MURRUMBIDGEE VALLEY FOOD AND FIBRE ASSOCIATION (MVFFA)

Response to Questions Taken on Notice

from

STANDING COMMITTEE ON STATE DEVELOPMENT

INQUIRY INTO THE ADEQUACY OF WATER STORAGES IN NSW

---

1. Water Allocations or Announcements of AWD (Available Water Determination)

The question on notice is in relation to how water is allocated to general security in the Murrumbidgee Valley.

The Hon. Dr PETER PHELPS: I want to get back to the issue of the problem of your allocation. Is it a timing issue? Are you talking about a greater number of opportunities to vary that allocation, or just timing it at different times of the year?
Ms BULLER: It is a really sticky question. I would be very willing to perhaps give you a long written answer to that. It is way more complicated than you realise, but it most definitely is a timing issue. It has got a bit to do with some of the things that happened during the drought as well.
Ms TROPEANO: If you cannot get your full allocation at the moment, there has to be something wrong. The dams are full and they are saying—
The Hon. Dr PETER PHELPS: But your allocation will vary. You said on 1 December you are expecting a variation, and that is too late.
Ms TROPEANO: And that is too late.
Ms BULLER: Yes, and some of the things that have happened during the drought has caused that to happen. We will probably need to have another look at that. You have to look at the state of the catchment. There are variable things that go on there that are not being looked at at the moment.
The Hon. Dr PETER PHELPS: Excuse my ignorance, but how often can you have a variation in your allocation?
Ms BULLER: Every month, especially for my type of allocation. There are the water-sharing plans. I think they should be called the water priority plans; that is a better name. Our type of general security water is

quite low on that list. All the others have to be filled first. Basically what is happening at the moment is the dams are full of all these other classifications of water that are not using them because they do not need them, including river flows and end-of-system flows, and all those things, but the water is still in there.
The Hon. Dr PETER PHELPS: Are you entirely on general allocation?
Ms BULLER: We are, yes.
The Hon. Dr PETER PHELPS: No wonder. It must be hard.
Ms TROPEANO: Because the dams are full there is nowhere to put the inflows, so that is why they are not giving allocations. I can understand it in years when there is a low availability of water and everybody understands we have to save the water and we have to be careful, but when dams are 100 per cent full, I cannot understand only giving them a 64 per cent allocation. It does not make sense to me.
The Hon. Dr PETER PHELPS: Unless there was an over-allocation of general water in the first place and they are trying to use this as an administrative tool to correct poor decisions?
Ms BULLER: That is a complicated question as well. I am happy to write it up.

We have attached two recent documents from NOW (NSW Office of Water)that explain the official reason why there has been questions about AWD in the last few years.

We have also attached a short description from David Harriss (NSW Water Commissioner) that was sent to one of MVFFA's members (mentioned in our presentation at the hearing).

Importantly, GS irrigators need a clear indication of AWD for their cropping irrigation programs in late Winter/early Spring (Aug/Sept) as it is during these months that winter cereal crops are irrigated and Summer cropping areas are prepared.

You will note a repeated reference to historic minimum inflows which is also sometimes called LIS (Lowest Inflow Sequence).

This anomaly occurred in OCT/NOV 2006 which created exceptional circumstances and announced allocations were reversed in Nov 2006. The result was widespread financial loss, distress and heartache for irrigators who had used up their meagre allocations to irrigate small crops which then perished from lack of water. Some irrigators were even placed into a negative allocation situation. This is a major driving factor behind NOW being incredibly over conservative in announcing allocations.

In OCT/NOV 2006, the circumstances were highly, highly irregular and the catchment was bone dry with no runoff from the minimal snow melt but, at the time, NOW was allocating by using predictive inflow figures based on approximately 100 years of historical data. In that particular year, this proved to be a mistake as even a 300ml rain event in the catchment would have made little difference at that time. Understandably, those who had their allocations reversed were very upset as it caused a great deal of financial hardship. Some of the behaviour was probably inappropriate but it needs to be remembered that the poor behaviour was born of distress.

However it is important to remember that NOW did do an exemplary job of keeping the Murray and Murrumbidgee Rivers flowing during the most difficult years of the drought. Without the dams and the regulatory systems the rivers would most certainly have been dry on many different occasions from 2002 to 2009.

David Harriss and other NOW executive was severely castigated by the NSW minister of the day for allocating water that was not available. This resulted in a change of rules that currently use those anomalous LIS figures as a base point for AWD announcements.

The circumstances of 2006 were a definite anomaly and should not be used as a basis for determining present allocations. By July 1st 2011 and again this year, it was **statistically impossible** for the events of 2006 to recur as the catchment was very wet (in 2012 it was a record wet) and even a 25ml rain event made a huge difference, but NOW, because of those LIS figures, is allocating as if it **might** happen again. There needs to be some flexibility built into the rules. The rules need to be flexible enough to recognise the actual state of the catchment in any given season.

The current situation is almost the **complete opposite mistake to the mistake that was made in 2006.** While it makes sense to **not allocate** water too early if inflows are dangerously low and the catchment is dry, equally it **does not make sense** to not allocate as early as possible when we know the inflows are at record levels with significant snow melt and when even small rain events create run off.

NOW is ignoring the current state of the catchment and relying on the anomalous figures from 2006 to justify late AWD GS announcements and this is having a serious detrimental effect on GS irrigators' ability to plan for winter and summer cropping seasons. They can have no certainty in their planting windows while ever NOW relies heavily on those anomalous OCT/NOV 2006 LIS figures.

It also needs to be recognised that the WSPs (water sharing plans) that began in 2004, actually use inflows as part of the mix and a great deal of GS allocation, because it is very low on the priority list, was designated from inflows from that 2004 point. The changes that happened during the drought have created negative impacts for GS water licence holders even in years of abundant water like 2011 and 2012.

Dr Phelps highlighted that there was probably an ‘over allocation’ of GS water in the first place and this is being used as an administrative tool to correct poor decisions. That comment is entirely rational, but the problem actually occurred when water entitlement was separated from land and 'sleeper licences’ were able to be activated for production or trade. They were therefore no longer available as extra conveyance water for State water authorities to run the rivers. This mistake was made by previous State administration bodies and some of the WSPs and other policy decisions are most probably an attempt to ‘share the pain’ of that mistake. Unfortunately this mistake, combined with the over allocation mistake in 2006 has caused an inappropriate ‘over conservative’ approach that is harming the ability for broad acre irrigators in NSW to produce at maximum capacity.

Another emerging problem is that the SHL (Snowy Hydro) licence is somewhat disconnected from the negative impacts it can cause downstream. As RAR (Required Annual Releases) from SHL are not limited to any set timing, much of the water that would have been designated as the following year's allocation has been allowed to flow straight through the over full storages. It is thus not sufficiently 'accounted for' and not available for allocation. This is essentially because there is not enough downstream storage to cope with these releases.

The SHL licence and its attached rules is also the reason why SHL was forced to dump water on the back of major flooding events in 2010. From our view, this behaviour is not paying attention to sensible & flexible water management. It appears that SHL and NOW are both in a constant (but separate) search for a magic 'one size fits all' set of rules. There needs to be communication and co-operation between these two authorities along with a more flexible management regime.

The catchment is not interested in conforming to a fixed set of rules. Following rules based on averages that pay no attention to the current state of the catchment at any given time is resulting in the needless waste of water or perhaps an unrealistic 'water accounting' system. From July to December 2012 approx 7,000 to 8,500 ML was spilled from Blowering and down the Tumut River every single day. The majority of that water has been wasted out to sea. To get some perspective on the wastage, conservatively in a 5 month period, that is almost the entire storage capacity of Blowering (1,630GL) that simply flowed through and was not able to be sufficiently accounted or utilised. This becomes further complicated when we examine how it impacts future AWD announcements for GS allocations.

Of course, in our view, the obvious sensible solution is to build at least two more storages (one on the Murrumbidgee and one on the Murray) below SHL releases. However that is a long term solution that we sincerely hope this Inquiry will fully investigate. We also need a short term water management/water policy solution that pays more attention to the variable nature of the catchments and links allocations sensibly to efficient and productive capabilities.

During the drought there was a concept known as 'forward borrowing' from SHL. It would make sense to also have a **'forward credit'** from SHL when the catchment is as wet as it is at present. The most sensible place to store water for future dry times is at the very top of the system (Eucumbene) and this is how the system was designed in the first place. Competing demands and/or expectations have caused a change or redefinition in the way water is being 'accounted' and subsequently stored. For many of us the system is simply not capable of delivering good outcomes based on those new competing demands and/or expectations.

A glaring example of competing demands is evident in the attached documents where we see a total of 1,138 GL storage designated for purposes for which they cannot be presently used, including IVT (Inter Valley transfers), 3 separate EWA (Environmental Water Accounts), conveyance water and carry over. However, because much of this water is not currently required, there is theoretically no space for GS allocations...even though inflows will obviously make up for those accounts. This water could ideally be stored further up the system for future use. It is actually merely a simple 'accounting' exercise which would of course necessitate some co operation between all the different water authorities, particularly NOW and SHL.

Another highlighted issue is that the 'carry over' rules have been re interpreted during the drought years. NOW and State Water currently calculates the carry over as a general average, even though many irrigators do not have carry over because they may have been in full production and/or the previous season had water shortages. The only way **genuine producers** (as opposed to bureaucratic bodies)could have carry over is if they actually purchase extra water (often from the State Govt) to carry over. Because NOW has become so reticent to announce early allocations (as explained above) many GS irrigators are now purchasing water to carry over and this forces them to become part of

the larger problem via financial necessity for water security. Carry Over water is also the first water to technically 'spill' in a year of water abundance.

CEWH (Commonwealth Environment Water Holder) is the new largest water holder in the system and there is a large percentage of carry over belonging to CEWH, State Water and Private infrastructure companies at the start of any watering year (July 1). From our view, this has put our water bureaucracies into direct competition with their agricultural customers for storage space and productive access. This water is often listed for sale at the start of a season when GS allocations are very low and water is urgently needed to finish winter cereal crops. There are also 'private' water holders and IVT accounts that hold carry over water in order to take market advantage of these early season sales.

It must also be remembered that all productive water licence holders must pay fixed asset charges to State Water, NOW, SHL and Private Infrastructure companies **even when they have no allocation**. Those charges are based on 100% of entitlement. While we understand it is necessary to recover costs and supply maintenance to the infrastructure, it is very hard to understand why charges are not more sensibly linked to productivity and availability.

While bureaucracies (including private infrastructure companies) can still be paid for not delivering water, there is **very little incentive** for them to make sure that water arrives at the most efficient and productive time for their paying customers. No other businesses would be allowed to operate in this manner. Companies supplying our other inputs, such as fertiliser and chemical, are only paid when they deliver...they cannot be paid for empty trucks. As mentioned in our submission, one of the most frustrating elements for irrigation businesses is that water is an input, not an end product. While it can also be traded (just as seed and fertiliser can be traded) it is not an 'end product' in and of itself. It is used to produce food, fibre and protein. If it cannot be accessed in a reasonable time frame for production, it causes severe logistic problems for irrigation businesses.

So in summary, Dr Phelps' questions regarding timing are highly relevant. There is an emerging problem with the accounting/timing of GS allocations that is seriously impacting the ability for some water users to produce. As we mentioned at the hearing, water policy seems to have become disconnected with productivity goals. Productivity is not just about agricultural productivity; it also includes environmental, ecological and other consumptive uses such as electricity, urban and industrial productivity. Our current storage and management systems are not capable of adequately supplying all of these demands in all circumstances which is why MVFFA is very appreciative of the terms of reference in this inquiry. There is however a real need to insert some sensible flexibility into water management that recognises the reality of the catchments and also the needs of the paying customers. Using rules that were designed to manage drought conditions when the catchment is extra ordinarily wet is not gaining good outcomes and is also resulting in the unnecessary wastage of productive water.

2. Proposed and Suggested Water Storage Sites

The questions on notice relate to the sites identified east of Wagga and east of Narrandera, creek names and anything other we have.

CHAIR: On a point of clarification, have the two sites you referred to been identified?
Ms TROPEANO: They have.
CHAIR: Can you tell us where they are?
Ms TROPEANO: We can take that on notice and get back to you.
Ms BULLER: We can get the information. A lot of that information has been around for about 30 years but it has been archived. The focus has not been there for at least that long.
The Hon. PAUL GREEN: Can you give us the names of creeks or anything you have?
Ms TROPEANO: We can supply that.

We have sourced the following information which we hope will be of assistance to the Committee:

PROPOSED DAM AT **MURRAY GATES** ON THE MURRAY RIVER (Snowy Mountains Hydro-Electric Authority, 1966)

Please see attached file .

LAKE MEJUM, A CASE TO GOVERNMENT TO FUND THE DEVELOPMENT OF A WATER STORAGE AND RECREATIONAL FACILITY (Submitted by The Shires of Balranald, Carrathool, Griffith, Hay, Jerilderie, Leeton, Murrumbidgee, Narrandera and Urana; The County Councils of Murrumbidgee and Southern Riverina; The Lowbidgee League; and The Rice Grower's Association of Australia, 1984)

Please see attached file.

The following information regarding suggested water storage sites has been supplied by various identities with local knowledge:-

There is a desperate need for water conservation measures upstream of Wagga on the Murrumbidgee River. There are several sites that would be suitable. Water storages could be constructed on several of the twelve major creeks, the **Tarcutta Creek** especially, but also at a later date the **Jugiong, Hillas** and **Kyamba Creeks**.

A dam should be constructed on the **Billabong Creek** near Holbrook mainly for flood mitigation purposes.

To overcome the in river water management problems consideration should be given to a **weir and low level storage east of Narrandera** to be considered with a reappraisal of the **Lake Mejum** scheme.

