Senate Inquiry into Additional Water Supplies for South East Queensland - Traveston Crossing Dam

April 2007

Submission from Dr. G. Bradd Witt[1], Katherine Witt[1] and Andrew Taylor[2]

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Summary of Points made in this submission

- This submission illustrates the failings of the Wyaralong dam option as a reliable and cost-effective water supply for SEQ.

- The main argument proposed is that the Wyaralong dam fails to produce the expected yield of 18,000ML and can only sustain a safe yield of 9,500ML (53%). This claim is supported by an analysis of actual flow data. This data is presented in the accompanying report "Wyaralong Dam: Issues and Alternatives".
- the cost of the proposed dam relative to yield makes it one of the most expensive options currently under consideration for water supply

- Premier Beattie's public justifications for selecting the Wyaralong options are negated with supporting evidence.

- Key concerns are outlined including: small, unreliable yield, inefficient use of the water resource, wastage through evaporation, water quality issues of salinity and pollutants, geographical barriers and the huge expense for little benefit.

- Environmental impacts include endangered regional ecosystems and RAMSAR and other wetlands. The full extent of impact is largely unknown.

- Lack of transparency in decision making and withholding of information from both affected landholders and the Federal government.

- A suite of alternative options exist that can provide the same or similar yield to that expected from the proposed Wyaralong Dam, with negligible waste and at far reduced economic, social and environmental costs.

- Supporting documents attached:

Witt, G. B. Witt, K. J. and Taylor, A. (2007). Alternative supply options to the proposed Wyaralong Dam: Preliminary analysis and presentation of potential supply options to achieve the proposed Wyaralong Dam contribution (to the proposed Cedar Grove weir) at lower social, economic and environmental cost. Report prepared for the Deputy Premier of Queensland and Minister for Infrastructure Anna Bligh.

Submission to the Senate Rural and Regional Services and Transport Committee for inquiry:

Submission from G. Bradd Witt, Katherine Witt and Andrew Taylor

Who we are:
We are primarily Wyaralong landholders directly impacted by the proposed dam. However, collectively we have valuable and relevant expertise that enables us to comment with a high degree of knowledge and objectivity on the failings of the proposal and its impacts..

Dr Bradd Witt has extensive experience in century scale environmental change and has lectured in environmental management and environmental problem solving at The University of Queensland for seven years. His expertise in problem solving has a strong focus on comprehensive problem analysis, and option generation using participative and inclusive stakeholder engagement methods. Ms Katherine Witt has an honours level degree in Environmental Management: natural systems and wildlife, and is currently undertaking a PhD at The University of Queensland exploring the policy environment surrounding landholder perceptions of property rights and responsibilities. Mr Andrew Taylor has a degree in Construction Management and has extensive experience in the management of large construction projects through all stages from inception, feasibility, approvals and delivery.

This submission was written in haste wedged between work and family commitments and so is perhaps not as lucid as we would like. We ask for the opportunity to be interviewed by the Committee to present the supporting evidence for our claims and to answer any further questions the Committee may have. This is the only forum available to us to have a say (and be heard) and we thank the Senators for their time and interest.

This submission addresses the Inquiry terms of reference stated as:

"the examination of all reasonable options, including increased dam capacity, for additional water supplies for South East Queensland, including:

(a) the merits of all options, including the Queensland Government's proposed Traveston Crossing Dam as well as raising the Borumba Dam: and

(b) the social, environmental, economic and engineering impacts of the various proposals"

Introduction

In response to the need for additional water supply to sustain exponential growth in SEQ, (and arguably, in response to an upcoming election) the Premier, Mr Peter Beattie announced a new water infrastructure package for SEQ, the "water grid". The two largest projects and "critical components of the water grid are the two new dams, one at Traveston Crossing on the Mary River and the other at Wyaralong on the Logan River" This submission demonstrates serious failings in the proposal to build a large dam at Wyaralong.

This submission addresses the above Terms of Reference by:

- clearly demonstrating the inefficiency, wastage and high cost associated with the proposal to construct a large dam at Wyaralong
- outlining serious concerns about its wider economic, social and environmental impacts and
- presenting a suite of alternatives with demonstrably less economic, social and environmental impact.

The main argument proposed is that the Wyaralong dam will not reliably produce the expected yield and is therefore not a reliable or cost efficient source of water for future urban needs. In addition it is argued that the cost of the proposed dam relative to yield makes it one of the most expensive options currently under consideration for water supply in South East Queensland. These arguments are justified using accessible data from across government agencies and consultants' reports including hydrographical, and rainfall data for the Teviot catchment. We can clearly show that the Wyaralong dam is a far more expensive, wasteful, and unreliable option than other available options and we would welcome the opportunity to present this argument along with the substantiating data to the Committee.

Critical and undisputed facts surrounding the proposed Wyaralong dam include:

1) Wyaralong dam is not intended operate as a stand alone project to deliver any water independently.
2) "21,000 megalitres per annum" is actually the yield from Cedar Grove weir with the addition of releases from the Wyaralong dam (on the Teviot Brook) to supplement Logan river flows delivered from the weir during periods of low flow in the Logan River.
3) Government has stated that the Cedar Grove weir "will provide 4,000 megalitres per annum" but this is the absolute minimum. It will normally provide much, much more than this from the typically high flowing and reliable Logan River. "there would be little or no requirement for release from Wyaralong when the Logan flows are adequate"

4) The proposed Wyaralong dam could, at best, contribute around 9,500 megalitres reliably per annum (but with enormous evaporative losses/waste and at the cost of some $500M)
5) The actual quantum of water required from Wyaralong dam has never been disclosed but is not 21,000mL, or 21,000mL less 4,000mL (17,000mL) but somewhere between "zero (when the Logan is flowing normally) and 17,000mL" (when the Logan is dry)
6) The decision to proceed with Wyaralong has been based on comparative assessments against other options assuming that it delivers 21,000mL p.a. which is simply not factual.

It has become quite obvious that the Wyaralong site was chosen in the lead up to an election based on the comparatively small number of property owners affected and not on its merits as a reliable or sustainable water storage. (Even the 'low social impact' justification is flawed. This point will be addressed further on).

Since the election, the costs and risks outlined in this submission have been made very clear to the Queensland government, and its construction company the QWI. However, they choose to belligerently persist with the project, with quotes like "the decision is made", "we are committed to building the dam at Wyaralong" despite advice from within its own agencies (source to remain anonymous) and from external consultants (e.g. Mary River Council of Mayors' commissioned report) that it is a "sub-standard dam site". Indeed the QWI are 'bulldozing' ahead and have been pressuring landholders into negotiations to sell without providing all the requested information to make a fully informed decision about our futures.

The decision to build a dam at Wyaralong continues to be justified using flawed and inconsistent data and arguments, including, either through blind incompetency or devious intent, lying to the Commonwealth about the full extent of impacts the Wyaralong dam proposal will have. We wish to bring to the attention of the Senate a few of these key inconsistencies in this document with the hope that it will provide some insight into the frustration and insult that Wyaralong landholders have been forced to endure.

Outline of submission

1) Discussion of the Wyaralong dam option highlighting the failings of the proposed Wyaralong dam option
2) the flawed decision making process resulting in selection of the Wyaralong option
3) the merits and impacts of alternative options that have not been considered

1.0 Discussion of the Wyaralong dam option: the failings of the current proposed Wyaralong dam

For those not familiar with the Wyaralong project, as it is very little mentioned in the wider press, a brief outline of the Wyaralong dam proposal follows.

Firstly, the proposed Wyaralong dam is *not* on the Logan River. In fact, it is not on a river at all, nor a creek, but on the lower sandy reaches the ephemeral Teviot Brook. This geography is important to understand because it directly impacts on the reliability of the proposed dam as a permanent water storage facility.

The proposed Wyaralong Dam on the Teviot Brook is intended to simply supplement operations of the Cedar Grove weir on the Logan River. The dam does not, and importantly, cannot operate independently as the sustainable annual yield is too low for the dam to be viable in its own right. The Queensland Government anticipates that the Wyaralong Dam when combined with Cedar Grove weir will yield up to 21,000ML/yr. However, contrary to what the public has been led to believe, the perceptions of some politicians and material published by the Queensland Government, the majority of the anticipated 21,000ML/yr will actually be provided by the Cedar Grove weir on the Logan River and not the Wyaralong Dam on the Teviot Brook. The Logan River has a very large annual flow which is quite reliable even during extended drought (see submission by Andrew Taylor). Conversely, the Teviot Brook has a highly variable flow and is an ephemeral creek illustrated by the fact that there has been no flow in the Teviot Brook for the past twelve months.

The proposed Wyaralong Dam is intended to supplement the Cedar Grove weir when flows in the Logan River would be inadequate. During periods of lower flow in the Logan River, at Cedar Grove, it is anticipated that water will be released down the lower Teviot Brook from the Wyaralong Dam.

Wyaralong Dam simply cannot reliably provide yields proximate to the 18,000ML/yr described as the ‘prudent yield’ in numerous government publications (eg. Queensland Government, 2006). Attempts to draw 18,000ML/yr from the proposed Wyaralong Dam would cause rapid depletion and imminent failure of the supply during normal and extended drought. If a steady annual yield was to be taken from the Wyaralong Dam then the maximum that could be safely drawn is only 9,500ML/yr (only 53% of the cited prudent yield) based on modelling of the dam using historical catchment yield data. The extreme inefficiency of the proposed dam is highlighted not only by very low and unreliable yields but also by the fact that average annual evaporation from the storage would exceed 17,000ML/yr to provide only 9,500ML/yr.

It is notable (and curious) that the 'prudent yield' values presented in government publications for Cedar Grove and the proposed Wyaralong Dam are reversed. For example, the prudent yield value for Wyaralong Dam of 18,000ML/yr is the absolute most that it could ever supply in any year, while the value of 3,000ML/yr is the least that Cedar Grove would supply in the worst year. To assume that the Wyaralong Dam can provide 18,000ML in the worst year to supplement the Cedar Grove weir (bringing the overall yield to 21,000ML/yr) creates the risk of dam failure. It has been demonstrated that to take more than 9,500ML from Wyaralong Dam would be very risky during dry periods.

To store water in a dam at Wyaralong in the hope that it will be available when the River runs low is not only overly optimistic, but is an extremely wasteful approach to providing relatively small volumes of water. Evaporation from the proposed Wyaralong Dam would be extreme due to the shallow nature of the dam and its very large storage area relative to its volume. These shallow areas of the dam will become super-heated and result in accelerated evaporation and dangerous conditions for the growth of blue-green algae.

If climate change projections for south east Queensland of reduced rainfall by at least 5% and increased average temperatures are correct then the dam, in combination with an already highly variable and small, low yielding catchment, would repeatedly fail. The complete blockage of natural flows in the Teviot Brook would result, but the dam would be so rarely full that it could never supply a reliable amount of water.

It is understandable, given the current drought and population growth in south east Queensland that the government is actively seeking solutions that ensure reasonable supply into the future. However, the proposed Wyaralong Dam is not a viable solution. In fact, the benefits from this proposed dam are minute relative to the extreme waste and costs involved in its construction and operation. In addition the proposed construction of a large dam on the Teviot Brook is an irreversible decision where the full extent of impacts is largely unknown. In keeping with Australia's policy of Ecologically Sustainable Development, the decision to build a dam over other alternative options should be treated with due caution. We believe insufficient time and resources have been allocated to the search for viable and sustainable alternatives to the proposed Wyaralong Dam.

Following is a summary only of the key issues of concern. More detailed information and supporting evidence including data and data analysis can be provided for each of the following points.

Proposed Wyaralong Dam: Key concerns and impacts

• Small, Unreliable Yield

The proposed Wyaralong Dam on the Teviot Brook is located in a relatively small catchment with extremely variable rainfall. The Teviot Brook is an ephemeral stream with high natural variability in annual flow. The proposed dam will fail to meet the expected 18,000 ML/yr during normal and expected periods of drought. Our modeling shows it can only safely yield 9,500 ML/year (53% of expected yield). With evaporation taken into account, the dam will almost never reach its capacity.

