page 98

References

Adept Economics and QEAS, 2020, *Economic Costs of Inaction on Paradise Dam*.

Building Queensland, 2020, *Summary Report: Paradise Dam Options Assessment*.

Deloitte Access Economics, 2019, *The social and economic cost of the North and Far North Queensland Monsoon Trough*, report prepared for the Queensland Reconstruction Authority.

NCEconomics, 2020a, *Paradise Dam Improvement Project: service needs, demand estimates and options assessment*.

NCEconomics, 2020b, *High level review of the Economic Costs of Inaction on Paradise Dam: Approach, findings and implications for Building Queensland*.

About the authors

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In recent years, Gene has been a course leader and expert presenter for several short courses delivered by University of Queensland's International Development unit. These courses have covered topics such as best practice policy development, industry policy and trade policy (e.g. tariff policies), cost benefit analysis, taxation, natural resource economics for officials from Indonesia's Ministries of Finance (Kemenkeu) and National Development Planning (Bappenas).

Gene has a first-class honours degree in economics from the University of Queensland and was a University Medallist. He has also lectured in UQ's School of Economics, most recently as course leader for ECON2040 Macroeconomic Policy.

Gene appears frequently in state and national media (e.g. the Courier-Mail, The Australian, and on 612 ABC Brisbane) commenting on economic issues.

Nick Behrens is a Senior Associate of Adept Economics and the Director of QEAS. Across his professional career Nick has realised many outstanding outcomes to complex challenges for the business community. He possesses significant experience in gathering and presenting information, and leveraging that information to achieve results across a range of economic areas including taxation, regulatory environment, workers compensation, employment legislation, and infrastructure and planning issues.

Nick's representations are based on extensive research and his preferred approach to advocacy has always been to achieve results rather than headlines, by working with stakeholders behind the scenes to secure positive outcomes.

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