A downstream **dam on the Murrumbidgee River east of Narrandera** could be built on the site where the river runs through a natural fold in the earth with high banks on both sides. If this dam had a total capacity of 250,000 megalitres and an average depth of only seven metres, it would cover an area of around 4,000 hectares. Net evaporation in this area is around 1.3 metres per year so would total about 40,000 megalitres per year. In most years the storage would be full at the commencement of the irrigation season and would be drawn down whenever the water authorities needed water quickly to respond to growers needs in the MIA and CIA. If the State only sold an extra 100,000 megalitres per year from this storage it is worthwhile because otherwise this water would be wasted and importantly there is still another 100,000 megalitres still stored in Burrinjuck or Blowering Dams.

Look at the possibility of building a **higher dam wall immediately downstream of the existing Burrinjuck Dam** (because engineers tell us the existing dam cannot safely be raised) and increasing the capacity to at least 1.5 MLs.

The previously planned but never built**, Gateway Dam** on the Murray River near Corryong above Hume Weir. This would immediately increase storage on the Murray by over 1.5M megalitres and would assist with conserving the power generating releases from Snowy Hydro.

The building of the **Chowilla Dam** in SA is a way of guaranteeing supplies for the lower Murray and SA forever - would have stored over 5M megalitres of water.

Snowy - investigate dams on the **Delegate** and **Bombala Rivers** with a further dam downstream on the **Snowy.**

Dams on several of the **tributaries of the Snowy River**.

A dam on the lower reaches of the **Kiewa River**.

Murray Valley - There are no significant storages downstream of Hume Dam (with the exception of Lake Victoria in SA). There is currently no capacity to store any of the floodwaters that flow from **the many creeks that feed the lower reaches** of The Kiewa, Ovens, King, Broken, Goulburn, Loddon, Campaspe and Avon rivers.

Lachlan River - There is capacity for extra storage on the **Belubula River** and the **Mandagery Creek**, both of which are ravaged by flooding. Consider raising the height of the **Wyangala Dam** wall - this could increase storage capacity by thirty to forty percent.

Darling River - the construction of **five or six weirs** of only 5 metres in height would back up over 200 kms and create a much more reliable water source. Also investigate storages on the **Culgoa, Condamine, Castlereagh** and **Barwon Rivers**.

Extract taken from "POSSIBILITIES FOR INLAND DIVERSION OF NSW COASTAL STREAMS" (prepared for Water Resources Commission of NSW in 1981)

Diversions from the Snowy Basin

For the Snowy Basin four schemes have been identified, all of which deliver water to the Upper Murray River. Details are given in Table 3.6. Two of the schemes SNO-1 and SNO-3 have relatively high annual costs of water and therefore should not be considered further. The other two have the lowest annual costs of water for all schemes investigated in this review, but since they both divert from the Snowy River only one can remain for consideration. This is **Scheme SNO-4** which could provide an annual diversion volume of 162,000 ML for an annual cost of water of $120 per megalitre. It is of interest to note that by constructing a larger dam the annual diversion volume could almost be doubled with only a small increase in annual cost per megalitre.

Location Details for SNO-4:-

Coastal Basin	- Snowy
Inland Basin	- Upper Murray
Diversion Offtake	- **Snowy R. 2kms downstream Jacobs R**

The following dam sites were examined in a preliminary way by The Water Conservation and Irrigation Commission in 1968:

Darbalara - 200,00 acre feet of possible storage, 105 ft height of wall, 4,400 ft length of crest, submerged area of 7,000 acres.

Mingaye - 800,000 acre feet of possible storage, 100 ft height of wall, 1,400 ft length of crest, submerged area 22,000 acres.

Extracts taken from "PINNEENA", A PROFILE OF THE WATER RESOURCES COMMISSION (prepared in the 1980's)

Floods

The Commission has also embarked on a major project of mapping the flood plains in all major river basins in New South Wales. Floods, like droughts, are inevitable happenings which we cannot avoid. But floods, unlike droughts, can be channelled, diverted, even stored to some extent, so that their wild, tempestuous nature is checked and their behaviour can be accurately forecast.

The Future

Extensive hydrologic and hydrogeological surveys have been undertaken to measure the State's water resources. The potential of all major river valleys is being mapped and measured above and below ground and a bank of information is being steadily compiled for future reference. Forward planning is going ahead on many projects designed to conserve and distribute water to the best advantage.

Extracts from "POTENTIAL OFF RIVER RE-REGULATION STORAGES" (Department of Water Resources, Murrumbidgee Region, 1994)

Ordering

The Irrigation Areas and Districts' demand is a large percentage of the total water order, is the most variable, and by default, the area where the greater loss potential originates.

The current ordering arrangements place onus on the river operator to "estimate" diversions for the various offtakes.

The factors affecting the acceptance of order forecast validity are:

- the consequences of under supply, time of year (panicle initiation, flowering, etc for rice, winter pasture establishment, etc)
- the system loss potential (condition of "catch potential" weighted against the need to be conservative)

The system flexibility increases when the operator has the option of accepting orders with less scrutiny when re-regulation storage is available to catch the supply excesses. The option exists to use these surpluses later when headworks releases can be trimmed and delay on delivery to customers does not result in undue anxiety.

The need for water order debit is also less urgent if the Department is able to accommodate what are at present unrealistic ordering procedures. It is essential that travel times for regulated supply must dictate order times for regulation extraction.

Development of Re-regulation Storages

The pressure on regulation efficiency and the current policy of "tight targets" and the replication of natural flow regimes are not necessarily compatible. The need to develop storages that can be filled from unregulated flows and used to provide a greater yield to the valley are in the interests of all consumptive users through increased security, but not necessarily in the interests of preservation of natural flow regimes.

The Department's charter is certainly to increase the productivity of the State through utilisation of its water resources, however this is to be undertaken consistent with environmental objectives.

The development of the off-allocation policy is a reflection of that need.

Identification of Potential Off River Re-Regulation Storages

The utilisation of **Tala** and **Yanga** storages in the lower river provide the opportunity to increase the yield of the valley and with an adequate operation protocol, provide the necessary flow variation to flows. Such protocol may involve replenishment if flows are over certain values.

The presence of re-regulation storages in the lower river would assist greatly in providing:

- flow control at Balranald
- timely response to Murray system demand
- increased valley yield
- a more flexible water ordering system, and
- meeting NSW Murray River commitments without depleting Murrumbidgee headworks unnecessarily.

In October 2011 an incident occurred where Murrumbidgee Irrigation and Coleambally Irrigation were unable to meet their irrigation commitments due to adjustments made to their orders by State Water and consequently insufficient water was released from the storage. This caused serious problems for irrigators trying to fill rice bays, etc.

An MI senior executive member indicated to Debbie Buller that there were two simple ways to fix the problem:-

" 1) Our systems max capacity is about 7800ML x day. Day travel time to our Customers is 7 days. We build a storage of 7 x 7800=54600ML which can carry us through forecast or river shortage.

2) We have 7 day water ordering which removed the requirement of forecasting."

Files attached:

Explanatory email from David Harris.

determination_water_allocation_murrumbidgee_regulated_valley.pdf

media_release_21203_available_water_determination_murrumbidgee_general_security.pdf

Lake Mejum.doc

Murray Gates.doc

Explanatory email from David Harriss (NSW Water Commissioner) to David Lindsay on Oct 30th in response to a question regarding low GS allocations in a very wet season.

The reference to minimum historic inflows refers to Oct/Nov 2006. This is also known as LIS (lowest Inflow Sequence).

From: David Harriss [mailto:David.Harriss@water.nsw.gov.au]
Sent: Tuesday, 30 October 2012 9:45 AM
To: david.lindsay@telcomail.com.au
Subject: RE: Increase of general allocation from 64%

David,

Probably simplifying a reasonably complex issue but here goes. Burrunjuck and Blowering Dams do not hold sufficient volume when full to meet all river flows, including end of system flows and to meet 100 percent of entitlements. Instead, as water is released from the dams to meet demand (that is, users are using their allocation) than any new inflows will be stored and can increase the allocation.

If the dams are full and there are no releases, then there is no airspace and no more water can be stored and made available. Instead access is by supplementary access which co0mpliments available allocation.

So for this year, there has not been much water released and no additional water has been able to be stored and so allocations have stayed the same. As we get into the warmer months we would expect releases to increase, providing airspace for future inflows. We then assume minimum historic inflows over the forecast period and can estimate what the genral security allocation will get to.

Regards DH

Department of Primary Industries
Office of Water

Determining water allocations in the regulated Murrumbidgee Valley

November 2012

Introduction

The NSW Office of Water is responsible for sharing water between consumptive users and the environment throughout NSW.

Within NSW, the sharing arrangements are typically undertaken in accordance with the statutory water sharing plan for the respective water source. In some valleys, including the Murray, Murrumbidgee and Lower Darling Rivers, the Office of Water must also consider interstate water sharing arrangements and the operations of the Snowy Hydro Scheme.

During severe water shortages, a statutory water sharing plan may be suspended, during which time the priorities for water sharing are undertaken in accordance with the Water Management Act, 2000.

Due to severe drought, the Murrumbidgee water sharing plan was suspended between on 10/11/06 and recommenced on 16/9/11. Since the drought has broken, water sharing has been undertaken in accordance with the Plan.

While the process for determining water availability and announcing available water determinations (typically referred to as allocation) is straight forward, climate variability, seasonal circumstances and a number of operating variables can make it difficult to understand how increases in water availability are made.

This fact sheet provides an overview of how water availability is determined in the Murrumbidgee Valley and how this has been applied in 2012/13.

Determining starting allocations at the beginning of the year

Immediately prior to the new water year 1 July, the NSW Office of Water calculates the minimum volume of water that will be available for consumptive use during the coming year

This includes;

- How much water is available in the storages, plus
- What are the minimum natural inflows into storages expected during the year that can be allocated for consumptive use, plus
- Required annual releases by Snowy Hydro Limited into Blowering Dam, minus
- The volume required to run the river, that includes meeting end of system flows, transmission and evaporation losses.

The opening allocation (1 July) is therefore the minimum volume of water that can be confidently made available and delivered during the year to licensed users.

The determination of water availability is typically very conservative but there are a number of variables that can have an impact, including;

- The forecast inflows are the minimum inflows experienced in the 120 years of records. However, in many NSW valleys in 2006/07, the inflows were well below the previously recorded minimums.
- During drought years, the volume required to run the river, transmission and evaporation losses are much higher than average
- While Snowy Hydro Limited must deliver required annual releases, the timing of releases is up to Snowy Hydro Limited and is not known to the Office of Water in advance.
- Arrangements under the Snowy Water Licence enable Snowy Hydro Limited to deliver greater than their Required Annual Release in any year, and this is reduced from their Required Annual Release in the following year. This is known as ‘flex’.

From the water available the Office of Water then;

- Allocates the volume of water that is available after allowing for water that has been carried over by users and the environment from the previous year and is available for use is the coming year, consistent with the rules in the WSP, then
- Reduces available water by the volume of any outstanding inter-valley transfers into the Murray Valley, that have not been delivered in the previous year, then
- Progressively allocates water to high security water accounts, then
- Allocates any remaining water to general security accounts

Typically, the volume of water available for allocation for consumptive use at the beginning of the water year is low, and will increase throughout the year as inflows into the storages, higher than forecast minimums, occur.

In the Murrumbidgee Valley it is only in very dry years that water availability for high security users is less than 95 percent of entitlement at the commencement of the year. It is unlikely that high security allocations will not increase to 100 percent during the year unless the inflows are greater than previous recorded minimums.

By comparison, there will never be enough water available at the commencement of the year to announce 100 percent of water availability for licensed general security users and increases in general security allocation will always depend on inflows during the year.

Increasing allocations

As the year progresses further assessments of water availability are undertaken and improvements, usually from better than minimum inflows and less than forecast transmission losses, will allow for allocation to be increased incrementally and volumes credited to accounts of licensed users.

Effectively the Office of Water makes the same assessment of available water at the end of each month through the year, and more frequently leading up to the summer cropping season or if there is a significant rain event.

The Office of Water will continue to increase allocations for general security entitlement holders up to 100 percent of entitlement is reached. However, when allocation plus average carry-over exceeds 80 percent of entitlement or after the end of the summer, water is proportionally set aside for the following year.

Why can't there be 100 percent of water availability if the dams are full?

In the Murrumbidgee valley there is approximately 2,700 gigalitres (GL) of high and general security entitlements and it takes about 1,170 GL to run the system to deliver water for the whole year and to maintain a minimum reserve.

The total volume of Blowering and Burrinjuck Dams is about 2,650 GL.

Therefore, even if the dams were full there is insufficient water to announce full general security allocation at the beginning of the year, and increases in general security allocation will depend on above minimum inflows into the dams that can be stored for release later.

Why doesn't allocation increase much, or at all, when the storages are full?

The water stored in Burrinjuck and Blowering dams at any time up to the end of summer are fully allocated to meet the volumes needed to run the river to the end of the year, and meet all environmental, high and general security allocations.

If the dams are full, any inflows cannot be stored for release later and so effectively pass straight through. This means that they cannot contribute to meeting any additional future demand than that which is already stored and allocated.

The flows that pass straight through will usually allow periods of supplementary flow to be made available, where licensed users may access these in addition to their allocation, consistent with the rules in the WSP that limit total use in any year.

The supplementary flows or downstream tributary inflows during any month will reduce the need to have released the volumes required to run the river for that month and so there is usually a small increase in allocation.

Offsetting this, however, is that the Office of Water assumes a pattern of inflows of Required Annual Releases from Snowy Hydro Limited into Blowering Dam as part of its minimum inflow sequence. If Snowy Hydro releases water into a full Blowering Dam, this cannot be stored for later use.

Often, when this happens for an extended period, as it has in 2012/13, it is the result of wet climatic conditions, and the passing-through of inflows that have been assumed they would be able to be

stored, will offset the incremental improvements that occur.

In summary, when the dams are full it will usually require water to be released to meet downstream demand and airspace made available to store future inflows to enable allocations to be increased.

How does carry-over impact of allocation announcements?

The maximum allowable carryover for general security entitlement holders in the Murrumbidgee valley is 30 percent of entitlement.

Under the Murrumbidgee WSP, unless a user has a specific supplementary licence, other licensed users can only use up to 100 percent of entitlement, whether it is from allocation, carry-over or supplementary flows, unless they purchase additional water through the year.