• Wastefulness

The dam is a gross waste of a precious natural resource. Over 20% of the storage area averages only 0.9m while a further 19% averages just 1.8m. Thus approximately 40% of the storage would experience elevated evaporation rates due to excess heating of shallow water. Evaporation from large dams is inevitable, but in the case of the proposed Wyaralong Dam evaporation rates would be approaching two times the available yield for human use (see the following section). Such an extremely inefficient and wasteful approach to the storage and provision of small volumes of water is unacceptable in an already stressed catchment and when water is such a scarce and valuable resource. More detail of the inefficiency of the proposed Wyaralong Dam can be found in Section 1 of the attached report "Alternative supply options to the proposed Wyaralong Dam".

With the reality of climate change upon us it is clear that large dams are not a suitable droughtproofing strategy as they are the most drought sensitive technology to supply water in areas of variable rainfall. The dam is also wasteful its inefficient use of the land area, requiring a very large area of land to produce only a small yield from a shallow dam.

• Water Quality is a SERIOUS concern

Serious water quality concerns are associated with the proposed Wyaralong Dam. Water quality in the Teviot is commonly very poor and this is well known to DNR water quality scientists and managers. An internal office memo released through the *Freedom of Information* Act dated 12/3/1999 written by the then Director of DNR, Resource Condition and Trend Unit makes grave warnings about the poor water quality in the Teviot and its "major implications for a dam at Wyaralong". Among other things, the memo raises serious concerns about the likelihood of toxic algal blooms during periods of low flow (almost always) as well as the likelihood of salinity outbreaks above the dam due to rising groundwater levels. Toxic algal blooms have already been sighted in farm dams and stagnant water during the recent drought.

The memo also raises serious concerns that water quality has not been adequately investigated particularly the impact of leachates from "contaminated water in the storage" into the groundwater system. Recent water quality monitoring at the dam site found very high levels of salinity

considered unsuitable for domestic use, unsuitable for irrigation of crops and suitable for tolerant stock only, with ten times the salinity as anywhere else in the Logan Basin. Poor water quality would add significantly to the cost required for treatment to make the water from the proposed Wyaralong Dam suitable for urban use. The additional costs of water treatment to provide an acceptable standard for urban use have not been determined. The environmental impacts of releasing saline and polluted water into downstream ecosystems, particularly the RAMSAR wetlands and the ecologically significant Logan estuary, must also be considered

The Teviot has a very sandy streambed with little or no visible bedrock. It is a very dynamic system and long term landholders have seen the changes brought about by sand drift and sedimentation. There is no doubt that the dam would silt up very quickly, which reduces its overall capacity and impacts on safe yield.

• **Environmental Impacts**

The Wyaralong Dam would destroy over 1,200 ha and 32 kms of riparian and floodplain ecosystems along the Teviot Brook, most of this is comprised of the Endangered Regional Ecosystem 12.3.3 (Eucalyptus tereticornis on alluvial soils). This ecosystem has less than 10% of its pre-European extent remaining today, with recent mapping indicating a remaining extent of only 3%.

Much of the Wyaralong area is remnant vegetation. The area was identified in the Draft South East Queensland Regional Plan as part of a bioregional wildlife corridor, linking areas of State and regional environmental significance. The vital role of this bioregional corridor was disregarded in the amended draft plan. No assessment of the environmental impacts including impacts on environmental flows has been completed.

Although the Logan itself is a well documented River system, it is important to note that there is very little data on the specific behaviour or ecology of the Teviot. Lungfish have been observed (recently) in Upper reaches. The editor and owner of the local newspaper found historical reports of a Teviot cod found in the 1950's, a very large cod similar to the Mary River cod but more like the Eastern cod, as well as a type of crayfish found deep underground while drilling for a bore in 1908. With its headwaters in the Border Ranges National Park, the diversity of dependent species and aquatic ecology of the Teviot Brook is largely unknown.

• **Social and cultural impacts**

The Wyaralong district in the Teviot valley is one of considerable European and Aboriginal cultural heritage significance. It is a significant traveling route linking western and coastal people. There are a number of Native Title claimants and ownership of the area is greatly contested. There seems to have been very little attempt at identifying all relevant Indigenous interest holders, but already a lucrative compensation deal ($20M) has been offered to at least one group. No such compensation is offered for loss of European

cultural heritage although Wyaralong itself was part of one of Queensland's oldest cattle runs. Impacts on cultural heritage have been overlooked because properties and places of archaeological significance are not listed on State or National Registers. This reflects the inadequacies of Cultural Heritage legislation and not a lack of heritage significance.

The Wyaralong dam option was justified because the government "already own 36% of required land". This figure is misleading. While it is true that the State have significant holdings in the area, most of the land was bought 5-10 years ago when another dam wall site was under consideration and is this land is located well upstream of the inundation area. For the current proposal, the State own 14% of the inundation area including the buffer. Why persist with a dam at Wyaralong when the State own 98% of an alternative dam site at Glendower on the Albert River (much closer to where the water is needed anyway). Numerous Sate water planning documents identify the Glendower dam site as scheduled for 2015. Wyaralong landholders' concerns about timelines for the proposed dam have always been placated by the relevant government agents who have steadfastly confirmed that the Glendower site was scheduled for construction long before Wyaralong (2060). Even in the referral for Federal government consideration under the EPBC Act, the Queensland Government only indicated that a dam at Wyaralong **may** be considered in the future, "possibly in 2060".

The decision to build a dam at Wyaralong therefore came as a shock, even though it was claimed that we "have known about it for 15 years". Subsequently, Wyaralong landholders were not eligible for a $50M 'special circumstances' compensation package that was available only to landholders affected by the Traveston Crossing and Tilleys Bridge dams. The decision to abandon Tilleys Bridge in favour of Wyaralong, often referred to as a "sub-standard" dam site by DNR employees was obviously political. The decision to construct a dam at Wyaralong, although boosting Beattie's pre-election popularity will not solve the current water supply problems not provide water security into the future.

The social impacts of the Wyaralong dam option are not limited to immediate land owners. Although there may be some short term local positive impacts in the way of jobs during the construction phase, the huge costs of new water infrastructure are to be borne by all SEQ ratepayers. There is gross social inequity in the distribution of costs, as the beneficiaries from the proposed dam are limited to "urban and industrial use in Beaudesert, Logan and Gold Coast shires" only. Since the dam was announced, the Gold Coast has approved a desalination plant and with climate change predictions predicting more rainfall along the extreme coasts, the Gold Coast will usually have enough water. This leaves a very narrow belt between Beaudesert and Logan, all a long way east of the Wyaralong dam catchment and into what climate change scientists are calling the "rain belt".

- **Expensive**

The estimated cost of the Wyaralong dam project is $500M. More detailed costing for the project and associated infrastructure is not available and we are told will not be released until the project is finished. Even at the conservative estimate of $500M, for an annual yield of less than 10,000ML, this is by far the most expensive of all water supply options in SEQ. The Wyaralong dam cannot be justified on economic criteria alone, regardless of yield

2.0 Lack of transparency (deceit) in decision making

The consideration of options, and the arrival at the decision to construct a dam at Wyaralong by the Qld State Government was subjected to a compressed timeframe and based on incomplete, and in places, inaccurate or misleading/misused information.

We believe that the politicization of the "water crisis" in south east Queensland, particularly against the backdrop of an impending state election, has severely and adversely affected the decision making process.

The Premier's press release from 4 July 2006, the day the Wyaralong dam was selected ahead of a site at Tilley's Bridge justifies the decision in terms of:

"*The initiatives had been chosen on a number of factors including cost effectiveness; yield; environmental, cultural and social impact; strategic value and reliability of the sources*"

Almost all these decision criteria have been negated, the exception being social impact. Evidence that the Wyaralong dam was chosen on the basis of social impact alone ahead of an impending election irrespective of its other failings is clear in the Deputy Premier and Minister for Infrastructure, Anna Bligh's response to a parliamentary petition against the Wyaralong dam.

"I wish to stress that if there was a comparable option to the Teviot Brook Dam at Wyaralong that could ensure that the region's water supply was secured into the future with minimized social impacts, it would certainly be undertaken." *Anna Bligh, Deputy Premier of Queensland, 18th December 2006*

The decision was primarily based on assumptions brought forward from a 1990 Water Commission report that contained very dated and overly optimistic estimates of yield from a proposed Wyaralong Dam. Immediately before the decision a desk top review (GHD 2006) also made extremely optimistic estimates of yield. At the time of the decision estimates of yield from a Wyaralong Dam were not up to date and did not include the latest climate/catchment yield data. Indeed a document written to explain and

justify the infrastructure ("The Long Term Solution") only modelled data to mid 2003 and was based on a dam operating at 66m AHD (Storage of 135,000ML). The document still contains this error. At this storage level, and based on out dated data, it was estimated that Wyaralong and Cedar Grove weir could yield 21,000ML/yr. The storage is actually currently planned for 63.6m AHD (storage 104,000ML). It has never actually been made public what the sustainable yield of Wyaralong Dam is. The "prudent yield" value is clearly an over estimate and is recognised as such by the Queensland Government. Thus the decision to build a dam at Wyaralong Was based on outdated and overly optimistic expectations of yield in addition to under estimates of cost.

We have requested very clearly from the Queensland Government on two occasions data that demonstrates the actual contribution of a Wyaralong Dam to the Cedar Grove weir. These data have not been provided, although promised on both occasions. What we requested was a detailed year by year model showing how much water would have been provided from Wyaralong and how much would have been provided by the Cedar Grove weir to achieve the 21,000ML/yr. These data are essential in order to assess the relative merits of the proposal but also are required to gauge the potential of other supply options as an alternative to the Wyaralong Dam.

It is clear that the Queensland Government gave considerable merit to the GHD (2006) desk top review "South East Queensland Regional Water Supply Strategy" in making its decision to build a dam at Wyaralong. The evidence for this is overwhelming and made very clear by the former Minister for the Department of Natural Resources and Mines (Mr Henry Palaszczuk) who on the 23rd of May 2006 referred to this document in Parliament as his "bible".

> "If I open up my bible and have a look at the detailed investigations for Wyaralong Dam, December 2005, I find that the estimated yield is 55 megalitres per day. That is about 20,000 megalitres per year."
>
> (Palaszczuk 2006 p 1775)

In addition Mr Palaszczuk refers to "detailed investigations for Wyaralong dam". There were no detailed investigations. Indeed the data that formed the basis of Wyaralong data were very out of date, and primarily derived from the Water Resources report of 1990. Contrary to Mr Palaszczuk's position and the use by the Queensland Government of the desk top review beyond its intended purpose, GHD made it very clear that:

> "This report has been prepared as a preliminary working document only, for use within the South East Queensland Regional Water Supply Strategy project, as a basis to progress more detailed and more accurate assessments. It is not intended for wider release or purpose."
>
> (GHD 2006, front cover page statement)

Perhaps more alarming than the incompetence shown in the process of selecting Wyaralong over other options is the blatant deceit in the process of

referring the project for approval by the Federal government under the EPBC Act.

In its referral document to the Minister for Environment, apart from overstating the yield *again*, the proponent (QWI) claimed that Wyaralong dam is a "stand alone project" with no dependent or associated infrastructure. This is a blatant lie

DNRM Minutes from a Meeting with landholders on 20 May 2006 clearly describes Cedar Grove Weir as dependent infrastructure.

"Mr Smith stressed the Governments commitment to constructing the Wyaralong Dam….." "It was also pointed out that a weir at the Cedar Grove on the Logan River would be constructed to provide a downstream pumping pool and regulatory control for the proposed Wyaralong Dam"

The Queensland Government's referral document for the Cedar Grove Weir was submitted on the 1st May 2006. In this referral documentation, specifically Section 2.6 where it must include other relevant and interdependent developments, the Queensland Government only indicated that a dam at Wyaralong **may** be considered in the future, "possibly in 2060". The State emphasised that the Cedar Grove Weir was intended as a "stand alone" project with a safe annual yield of 3000ML from the Logan River. In addition, there was no reference made to a dam at Tilley's Bridge on the Logan River which was being seriously investigated at the time. Consequently, it was decided that Cedar grove Weir has limited environmental impact and is therefore not a "controlled action" under the EPBC Act.

