Border Rivers Regional Water Strategy – additional analysis on inland diversion schemes

During public consultation on the Border Rivers Regional Water Strategy, the department was asked to undertake further analysis on inland diversion scheme options to consider benefits to connectivity with the Barwon-Darling, coastal flood mitigation and energy generation. This paper reports on the results of this analysis.

Summary of results

At the request of stakeholders during public consultation on the Border Rivers Regional Water Strategy: Shortlisted Actions – Consultation Paper (Border Rivers RWS shortlisted actions) the department has undertaken additional analysis on inland diversion schemes. The analysis aimed to assess whether a broader consideration of the benefits of an inland diversion scheme would make the infrastructure economically viable. The analysis found that even with aspirational assumptions, inland diversion schemes are unlikely to be economically viable because:

- the costs remain prohibitively expensive, and would ultimately need to be recovered by water users or the beneficiaries of the scheme
- an inland diversion scheme could reduce impacts on Border Rivers licence holders from the draft connectivity options presented in the draft Western Regional Water Strategy if they were progressed, but would not remove all of the impacts or be capable of providing flows to the Barwon-Darling in the quantities needed during ecologically important times
- the scheme is unlikely to significantly reduce high flows in the Clarence Valley and so may not provide meaningful flood mitigation benefits, but could have significant impacts on low flows in the valley during droughts - which could further stress coastal communities, industries and environmental needs. We heard strong opposition from coastal communities around options to divert water from the Clarence Valley to inland regions as part of the public consultation on the North Coast Regional Water Strategy
- Hydropower energy potential has been determined to be limited.

Recent investigation by CSIRO into the viability of the Bradfield scheme, a comparable inter-catchment concept moving water inland from the north Queensland coast, found similar findings to the Regional Water Strategy. They include prohibitively high capital and operational expenditures, significant environmental concerns, limited opportunity for hydropower generation to mitigate expenses, and limited benefits to inland catchments under highly optimistic conditions.

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As a result, the Border Rivers Regional Water Strategy focuses on smaller scale, more affordable actions to support the resilience of the region's communities, industries and ecosystems over the coming decades.

Inland diversion schemes assessed

The inland diversion scheme was listed as Option 8 in the long list of options in the draft Border Rivers Regional Water Strategy[1] released in late 2020. In assessing the long list of options, the Department of Planning and Environment analysed a large and a small inland diversion scheme.

The analysis found that the benefits of the inland diversion schemes did not outweigh the costs[2].

During public consultation on the Border Rivers Regional Water Strategy: Shortlisted Actions – Consultation Paper (Border Rivers RWS shortlisted actions) some stakeholders requested the department undertake further analysis on the inland diversion scheme. As part of this analysis the department considered a small inland diversion scheme, as well as a modified large scheme. Table 1 summarises the options analysed:

Table 1: inland diversion schemes analysed through Border Rivers Regional Water Strategy process

	Initial analysis as part of Draft Border Rivers Regional Water Strategy	Further analysis following consultation on the shortlisted actions
LARGE INLAND DIVERSION SCHEME		
Infrastructure	• 897 GL dam on the Timbarra River (Clarence valley) directly on the other side of the Great Dividing Range from the headwaters of the Mole River • captured water was diverted across the range in a 41 km tunnel/pipeline through a combination of pumping and gravity	
Diversions	• 89 GL/year transferred	• 50GL/year transferred The original option assumed diversions of 89GL/year would have resulted in a violation of coastal extraction limits. Reducing diversions to 50GL/year is expected to remain within coastal extraction limits.
Purpose of diversion	Water was used to create 49 GL of additional high security licences	Water was left in the system to flow downstream

[1] Available for download at: www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/border-rivers-regional-water-strategy

[2] See Inland Diversion Scheme Strategic Assessment: Draft Border Rivers Regional Water Strategy available at www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/what-we-heard/border-rivers-regional-water-strategy . Further information on detailed hydrological and economic assessment can also be accessed at this link.