Before water is allocated for any other purpose, the total amount of carry-over is allocated to those users who carried water over.

If an individual irrigator has carried over 30 percent of entitlement, as general security allocation increases above 70 percent, that user will not have any additional increases credited to their account. Instead, any additional allocation above 70 percent will be available for allocation across all other users.

Forecasting water availability in 2012/13

A minimum volume of water is expected to be available as inflow during the year (up to 1,200 GL) and this is incorporated into the calculations to maximise the announced commencing allocations in July (100 percent town water and stock and domestic, 95 percent high security and 64 percent general security).

This was based on assumptions of minimum natural inflows into the storages in the coming months and releases into Blowering Dam from Snowy Hydro, and that some of this would be stored for future use. However, the timing of those inflows into storages is unpredictable.

In the first few months of 2012/13, with full storages, and with Snowy Hydro releasing significant volumes of Required Annual Releases (RAR) to meet electricity demand, much of the assured inflows that had been assumed could be stored for future release passed straight through the storages.

The Office of Water had assumed that some of the releases from the Snowy Scheme and natural inflows into Blowering dam would be able to be stored for future release and contribute to the announced allocation. However, these spilled inflows that were expected to support the announced allocation (64 percent at 1 July) had the effect of reducing water availability to meet the announced allocation, and have been requiring subsequent improvements in water availability to meet the shortfall rather than increasing allocation.

With the onset of sustained demand for water, inflows have now been able to increase the general security allocation.

How has carry-over influenced general security allocation in 2012/13?

In 2012/13, on average about 27 percent of entitlement was carried over by licensed general security users in the Murrumbidgee Valley from 2011/12 and was credited (carried-over) to private accounts on 1 July 2012. This is because the 2011/12 summer was wet and demand for water was reduced.

With general security allocation currently at 68 percent, those who carried over the maximum 30 percent can only fit a further 2 percent in their account before additional allocation is distributed to less-full accounts.

As an average of 27 percent of entitlement was carried over this year in the Murrumbidgee valley, it will take just a 5 percent increase in general security allocation to ensure that all accounts will have 100 percent of entitlement credited.

This is why there is often a significant jump in general security allocation from between 70 and 80 percent to 100 percent over a short period, depending on the average amount of carry-over.

A small improvement in resource availability produces a significant increase in allocation because those accounts with carryover cannot be credited with more water once full.

The resource balance sheet

Storages

Burrinjuck Dam - full capacity	*1,026 GL*
Blowering Dam- full capacity	*1,631 GL*
Total	***2,657 GL***

Minor re-regulating weirs and storages downstream, total capacity approximately 50 GL, are used to manage (regulate) flows and maximise resource availability.

Assured Inflows during the year

Snowy RAR (plus flex) approx	*900 GL*
Minimum (new drought) inflows	*300 GL (220 GL into storage plus 80 GL from d/s tributaries)*
Total	***1,200 GL*** *(maximum, usefulness subject to timing of inflows)*

Entitlements

Conveyance	*373 GL*
TWS and D&S	*80 GL*
High Security	*359 GL*
General Security	*1,890 GL*
Total	***2,702 GL***

Commitments (1 July 2012)

Carryover	*507 GL (27%)*
Undelivered IVT	*84 GL*
Balance EWA1, EWA2, EWA 3	*94 GL*

* There are 3 environmental water allowances in the Murrumbidgee Water Sharing Plan, that collectively provide water for environmental purposes in the Murrumbidgee Valley.

Total	***685 GL***

Annual System Operational Requirements

Losses budget for full year	*630 GL (550 GL transmission, 80 GL evaporation)*
End of System Target for full year	*220 GL*
Storages Reserves*	*320 GL*
Total	***1,170 GL***

*includes the Provisional Storage Volumes required under the WSP.

General Security allocation announcements in recent years

The last couple years have been relatively wet, meaning demand for stored water has been reduced and storages have been relatively full. This year's pattern of allocation increases has been similar to the previous two years. Prior to that allocations were drought affected.

In 2012/13 general security allocation announcements have been;

Date of announcement	Allocation %	Average carry-over
15-Nov-12	68	27%
15 Oct-12	64	
17-Sept-12	64	
15-Aug-12	64	
16-Jul-12	64	
1-Jul-12	64	

In 2011/12

Date of announcement	Allocation %	Average carry-over
1-Dec-11	**100**	27%
15-Nov-11	72	
31-Oct-11	69	
14-Oct-11	65	
30-Sep-11	63	
15-Sep-11	59	
1-Sep-11	57	
15-Aug-11	53	
14-Jul-11	50	
1-Jul-11	44	

In 2010/11

Date of announcement	Allocation %	Average carry-over
15-Dec-10	**100**	25%
1-Dec-10	59	
1-Nov-10	56	
15-Oct-10	51	
1-Oct-10	47	
15-Sep-10	45	
1-Sep-10	9	
1-Jul-10	**0**	

In 2009/10

Date of announcement	Allocation %	Average carry-over
1-Apr-10	27	14%
15-Mar-10	26	
1-Mar-10	24	
15-Feb-10	20	
15-Jan-10	18	
30-Nov-09	15	
2-Nov-09	14	
23-Oct-09	11	
15 –Oct- 09	4	
1 July 09	0	

From 2004/05 to 2008/09

During the drought years from 2004 to 2009 the final general security allocations were

Year	Allocation %	Average carry-over
2008 – 09	21	Na
2007- 08	13	2%
2006 – 07	15	13%
2005 - 06	54	8%
2004 - 05	40	10 %

More information

Bunty Driver: M 0407 403234

www.water.nsw.gov.au

Published by the Department of Primary Industries, a division of NSW Department of Trade and Investment, Regional Infrastructure and Services.

Reference number 11634

Department of Primary Industries
Office of Water

Media Release

Monday, 3 December 2012

100 percent allocations for Murrumbidgee Valley water users

NSW Water Commissioner, David Harriss, today announced an increase of 32 percent to general security water allocation in the Murrumbidgee Valley bringing it to 100 percent of entitlement.

The Murrumbidgee Valley high security allocation will also increase to 100 percent of entitlement.

“The warmer weather over recent weeks has meant that the volumes of undelivered trade, carry-over and allowances in the valley storages is being released or used, meaning that new inflows can be allocated for consumptive use.

This has enabled all water users in the Murrumbidgee Valley to receive their full entitlements for the third year running,” said Mr Harriss.

“The NSW Office of Water has been advising of a high likelihood that full allocations, in the Murrumbidgee Valley, would be reached before Christmas.

“Early allocation announcements are typically conservative as a number of variables need to be considered and it would be irresponsible to make water available if this ultimately could not be delivered,” said Mr Harriss.

“Allocation increases throughout the year as inflows into the storages occur that can be stored and subsequently released.”

“We have prepared an information paper to reassure water users in how the allocation process is determined in the Murrumbidgee Valley.”

This information paper is available on the Office of Water’s website.

Supplementary access is still available in some sections of the Murrumbidgee Valley and has been for most of the past 2 years. However, general security licence holders are reminded that they can no longer divert water from supplementary flow events without-debit.

“Licensed water users in the Murrumbidgee Valley are not permitted to divert more than 100 per cent of their entitlement in any year, unless they have a specific supplementary water licence, or buy additional water on the temporary trade market,” Mr Harriss said.

More information on water allocations can be found on the NSW Office of Water website -**www.water.nsw.gov.au**

Media contact: Bunty Driver – 0407 403 234

LAKE MEJUM

A CASE TO GOVERNMENT TO FUND THE DEVELOPMENT

OF A WATER STORAGE AND RECREATIONAL FACILITY

Submitted by

The Shires of
Balranald, Carrathool, Griffith, Hay, Jerilderie,
Leeton, Murrumbidgee, Narrandera and Urana

The County Councils of
Murrumbidgee and Southern Riverina

The Lowbidgee League

The Rice Grower's Association of Australia

Coordinated by

McGowan Associates
Albury and Hay

MAY 1984

CONTENTS

SUMMARY AND CONCLUSIONS

The Mejum Lakes comprise a series of natural depressions just north of the Murrumbidgee River at Narrandera. For many years consideration has been given to using the lakes as a storage for surplus river water. The Average Annual Flow in the Murrumbidgee River at Wagga Wagga is 4 400 000 megalitres (Ml) whereas the Average Annual Supply obtainable for the system under the present Volumetric Allocation Scheme is 2 500 000 Ml per year.

Local pressure to create a storage at Lake Mejum has arisen from a number of different community groups. Farmer organisations have requested both an increased supply of irrigation water and a means of more efficiently using the present water resources available. Recreational interests point out that the area is inadequately served for water based sports when compared with other areas of the state despite the availabilty of river water. Those involved with tourist promotion claim that the area needs a focal point to attract tourists from outside the region. The drought of 1982-83 has impressed on all how dependent the area is on conserved water and especially the importance of adequate water supplies in securing employment opportunities.

In response to these various local pressures the Shires and County Councils of the region and various local organisations coordinated by the Murrumbidgee Valley User's Association decided to put a case to government to fund the implementation of the Lake Mejum scheme. A representative committee has prepared this report with the help of consultants.

The report aims to marshal arguments in favour of the scheme with a view to persuading government to allot a high priority to the project. The scope of the report is not to produce a new study but to consolidate previous work and local knowledge into a convincing case to implement the current proposal which has wide community support.

The key features of the proposed scheme are the construction of a storage at Lake Coolah of 450 000 Ml of which 50 000 Ml would be retained throughout the summer as a recreational reserve at a cost of $36 million. The Mejum Swamp would be a wildlife reserve and appropriate facilities for recreation and tourism would be developed.

Benefits would flow to many sectors of the community; irrigation farmers would have more water available and because the storage would be close to the farms this would enable more efficient use of all available irrigation water; the large local population which is now poorly served with areas for water recreation would have facilities comparable with other areas; tourism would bring new development to the area and overall job opportunities could increase.

The source of funds to implement this project is a matter for government decision. The difficult decision of who pays for what will require lengthy discussion. This will be a demanding exercise because of the multipurpose nature of the project and the wide dispersion of benefits both geographically and to different groups within the community.

The committee believes the project meets all the requirements of current government policy to achieve the highest priority. It is directed to improve the management of existing supplies and reduce waste of the limited quantity of water currently available. It is a low cost project when compared with alternatives of a major new headworks storage. With an internal rate of return of 13 percent it compares favourably with other investments of public funds.

1. BACKGROUND

The benefits which flow to people living in inland New South Wales as a result of water conservation become more clear with each passing year. The drought which ended in 1983 showed that many large towns in irrigation areas as well as their dependent rural population were not only insulated from the effects of natural disaster but maintained business and employment levels which helped the whole state.

The benefits of irrigation have long been recognised. However the drought of 1982-83 has emphasised the importance of secondary benefits to towns in irrigation areas. Because of the business generated by secure irrigation production as well as the recreation and tourism that has been attracted to the larger water storages, towns adjacent to these facilities were able to maintain high employment levels while other inland areas were severely depressed.

The growing demand for water based recreational locations plus the secure demand created for farm inputs provided river areas with a cushion against the drought. These activities provided work for a large part of the population and enabled even those affected to recover more quickly. The recreational facilities provided in the neighbourhood of Burrinjuck, Lake Wyangala, Lake Hume and Lake Mulwala are now creating a community interest in and justification for water conservation that in a previous generation was centred almost exclusively on the irrigated land which was fed by the storages. Unfortunately the benefits of such storages are geographically remote for much of the population of southern NSW and the smaller reserves such as Lake Wyangan near Griffith (240 ha), Lake Albert in Wagga Wagga (104 ha), and Lake Talbot in Narrandera (40 ha) are quite inadequate for the demands placed on them. For example Lake Talbot has a maximum permissable number of six power boats on the water at any one time. Other towns are deprived of even these restricted recreational opportunities which are so taken for granted by the majority of Australians living in the seaboard capital cities with their easily accessible beaches.

The benefits of water conservation are enjoyed by wide sections of the community; many perceive the greatest benefit being derived from the recreational oppportunities afforded by water storages; others appreciate more the security of town water supplies made possible by river regulation. Those concerned more with affairs of state see the widespread regional benefits arising from business and employment opportunities which are secured by the economic strength of the farming industries based on irrigation which make the other benefits possible. From a national viewpoint the overall economy benefits by increased exports of commodities in which Australia has a comparative advantage over its competitors, the circulation throughout the community of the large income derived from these crops and the very significant amount of tax generated by this prosperity.

In the Murrumbidgee Valley the main irrigation areas (the Murrumbidgee Irrigation Area [MIA], centred on Griffith and Leeton, the Coleambally Irrigation Area [CIA], the Hay Irrigation Area) and the river pumpers have now developed their enterprises to the stage where the regulated flow of the river is virtually fully committed. In fact, there are competing forces vying to use the available water. While recognising the value of in-stream and down-stream uses of water the present position is that although the Average Annual Flow in the river at Wagga Wagga is 4 400 000 Ml, the Average Annual Supply obtainable from the system under the present Volumetric Allocation Scheme is 2 500 000 Ml with operational losses running at approximately 300 000 Ml per year. The proposal to store water in the Lake Mejum depression is based on the concept of storing and using water which would be diverted to the lake from surplus Murrumbidgee River flows. Uncontrolled flows arise from spills from the existing storages of Blowering and Burrinjuck, the significant contribution of tributaries, for example the Tarcutta Creek, which flows into the Murrumbidgee below the existing storages on the upper reaches of the river and from irrigation cut-backs.

The existence of a large body of water in close proximity to the centre of irrigation demand will significantly increase the efficiency of utilisation of water available from the Murrumbidgee. Because the main storages in the headwaters of the river are many days flow away from the irrigated areas it is impossible to control with accuracy the release of the desired quantity of water as this is varied from day to day by changing demand (irrigation cut backs) and supply (tributary flows). The recent construction of the small en route storage of Tom Bullen near Darlington Point is the best proof of this need. Though this storage capacity is only 11 000 megalitres (Ml) it is estimated that this small facility saved 80 000 Ml in the 1982-83 season. With adequate storage close to the irrigated areas as would be supplied by Lake Mejum efficiency of use would improve significantly.