In December 2006, the Queensland Government submitted a referral for the Wyaralong dam as an independent project, a dam that is clearly intended to work specifically in conjunction with the Cedar Grove Weir. The dam cannot function on its own and cannot yield the 21000 ML/annum as claimed by the State. The Wyaralong Dam **cannot** be treated as an independent project. The cumulative impacts of planned infrastructure development in the Logan Basin catchment will have long-term and irreversible impacts on areas of national natural significance including critical habitats for migratory species of birds, estuarine breeding habitats for fish and turtles, as well as stream and riparian habitat for iconic species such as platypus and dugong.The full severity of these impacts has not been considered by the State.

At the same meeting we were told "*a draft assessment report would take approximately 12 to 18 months to finalise*". This is now being rushed through in 6 months. 'Baseline' data collection for the EIS began months before the Terms of Reference have been agreed to and finalised.

3.0 Options considered, and those that must be considered as alternatives to the Proposal

3.1 the consideration of options by the State

The states consideration of options (as identified by the key GHD report) was largely limited to the options for large dam sites identified in the 1990 report.

This fails to assess options that are necessarily alternatives to large dam sites and relies on assessments of 16 years ago

The desktop study does not include latest data and itself identifies that it "could likely have missed showstoppers"

The desktop study tends toward low estimates of costs and high estimates of yield (most likely for all the dam options).

3.2 options identified that must be considered

"I wish to stress that if there was a comparable option to the Teviot Brook Dam at Wyaralong that could ensure that the region's water supply was secured into the future with minimized social impacts, it would certainly be undertaken."
Anna Bligh, Deputy Premier of Queensland, 18th December 2006

This Ministerial response to a parliamentary petition against the construction of Wyaralong dam prompted us to identify and document a number of alternative water supply options to the currently proposed Wyaralong dam. We wish to duly acknowledge that the Minister for Infrastructure has publicly indicated preparedness to consider alternatives, although the evidence for this actually occurring is yet to be seen.

Last month we presented a report to the Deputy Premier and Minister for Infrastructure, Ms Anna Bligh for consideration. As yet there has been no formal response. This report is a public document and is attached in full with this submission. We urge Senators to read the attached report for a full understanding of the alternatives presented. In this report we outlined seven (7) practicable options that offer more efficient and sustainable alternatives to the proposed Wyaralong Dam. The options presented in this report are intended to operate in some combination and it is demonstrated that a configuration of options, presented as 'scenarios' has the potential to replace the Wyaralong Dam 'contribution' for as little as an estimated 10 to 15% of the current cost estimates for that dam.

The following options are not to be considered entirely in isolation from each other, or that any one on its own is intended to replace the entire 'contribution' of the proposed Wyaralong Dam. We are advocating that some configuration of the options detailed in this section and Section 4 would likely

provide approximately the same volumes as the reliable yield of a large dam at Wyaralong.

Seven (7) options are provided in the report. They are presented in outline only. Detailed analysis, exploration and evaluation with complete data would be expected of the Queensland Government. The seven options comprise:

Option 1: Potential increase in the operational full storage level of Maroon Dam (up to 76,000ML)
Option 2: Recycled water diverted to Cedar Grove weir or Logan River via wetland or stored and reused for industry in addition to rain and storm water capture
Option 3: Intermittent supplementary utilization of water via the 'water grid' from either Hinze Dam and/or the proposed Gold Coast desalination plant
Option 4: Water harvesting from the upper Teviot Brook at times of high flow into Moogerah Dam
Option 5: Intermittent use of ground water
Option 6: A reduced scale Glendower Dam on the Albert River to provide 10,500ML/yr
Option 7: A reduced scale Wyaralong Dam

This is not an exhaustive list but highlights that there a number of alternative options to the Wyaralong dam with far less impacts. If a suite of alternative options can provide the majority of water that is anticipated from the proposed Wyaralong Dam, with negligible waste and at far reduced economic, social and environmental costs, then it is not justifiable for the Queensland Government to proceed to spend $500 million on a large, wasteful and risky dam at Wyaralong simply to provide the additional small quantity of water.

None of these alternatives have been investigated by the Queensland government or QWI and they clearly have no intention of investigating them. This in itself violates the bilateral agreement for the National Water Initiative as well as negligence of the legal obligation to consider all options as outlined in the *Water Act Amendment* 2007 Logan Basin Water Resource Plan.

Indeed, it is such appalling evidence of poor decision-making and lack of transparency that has triggered this Senate Inquiry. We sincerely thank you for your interest in this matter. As 4th generation custodians of this land (and with respect to those have owned it before us) we cannot sit back and let this government make such a wrong decision which will result not only in the devastation and destruction of the land we love but in a gross waste of public money and a precious natural resource.

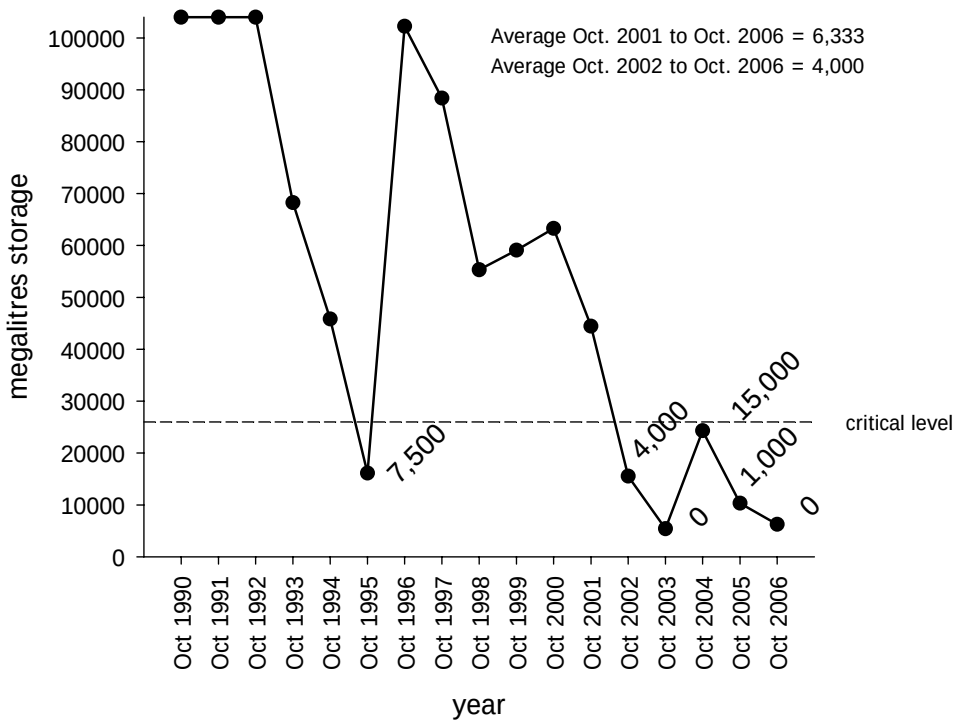

Figure 1: Model of the proposed Wyaralong Dam indicating performance under 18,000ML/yr extraction. The model shows only the maximum storage for each year and also indicates how much water could have been extracted in those years when less than 18,000ML would have been available. A very low average environmental flow allocation of 5.5ML/day (ie. 2007ML/yr) was included for years with no natural flow past the dam. Average annual yields during the current drought are indicated in the upper right.

Note that the average annual contribution from the proposed Wyaralong Dam since October 2002 is only 4000ML/yr. From 2001 it is slightly more at 6,333ML/yr

Alternative supply options to the proposed Wyaralong Dam

Preliminary analysis and presentation of potential supply options to achieve the proposed Wyaralong Dam contribution (to the proposed Cedar Grove weir) at lower social, economic and environmental cost

Report to
The Deputy Premier of Queensland and Minister for Infrastructure
Anna Bligh

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2007

This report should be cited as:
Witt, G. B. Witt, K. J. and Taylor, A. (2007). *Alternative supply options to the proposed Wyaralong Dam: Preliminary analysis and presentation of potential supply options to achieve the proposed Wyaralong Dam contribution (to the proposed Cedar Grove weir) at lower social, economic and environmental cost.* Report prepared for the Deputy Premier of Queensland and Minister for Infrastructure Anna Bligh.

March 2007

Cover picture: The ephemeral, and empty, Teviot Brook stream channel, November 2006 (photo by Bradd Witt)

Preamble

The authors of this report have experience and expertise in environmental management and construction industry project management. This experience has been brought together in this report to the Deputy Premier of Queensland on the understanding that all reasonable options and alternatives to the proposed Wyaralong Dam will be appropriately investigated and evaluated, and that if any or all of those options result in a reduced economic, social and environmental impact they will be undertaken by the Queensland government in place of a large dam at Wyaralong. This undertaking has been made public and in writing by the Deputy Premier of Queensland.

Dr Bradd Witt has extensive experience in century scale environmental change and has lectured in environmental management and environmental problem solving at The University of Queensland for seven years. His expertise in problem solving has a strong focus on comprehensive problem analysis, and option generation using participative and inclusive stakeholder engagement methods. Ms Katherine Witt has an honours level degree in Environmental Management: natural systems and wildlife, and is currently undertaking a PhD at The University of Queensland exploring the policy environment surrounding landholder perceptions of property rights and responsibilities. Mr Andrew Taylor has a degree in Construction Management and has extensive experience in the management of large construction projects through all stages from inception, feasibility, approvals and delivery.

Although all three authors have a collective professional experience that makes them eminently qualified to produce and research this report, the undertaking to provide the Deputy Premier with a report on alternative water supply options has been carried out as private citizens. The views of the authors and the work undertaken do not necessarily imply support from the authors' employers. We submit this report in the public interest and in the spirit of good governance guided by the principles of sustainable development and transparent and accountable decision making.

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Abbreviations and acronyms used in this report

ASL.....Above Sea Level
DP .....Deputy Premier
EIS .....Environmental Impact Statement
ESD .....Ecologically Sustainable Development
FSL.....Full Supply Level
ML .....mega litres
ML/yr.....mega litres per year
OFSL .....Operational Full Supply Level
WRP.....Water Resource Plan

Acknowledgements

We wish to acknowledge and thank the following:

- The families, people and community directly affected by the proposed Wyaralong Dam,
- Our forebears and ancestors for their legacy and the responsibility they have given us, and
- The Deputy Premier of Queensland, Ms Anna Bligh and her Policy Advisor Mr Don Wilson for their cooperative and consultative approach.

Executive summary

This report has been prepared pursuant to discussions between the Deputy Premier, the authors and others affected by the proposed Wyaralong Dam. The Deputy Premier has stated though public and other private forums that Government will undertake to explore and evaluate all reasonable options or alternatives to the proposed Wyaralong Dam. This undertaking is clearly captured in the Deputy Premier's response to a parliamentary petition regarding the proposed Wyaralong Dam tabled in the Queensland Parliament on the 18th of December 2006:

> *"I wish to stress that if there was a comparable option to the Teviot Brook Dam at Wyaralong that could ensure that the region's water supply was secured into the future with minimized social impacts, it would certainly be undertaken."*
>
> Anna Bligh, Deputy Premier of Queensland, 18th December 2006

This report demonstrates clearly the inefficiency, wastage and high cost associated with the Queensland Government's current proposal to construct a large dam on the Teviot Brook at Wyaralong. In this report we outline seven (7) practicable options that offer more efficient and sustainable alternatives to the proposed Wyaralong Dam. It is foreseen that a number of options would be combined into flexible and efficient 'packages' to replace the current proposal. Descriptions of these options are not intended to be highly prescriptive, but should form the basis of detailed analysis and evaluation by the Queensland Government into their feasibilities both collectively in 'packages' and independently. This report demonstrates that a configuration of options has the potential to replace the Wyaralong Dam 'contribution' for as little as an estimated 10 to 15% of the current cost estimates for that dam. Consistent with the Deputy Premier's undertaking (above) and the Queensland Government's policy and obligation to explore all alternatives, we present these options in this report along with the following seven (7) key recommendations:

We recommend that the Queensland Government should:

1. revise the programme for delivery of a large dam at Wyaralong to allow sufficient time to diligently and thoroughly investigate plausible options,
2. commit to detailed investigation, analysis and evaluation of these options (and others discovered or that become evident during the course of detailed investigation),
3. adopt the culture that investigation of these options is critical to the 'Wyaralong Dam project' and has the potential to provide an alternative solution at far reduced economic, social and environmental costs, and that the proving of an alternative solution is to be embraced as a success,
4. be prepared to accept that the proposed dam does not prove feasible against a range of measures (especially core ESD principles) and actively seek ways to replace the 'Wyaralong contribution' even if that involves a reappraisal of the quantum of the contribution should a particular suite of options fall short, but are still proximate,
5. acknowledge that the Logan River system, which is already ecologically stressed, is at risk of becoming further degraded by over allocation in face of uncertain climate future,
6. establish immediately a process that requires these options and others to be fully explored and evaluated within the feasibility phase of the Wyaralong Dam, well ahead of any commitment to preparatory works, and
7. establish immediately a parallel process (in conjunction with Recommendation 6) that clearly demonstrates publicly the nature, extent and results of the investigations undertaken in the option evaluation process. This could be achieved either through full disclosure or the appointment of an independent party to oversee the evaluation of our options and any that may emerge from them.