	Initial analysis as part of Draft Border Rivers Regional Water Strategy	Further analysis following consultation on the shortlisted actions
SMALL INLAND DIVERSION SCHEME		
Infrastructure	• 49 GL dam on the upper Mann River (Clarence valley) directly on the other side of the Great Dividing Range from Glen Innes • captured water diverted across the range in a 12 km tunnel/pipeline and discharge via gravity into Beardy Waters approximately 13 km north of Glen Innes. The water would then flow into Pindari Dam where it was captured.	
Diversions	• 12.3 GL/year transferred	
Purpose of diversion	Increase reliability of general security licences in the Border Rivers	Remains in the system to provide connectivity benefits downstream

Barwon-Darling connectivity benefits

The Draft Western Regional Water Strategy[3] published in June 2022, included a long list of options that could help to improve water flowing from the Border Rivers catchment into the Barwon-Darling River system at important times. Some of these options had the potential to impact on licence holders in the Border Rivers if the options were progressed without additional action to offset impacts on licence holders.

During public consultation on the Border Rivers shortlist, some stakeholders asked the department to analyse whether an inland diversion scheme could help offset impacts on licence holders from any of the proposed connectivity options in the draft Western Regional Water Strategy.

These connectivity options included:

- Protecting the first flush by restricting supplementary licences in the Border Rivers (and other valleys) when Menindee Lakes was below 195GL – this results in a long-term reduction of 8GL over the long-term in the Border Rivers if the trigger was an active trigger, or less if the trigger included inactive and inaccessible storage in Menindee Lakes
- Supporting fish migration and algal suppression by restricting supplementary licences at certain times of the year for specific flow targets. If progressed without any offsetting actions, at a minimum this could reduce long-term diversions in the Border Rivers by approximately 8GL/year

[3] Available for download at: https://www.dpie.nsw.gov.au/water/plans-and-programs/regional-water-strategies/public-exhibition/western-regional-water-strategy

Both a small inland diversion scheme transferring approximately 12GL/year and a large scheme transferring 50GL/year could help reduce the impacts of a connectivity option on licences in the Border Rivers on average over the long-term.

However, an inland diversion scheme, regardless of size, is unlikely to remove all impacts from potential connectivity options because:

- there are a small number of individual years (approximately 4-6) where the modelling suggests the impacts on licence holders in the Border Rivers from the connectivity options exceed the flows diverted from coastal catchments (approximately 50-90 GL).
- The flow rates from both the small and large inland diversion scheme options may be too low to directly provide some of the connectivity outcomes, and too low to provide supplementary access at times when there are no releases being made for irrigation requirements. For example, the large inland diversion scheme transfers 50 GL/yr into the Mole River which converts to a uniform rate each day of 137 ML/day. This is not enough to provide supplementary access during September to April, when supplementary access is only announced if flows will exceed 100 ML/day at Mungindi, unless other inflows occur.

This means that there might be individual years or sequences where water diverted from an inland diversions scheme is unable to offset impacts on licence holders in the Border Rivers from a connectivity option.

This analysis also assumes that no water from the inland diversion scheme is taken by water users.

End of system flows

The department assessed the change in end of system flows from the two inland diversion schemes analysed (Table 1). The large inland diversion scheme, diverting approximately 50GL/year results in an increase of 18 GL (3%) in the mean annual end of system flow at Mungindi, while the small inland diversion scheme results in an increase of 2.2 GL (0.4%) assuming no water from the inland diversion scheme is taken by water users. These small increases from large diversions are a function of the evaporation and seepage of water that occurs in the rivers as water moves across large distances in the Border Rivers.

Table 2 change in mean annual end of system flows and water take by licences – small and large inland diversion schemes

Diversion scheme	Change in average end of system flow (GL/yr)
Small diversion scheme	+ 2.2 GL (0.4%)
Large diversion scheme	+18 GL (3%)

These incremental increases suggest that the construction and operation of inland diversion schemes are not a cost-effective way of increasing end of system flows in the Border Rivers.

Coastal flood mitigation benefits and environmental impacts

The potential for the dams associated with the inland diversion scheme to reduce flooding impact on coastal centres such as Grafton is very small. This is due to the distance of the dams from Grafton and small portion of the Clarence catchment that the dams would capture water from.

The catchment for the dam on the Mann River for the small inland diversion scheme covers about 4% of the Clarence catchment, while the catchment for the dam on the Timbarra River for the large inland diversion scheme covers about 8% of the catchment[4].

Our analysis showed the small inland diversion scheme would reduce high flows at Grafton by less than 1% and the large inland diversion scheme would reduce large flows by less than 4%.