According to the Water Resources Commission (WRC) 1/, "The main purpose of the Lake Mejum storage is to provide an improvement in the regulation of the flow of the Murrumbidgee River in order to augment the volume of water available for irrigation purposes". The Commission however, also recognises the great importance attached to the preservation of environmental quality and social welfare, integral components of the proposed storage.

The concept of storing this surplus water in the large natural depression just north of the Murrumbidgee River at Narrandera has been discussed for many years and has been the subject of detailed feasibility 2/ and environmental 3/ studies.

1/ Lake Mejum Storage Proposals, December 1980, Water Resource Commission, P.2.

2/ Water Resources Commission Proposal, 1980, identified three project options.

3/ The Lake Mejum Storage Proposal Environmental Study Report, 1977, Rankine & Hill, Consulting Engineers for the Water Resource Commission.

As a result of these studies and the subsequent consideration of the various options available for the construction of storages of different sizes and their associated social and environmental impact, there has been substantial community discussion. As a result of this process, agreement has now been reached regarding the preferred and acceptable nature of development in the area. The recommended option for development is shown on the attached plan (see Map 2) but it is expected that this could be amended as ongoing studies, including this report, are developed and accepted. A summary of the scheme is set out in the attached table, Appendix 4, with costs expressed in December 1983 values.

The key features of the present proposal are that a storage basin with capacity of 450 000 Ml will be constructed at Lake Coolah; a combined inlet/outlet canal, 9 kilometres in length will be constructed from Bundidgerry Creek to the storage and water will be pumped an average of 18 metres lift. In order to maximise the benefits of the scheme and because of the evaporation factors, the water from Lake Coolah which will be stored mainly during late winter and spring, will be released to provide for the demands of irrigators as soon as possible. This will conserve the waters stored in the headwater dams for later use and allow space in Lake Coolah for the capture of surplus flows as they arise. For recreational purposes a reserve of 50 000 Ml will be held in the lake for the whole summer period and this reserve, together with the adjoining Mejum Swamp, a wildlife breeding ground, will present a major recreational area with a variety of water-based interests to service the region.

Because of the complexity of the various developmental options considered, the desirability of community participation, the need to balance community interests in irrigation development, recreational pursuits, environmental issues, wildlife preservation and the social disturbance associated with property acquisition, progress towards an agreed development plan has been slow. It is also recognised that in the step-by-step process being followed by state government, local government and the various community interests involved, there are still many issues to be discussed and resolved. For example, the Minister's recent commitment to a further environmental impact study building on the 1977 environmental study has become necessary because the nature of the development has changed and new issues have arisen. The first study emphasised the importance of Mejum Swamp as a wildlife reserve and this has led to the retention of this area for this purpose and its exclusion from inundation as a water storage. Other issues are still to be resolved such as whether the works to drain Mejum Swamp should be utilised to improve it as a wildlife reserve by allowing Lake Coolah waters to supplement it at appropriate times. Despite the foreseen questions, which must still be resolved, local government is now fully supportive of the decision to move one step closer to development of the scheme but the major consideration now is a funding commitment for implementation.

The scheme has for many years been supported, in principle, by the WRC although the earlier priority for implementation enjoyed by the project was not upheld because of the procedures necessary to obtain community agreement in the choice of an acceptable option. The Commissions' position is probably best summarised in the following statement:

"Commitment of the regulated flow now available in the Murrumbidgee River system has reached the stage at which plans need to be prepared for the development of the next major storage on the system if appreciable further irrigation is to be possible". 4/

"The decision to intensify investigation of the Lake Mejum storage was made after examination of a number of other alternatives available to supplement the supply available in the Murrumbidgee system. Earlier work included consideration of alternative headwater storages....." and "consideration of pumping from the groundwater reservoir". 5/

The support of the Government of New South Wales has been expressed by a number of Ministers on various occasions. On 27 March 1981, Mr Lin Gordon, Minister for Lands, Forests and Water Resources stated in Narrandera: "It is the Government's intention to press ahead with the Lake Mejum Scheme. A good deal of work and planning has already gone into the Lake Mejum Project ..... now we are going to do something about it ..... the New South Wales Government gives it a very high priority. We will be stressing to the Federal Government the economic and other advantages of this scheme ..... We hope that the feasibility studies for the Lake Mejum Project will be completed within the next year, so that normal design and environmental procedures can be followed and construction will be started as soon as possible".

4/ Water Resources Commission Report, December 1980, P.2.

5/ Water Resources Commission Report, December 1980, P.3.

2. BENEFITS FROM IRRIGATION

2.1 Water Supply

Irrigation benefits from increased water availability are more easily quantified, particularly in dollar terms, than benefits such as those associated with recreation or the environment. The development of the irrigation areas drawing water from the Murrumbidgee River (by far the largest areas in New South Wales) has been so successful over the years that the demand for water continues to increase. The Murrumbidgee Valley Water User's Association has taken the lead in coordinating and assessing the water needs to ensure ongoing development of the area. In this regard they maintain close liaison with the Water Commission and local government authorities.

The irrigation benefits directly associated with Lake Mejum are many and diverse. By diverting into Lake Mejum water which would not otherwise be used, more irrigation water is available in the whole system. This in turn has a variety of benefits. For existing irrigators it could enable them to increase the output of their current enterprises and it provides security in making the decision to intensify. The availability of water at critical stages of the crop's growth is all important in achieving the potential yield; if supply is not available when needed much of the other expenditure on the crop is less effective than it could be and income is significantly less. Since all other costs of production have been covered and the infrastructural support is already in existence, the availability of water at the margin of production can be the most profitable. By securing this availability decisions can be made not only to increase overall production by planting a larger area but also the quality and efficiency of water utilisation on the farm is enhanced so that each hectare will produce more (Appendix 2, Table 4 [Assessment of Water Use Efficiency in Irrigation, WRC Report, November 1983, Annex 3]).

Another benefit arising from additional water is the potential to expand the area which can be irrigated. At this stage it is unnecessary to forecast exact allocations to individual water users since there is already a demand considerably in excess of the extra water which will be available. Appendix 3 sets out in some detail the various localities and industries which have expressed dissatisfaction with their present low allocations or their need for additional water supplies and areas currently inadequately served which could be profitably expanded if water were available. The demand for the increased supplies is well documented and since allocation decisions will be difficult, it is inappropriate to consider these details until the scheme is under way, as long as decision-makers are sure that adequate demand exists. This question is not in doubt.

2.2 Water Management

Additional benefits arise from improvements in water management. En route water storages, that is those in addition to the major headwater storages of Burrinjuck and Blowering (Berembed, Yanco, Googelderie, Maude and Redbank Weirs and Tom Bullen storage) significantly improve the system's capability to deliver water as required to irrigators. Lake Mejum, with its large storage capacity and outlet channel, could provide water close at hand for quick release to the MIA, CIA and downstream private pumpers in localities such as Narrandera, Darlington Point, Yanco Creek, Carrathool, Hay, Maude and Balranald.

2.3 Water Use and Value

In order to calculate the financial benefits arising from the increased supply of available water, it is necessary to consider the use to which the water may be put. In recent years the WRC has received from a variety of water user groups (Ricegrowers Association, Riverina Coarse Grain Association, Murrumbidgee Valley Licensed Pumper's Association) requests for both additional water and a greater surety of supply to existing irrigators. It is this pressure for supplies which is now the main motivating force for the construction of the storage. With the increased demand, the Commission has introduced a system of volumetric allocations for different users. Thus the licensed pumpers have been allocated 6 Ml per hectare whereas they have requested 9 Ml per hectare. Without considering the justification for competing claims, it need only be pointed out that currently licences to licensed pumpers cover 104 000 hectares and even to provide the requested increase in allocation from 6 to 9 Ml for this area would require more than the total regulated flow estimated to become available from Lake Mejum (see Appendix 1).

With regard to the value of water, Appendix 2 sets out details of "high" (the top few percent) and "low" efficiency irrigated farms in the Murrumbidgee Valley. It also calculates gross margins per hectare and per Ml for typical enterprises - calrose rice, maize, wheat and sheep. The figures indicate the importance of 'high' water availability and the influence this has on the ultimate value of water. The tables indicate also the variability of value between enterprises and the standard of efficiency. There is no such thing as a 'typical' farm and hence the weighting to be put on the various factors is a matter of judgement. Further study would enable a more accurate estimation of water value in different categories but it is suggested that for this exercise a figure of $20.00 per Ml is appropriate. This approximates the figure of $18.80 used by the WRC in its 1980 study.

3. BENEFITS FROM RECREATION

There is no doubt that the Australian population, whenever given a choice of recreational locations, prefers a water-based situation.

By far the greater proportion of urban based populations have access to good beaches which have made a marked contribution to the Australian character. For the vast number of Australians living inland where the attraction of the sea is not available, the limited water based resorts have been the undoubted attraction, not only for families as camping and picnic sites for weekend or holiday outings, but also for the increasing proportion of Australia's population represented by the younger age groups, adolescents and young adults, who pursue whenever possible outdoor recreational pursuits oriented to enjoyment of water based recreation.

In the inland areas of New South Wales, there are understandably very few permanent lakes which can be patronised for recreation but those that do exist are well utilised and those nearer the major centres of population are considered to be fully utilised, for example Lake Talbot at Narrandera, Lake Albert at Wagga Wagga and Lake Wyangan at Griffith. Water Commission storages further removed from the inland population such as Lake Wyangala and Lake Blowering are becoming popular. On the Murray, the storages at Lake Hume and Lake Mulwala, which are shared with Victoria are utilised more by the higher densities of population represented in that State and have long been major tourist attractions. In inland Victoria, the Water Commission storages such as Lake Eildon and Lake Eppalock are not only drawcards for the rural population but also attract large numbers of metropolitan users who prefer the environment and the advantages of freshwater storages.

It seems that the popularity of inland water storages need not be laboured, since it is universally accepted that their appeal is to all groups and all ages. A previous study of Lake Mejum estimated a long term yearly figure of approximately 200 000 visits for recreation. This study supports this estimate, which is comparable to a Victorian storage such as Lake Eppalock which caters for up to 7000 visitors per day.

From a national viewpoint, the population of the inland has far fewer recreational opportunities than is available to those living on the coast or in the major urban centres. Since the Lake Mejum Scheme has the potential to provide recreational facilities for a section of the population which is currently severely disadvantaged in this area, it appears appropriate that as part of a national program, due attention should be given to these recreational benefits.

Map 4 shows the main centres of population within recreational driving distance of Lake Mejum. Population within 50 miles is 56 250 with Narrandera 7650, Leeton 11 300 and Griffith 21 350 being the main centres. Within 100 miles but excluding Victoria 6/ the population is 228 850.

6/ A survey of the Tourist Industry in the Riverina Region of NSW, G A Lawrence, Riverina College of Advanced Education, 1976. Victorian visitors (normal residence x destination) equalled both Sydney and other NSW visitors, hence must be given some weight.

However, this includes Albury and Corowa which are served by excellent facilities for water-based recreation at Lake Hume and Lake Mulwala. Burrinjuck, Blowering and Lake Cargelligo are all outside the 100 mile radius. It seems therefore that the Riverina is Australia's largest concentration of population without a convenient water-based recreation location despite the fact that it is drained by one of the biggest and most reliable rivers in the nation. The new lake will be about 8 kilometres from Narrandera and 12 kilometres from Leeton and hence is in an ideal location to serve these areas.

A number of methodologies are used to try and quantify the value of recreational benefits. Two typical techniques have been to estimate the cost which a person is prepared to incur in travelling to the resort and allocate this cost as a benefit of the resort itself. The alternative method has been to estimate the expenditure which a user is prepared to incur on water based recreational equipment, eg. boat, sailboard, fishing gear, swimming gear etc, and to equate this total expenditure with the benefit attributable to the recreational resort. Despite the justification which can be argued for these methods of estimating the dollar value of resources, we are aware that the methods of evaluation are far from ideal even though the best or most practicable available (see Appendix 5). Using these methods a figure of $7.50 per visit is estimated.

In 1979, a Recreation Tourist Study 7/ of Lake Mejum involving a questionnaire and interview technique approach was undertaken to quantify the demand for these facilities. The questionnaire was designed to generate source data on the expected benefits of recreation/tourism. It was distributed to Aquatic Clubs, Local Government Authorities and Chambers of Commerce in the towns of Narrandera, Griffith, Leeton and Wagga. Analysis of data provided by responses to the questionnaires enabled an aggregated recreational benefit in monetary terms to be derived. The recreational benefits include sailing, powerboating, water skiing, canoeing, fishing, swimming, as well as passive recreational pursuits such as camping, picnicking and bird watching.

Benefits would accrue not only to residents of Narrandera and regional sporting bodies but also to tourists who would seek to utilise the recreation and accommodation facilities which will follow once the tourist potential of the Scheme is recognised.

Widespread community participation has expressed the need to plan and incorporate into the design of the scheme full recreational facilities.

Previous studies of both the Riverina Area and other major storages clearly indicate a dual requirement to satisfy visitors. Firstly there must be good access to a number of areas from which water based activities can be conducted and secondly there must be an extensive opportunity for passive enjoyment both by restfully observing the water and by a scenic drive which will encompass a variety of water aspects.

7/ Water Resources Commission Lake Mejum Storage Proposal, P.11-12.

The present plan caters for two major access areas for water based sports and activities. A preliminary survey indicates that the contour of the sites will allow vehicle access, good viewing of the basic 50 000 Ml water storage and adequate access to water without long travel over "mud flats". These sites also have adequate room to develop tourist facilities, caravan parks etc. as the need develops. The environmental studies now due to be undertaken will survey these sites in detail to determine their suitability for recreation. Points for consideration could include: impact on recreation of steep shore resulting from substantial variations in levels; provision and suitability of areas for swimming, boating etc; usage of foreshore land for various purposes and the relationship bewteen water area and shoreline with recreation supply standards. Soil studies should determine the dispersive nature of the soils at the selected sites to indicate whether the clay and sand fractions will separate out to provide a measure of sandy beaches or whether other improvements such as sand transportation would be desirable to raise the facilities to an acceptable level.