1.0 Introduction

1.1 Purpose and aims of the report

This report has been prepared pursuant to discussions between the Deputy Premier, the authors and others affected by the proposed Wyaralong Dam. The Deputy Premier has stated though public and other private forums that Government will undertake to explore and evaluate all reasonable options or alternatives to the proposed Wyaralong Dam. This undertaking is clearly captured in the Deputy Premier's response to a parliamentary petition regarding the proposed Wyaralong Dam tabled in the Queensland Parliament on the 18th of December 2006:

> *"I wish to stress that if there was a comparable option to the Teviot Brook Dam at Wyaralong that could ensure that the region's water supply was secured into the future with minimized social impacts, it would certainly be undertaken."*
>
> Anna Bligh, Deputy Premier of Queensland, 18th December 2006

In response to the Deputy Premier's undertaking, the Queensland Government's obligations, and the need for sustainable water supply options for the future, this report aims to:

1. highlight the significant failures and inefficiencies associated with the current proposal to construct a large dam at Wyaralong,
2. provide the Deputy Premier with an outline of a number of practical alternative options to the current proposed Wyaralong Dam,
3. suggest how these alternative options might be configured to provide a more economically efficient, socially acceptable and environmentally benign solution to future water supply than the current proposed Wyaralong Dam, and
4. stimulate more holistic and creative thinking in solving the supply side challenges for future water in south east Queensland.

In achieving its aims, this report will assist the Queensland Government in fulfilling its legal and policy obligations to fully consider all alternatives (including recycling) before constructing a dam as described in the *Water Act Amendment 2007*: Logan Basin Water Resource Plan, the National Water Initiative, the *Water Act 2000*, and Australia's policy for Ecologically Sustainable Development.

1.2 Outline of report

The report is structured such that sufficient detail is given first to demonstrate the key failings and inefficiencies associated with the current proposed Wyaralong Dam (Section 2). This critique of the current Queensland Government proposal is essential so that the relative merits and reduced impacts of the alternative options can be gauged. Secondly, a series of alternative options are outlined in sufficient detail (Section 3) for the Queensland Government then to undertake detailed investigations, analyses and evaluation of those options. The options presented in this report are intended to operate in some combination. Section 4 indicates, using three scenarios, how the alternative options can be 'packaged' and further indicates how they achieve supply equivalent to the current Wyaralong Dam proposal but at greatly reduced economic, social and environmental cost. Key recommendations emerging from this report are detailed in Section 5.

1.3 Limitations

This report has been produced within a very limited time constraint due to the 'fast tracking' of water supply infrastructure projects generally, and particularly in the case of Wyaralong. The EIS phase of the project appears to have been condensed from a previously estimated '12 to 18 months' to reportedly 6 months to facilitate a hasty commencement. The authors have also been constrained by limited availability of data and information in respect of the proposed dam made available in the public domain. However, we have conducted sufficient research to demonstrate that, within the performance parameters available to us, the current project in not viable or efficient and we have sufficient insight to suggest a range of practicable alternatives. It could be argued that the exploration of alternatives by Government was restricted due to the political imperative of a clear direction in respect of water infrastructure during the period leading into October 2006. Any hasty decisions from that period must be reevaluated and the process of 'pre-feasibility' selection of the most appropriate option revisited in a less politicized environment. We strongly recommend that the Queensland Government establishes a mechanism that will publicly demonstrate that these options have been fully explored and evaluated. This could be achieved either through full disclosure of findings or the appointment of an independent person or body to oversee the evaluation of our options and any that may emerge from them.

2.0 Overview of the current proposed Wyaralong Dam

The proposed Wyaralong Dam on the Teviot Brook is intended to simply supplement operations of the Cedar Grove weir on the Logan River. The dam does not, and importantly, cannot operate independently as the sustainable annual yield is too low for the dam to be viable in its own right. The Queensland Government anticipates that the combined Cedar Grove weir and Wyaralong Dam will yield up to 21,000ML/yr.

However, contrary to what the public has been led to believe, the perceptions of some politicians and material published by the Queensland Government, the majority of the anticipated 21,000ML/yr will actually be provided by the Cedar Grove weir on the Logan River and not the Wyaralong Dam on the Teviot Brook. The Logan River has a very large annual flow which is quite reliable even during extended drought. Conversely, the Teviot Brook has a highly variable flow and is an ephemeral creek illustrated by the fact that there has been no flow in the Teviot Brook for the past twelve months prior to this report being written. In 2003 the Teviot Brook only yielded 626ML for the entire year. Average annual catchment yield for the Teviot Brook has been less than 9,500ML since 2001. These persistent and very low catchment yields are in stark contrast to the reported average annual yield of the Teviot Brook of 54,000ML/yr, which was used in part to justify the decision to build a dam at Wyaralong, and highlight the meaningless nature of long term average values in highly variable systems where average values are pushed up by rare and extreme rainfall events (eg. the mid 1970s).

The proposed Wyaralong Dam is intended to supplement the Cedar Grove weir when flows in the Logan River would be inadequate to supply the 60ML/day required to yield 21,000ML/yr. During periods of lower flow in the Logan River, at Cedar Grove, it is anticipated that water will be released down the lower Teviot Brook from the Wyaralong Dam.

Wyaralong Dam simply cannot reliably provide yields proximate to the 18,000ML/yr described as the 'prudent yield' in numerous government publications (eg. Queensland Government, 2006). Attempts to draw 18,000ML/yr from the proposed Wyaralong Dam would cause rapid depletion and imminent failure of the supply during normal and extended drought (Figure 1). If a steady annual yield was to be taken from the Wyaralong Dam then the maximum that could be safely drawn is only 10,500ML/yr (only 58% of the cited prudent yield) based on modelling of the dam using historical catchment yield data. The extreme inefficiency of the proposed dam is highlighted not only by very low and unreliable yields but also by the fact that average annual evaporation from the storage would exceed 17,000ML/yr to provide only 10,500ML/yr.

It is notable (and curious) that the 'prudent yield' values presented in government publications for Cedar Grove and the proposed Wyaralong Dam are reversed. For example, the prudent yield value for Wyaralong Dam of 18,000ML/yr is the absolute <u>most</u> that it could ever supply in any year, while the value of 3,000ML/yr is the <u>least</u> that Cedar Grove would supply in the worst year. To assume that the Wyaralong Dam can provide 18,000ML in the worst year to supplement the Cedar Grove weir (bringing the overall yield to 21,000ML/yr) creates the risk of dam failure. It has been demonstrated that to take more than 10,500ML from Wyaralong Dam would be very risky during dry periods.

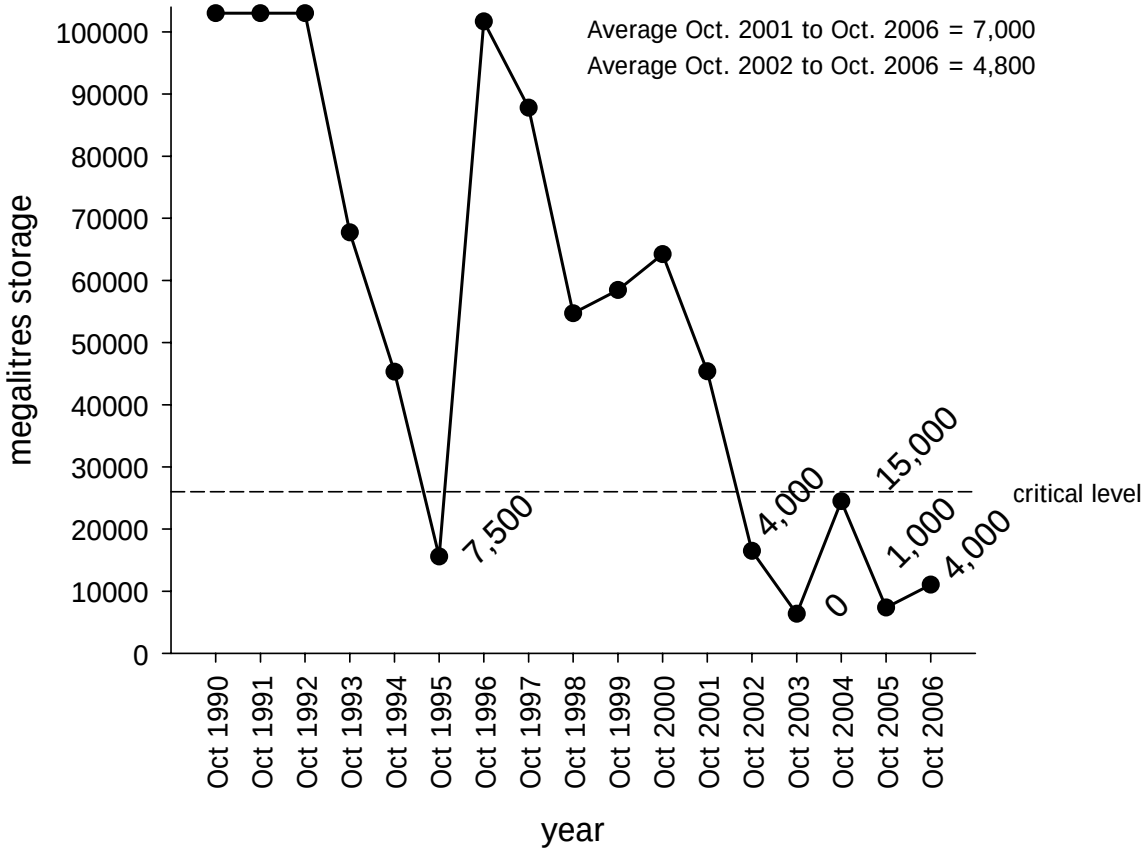

Figure 1: Model of the proposed Wyaralong Dam indicating performance under 18,000ML/yr extraction. The model shows only the maximum storage for each year and also indicates how much water could have been extracted in those years when less than 18,000ML would have been available. A very low average environmental flow allocation of 5.5ML/day (ie. 2007ML/yr) was included for years with no natural flow past the dam. Average annual yields during the current drought are indicated in the upper right. It should be noted that under these parameters the dam fails completely in 2003 and would be empty in March 2007 as this report was being prepared.

To store water in a dam at Wyaralong in the hope that it will be available when the Logan River runs low is not only overly optimistic, but is an extremely wasteful approach to providing relatively small volumes of water. Evaporation from the proposed Wyaralong Dam would be extreme due to the shallow nature of the dam and its very large storage area relative to its volume (Table 1 and Figure 2). Evaporation rates in the Wyaralong area have averaged 1.73m/yr for the past decade and the area experiences high and persistent wind velocities throughout the year. Both our modelling and that of the Queensland Government has only assumed an evaporation rate of 1.6m/yr. In reality the evaporation rates from Wyaralong will be far greater. Over 20% of the dam storage averages just 0.9m in depth, while a further 20% of the dam averages only 1.8m (one year's worth of evaporation) (Figure 2). The temperatures at Wyaralong are very high during summer (usually 2 to 3°C higher than Ipswich). These shallow areas of the dam will become super-heated resulting in accelerated evaporation and dangerous conditions for the growth of blue-green algae. Thus, even our modelling of the dam's performance is conservative and probably overly optimistic regarding safe yields.