The analysis does however suggest that the impacts on low flows are likely to be higher than the impacts on high flows. Increasing low flow periods in coastal catchments will place additional stress on industries, communities and ecosystems during droughts.

While this analysis provides a indicative assessment of how these schemes could modify flows in rivers, it cannot sufficiently analyse impacts on flood events. Specific flood analysis requires more detailed and granular analysis.

Improvements to flood risk mitigation are being considered through the 2022 NSW Flood Inquiry. The inquiry report and the NSW Government response can be found at: https://www.nsw.gov.au/nsw-government/projects-and-initiatives/floodinquiry

Hydropower energy generation

The department sought expert advice[5] on the potential of the inland diversion schemes to provide hydropower energy generation. The hypothesis was that energy generation could improve the economic feasibility of the scheme.

Hydropower refers to the generation of electricity through the force of moving water. Typically, the greatest hydropower generation occurs when a volume of water undergoes a large elevation drop, converting the stored potential energy to kinetic or mechanical energy at the point of a mechanical turbine.

Expert advice has found that hydropower energy potential is limited for both inland diversion schemes considered. Energy generation capabilities via water diverted from the Clarence Valley to the west of the Great Dividing Range and via dam releases towards the east from required eastern storages within the Clarence Valley were investigated.

The drop in elevation across the length of the proposed pipelines transferring water from coastal catchments to the inland catchments is not great enough to generate any hydropower. If the inland diversion schemes were to proceed to more detail design, it is likely that hydropower proposals will result in additional pumping requirements and therefore further cost due to the lack of slope.

[4] Department of Primary Industries – Water 2016. *Water Sharing Plan for the Clarence River Unregulated and Alluvial Water Sources – background document*. www.industry.nsw.gov.au/water/plans-programs/water-sharing-plans/status/north-coast-region

[5] Provided by Carbon and Energy Markets (September 2022), an independent consultancy

Releases from eastern storages towards the Clarence Valley are considered the only possible source of hydropower generation for the two schemes and in neither case do they provide an economically sound source of power generation. An assessment of the hydro-energy generation potential, with an assumed 100 ML/d release, resulted in estimated annual revenues of $300,000 per year for the small inland diversion and $970,000 per year for the large inland diversion. These annual incomes would improve the Net Present Value (NPV)for the small inland diversion by $4.2 million and the large inland diversion by $13.8 million across a 40-year analysis period, which are not high enough to provide economic justification to progress either scheme. Updated NPVs for the two schemes now including the potential hydropower generation, along with previously released NPVs without hydropower, are given in Table 3. This shows very little change in economic outcome for each scheme with the added benefit of hydropower generation.

Table 3 – Cost Benefit Analysis outcomes comparison

Option	Description	NPV without Hydropower ($, Mil)	NPV with Hydropower ($, Mil)
Large diversion	Inland Diversion (89 GL/year to Mole River, New 49GL HS) – without Mole River Dam	-6,520	-6,506
Small diversion	Inland Diversion (13 GL/year to Pindari Dam)	-1,797	-1,793

Economic benefits of hydropower presented are highly optimistic as they do not include any capital, operational, or maintenance expenditure of required generation and transmission infrastructure which may significantly impede the economic viability of any hydropower component. Additionally, releases of 100 ML/d, amounting to 36.5 GL/y, are unlikely to be achieved consistently, with any reduction in the quantity of releases resulting in a reduction of revenue.

Comparative studies

Recent investigation by CSIRO into the viability of historic and modern variations of the Bradfield Scheme, a comparable inter-catchment concept moving water inland from the north Queensland coast, found that the scheme was technically feasible but not commercially viable.

Whilst the Bradfield Scheme is a larger scale proposition than the Border Rivers inland diversion schemes, many of the themes of the technical findings between the CSIRO study and the assessment completed for the RWS are consistent. They include prohibitively high capital and operational expenditures, significant environmental concerns, limited opportunity for hydropower generation to mitigate expenses, and limited benefits to inland catchments under highly optimistic conditions. In the case of a modern conceptualisation of the Bradfield scheme adopting optimistic assumptions, the increase in net farm revenue would recover just 25% of the project cost, more conservative assumptions would reduce this figure to 8%.

The CSIRO study can be accessed at https://www.csiro.au/en/research/natural-environment/water/water-resource-assessment/the-bradfield-scheme-assessment