To cater for the likely demands of a scenic drive the location is ideally suited to combine the attractiveness of the deeper water of the major storage in Lake Coolah with the shallow water wildlife reserve area of Lake Mejum. The drive from Narrandera now proceeds through a Murray Pine forest for several kilometres which then thins out to a very pleasant Murray Pine savannah extending onto the sand ridge separating Lake Coolah from Mejum Swamp. Altogether it is a most attractive environment which with little expense can be made quite unique as regards scenic attraction. The situation of lakes and proposed embankments would facilitate a scenic drive adjacent to the water side and encircling both bodies of water so that a figure-eight route would enable the visitor to enjoy the varied aspects of water and wildlife scenery. Appropriate tree, shrub and grass plantings will over time develop the scenic attractiveness of this diverse area and bring together in close approximation the unique attraction of Riverina waters - the still water with its red gum dominant vegetation and the fluctuating reedy shallows so suitable for wildfowl habitat.

The Mejum Swamp is considered somewhat unique in that it is a river redgum swamp not associated with a river or creek and this in turn provides excellent waterbird habitat, providing both breeding and feeding areas and overall, considered a most valuable regional wetland area.

Another survey 8/ of the tourist industry in the Riverina concluded that the 'scenery/countryside' was the feature most enjoyed by visitors, 21 percent compared with 'tourist attractions' at 7 percent. A feature of the survey was the absence of any single feature in the Riverina to which tourists could specifically relate despite the Riverina's overall tourist attraction. This absence is an important reason for the region's lack of appeal when compared with other regions of the state. This survey concludes "Just as water is a scarce resouce in the Riverina for farming activities, it is also a scarce resource for recreational and tourist activities. In the United States a great number of inland lakes have been developed as multipurpose recreational/tourist attractions as well as for the provision

---

8/ A Survey of the Tourist Industry in the Riverina Region of NSW, G A Lawrence, Riverina College of Advanced Education, 1976.

of irrigation water. This sort of development could be achieved in both the Tumut and Narrandera areas". It is also recommended "...that developments begin on Lake Blowering as soon as possible, that plans be made for large areas of Lake Mejum (when constructed) to be used for recreational/holiday purposes.....The Griffith/Leeton area is destined for increased tourist activity in future years if present trends continue". There is every reason to support these recommendations and to conclude that the establishment of a major tourist feature such as the Lake Mejum Recreation and Wildlife Reserve would be the most efficient single investment to advance tourism in the Riverina and act as a drawcard to attract potential tourists from other areas of NSW and the ACT.

4. ENVIRONMENTAL BENEFITS

One of the disadvantages of earlier plans for a Lake Mejum Scheme was that by flooding the swamp a unique feature of the landscape would be destroyed. Previous environmental studies have shown that the Mejum Swamp provides an important regional habitat for waterbirds in respect of both feeding and breeding. The proposed scheme leaves Mejum Swamp in its original condition. One of the effects of irrigation in the Murrumbidgee Valley has been to cause a change to the wildlife habitat in billabongs associated with the river system. The Commission is investigating the feasibility and likely benefits of artificially prolonging flooding of the billabong system to create a flooding pattern more similar to the natural system which would have prevailed prior to regulation of flows in the Murrumbidgee River System. While Mejum swamp in its present condition provides excellent habitat for waterbirds it is possible this situation may be enhanced by a system of artificial flooding which would fit in well with the overall plan for the two interconnected water areas.

With regard to fish life, the New South Wales Inland Fisheries has expressed interest in stocking a water storage in the vicinity of its Research Station at Narrandera. It is anticipated that there will be no significant detrimental effects to other fauna.

The Minister has announced that an Environmental Impact Study will be conducted and the Commission has initiated work on relevant water quality aspects. Water quality data already gathered indicates that unless properly managed, the waters of the proposed storage could be potentially eutrophic and might result in undesirable environmental effects including algal blooms and fish kills. The Commission will undertake a water management program taking into account the likelihood of eutrophication.

If additional areas of shallow stagnant water and swampy ground are created as the storage area drains, these may provide potential breeding areas for arbo-viral disease carriers such as mosquitoes. However, it is planned that drains would be constructed to allow residual detached swampy ground to be drained towards the central retention recreational area. A pipe through the embankment separating Lake Coolah from Mejum Swamp would allow water depth to be controlled in Mejum Swamp and retain its value as a wildlife habitat.

5. QUALITY OF LIFE BENEFITS

Apart from the general improvement to quality of life by improving leisure opportunities County Council support arises primarily because of the prospective benefit and security which the scheme offers to town and rural water supplies. These requirements are expected to increase as population growth occurs and besides affording security in times of drought for the present population the scheme will enable planning for future population growth to proceed with confidence.

Indirectly the improved availability of water for river pumpers will assist in overcoming the conflict which presently exists between the Council and landholders in situations where the Council is desirous of establishing source bores for town supplies on lands adjacent to the river. Because the available surface waters are fully committed these landholders are unable to obtain pumping licenses to extract water from the river and are forced to employ underground resources to thus compete with town supplies which are drawn from these same resources.

The proposal would require acquisition of all or part of 10 properties. The Commission will either acquire landholdings on which viability has been lost or provide access to severed holdings which remain viable. Consideration is also being given to landholders' requests for access to the inlet-outlet canals for water supplies.

Inundated arterial roads would be relocated. It is not expected that the scheme will cause increased travelling distances or stock transportation costs or disrupt existing social contacts.

The Commission will engage an archaeologist to undertake a survey for Aboriginal artifacts in the area and will report any findings to the National Parks and Wildlife Service for a decision on the appropriate course of action.

6. REGIONAL BUSINESS AND EMPLOYMENT BENEFITS

Primary benefits arise owing to the stimulation to local commerce in the course of the construction of the new works. It is recognised that this is a relatively small and short term benefit but to the extent that a significant part of construction costs remain in the immediate area, they are a benefit to local towns. The significant benefit to business and employment however is the flow on from the irrigation, recreation and tourist development which the storage makes possible.

The Murrumbidgee Irrigation Area, with its towns of Griffith and Leeton, is one of the prime examples in Australia of how a wisely planned and well developed irrigation system has without doubt created widespread employment opportunities and is a practical example of efficient decentralisation. The success of the area and the large population which it supports is the best argument which can be put forward to support further development. Without the job opportunities which will be created by further irrigation development, there will be increased demands for welfare payments.

Although it is accepted that the prime beneficiaries are the irrigation farmers who sell the increased produce, the flow-on or multiplier effect must also be considered. Associated with irrigation are the industries supplying farm inputs; machinery, chemicals, services etc. which are an integral and essential component of production and a significant employer. Associated with recreation and development (in addition to the direct benefits of accommodation, food etc.) are the indirect benefits flowing to outlets such as cafes and milk bars, garages and service stations, taxis, aircraft maintenance, boat builders, sports goods and camping equipment, travel agencies, bus services, museum galleries, sporting and social clubs etc.

Some economists do not count any multiplier benefits while others calculate a factor by which primary benefits are adjusted. In the WRC Study of 1980 a multiplier benefit of 1.2 was allocated to irrigation and 1.4 to recreation and tourism when assessing the regional impact of the scheme. In the study "The Role of Tourism and Recreation in the Albury/Wodonga Growth Centre", carried out by PA Management Consultants for the Department of Tourism and Recreation in 1974, an extensive survey was carried out to estimate the multiplier effect in a comparable environment. It was concluded (page 295) that "for each dollar spent by tourists in hotels or motels in Albury/Wodonga, 36 percent generates secondary spending in Melbourne or Sydney; for each dollar spent in these establishments in the total area studied 44 percent leaks out of the area immediately. Since there are other leakages as well (taxes, savings, secondary spending on goods and services from outside the area) the tourist multiplier is probably of quite modest magnitude, say between 1.2 and 1.4". It is beyond the scope of this present report to carry out the detailed investigation necessary to come up with a more accurate figure. Since the WRC report has already decided to use multipliers of 1.2 and 1.4 for Lake Mejum for assessment of regional impact these figures are accepted until further information with more local content becomes available.

7. ECONOMIC ANALYSIS

Because it is relatively easy to assign a dollar value to the benefits which arise from irrigation it has become accepted practice for potential irrigation investment to be subjected to cost benefit or net present benefit analysis. It is a straight forward exercise to identify project costs (land acquisition, road reconstruction, engineering works etc.) and then estimate the extra benefits that are expected to be generated by the application of additional irrigation. Because costs are incurred early in the project's life and benefits arise later it is necessary to apply an appropriate rate of interest to the cash flow of each year. The real interest rate which equates present value of costs with benefits is defined as the internal rate of return.

For recreation it is far more difficult to assign a dollar value to benefits. However, in order to assist in decision making it has become accepted that wherever possible estimates of monetary values should be made even for benefits which would not normally be expressed in dollar terms. The available methodologies in the bases for these calculations have been dealt with in their appropriate sections.

It is assumed that the benefits, though of differing origins, will be stable once the construction period is over. Benefits are summarised as:

-	Irrigation	208 000 Ml per year @ $20.00 = $4 160 000
-	Recreation	200 000 visits per year @ $7.50 = $1 500 000
-	Regional Multiplier providing business and employment	(0.2 for irrigation and 0.4 for recreation) = $1 432 000
-	Total Yearly Benefit	= $7 092 000

With regard to capital costs these have been estimated (after making allowances for land acquisition, fencing, road construction, earthmoving and engineering works, recreational facilities) at $36 million. Annual costs are operation and maintenance, estimated at $275 000 and electricity for pumping estimated at $1.1 million per year (see Appendix 4 9/). There is thus an annual cost of $1.375 million which when deducted from the annual benefit leaves a net annual benefit of $5.717 million.

It is assumed that capital costs will be equally spread over a three year construction period and that no benefits will occur until construction is completed but thereafter will remain stable at the above figures. Using these assumptions the discounted present value of costs and benefits are equal (over a life of 30 years) if a discount rate of 13.5 percent is applied to both, ie. the financial rate of return is 13.5 percent.

9/ WRC estimates at December 1983.

To arrive at this figure a number of assumptions have been made and set out in the text and the appendices. However, some of these assumptions may be wrong and therefore it is wise to see how sensitive the profitability of the scheme is to some key assumptions. The fact that the scheme relies on electricity for pumping concerns many local people being aware of the very steep increases in electricity charges in recent years.

In the above calculations electricity charges have been escalated from a 1980 estimate of $620 000 to $1 100 000 (an increase of 77 percent compared will 31 percent in other costs). However, if electricity costs were again to take a major leap and increase by say, double the level of other costs half way through the estimated life of 30 years, what effect would this have? The return would reduce from 13.5 percent to 13 percent. On the other hand if the life of the capital works is considered to be 50 years not 30 years the original figure rises from 13.5 percent to 13.9 percent and with the electricity price doubling then the return would be 13.4 percent.

Another concern expressed is that if there is a severe drought, say 1 year in 15, the waters of Lake Coolah will be unavailable for recreation and hence, there would be no recreation benefit. This would reduce the benefit from 13.5 percent to 13.3 percent. However the loss of recreational benefits would to an extent be offset by the irrigation benefits derived from the water released.

APPENDIXES

1. VOLUMETRIC WATER ALLOCATION
2. CROP/ENTERPRISE GROSS MARGINS
3. POTENTIAL WATER USE
4. KEY TABLES - FEATURES AND COSTS OF THE SCHEME
5. EVALUATION OF RECREATIONAL BENEFITS

VOLUMETRIC WATER ALLOCATION - MURRUMBIDGEE VALLEY

		Ml/Year
1.	Fixed Commitments	280 000
2.	Losses	500 000
3.	Irrigation Commitments	
	(i) Permanent Plantings	157 000
	(ii) Licensed Irrigation	
	Other than Yanco, Colombo and Billabong Creeks System	385 000
	Yanco, Colombo and Billabong Creeks System	163 000
	(iii) Murrumbidgee Irrigation Areas and Associated Districts	1 059 000
	(iv) Coleambally Irrigation Area	620 000
	(v) Hay Irrigation Area and Gumly Irrigation District	8 000
	(v) Reserve for resolution of anomalies	50 000
4.	Unallocated Contingency Reserve	130 000
	TOTAL	3 362 000