Table 1. The proportional distribution of areas at different depths in the proposed Wyaralong Dam highlighting that 21% of the dam averages 0.9m with a further 19% averaging 1.8m and therefore, that approximately one third of the dam's storage surface area is the equivalent of one year's evaporative loss

contour interval (m ASL)	average depth (m)	hectares	% of storage area
60 – 63.6	**0.9**	258	**21**
60 – 63.6	**1.8**	230	**19**
50-60	4.0	273	22
50-60	4.3	166	13
40-50	12.0	306	25
Average	**4.97**	**Total 1,233ha**	100

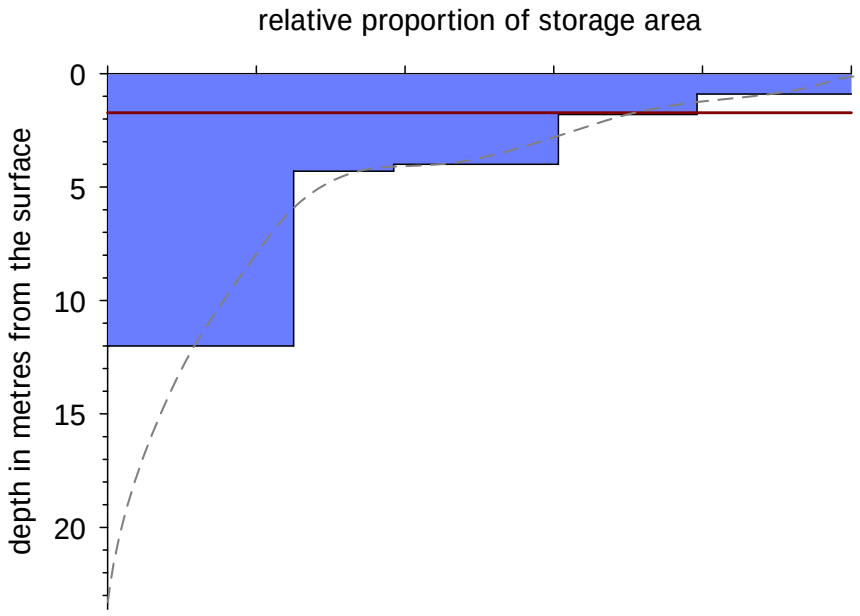

Figure 2. Schematic of the proposed Wyaralong Dam indicating the relative proportions of the storage at different average depth intervals. The horizontal dark red line indicates approximately one year's worth of evaporation. The light grey shaded line simply indicates a more realistic distribution of depth. Note that depth is indicated in metres from the surface and that the 'tick marks' on the horizontal axis are each worth 20%.

In summary, the proposed Wyaralong Dam yields less than 10,500ML/yr while simultaneously losing over 17,000ML/yr to evaporation (over 20,000ML/yr when full) at a cost of up to or even over $500 million. In a time when the real cost of water is being recognized widely such an expensive and grossly wasteful means of providing a trivial volume of water, as a 'back up' only to a more reliable river system, cannot be justified and must surely seem abhorrent in these water 'enlightened' times. Furthermore, the calculations described above take into account only the smallest of environmental flow allocations which would be essential from the Wyaralong Dam (in addition to our under estimation of evaporation). If the higher rates of evaporation and a more realistic environmental flow regime are included then it is likely that the Wyaralong Dam would yield well below 10,000ML/yr. It should be noted that no evidence of provision of environmental flow releases from a Wyaralong Dam can be found in the limited information made available.

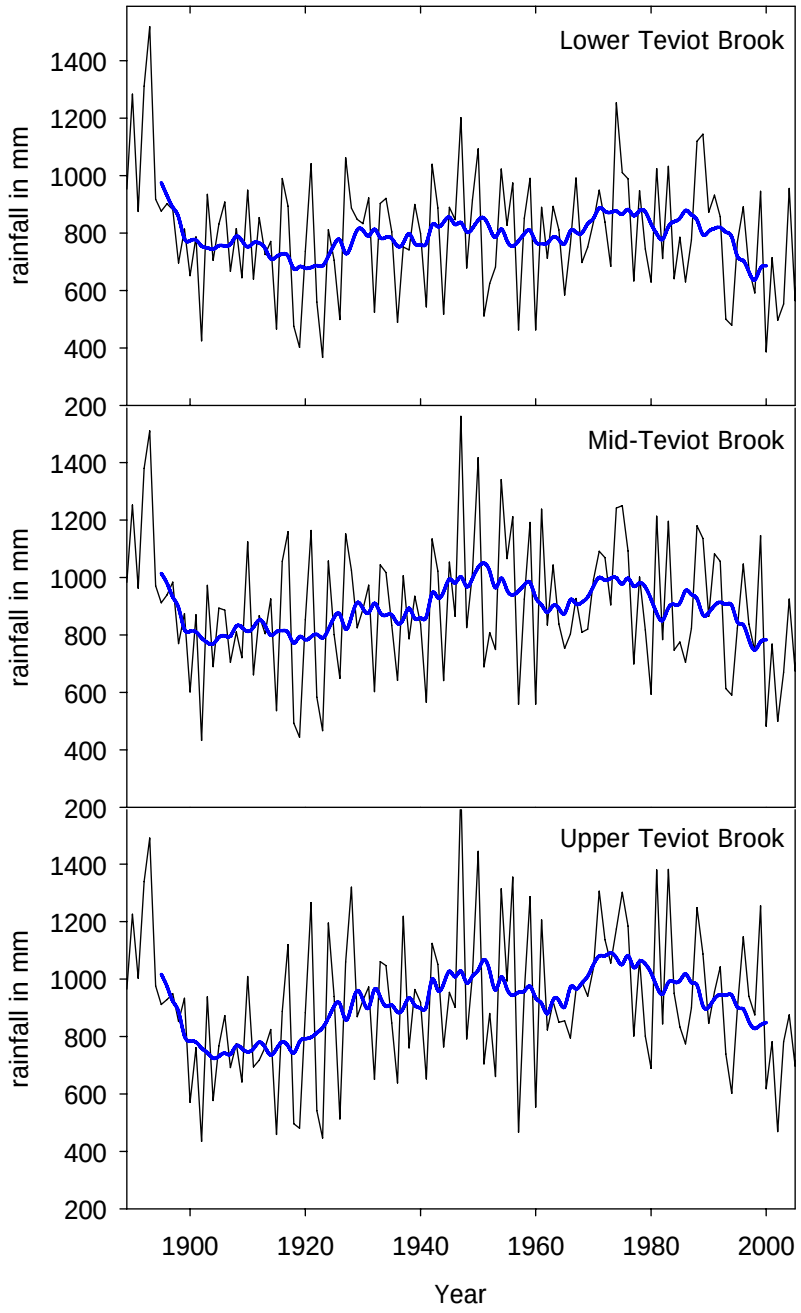

Figure 3. Historical rainfall for the Teviot Brook catchment indicating annual totals and a 10 year moving average (blue line) from 1889-2005. Data are derived from publicly available interpolated rainfall records based on a number of nearby Bureau of Meteorology rainfall stations and are available at cost from the DNRM&W.

Irrespective of climate change predictions, the current protracted drought displays all of the features of the 'Federation drought' experienced after the turn of the 20th century (see Figure 3). Based on the observed rainfall patterns for the past 120 years, and supposing the currently proposed Wyaralong Dam were completed by 2011, it is quite possible that insufficient stream flow in combination with high evaporation rates would render the dam useless many years after completion. If climate change projections for south east Queensland of reduced rainfall by at least 5% and increased average temperatures are correct (Hughes, 2003) then the dam, in combination with an already highly variable and small, low yielding catchment, would repeatedly fail. The complete blockage of natural flows in the Teviot Brook would result, but the dam would be so rarely full that it could never

supply any reliable quantity of water (let alone the trivial 10,500ML/yr it is currently able to contribute). This situation should sound a clear warning that there is a significant risk that the proposed Wyaralong Dam may not provide any water in the medium term (10 to 20 years), nor any reliable water in the longer term. The Queensland Government's own modelling agrees with ours in identifying that the Wyaralong Dam would have performed very poorly for three decades from the turn of the last century (the period including the 'Federation drought').

The greater Logan River catchment is recognized as being stressed and in poor ecological condition due largely to the over allocation of its water resources (South East Queensland Waterways, 2006). The Draft Logan River WRP suggested that approximately 50,000ML/yr remains as 'unallocated' in the Logan River system (NRM&W, 2006). However, this value has been revised down significantly by Queensland Government hydrologists to approximately 35,000ML/yr although even this quantity could be argued as optimistic. If the Wyaralong Dam and Cedar Grove weir are to provide 21,000ML/yr, while simultaneously losing 17,000ML/yr or more to evaporation, then the average combined total 'take' (including evaporation) from the system will be 38,000ML/yr. This means that in conjunction with the proposed Bromelton weir (expected to provide between 5,000 and 8,000ML/yr) would further over allocate the Logan River system by at least 8,000ML/yr. It is unclear to what extent the Logan Basin WRP accounted for realistic evaporative losses from a large shallow storage.

It is understandable, given the current drought and population growth in south east Queensland that the government is actively seeking solutions that ensure reasonable supply into the future. However, the proposed Wyaralong Dam is not a viable solution. In fact, the benefits from this proposed dam are minute relative to the extreme waste and costs involved in its construction and operation. In addition the proposed construction of a large dam on the Teviot Brook is an irreversible decision where the full extent of impacts is largely unknown. In keeping with Australia's policy of Ecologically Sustainable Development, the decision to build a dam over other alternative options should be treated with due caution. We believe insufficient time and resources have been allocated to the search for viable and sustainable alternatives to the proposed Wyaralong Dam.

If full recognition of the current political climate surrounding water infrastructure (especially in south east Queensland) we urge extreme caution with further progress on the proposed Wyaralong Dam until all alternatives have been fully explored. Such an exploration of alternatives should be viewed as a very wise investment for future sustainable water supply.

We promote a collaborative approach with the Queensland Government, particularly the Deputy Premier, in the search for a truly sustainable future water supply solution or solutions. We are confident that the opportunity exists to replace the current Wyaralong Dam proposal with options that solve the problem in a manner that achieves far lower economic, social and environmental costs and in a timely fashion.

Thus, our shared problem can be posed as the question of:

> ***"what are the options that are alternatives to the proposed Wyaralong dam that would deliver comparable supply performance but with significantly reduced social, environmental and economic cost in a flexible and potentially reversible manner?"***

3.0 Alternative options

It is essential that the following options are not considered entirely in isolation from each other, or that any one on its own is intended to replace the entire 'contribution' of the proposed Wyaralong Dam. We are advocating that some configuration of the options detailed in this section and Section 4 would likely provide approximately the same volumes as the reliable yield of a large dam at Wyaralong. It will also be demonstrated (pending further detailed analysis) that these alternative options provide the basis of a flexible and sustainable solution to future water supply in the region at significantly reduced economic and social cost with the additional advantage of significant reduction in water wastage and environmental impacts.

Seven (7) options are provided in this section. They are presented in outline only. Detailed analysis, exploration and evaluation with complete data would be expected of the Queensland Government. The seven options comprise:

Option 1: Potential increase in the operational full storage level of Maroon Dam (up to 76,000ML)

Option 2: Recycled water diverted to Cedar Grove weir or Logan River via wetland or stored and reused for industry in addition to rain and storm water capture

Option 3: Intermittent supplementary utilization of water via the 'water grid' from either Hinze Dam and/or the proposed Gold Coast desalination plant

Option 4: Water harvesting from the upper Teviot Brook at times of high flow into Moogerah Dam

Option 5: Intermittent use of ground water

Option 6: A reduced scale Glendower Dam on the Albert River to provide 10,500ML/yr

Option 7: A reduced scale Wyaralong Dam

NOTE: Options 1 to 6 assume that natural flows from the Teviot Brook (un dammed) that will, to an extent, supplement the Cedar Grove weir. Option 7 will provide far greater natural flows than the currently proposed large dam on the Teviot Brook. These flows would improve the performance of the Cedar Grove weir in many years and thus reduce the potential water supply requirements of alternative options to the proposed Wyaralong Dam.

Option 1: Potential increase in the operational full storage level of Maroon Dam (up to 76,000ML)

Option overview

Maroon Dam is located in upper reaches of the Logan River catchment on Burnett Creek. This dam incorporates an extremely large temporary flood storage buffer of approximately 44,000ML representing almost half the storage capacity of the proposed Wyaralong Dam. The dam has been operating at 37,500ML (OFSL, 205.05m ASL) (NRM, 2004). However, this level has now been permitted to increase to between 42,110 and 44,300ML at a new OFSL at 207.14m ASL. The spillway is located at 217.52m ASL providing a total potential storage capacity of 86,400ML (Figure 4). Historical records indicate that the temporary flood storage buffer at Maroon Dam has never been fully utilized. Thus, there appears considerable potential for Maroon Dam to be operated at a higher level to provide extra yield as a partial alternative to the proposed Wyaralong Dam. In the absence of full data and access to detailed modelling capacity we are not able to provide estimates of a range of scenarios of new storage alternatives for Maroon. However, as an indicative example, perusal of Maroon Dam storage behaviour models shows that even large floods only contribute in the order of 10,000ML to the temporary storage, which is then subject to controlled release soon after the event. The largest modelled flood event (in the 1940's) contributed only around 30,000ML. Subject to engineering assessment, Maroon Dam could potentially operate up to 76,000ML (leaving more than 10,000ML for flood mitigation purposes) in order to provide an additional notional annual yield (additional to all current allocations) of 5,000ML or more. These values are theoretical, however, they demonstrate that significant and tangible potential exists to better utilize the already constructed Maroon Dam to contribute to future water needs in south east Queensland. The full extent of opportunities requires detailed engineering and hydrological analysis.

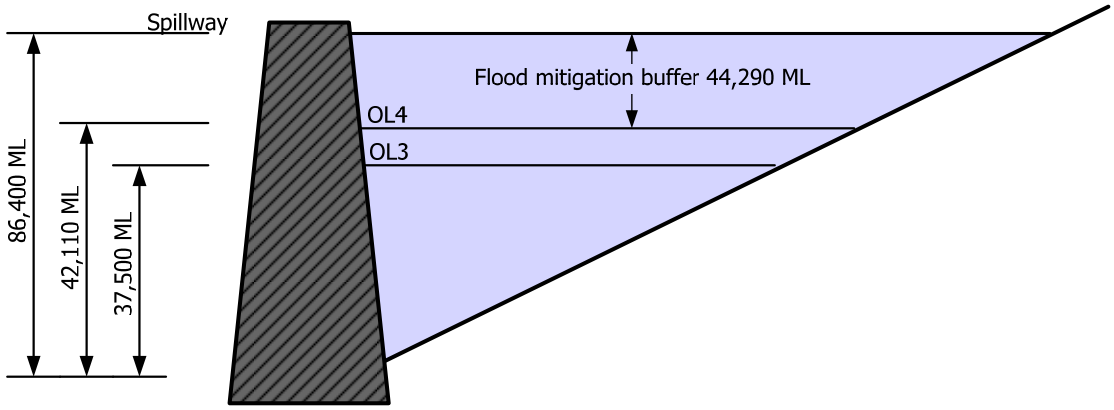

Figure 4. Schematic of Maroon Dam indicating the potential extra storage volume of over 44,000ML currently only provided as a flood mitigation tool. This flood margin has never been fully used since Maroon Dam was constructed.

Costs

Because Maroon Dam is already constructed and has built-in release measures there should be effectively little or no works cost involved in the provision of this option. Some investigation will be required in terms of modelling and engineering assessments. However, these costs are insignificant. This option also has no obvious social costs as the extra storage does not impact on current users of the water. Additional water is only to be used as a partial alternative supply to the proposed Wyaralong Dam. There will be minor

environmental cost associated with this option due to the capture of some large flood waters in the storage. However, this impact on natural flows is insignificant relative to the proposed Wyaralong Dam option.

Minor additional costs would be incurred to reconfigure recreational and other infrastructure currently surrounding the dam as the maximum water level would rise between 6 and 8 metres. In our modelling of scenarios (Section 4) we have allowed a generous $10 million for these and other costs associated with the option.

Advantages

This option could potentially provide up to 50% of the proposed Wyaralong Dam contribution to future water needs at next to no economic, social or environmental cost. Evaporative wastage would be significantly less relative to the highly inefficient and shallow Wyaralong Dam because of the extra deep storage potential of Maroon Dam.

A valuable feature of this option is that it could be delivered almost immediately, certainly by the time that the Cedar Grove Weir is constructed. In addition, the option to increase the operating full storage level of Maroon is reversible and flexible in that storage and release can be altered and does not require any further public investment in infrastructure. This contrasts against the construction of a large dam at Wyaralong which is risky and is irreversible. Once constructed the Wyaralong dam will permanently block the Teviot Brook and lose on average over 17,000ML to evaporation every year. In accordance with the principles of ESD the Maroon Dam option (Option 1 as outlined in this section) must be a preferred option over the Wyaralong Dam proposal.

Risks

Control of rare large flood events will be slightly reduced if Maroon Dam was operated closer to the full storage capacity of 86,400ML. However, historical records and modelling of the period since 1890 indicates that the flood buffer has never been fully utilized and that the largest modelled flood would have contributed only around 30,000ML to the flood buffer. With ever increasing flood prediction and warning a flood event of this magnitude could be managed. At the other climatic extreme, the current drought would mean that it may take some time for the storage to be filled to this higher level. This limitation is equally true for the proposed Wyaralong Dam which would also take many years to fill to a capacity that would make it useful. For example, had Wyaralong Dam been built in 2001 it would still have not filled sufficiently to provide any reliable water to the Cedar Grove weir, some seven years after construction, due to poor inflows and very high evaporation rates.

Option 2: Recycled water diverted to Cedar Grove weir or Logan River via wetland or stored and reused for industry in addition to rain and storm water capture

Option overview

Because much of the industrial and residential development in the corridor south of Brisbane is yet to occur there is significant potential to ensure that these developments meet or exceed current expectations of sustainability (especially water efficiency, reuse and conservation). The practices and technologies required can be 'built into' industrial areas and residential developments as they occur. Such advances have already been incorporated into developments such as the new Springfield shopping centre. Likewise, the industrial developments planned for the Bromelton area should be designed to ensure that all rainwater and storm water is captured and used on site to the greatest possible extent.

Industrial estates are large and typically consist almost exclusively of hard surfaces and roofs suitable for the efficient capture of relatively clean water. A typical 100ha industrial estate, if located in the Beaudesert area, could capture close to 900ML/yr from rainfall alone. However, the planned Bromelton industrial precinct will potentially include "the largest inland freight port ever proposed in Australia" (QCL, 2007 p. 25). Thus, far greater than 100ha of hard surfaces are likely to be available for clean rain and storm water capture. In addition, water used by industry should be recycled (nearby to reduce costs) and returned to the Logan River above the Cedar Grove weir via an artificial wetland. Alternatively, recycled water, potentially in conjunction with storm water, could be stored locally (on site or near by) for reuse. Artificial wetlands ensure water quality enhancement via an environmental buffer as well as a capacity to modify and regulate flows to the weir or an off stream storage possibly even the Bromelton off stream storage facility. An artificial wetland is particularly suitable for the Beaudesert region because it would complement and be populated by species inhabiting an existing chain of natural wetland areas.

By the time developments proceed in the local region it will be a common social expectation that the adoption of sustainable technologies to reduce demand for water is normal and essential. The potential benefits of recycling, rain and storm water harvesting and return of water to the system (close to the source of capture) are that they will dramatically reduce raw demand in the first instance, while simultaneously returning water at a relatively constant rate to supplement demand on the Cedar Grove weir or other weirs in the area. This option could comfortably return a minimum of 10ML/day (between 3,500 and 4000ML/yr) which is available for use while reducing initial demand on future supply infrastructure.

The future adoption of recycling technologies has the additional advantage of increasing supply dramatically as every industrial development (and residential development in the region) will have its own rainwater and storm water capture capacity and much of this will be returned to the systems thus boosting supply beyond the traditional infrastructure of dams and weirs on the Logan River system. Although the option we have outlined has focused on industrial development, there is no reason that future residential development should not also contribute to a similar local recycling capacity. Residential recycled water could be used for industry (reducing raw demand completely), or alternatively returned to the supply weirs via treatment and an environmental buffer such as the artificial wetland described above.

Costs

Option 2 has two distinct advantages. Firstly, the costs are shared between the primary beneficiaries and the public. Secondly, the initial capital investment results in reduced future demand on the region's increasingly scarce water resources. Private enterprises (industrial) are the primary beneficiaries, and in the case of the new Springfield shopping centre (discussed above), clearly perceive that the long term benefits make the initial capital investment far more desirable than dependency on ever increasing raw water costs.

There will be energy costs to run and maintain the recycling technology. However, solar technologies are already available and are reducing in cost rapidly. For future industrial development solar augmentation of power is likely (or should be) the normal practice and expectation as society meets the 'greenhouse gas' and climate change challenges we collectively face. Large open spaces and extensively roofed areas such as industrial estates are ideal for efficient solar energy capture. These new industrial estates have the opportunity to become as close to water and energy demand-neutral as possible.

Advantages

Given the technology available today (let alone in 10 years time) industry has the capacity and opportunity to be as close to water and energy neutral as possible. The costs of this option should be shared as the benefits ultimately are enjoyed by both the public and private sectors. A clear advantage is that capital investments are spread over time as required by matching infrastructure cost outlay to growing demand thus distributing the costs over time and avoiding the situation where the public make a massive upfront investment in anticipation of demand that may not eventuate.

The dramatic reduction in raw demand for water and cost sharing approach ('user pays') are clear advantages. However, the technologies highlighted in this option result in a highly efficient use of the scarce water resource as evaporative losses are reduced to almost zero relative to the extreme wastage of the proposed Wyaralong Dam (as outlined in Section 2).

Businesses utilizing such advanced technologies and located in known 'sustainable' precincts will find it a considerable marketing advantage in the future. These enterprises will be able to demonstrate the latest sustainable practices are incorporated into their products and services. They will be a model of 'sustainable enterprise'. Government has the opportunity to enhance and encourage this type of sustainable development through good planning, support and cost sharing arrangements.

Risks

There are few risks associated with this option, careful planning and monitoring is required to ensure water quality is maintained (eg. during floods). Infrastructure and management must ensure the highest water quality standards are maintained to minimize environmental and health risks. However, these are largely technological and engineering issues that are relatively simple to implement. The current 'fear' of recycled water is rapidly diminishing in society, and as the reality of our water situation sinks in and people are becoming accustomed to, and accepting of, the use of recycled water (at least for industry) it is highly unlikely that such an option will be politically unattractive in the future. Indeed it is likely to be politically desirable to invest in such options.

Option 3: Intermittent supplementary utilization of water via the 'water grid' from either Hinze Dam and/or the proposed Gold Coast desalination plant

Option overview

Even with the adoption of other options suggested in this report there may be times (quite likely only short periods) when there is a minor shortfall in the supply of available water. During these periods water can be harnessed from the 'water grid' via Hinze Dam or the desalination plant proposed for the Gold Coast area. Hinze Dam has considerable yield and storage capacity which is to be increased by the raising of the dam wall. Acknowledging that this water will largely already be 'allocated' the option outlined here suggests only intermittent and occasional augmentation when required at the Cedar Grove weir. This option would not be used continuously. The reliability of Hinze dam is clearly demonstrated by its high levels of storage even during the 'worst drought on record'. With the combined input from water harvesting from Canungra Creek and the proposed desalination plant and raising of Hinze Dam the 'water grid' will have more that adequate capacity to make up a shortfall of up to a few thousand megalitres every one in five or one in ten years.