KEY TABLES - FEATURES AND COSTS OF THE SCHEME

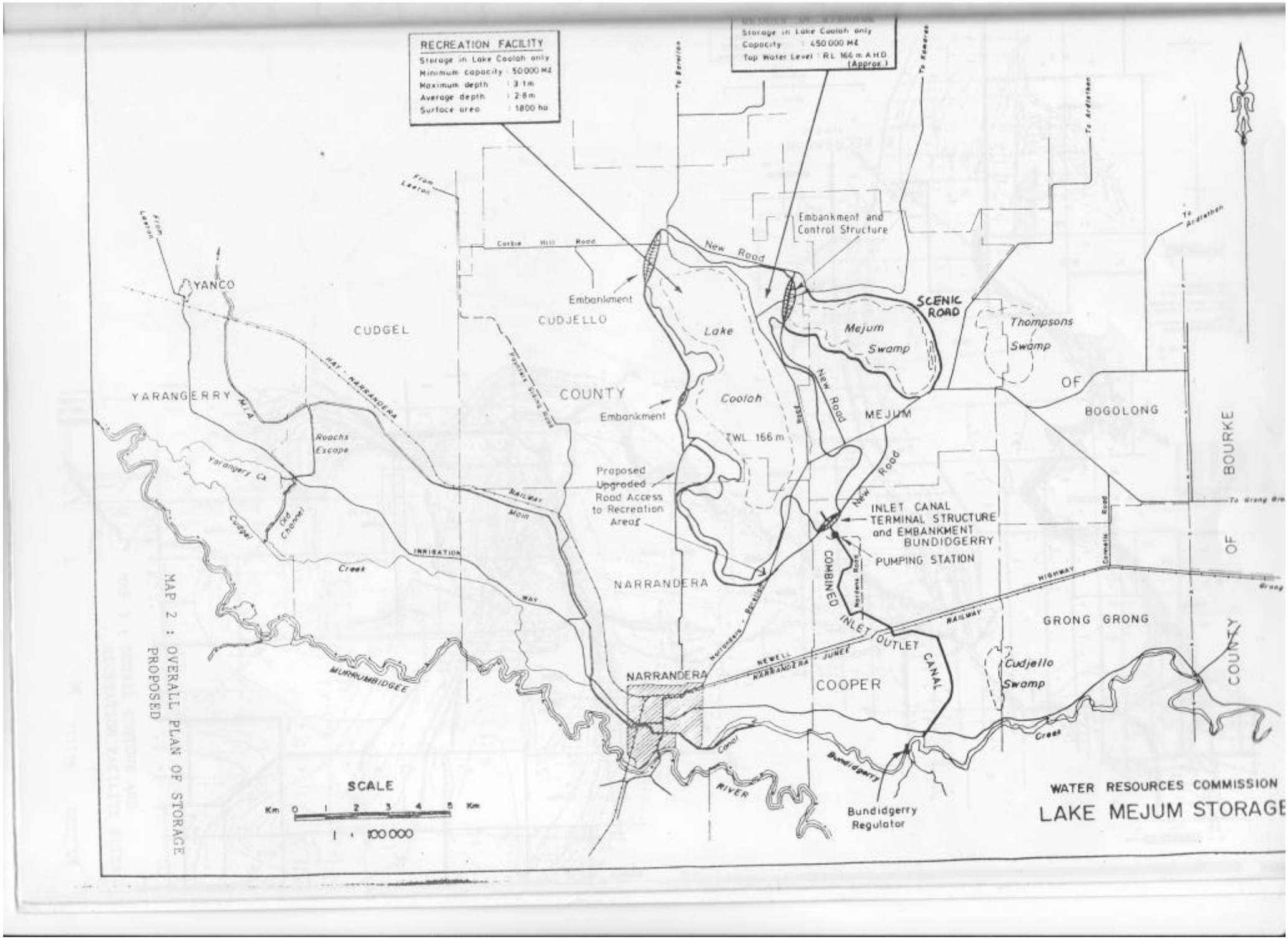
PHYSICAL DETAILS OF THE SCHEME

Capital Cost (December 1983 Money)	$35.8 million
Construction Time	3 years
Top Water Level (AHD)	166 m (approx.)
Storage Capacity - Lake Coolah	450 000 Ml 1/
Surface Area (at top water level)	3700 ha
Addition to Average Annual Supply (Yield)	208 000 Ml
Average Pumping Lift (metres)	18.2
Maximum Pumping Lift (metres)	21.8
Average Annual Electricity Energy Consumption (kilowatt-hours)	20.4 million
Peak Electrical Power Requirement (megawatts)	9.0
Combined Inlet/Outlet - Capacity	2800 Ml/day
- Length	9 km

Recreation Facility

Location	Lake Coolah
Minimum pool level (AHD)	153.20 m
Maximum pool level (AHD)	166 m (approx.)
Minimum Volume	50 000 Ml (min)
Minimum Surface Area	1800 ha
Maximum depth at minimum pool level	3.1 m
Average depth	2.8 m
Water Level Fluctuation	12.8 m

1/ Ml = megalitres = 1 000 000 litres = 0.8 ac. ft. (approx.)


RECREATION FACILITY
Storage in Lake Coolah only
Minimum capacity : 50000 ML
Maximum depth : 3·1 m
Average depth : 2·8 m
Surface area : 1800 ha
Storage in Lake Coolah only
Capacity : 450 000 ML
Top Water Level : RL 166 m AHD (Approx.)
To Barellan
To Kamarah
To Ardlethan
From Leeton
Corbie Hill Road
New Road
Embankment and Control Structure
Embankment
YANCO
CUDGEL
CUDJELLO
Lake
Coolah
Mejum Swamp
SCENIC ROAD
Thompsons Swamp
COUNTY
OF
BOGOLONG
MEJUM
BOURKE
YARANGERRY N.P.A.
HAY - NARRANDERA
Roachs Escape
Yarangery Ck
Old Channel
Cudgel
Creek
Embankment
TWL 166 m
Proposed Upgraded Road Access to Recreation Areas
RAILWAY
Main
IRRIGATION
WAY
INLET CANAL TERMINAL STRUCTURE and EMBANKMENT
BUNDIDGERRY
PUMPING STATION
COMBINED INLET OUTLET CANAL
HIGHWAY
Grong Grong
NARRANDERA
NEWELL
NARRANDERA - JUNEE
COOPER
Cudjello Swamp
GRONG GRONG
COUNTY
MURRUMBIDGEE
Canal
RIVER
Bundidgerry
Bundidgerry Regulator
SCALE
Km 0 1 2 3 4 5 Km
1 : 100 000
MAP 2 : OVERALL PLAN OF STORAGE PROPOSED
WATER RESOURCES COMMISSION
LAKE MEJUM STORAGE

2nd Copy
Copy

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

PROPOSED DAM

AT

MURRAY GATES

ON THE

MURRAY RIVER

1966

1a

SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

PROPOSED DAM

AT

MURRAY GATES

ON THE

MURRAY RIVER

1. Review of Preliminary Studies for a Dam at Murray Gates on the Murray River.

2. Estimated Monthly Flows at the Dam Site.

3. Residual Mass Curve.

.....

2b

FOR A DAM

AT MURRAY GATES ON THE MURRAY RIVER

1. Introduction

At the 38th Meeting of the Snowy Mountains Council held on the 8th February, 1966, the Authority was asked to inform Council on the practicability of its constructing a storage on the Indi or upper Murray River in relation to its obligations under Clause 5. (1.) (a) of the Snowy Mountains Agreement, which would, in addition, contain some provision for flood storage.

Council, at its 39th Meeting held on 11th May 1966, considered "Notes on Preliminary Investigations into a dam on the Murray River at Murray Gates" prepared by the Authority. Council then requested that the Authority continue its investigations in conjunction with other interested bodies after supplying such bodies with a full account of work carried out to date. The following report has been prepared to meet this requirement.

2. Historical Aspects

Clause 5 of the First Schedule of the Snowy Mountains Hydro-electric Power Act states as follows:-

"5.(1.) After completion of works of the Authority which provide for the diversion of approximately 730,000 acre feet of water annually from the Snowy River to the River Murray catchment, the Authority shall, at its option -

(a) for the purpose of regulating the diverted water before it enters the Hume Reservoir, provide, as soon as practicable, between the Hume Reservoir and the point where the diverted water is discharged from the works of the Authority (other than the works constructed pursuant to this sub-clause and sub-clause (2) of this clause) into a stream feeding or joining the River Murray, a balancing storage work for the storage of not less than 250,000 acre feet of water; or

(b) within five years after the completion of that diversion contribute to the River Murray Commission an amount equal to one half the cost of increasing the capacity of the Hume Reservoir from 2,000,000 to 2,500,000 acre feet of water".

.../2

at a cost understood to be about $8 million, but the Authority's option to contribute one half of the cost of this work or to construct a separate storage, remains. Construction of a storage on the upper Murray by the Authority would not satisfy the requirements of Clause 5.(1.)(a) and if such a storage were contemplated, an amendment to the Commonwealth-States Agreement would appear to be necessary.

3. The Functions of Any Dam Provided

The function of any dam required to meet Clause 5.(1.)(a) is to provide additional storage to enable further regulation of discharges from the Snowy-Murray Development to be achieved. To be strictly in accord with the Act, such a dam should be located between Khancoban and Hume Reservoir. However, a dam provided upstream of where the Snowy-Murray flow enters the Murray River, i.e. at its junction with the Swampy Plains River, could fulfill the same function provided that the dam is large enough and that the inflow at the damsite is adequate to enable the same increase in regulated flow to be achieved. Any such dam provided could, in addition, fulfill other functions such as flood storage or power generation.

4. Location of Dam Site

The most favourable site on the Murray River for a dam with a large storage capacity located upstream of the junction of the Murray River and the Swampy Plain River is at a site known as "Murray Gates" (see Fig. 1.).

5. Characteristics of the Dam Site and Catchment

At the Murray Gates site the river passes through a prominent ridge of metamorphic rocks and flows in a steep V shaped gorge which appears topographically suitable for a dam up to 600 or 700 feet in height. Upstream from the damsite, the valley opens out considerably to provide a good storage basin. Only limited information is available for the site and no recent visit or geological mapping has been made. Survey information is also limited and the plans used for investigation were enlarged from 4" to 1 mile sheets. Other information was obtained from aerial photos and general geological mapping of the area. Fig. 2 shows capacity and surface area curves for the dam site.

The catchment area is 410 sq. miles and the estimated average annual flow of the Murray River at the dam site is 360,000 acre feet. (Note: An earlier

.../3

estimate given in "Notes on Preliminary Investigations into a Dam on the Murray River at Murray Gates" prepared for the Snowy Mountains Council was 330,000 acre feet).

The nearest gauging stations with long periods of record are located at Tom Groggin, approximately 6 miles upstream and at Biggara approximately 15 miles downstream. The run-off pattern is similar to others in the Snowy Mountains Area with a pronounced snow melt influence in the months July to October.

No regulation studies have been made and the storage required will depend upon the method of operation e.g. it might be that the inflow will be stored for several years and released only during periods of low flow from other parts of the catchment above the Hume Reservoir. However, with an inflow of 360,000 acre feet it is unlikely that a storage in excess of 1,000,000 acre feet would be required to achieve close to 100% regulation. Should a dam be constructed at Murray Gates, flood storage might also be provided.

In the preliminary studies into the required spillway capacity a 2-day probable maximum flood was used. This flood had a peak of 140,000 cusecs and a flood volume of 310,000 acre feet. More detailed studies might show that with larger capacity dams longer duration storms would be more critical.

6. Types of Dams Considered

In view of the apparently favourable nature of the damsite and its low width to height ratio, concrete arch and gravity dams were investigated as well as earth and rockfill embankments. Layouts for the arch dams were based on preliminary design curves for a thick arch and no refinement of design for a thinner arch was attempted. Spillway arrangements for the arch dams were assumed to consist of orifice type openings within the dam controlled by vertical lift gates. To keep the size of openings required to a minimum the top water level was taken to be the same as for the ungated chute spillways which were adopted for the earth and rockfill alternatives. For the gravity dam, crest gates were assumed. The adopted size of these gates gave a lower top water level for the gravity dam than for the other types considered. No attempt was made to optimise the various spillways.

For the earth and rockfill alternatives, it was considered desirable that gated spillways should be avoided in view of the remoteness of the site. In more detailed studies the use of automatic gates might be considered. Since it was

.../4

recognized that side chute spillways with their crest located as an extension to the crest of the dam involved considerable excavation quantities, both side channel and glory hole alternatives were also investigated.

Full supply levels of 250, 350 and 450 feet above river bed level (assumed to be R.L. 1500) were examined. The corresponding storages and surface areas at full supply level are listed below.

F.S.L.		Storage Ac.Ft.	Surface Area (acres)
Ht. above bed level	Approx. R.L.		
250	1750	147,000	2,080
350	1850	470,000	4,440
450	1950	1,060,000	7,320

Considerable routing effect was obtained with the uncontrolled spillways for the higher dams as shown in the following Table. While a side channel or glory hole might be a workable solution for the higher dams, the cost would not be significantly different to chute spillways and therefore for this preliminary study, chute spillways were adopted for all heights of dam. However, the lack of significant routing effect for the lowest dam coupled with the steepness of the valley sides makes any spillway solution for this dam difficult and very expensive. The lowest earth and rockfill dam necessitated a spillway on each side of the valley.

Results of Flood Routings at Murray Gates

Type of Dam	Height to F.S.L.	Spillway Type & Size	Top Water Level	Peak Discharge (cusecs)	Flood Surcharge (feet)
Gravity	250'	Gated 3/50' x 35'	1755.5	143,000	5.5
	350'	" " "	1854.7	139,000	4.7
	450'	" " "	1954.1	136,000	4.1
Earth & Rockfill (T.W.L.also adopted for arch)	250'	Ungated 150'	1783.6	108,000	33.6
	250'	" 200'	1779.2	117,000	29.2 *
	350'	" 150'	1876.7	77,000	26.7
	350'	" 200'	1874.1	87,000	24.1 *
	450'	" 150'	1971.50	55,000	21.50 *
	450'	" 200'	1969.7	65,000	19.7

* Layout adopted for economic studies. Approximately 6.0 feet of freeboard allowed to crest level in each case.

Fig. 3 shows the adopted arrangement of the 350' high earth and rockfill dam.

.../5

7. Costs

Preliminary cost estimates were made for each type and height of dam. It was assumed that foundation conditions would be good and only normal stripping would be required. In the case of the earth and rockfill dams it was assumed that the bulk of the material excavated from the spillway would be utilized in the dam; any additional rockfill required would be obtained from a quarry established locally while material for the core would be obtained from the river flats upstream of the dam. The costs include provision for diversion works and land resumption.

The first part of the following table shows comparative prime costs for the alternatives considered. It is noted that for each height of dam the earth and rockfill dams offer the cheapest solution.

The second part of the table shows the derivation of the capital costs for an earth and rockfill dam for each height considered. An allowance for unestimated items has been included in the prime costs.