Costs

The raising of Hinze Dam, the desalination plant and water 'grid' are already planned for. Costs of this option are accounted for in these respective schemes. Energy used in desalination and to pump water through the 'grid' will be a significant cost. However, these intermittent costs will be far less than a new large and wasteful large dam on the Teviot Brook at Wyaralong. There are no additional social impacts associated with this option and environmental impacts are minimized relative to the large proposed Wyaralong Dam.

Advantages

This is a flexible option that has the distinct advantage of supplying water only when needed while avoiding excessive losses to evaporation that results form storage in a large shallow dam at Wyaralong. The option would offset any occasional shortfalls (ie. our options versus the proposed Wyaralong Dam) at no additional cost other than those associated with the energy to pump the water. There are no social costs and almost zero environmental costs. Water will be available within two years once the 'grid' is complete. Increased supply capacity of this option will be available once the desalination plant is operational.

Risks

There are no risks associated with this option recognizing that it is only used intermittently as an occasional 'top up' to water supply needs in the Logan and Beaudesert areas.

Option 4: Water harvesting from the upper Teviot Brook at times of high flow into Moogerah Dam

Option overview

Moogerah Dam has been subject to consistently low storage levels for much of the past twenty years (Figure 5). This has been exacerbated by the dam's provision water for power generation. With the soon to be completed recycled pipeline from Brisbane to augment water supplies required for power generation, demands on Moogerah Dam's water storage will be eased. However, the fact remains that Moogerah Dam rarely contains significant storage volumes. In essence, our proposition of an alternative worth serious investigation is that Moogerah Dam which is already constructed (and in an adjacent catchment running close to areas of the Teviot Brook) could serve as the water storage facility for safe levels of water harvesting from the Teviot Brook.

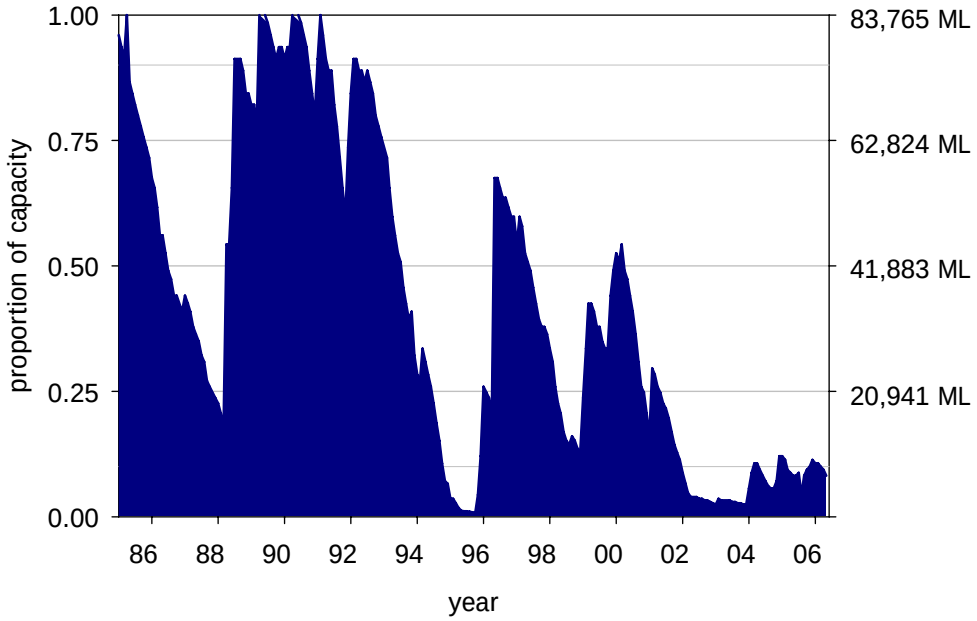

Figure 5. Moogerah storage level from 1985 - 2006 (**Note**: These data were supplied by Sunwater, the authors acknowledge that Sunwater is not party to, nor has any agenda with the Wyaralong dam project).

The majority of the Teviot Brook catchment yield is generated by rainfall upstream of Boonah and the lower catchment (where the Wyaralong dam is proposed) contributes relatively little due to the low rainfall and narrow nature of the catchment. In this upstream location, the Teviot is very close (within 3 kilometres in places) to the catchment boundary of Moogerah on Reynold's Creek. A weir or number of weirs on the Teviot Brook above Boonah could potentially provide a point to pump water a short distance into Moogerah Dam. Both the height difference and distance from the Teviot Brook in this area is minimal. Thus, distribution network and pumping costs to Moogerah would be small relative to the costs of the water 'grid' currently underway in south east Queensland.

A water harvesting alternative from the Teviot Brook may or may not provide the 10,500 ML which is provided by the Wyaralong Dam proposal. However, a safe extraction from the Teviot Brook needs to be determined and assessed according to detailed environmental, economic and social criteria.

Costs

We are not in a position to estimate the capital and ongoing costs associated with this option. Clearly, any infrastructure would impact to some extent on landholders in this area so it is imperative that any weir or weirs are located to be efficient in terms of pumping distance but also creates minimal impact on any current land use.

Advantages

A key feature of this proposed alternative is that is has the potential to significantly increase the storage of Moogerah Dam which is far deeper than a dam at Wyaralong would be. Moogerah Dam is a scenic location, and was intended to provide a diverse range of recreational opportunities for south east Queenslanders as well as water provision. Unfortunately, the dam has not been able to provide these recreational and tourism opportunities for well over a decade due to very low storage levels. By harvesting safe levels of water from the adjacent Teviot Brook and storing it in Moogerah Dam several objectives could potentially be met simultaneously. The dam would store more water for consumptive use, provide recreational opportunities, and save potentially hundreds of millions of dollars by avoiding the construction of a new dam.

Risks

Flows in the Teviot Brook are highly variable, and frequently very low. Opportunities to pump water from the Teviot Brook at medium to high flow rates may be many years apart. Irrigators in the upper Teviot Brook area would have to be guaranteed that their legal allocations are not compromised by such an investment. However, years such as 1996, which only just managed to fill Moogerah to over 50% had a catchment yield in the Teviot Brook of close to 100,000ML. It is likely that 25,000ML could have been taken from the Teviot in that year and stored in Moogerah taking it to almost 100% capacity. Clearly, opportunities to pump would be rare due to low flows and this may affect the viability of the investment.

Option 5: Intermittent use of ground water

Option overview

An option to 'top up' occasional inadequate flows at Cedar Grove is to investigate any potential ground water supplies in the area that could be used intermittently. Clearly this option should not be viewed in isolation of any other options or current demands on ground water. However, if available this source of water could contribute small but important additional flows in the Logan River (to Cedar Grove weir) or to supplement infrastructure such as the Bromelton off stream storage facility which is soon to be completed. If one to two thousand megalitres are required in occasional years then ground water is a sensible option where available.

Costs

The cost of this option including investigation, capital investment and the running costs of moving ground water either to a river or off stream storage are relatively inexpensive. If between one and two thousand megalitres can be acquired for approximately $1 million then it makes this potentially some of the cheapest water when used in conjunction with other infrastructure.

Advantages

Ground water has the advantage of not being subject to evaporation. This is a relatively cheap option for acquiring small volumes of water intermittently. Providing ground water use is sustainable then there are few if any environmental impacts, and there would be few if any social impacts associated with this option.

Risks

It is unknown to the authors whether there exist sufficient ground water supplies in the local region that would be able to deliver up to approximately five megalitres per day. If less than 500ML/yr (less than 1.5 megalitres per day) are available from this source, then it may be an unwarranted investment.

Option 6: A reduced scale Glendower Dam on the Albert River to provide 10,500ML/yr

Option overview

Glendower has been identified as a likely dam site for many years and the Queensland Government has already acquired 98% of the land required for construction of a dam at that location. The site has also been identified as a 'strategic reserve' indicating that it is likely to be built. Given that the proposed Wyaralong Dam is so extremely expensive and wasteful in providing only about 10,500ML/yr, and that only approximately 14% of the area of inundation at Wyaralong is owned by the Queensland Government, we suggest that a relatively small dam constructed at Glendower is an option with "minimized social impact" (see quotation below).

> "I wish to stress that if there was a comparable option to the Teviot Brook Dam at Wyaralong that could ensure that the region's water supply was secured into the future with minimized social impacts, it would certainly be undertaken."
>
> Anna Bligh, Deputy Premier of Queensland, December 2006

Clearly this option of a smaller but efficiently yielding dam at Glendower meets the above criteria. In addition, it could be constructed a far less cost than the proposed Wyaralong Dam. We recommend investigating the construction of a much smaller dam than those outlined by GHD (2006) (most likely operating at approximately 70 to 72m ASL) at Glendower that can safely yield between 10,500 and 11,000ML/yr. In the GHD (2006) desktop review a dam at Glendower, operating at 75.4 m ASL was expected to yield 24,000L/yr. Given the serious overestimation of that study for the proposed Wyaralong Dam yields, then Glendower's yield capacities would need to be investigated in detail. We recommend investigation a smaller storage than those outlined by GHD (2006) to reduce costs as well as social and environmental impacts.

Costs

We have used cost projections from the GHD (2006) desktop review to estimate that a dam operating at approximately 70 to 72m ASL would cost approximately $200 million. The Glendower Dam site has no endangered regional ecosystems within its boundary unlike the proposed Wyaralong Dam site.

Advantages

A medium size dam on the Albert River at Glendower would be an extremely reliable and efficient storage. Almost all of the land has been acquired for the site, and at a lower water level than the lowest outlined in GHD (2006) impact on remaining freehold land owners would be reduced (reportedly 70ha remains to be resumed).

Risks

As is the case with Wyaralong, Aboriginal cultural heritage values may be adversely impacted by a dam at Glendower. However, it is not known how these sites may be affected at a FSL between 70 and 72m ASL. It may bee that an even lower operational level could yield between 10,500 and 11,000ML/yr.

Option 7: A reduced scale Wyaralong Dam

Option overview

The proposed Wyaralong Dam at 63.6m ASL, storing up to 104,000ML is the most inefficient possible configuration and storage level for a dam on the Teviot Brook. At this level (63.6m ASL) the dam yields approximately only 10,500ML/yr while losing over 17,000ML/yr to evaporation at a cost of $500 million. It would appear that this option is made attractive to decision makers who may have been too focused on total storage volumes rather than the most efficient configuration in terms of reliable yield, wastage and costs. Indeed, when the decision was made to proceed with a dam at Wyaralong the data informing the decision was out of date and overly optimistic in terms of yield calculation (let alone the cost estimates). Now that the actual safe yield has been demonstrated to be vastly reduced and the costs dramatically increased the original decision can no longer be justified.

At storage level of 54.74m ASL (9m below the current proposal) a dam at Wyaralong would have minimal impact on the Boonah – Beaudesert road, would vastly reduce social and environmental impacts and massively reduce the capital cost of construction. The storage of this smaller dam would be close to 30,000ML with a surface area of just 536ha. This vastly reduced but greatly more efficient dam would still safely yield over 5,100ML/yr while maintaining significant flows in the Teviot Brook (and in any case on into the Cedar Grove weir), thus augmenting flows at the weir regardless of releases from the dam. Evaporative losses from this smaller dam would be closer to the annual yield at 6,155ML/yr. Thus, although yield with this option is halved (from 10,500 to 5,100ML/yr) evaporation is simultaneously reduced by an average of 11,000ML/yr. This water remains in the system to be either 'used' at Cedar Grove weir to supplement Logan River flows or to ensure improved environmental flows in the greater catchment and out into Moreton Bay.

Costs

It is difficult to accurately estimate the costs of this option. However, given that the road realignment could reportedly cost approximately $300 million under the current configuration of the proposed Wyaralong Dam, then a reasonable stating point would be $200 million. By reducing the dam operating level by approximately nine metres (from 63.6 to 54.74m ASL), then the volume of material and the construction costs for the dam wall would be dramatically reduced by approximately one third to one quarter (based on cost projection detailed in GHD (2006)). Thus, a reasonable estimate for a dam operating at 54.74m ASL at Wyaralong would range between $132 and $150 million (this may include the small modification required on one stretch of the Boonah-Beaudesert road). Water could be provided at a rate less than 60% of the current cost per megalitre of annual yield that would be incurred by a large dam on the Teviot Brook.