Summary of Costs

(i) Prime Costs of Alternatives Considered

Type of Dam	Earth and Rockfill	Concrete Gravity	Thick Arch
Type of Spillway	Ungated side Chute	Gated Overfall	Gated Orifice through arch.
Full Supply Level			
1750	$10,200,000	$11,500,000	$14,800,000
1850	13,900,000	24,400,000	27,500,000
1950	20,100,000	Not estimated but would obviously be more expensive than earth and rockfill alternative.	
2025	27,400,000	"	"

(ii) Capital Cost of Cheapest Alternatives (Earth and Rockfill in each case)

Bed Level	1500	1500	1500	1500
Full Supply Level	1750	1850	1950	2025
Crest Level	1785	1880	1977	2050
Height of Dam (ft)	285	380	477	550
Prime Cost	$10,200,000	$13,900,000	$20,100,000	$27,400,000
Add 12½% Overheads	1,300,000	1,700,000	2,500,000	3,400,000
Add 10% Invest. Design & Super.	1,000,000	1,400,000	2,000,000	2,800,000
Total Capital Cost	$12,500,000	$17,000,000	$24,600,000	$33,600,000
Storage (ac.ft.)	147,000	470,000	1,060,000	1,690,000
Cost per ac.ft.	$85.2	$36.3	$23.2	$19.9

.../6

These figures were the ones quoted to the Snowy Mountains Council and it will be noted that they do not include interest during construction. If interest during construction were added, the capital cost would be increased by about 12½%. A curve showing cost versus capacity is shown on Fig. 4.

8. Power Development

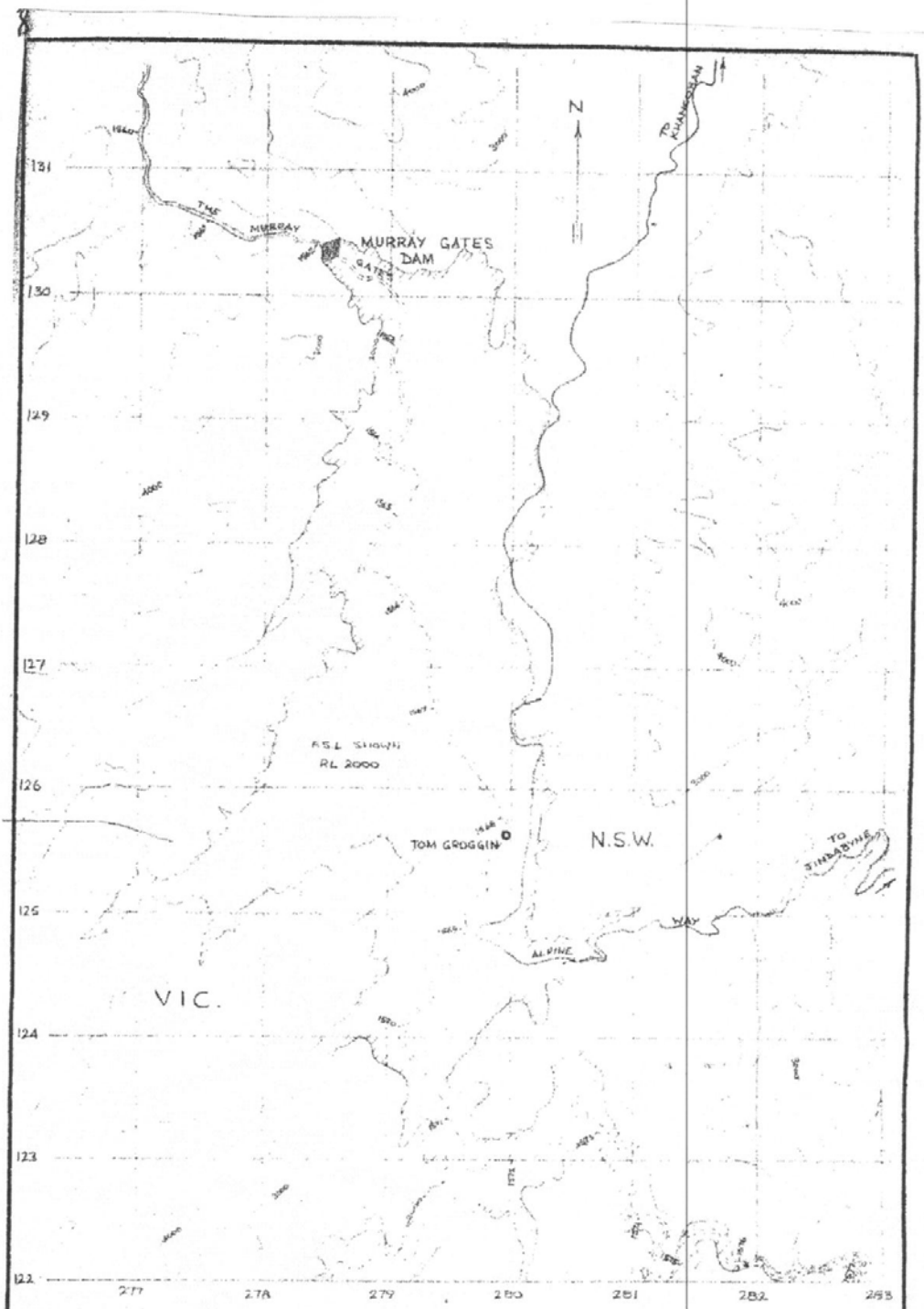
No study has been made of a power development associated with a dam at Murray Gates but the following points are pertinent to any such development.

In order to minimise flooding downstream of the power station, some form of re-regulating pondage would be required. At the same time, if the main function of the dam is for irrigation purposes, there would be many months, (and even years depending on the mode of operation) when releases from the dam would be virtually zero. To firm up any power development it would therefore be necessary to provide pumping facilities. In other words, any power development would be essentially a pumped storage scheme but with additional energy produced from local inflow.

During the operating cycle of the reservoir there will be many periods when the water in the reservoir will be at or near minimum operating level and hence, to provide a reasonable head for power generation at all times, it would be necessary to provide a substantial dead storage. To provide a power scheme which would be economically attractive it would probably be necessary to fix the MOL at 300 to 400 feet above river bed level. Thus, if an active storage of 750,000 acre feet is required, together with a flood storage of, say, 50,000 acre feet above an MOL 400 feet (R.L. 1900) above river bed, a storage capacity of about 1,525,000 acre feet would be required. This would require a full supply level of about R.L. 2010 or a dam height of about 540 feet.

.....

JULY 1966.

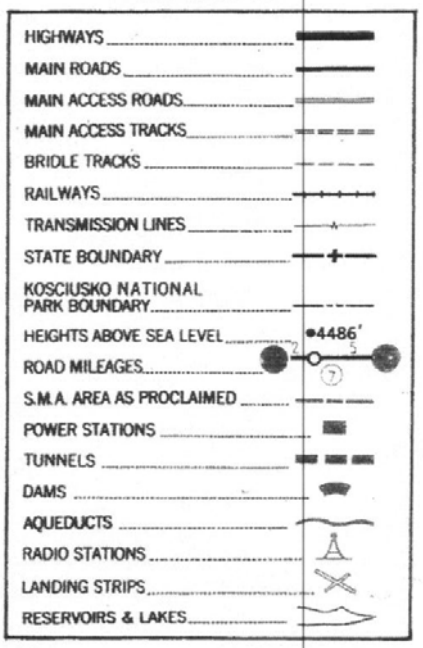


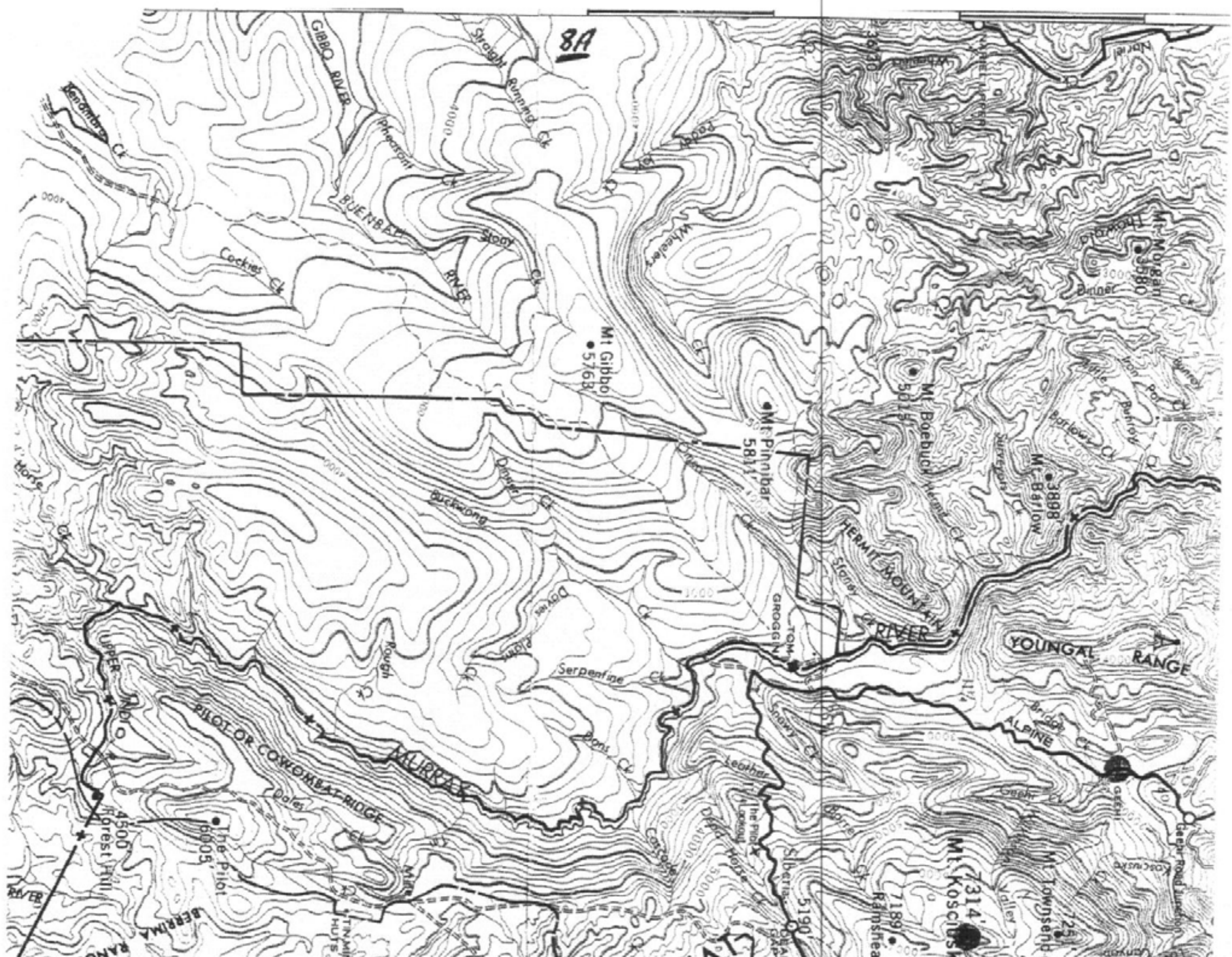
SEE 8a AND 8b + PLACE SIDE BY SIDE

FIG 1

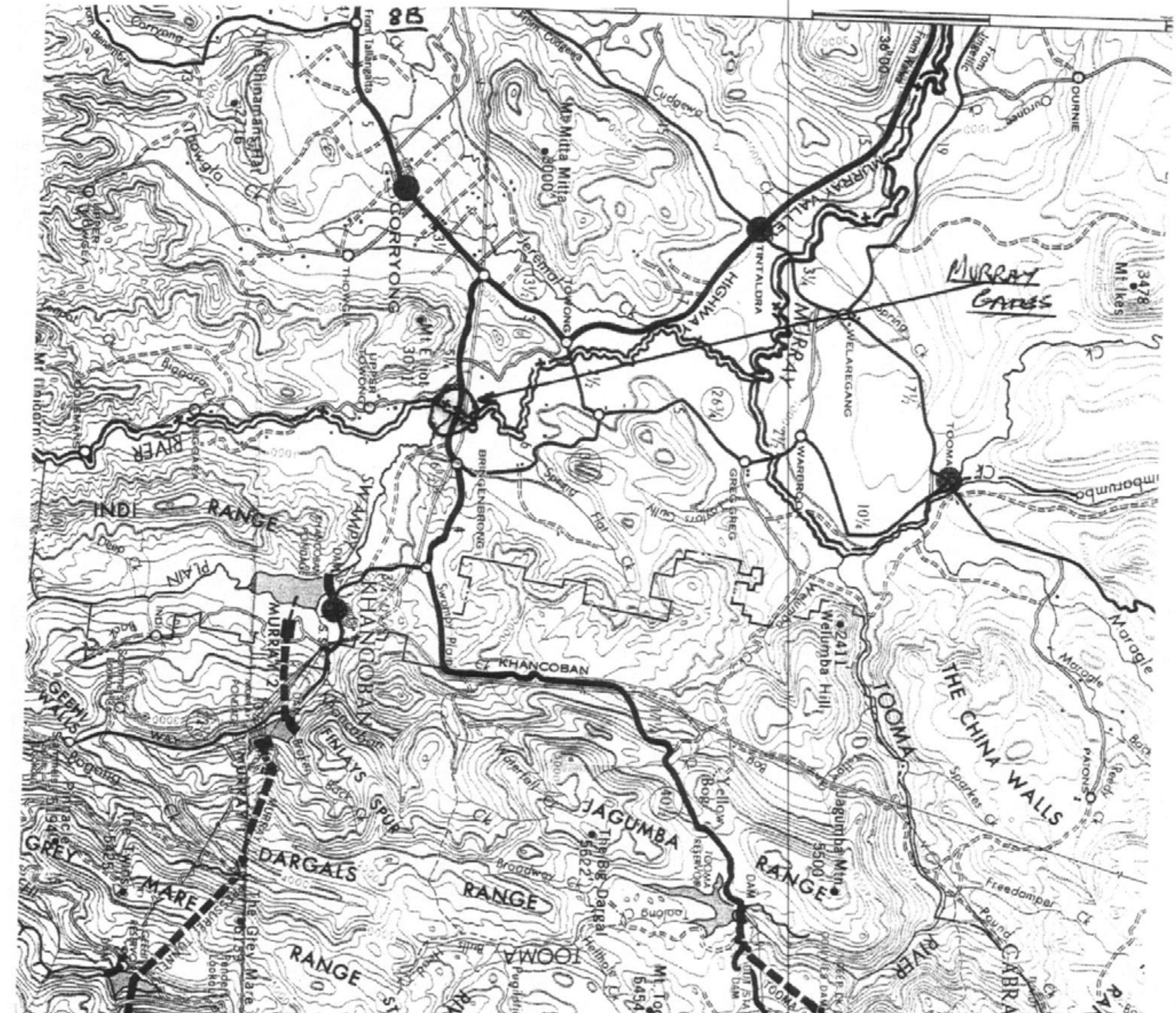
DEVELOPMENT DIVISION		SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY		
DRAWN C.M.	SUBMITTED	MURRAY GATES DAM		
TRACED	RECOMMENDED	LOCALITY PLAN		
CHECKED	APPROVED	COOMA	JULY 1966	PI/G/92