Table 2. Comparison between the current Wyaralong Dam proposal and a vastly reduced dam operating at 54.74m ASL

operating level (m ASL)	storage (ML)	surface area (ha)	safe yield* (ML/yr)	av. evaporation (ML/yr)	cost $ (millions)	cost per ML yield
63.6	104,000	1,280	10,500	17,307	500	47,619
54.74	29,900	561	5,100	6,155	150	29,412

NB: *safe yield is the yield that can be sustained every year over 120yrs without the dam falling below assumed dead storage.

Advantages

If this option is combined with a potential increased supply from Maroon Dam (Option 1) of approximately 5,000ML/yr) then the 'Wyaralong contribution' can be achieved at a cost of only approximately $14,500 per megalitre yield. This is less than 30% of the current cost of $500 million.

The 'deep end' toward the dam wall under our option remains close to full most of the time and natural flows through the system are vastly improved. Evaporation is reduced from 17,000ML/yr to just over 6,150ML/yr reducing wastage of water from the greater Logan River system. Because the dam is flushed more regularly and evaporation reduced the risk of water quality problems emerging is also reduced which ultimately reduces water treatment costs.

Impacts on the areas of the Endangered Regional Ecosystem (12.3.3 - *Eucalyptus tereticornis* woodland to open forest on alluvial plains) would be reduced under this option as well as overall impact on the natural bioregional wildlife corridor running north to south through the area.

Risks

It is unlikely that there are any major risks associated with this option. However, it will still impact on landholders nearer to the dam wall and those below it on the Teviot Brook.

4.0 Combining the options: examples of scenarios

The alternative options outlined in Section 3 are intended to be evaluated in terms of their ability to be 'packaged' into scenarios that would achieve close to the current expected contribution of the proposed Wyaralong Dam of only 10,500ML/yr at a cost of half a billion dollars. In this section three such scenarios have been presented along with very preliminary cost, yield and efficiency comparisons. A summary of the estimated costs, yield, waste and timing of all options are compared and presented below in Table 3. The final costs and yield of the options will require detailed assessment, which would be undertaken by the Queensland Government. However, the work presented in this section clearly demonstrates that considerable opportunities exist to ensure water supply into the future at a vastly reduced economic, social and environmental cost.

Table 3. Yield, cost, evaporative waste and timing estimations for all options outlined in Section 3, including the current proposal of a large dam at Wyaralong

Option	Est. yield or reduced demand (ML/yr)	Evap. loss (ML/yr)	Est. cost ('000,000s)	Lead time to delivery	Cost per ML yield ($)*
Option 1 Maroon Dam (76,000ML FSL)	5,000	1,500	10.0	2 to 5 yrs	2,000
Option 2 Recycling	4,000	800	50.0	match demand	12,500
Option 3 'Grid'	2,000	0	0.5	<2 yrs	250
Option 4 Teviot water harvesting	?	?	?	5 yrs	?
Option 5 Ground water	2,000	0	1.0	<3 yrs	500
Option 6 Smaller Glendower Dam (~ 70m ASL)	10,500	11,000	200.0	5 yrs	19,050
Option 7 Small Wyaralong Dam (54.74m ASL)	5,100	6,155	150.0	5 yrs	29,400
Currently proposed Wyaralong Dam	10,500	17,000	500.0	5 to 10 yrs	47,600

***** Cost per ML yield has been rounded to the nearest $50 to simplify visual comparison

4.1 Scenario 1

Scenario 1 packages together Options 1, 2 and 3 (see Table 4 and details of these options in Section 3). This scenario has the lowest cost and results in no social impacts. Environmental impacts are minimal relative to the current Wyaralong Dam proposal. We estimate that this Scenario 1, at a cost of only 10 to 15% of the proposed Wyaralong Dam will be able to comfortably deliver the vast majority of the future supply expected from the proposed dam. This scenario would provide water both in the short term (Options 1 and 3) as well as matching future demand as it is required (Option 2). This is an extremely attractive suite of options as it is very flexible and highly efficient in terms of investment and minimized waste. Although it may be that this scenario occasionally falls short of the anticipated yield of the proposed Wyaralong Dam the following question has to be seriously addressed by the Queensland Government:

> If the suite of options combined in Scenario 1 can provide the majority of water, with negligible waste and at a cost of between 10 and 15% of the current proposal (Wyaralong Dam), is it reasonable for the Queensland Government to justify spending an additional $400 to $450 million on a large dam at Wyaralong simply to provide an additional few thousand megalitres per year while simultaneously losing over17,000ML/yr to evaporation?

This question is central to this report and relevant to all the scenarios provided. The apparent marginal benefit from the proposed Wyaralong Dam of a few thousand megalitres over what Scenario 1 may provide is swamped by the sheer magnitude of wastage associated with that proposal. If two-thirds to three-quarters of the water thought to be provided by Wyaralong Dam can be obtained with minimal impact and cost then the additional funds would be more wisely invested elsewhere.

The cost of Scenario 1 is expected to be in the magnitude of $60 million. The costs are very low because this scenario is based primarily on options that utilize already existing infrastructure or in the case of Option 2 (recycling) the costs are anticipated to be shared between the public and private sectors. At approximately $60 million dollars and delivering up to 11,000ML/yr (with only 2,300ML/yr lost to evaporation). This package of options could replace the Wyaralong Dam at a saving of over $400 million dollars. In comparative terms Scenario 1 delivers almost the entire future water supply requirement (expected from Wyaralong Dam) at only $5,500 per megalitre of annual yield versus $47,600 per megalitre of annual yield – just 11½ % of the cost of a major dam!

4.2 Scenario 2

Scenario 2 combines Options 6, 2 and 3 (see Table 4). This scenario includes the construction of a smaller dam at Glendower, yielding around 10,500ML/yr, recycling, rain and storm water capture in future development in the Beaudesert/Logan region, and supplementary use of the 'grid' during occasional periods of low flow. Scenario 2 could potentially yield up to 16,500ML/yr at a cost of just over $250 million. This cost of $15,200 per megalitre of yield, is still only approximately one third of the cost of the currently proposed Wyaralong Dam. This scenario can be implemented in the short to medium term delayed only by the time required to complete a medium size dam at Glendower. However, such a dam could be virtually guaranteed to fill rapidly on completion unlike a large dam on the Teviot Brook. Impacts of this scenario are also significantly lower although not as low as Scenario 1.

4.3 Scenario 3

Scenario 3 combines Options 7, 2 and 3 (see Table 4). This scenario includes a reduced scale dam at Wyaralong, reliably yielding 5,100ML/yr in conjunction with the same options that make up Scenario 2. The reduced scale dam at Wyaralong (Option 7) would operate at this level largely to avoid the very costly and socially disruptive relocation of major parts of the Boonah – Beaudesert road through difficult terrain. However, at this size the dam is very efficient and remains close to full most of the time. Evaporative loss is also reduced. Social impacts are still much higher for this scenario than those outlined above in Scenario 2. In addition, while still more economical than the current proposal (large Wyaralong Dam), Scenario 3 is the most expensive of those that this report has presented. At $18,000 per megalitre of yield this solution is approximately 40% of the cost of the currently proposed Wyaralong Dam while only yielding approximately 11,100ML/yr. Clearly Option 1 could be included in this scenario as well as Scenario 2 to reduce costs relative to yield.

Table 4. Yield, cost, evaporative waste and timing estimations for the three scenarios outline in Section 4 (the current proposal of a large dam at Wyaralong can be compared by referring to the final row in Table 3)

Scenario	Est. yield or reduced demand (ML/yr)	Evap. loss (ML/yr)	Estimated cost ('000,000s)	time online	Cost per ML yield ($)*
Scenario 1					
Option 1 Maroon Dam (75,000ML FSL)	5,000	1,500	10.0	2 to 5 yrs	2,000
Option 2 Recycling	4,000	800	50.0	match demand	12,500
Option 3 'Grid'	2,000	0	0.5	<2 yrs	250
	11000	2300	60.5	short term	**5500**
Scenario 2					
Option 6 Smaller Glendower Dam (~ 70m ASL)	10,500	11,000	200.0	5 yrs	19,050
Option 2 Recycling	4,000	800	50.0	match demand	12,500
Option 3 'Grid'	2,000	0	0.5	<2 yrs	250
	16,500	11,800	250.5	short to mid-term	**15,200**
Scenario 3					
Option 7 Small Wyaralong Dam (54.74m ASL)	5,100	6,155	150.0	5 yrs	29,400
Option 2 Recycling	4,000	800	50.0	match demand	12,500
Option 3 'Grid'	2,000	0	0.5	<2 yrs	250
	11,100	6955	200.5	short to mid-term	**18,050**

***** Cost per ML yield has been rounded to the nearest $50 to simplify visual comparison

<u>To reiterate:</u> The apparent marginal benefit from the proposed Wyaralong Dam of a few thousand megalitres over what Scenarios 1, 2 and 3 may provide is swamped by the sheer magnitude of wastage and cost associated with that proposal. If two-thirds to three-quarters of the water thought to be provided by Wyaralong Dam can be obtained with minimal cost and impacts (costs perhaps as low as 10 to 15% of the current proposal), then the additional many hundreds of millions of dollars required to build the large Wyaralong Dam would be more wisely invested elsewhere. Surely the Queensland Government cannot justify many hundreds of millions of dollars to chase after a few thousand megalitres while ignoring the wasted water associated with that marginal increase in yield.

5.0 Conclusions and Recommendations

This report has demonstrated the inefficiency, wastage and high cost associated with the Queensland Government's current proposal to construct a large dam at Wyaralong on the Teviot Brook. Given the clear need for improved supply capacity in the near future in south east Queensland it is inappropriate to simply criticize the current proposal without offering practical alternatives. In this report we have outlined just 7 options that can potentially offer a far more efficient and sustainable alternative to the Wyaralong Dam. These options are not intended to be highly prescriptive, but should form the basis of detailed analysis and evaluation by the Queensland Government into their relative merits both collectively and independently. We have shown that it is likely that a configuration of options could potentially replace the Wyaralong Dam for as little as 10 to 15% of the current cost. The following key question is triggered by this report on alternative options:

> If a suite of alternative options can provide the majority of water that is anticipated from the proposed Wyaralong Dam, with negligible waste and at far reduced economic, social and environmental costs, then is it justifiable for the Queensland Government to proceed to spend $500 million on a large, wasteful and risky dam at Wyaralong simply to provide the additional small quantity of water?

In light of the Deputy Premiers undertaking (see page 3, Section 1) and the Queensland Government's policy and legal obligations to explore all alternatives, we present the following recommendations:

We recommend that the Queensland Government should:

1. revise the programme for delivery of a large dam at Wyaralong to allow sufficient time to diligently and thoroughly investigate plausible options,
2. commit to detailed investigation, analysis and evaluation of these options (and others discovered or that become evident during the course of detailed investigation),
3. adopt the culture that investigation of these options is critical to the 'Wyaralong Dam project' and has the potential to provide an alternative solution at far reduced economic, social and environmental costs, and that the proving of an alternative solution is to be embraced as a success,
4. be prepared to accept that the proposed dam does not prove feasible against a range of measures (especially core ESD principles) and actively seek ways to replace the 'Wyaralong contribution' even if that involves a reappraisal of the quantum of the contribution should a particular suite of options fall short, but are still proximate,
5. acknowledge that the Logan River system, which is already ecologically stressed, is at risk of becoming further degraded by over allocation in face of uncertain climate future,
6. establish immediately a process that requires these options and others to be fully explored and evaluated within the feasibility phase of the Wyaralong Dam, well ahead of any commitment to preparatory works, and
7. establish immediately a parallel process (in conjunction with Recommendation 6) that clearly demonstrates publicly the nature, extent and results of the investigations undertaken in the option evaluation process. This could be achieved either through full disclosure or the appointment of an independent party to oversee the evaluation of our options and any that may emerge from them.

6.0 References

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