LEGEND


HIGHWAYS
MAIN ROADS
MAIN ACCESS ROADS
MAIN ACCESS TRACKS
BRIDLE TRACKS
RAILWAYS
TRANSMISSION LINES
STATE BOUNDARY
KOSCIUSKO NATIONAL PARK BOUNDARY
HEIGHTS ABOVE SEA LEVEL
•4486'
ROAD MILEAGES
S.M.A. AREA AS PROCLAIMED
POWER STATIONS
TUNNELS
DAMS
AQUEDUCTS
RADIO STATIONS
LANDING STRIPS
RESERVOIRS & LAKES



8A
GIBBO RIVER
BUENBA RIVER
Cockies Ck
Stony Ck
Mt Gibbo 5768
Mt Pinnibar 5811
Buckwong
Serpentine Ck
Dora Dora
Tom Groggin
HERMIT MOUNTAIN
Mt Bogong
Mt Morgan
Mt Barlow 3888
YOUNGAL RANGE
ALPINE WAY
RIVER
MURRAY
UPPER
PILOT OR COWOMBAT RIDGE
The Pilot 6005
Forrest Hill 4500
BERRIMA RANGE
INGEEGOODBEE
SUGGAN BUGGAN RANGE
CHARCOAL RANGE
Bills Garden
TONGARO RIVER
BARRY WAY
GREAT
CHIMNEYS RIDGE
Mt Stony 5875
Thatchers Mtn 4500
Dead Horse Gap 5190
THREDBO VILLAGE
Crackenback
Ramshead 7189
Mt Kosciusko 7314'
Mt Townsend 7251
Carruthers 7042
THE SNOWY MOUNTAINS
THE RAMSHEAD
CRACKENBACK 6318
The Porcupine
PERISHER VILLAGE
THE SMIGGIN HOLES
RANGE
ROAD
HOTEL KOSCIUSKO
LITTLE THREDBO RIVER
MOWAMBA
MOONBAH
Lake Jillamatong
Round Hill 4141'
JINDABYNE
SNOWY RIVER
Ingebyra
Sheep Station Ck
Little Back Swamp
Steel's Ck
Black
Pot Hole Ck
Gadan Hatcher


8B
MURRAY GATES
CORRYONG
TOWONG
KHANCOBAN
INDI RANGE
SWAMPY PLAIN
MURRAY 2
FINLAYS SPUR
JAGUMBA RANGE
DARGALS RANGE
GREY MARE RANGE
STRUMBO RANGE
TOOMA
THE CHINA WALLS
CABRAMURRA
KIANDRA
TUMUT
TOOLONG RANGE
THE KERRIES
DIVIDING
MUNYANG
GUNGARLIN
SNOWY
TUNNEL
ISLAND BEND
Tabletop Mtn.
Kings Cross
TANTANGARA

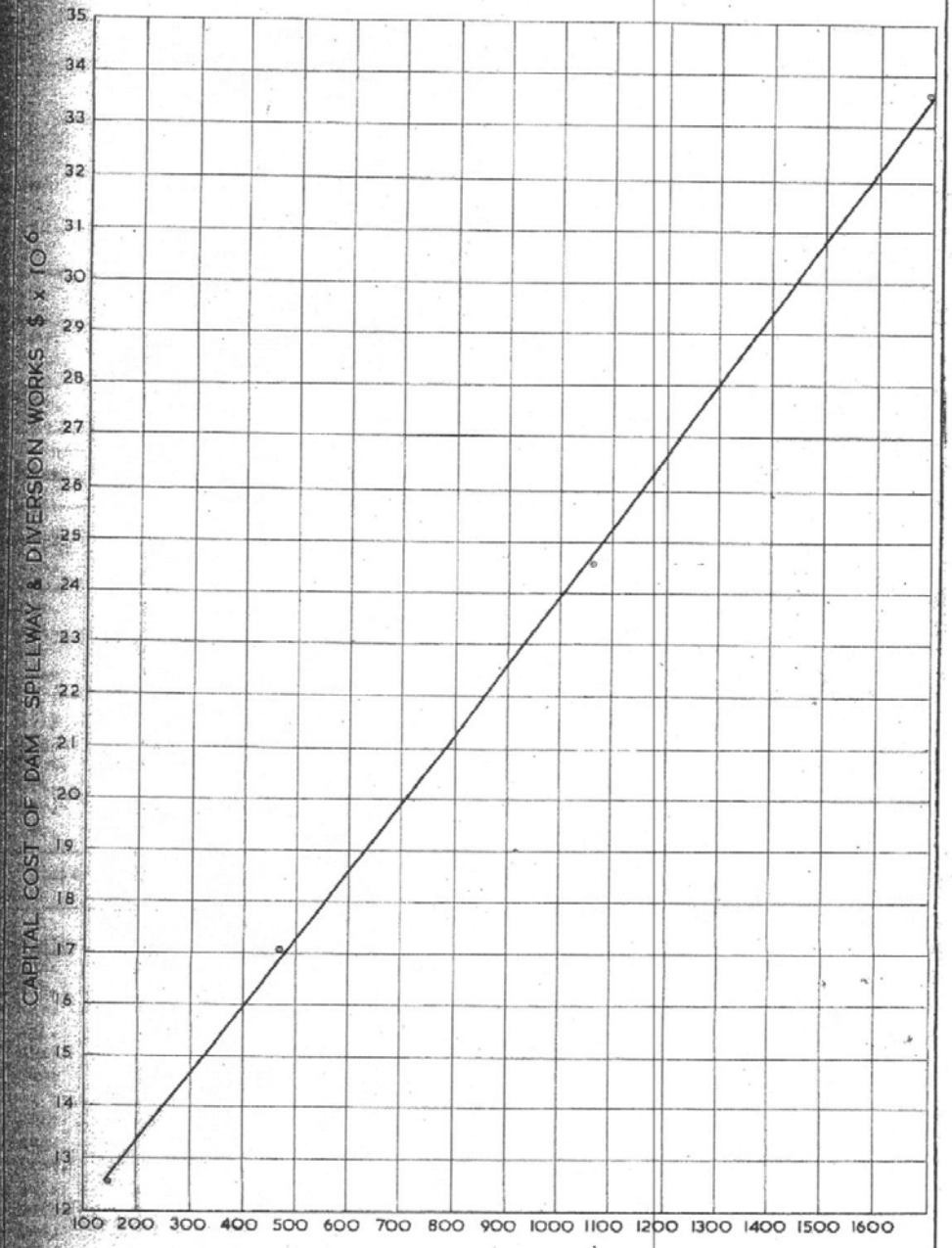


FIG 4

DEVELOPMENT DIVISION		SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY	
DRAWN C.M.	SUBMITTED	MURRAY GATES DAM COST CURVE FOR EARTH & ROCKFILL DAMS WITH SIDE CHUTE SPILLWAYS	
TRACED A.D.	RECOMMENDED		
CHECKED	APPROVED	COOMA N.S.W. JUNE 1966	DRG. No. P1/G/87A

Snowy Mountains Hydro-electric Authority

MONTHLY RUN-OFF OF THE MURRAY RIVER AT MURRAY GATES
(A.R.M. 1562-1)

Monthly Run-off, thousands of acre feet

Month	1905	1906	1907	1908	1909	1910	1911	1912
Jan.	7.6	9.9	16.0	9.8	5.8	9.9	24.1	6.6
Feb.	4.9	4.0	10.2	8.9	5.3	3.6	19.2	3.7
Mar.	3.4	15.6	8.3	6.3	8.6	4.9	28.4	4.0
Apl.	4.8	19.6	9.7	3.9	11.4	4.5	14.0	4.1
May	7.9	32.3	14.5	12.0	23.9	5.3	15.4	4.0
June	21.6	55.8	15.7	14.2	75.3	11.8	36.5	7.4
July	71.2	66.8	16.6	19.6	41.0	19.3	48.5	20.3
Aug.	39.2	70.8	33.5	19.0	104.2	19.6	43.6	21.4
Sept.	39.1	92.0	34.3	45.0	53.2	58.8	36.0	67.0
Oct.	58.0	101.0	33.1	50.1	49.4	45.0	24.6	42.4
Nov.	54.5	51.1	30.6	24.9	24.4	32.3	17.2	26.9
Dec.	26.0	43.5	19.6	11.4	12.8	28.5	13.9	35.3
Totals	338.2	562.4	242.1	225.1	415.3	243.5	321.4	243.1

Month	1913	1914	1915	1916	1917	1918	1919	1920
Jan.	19.3	9.0	6.4	11.3	22.7	25.7	6.3	25.1
Feb.	6.6	4.4	1.1	8.7	15.0	19.6	6.2	10.3
Mar.	21.9	6.6	1.2	8.8	14.2	19.3	9.7	9.5
Apl.	12.0	9.7	1.3	7.5	16.0	15.4	9.3	8.6
May	23.0	15.2	9.3	8.8	34.4	39.6	15.2	11.0
June	26.2	11.2	23.3	18.4	87.8	46.2	24.1	30.5
July	23.0	16.6	46.5	64.1	110.0	53.3	19.9	70.3
Aug.	36.1	14.2	65.0	60.2	92.3	71.8	24.2	76.2
Sept.	41.6	18.0	69.8	69.0	141.5	67.3	36.9	74.2
Oct.	47.1	10.2	92.0	66.5	192.0	36.2	35.3	43.0
Nov.	29.1	1.3	42.9	76.2	73.5	25.7	17.2	26.6
Dec.	11.1	9.3	21.2	51.3	39.2	15.2	23.1	22.1
Totals	297.0	125.7	380.6	450.8	838.6	435.3	227.4	407.4

Month	1921	1922	1923	1924	1925	1926	1927	1928
Jan.	17.5	13.0	8.5	29.3	29.9	8.9	18.5	7.6
Feb.	9.9	9.4	3.6	24.1	22.0	4.3	7.0	14.2
Mar.	11.6	7.9	1.8	15.8	14.5	7.9	8.1	20.8
Apl.	15.2	5.8	2.2	16.1	11.0	15.4	5.9	21.7
May	12.1	12.6	11.5	16.2	19.3	37.8	11.6	23.8
June	31.9	9.9	56.0	23.1	20.5	41.6	11.4	31.1
July	32.6	41.4	52.2	18.7	24.1	61.3	23.9	32.1
Aug.	71.5	34.7	43.8	62.8	50.1	64.5	39.6	27.4
Sept.	96.5	38.9	50.1	67.1	44.4	55.3	33.6	32.0
Oct.	62.8	38.5	85.1	65.8	49.5	59.2	58.8	58.0
Nov.	29.3	20.7	51.0	72.9	28.1	28.5	29.3	30.9
Dec.	19.3	10.7	34.5	34.1	12.3	18.1	13.3	13.3
Totals	410.2	243.5	400.3	446.0	325.7	402.8	261.0	312.9

MONTHLY RUN-OFF OF THE MURRAY RIVER AT MURRAY GATES
(A.R.M. 1562-1)

Monthly Run-off, thousands of acre feet

Month	1929	1930	1931	1932	1933	1934	1935
Jan.	6.3	9.7	21.7	7.4	8.6	26.7	21.3
Feb.	6.2	4.3	9.9	6.9	4.7	12.6	15.7
Mar.	5.6	3.7	19.9	13.0	4.0	10.2	11.8
Apl.	11.4	3.1	18.4	22.3	4.8	14.2	25.1
May	12.6	8.0	42.0	14.4	10.5	13.0	26.1
June	18.8	10.0	125.7	33.0	15.2	11.0	21.7
July	15.4	14.2	104.3	46.4	34.2	33.7	36.5
Aug.	27.4	31.5	72.9	53.9	23.2	53.2	66.0
Sept.	36.5	29.4	65.2	90.1	70.7	48.9	60.1
Oct.	39.5	67.8	49.2	43.7	42.8	106.0	56.4
Nov.	22.6	32.6	29.9	29.0	20.5	72.2	32.3
Dec.	16.3	32.3	18.1	15.4	29.0	67.0	20.3
Totals	218.6	246.6	577.2	375.5	268.2	468.7	393.3

Month	1936	1937	1938	1939	1940	1941	1942
Jan.	15.4	20.6	7.5	2.2	13.2	20.5	4.2
Feb.	9.7	10.6	4.8	3.1	6.3	9.1	3.9
Mar.	11.8	10.5	5.1	31.1	4.6	10.2	2.1
Apl.	12.3	7.5	4.5	26.9	9.3	8.0	2.8
May	10.7	10.8	8.8	20.4	14.2	7.2	31.1
June	19.6	10.4	11.1	39.9	14.2	11.1	36.3
July	43.5	10.6	12.3	51.3	12.4	22.0	77.5
Aug.	103.5	14.5	17.8	96.2	17.6	16.0	54.2
Sept.	54.2	49.5	26.2	75.9	21.1	27.8	76.2
Oct.	42.3	34.4	19.3	83.2	16.8	33.7	63.2
Nov.	37.1	19.0	8.0	66.3	10.5	18.0	39.0
Dec.	27.8	11.4	3.9	26.6	5.9	10.2	20.7
Totals	387.9	209.8	129.3	523.1	146.1	193.8	411.2

Month	1943	1944	1945	1946	1947	1948	1949
Jan.	14.2	8.2	2.8	5.8	8.8	23.1	12.7
Feb.	8.2	4.0	4.5	9.5	6.3	19.3	8.1
Mar.	5.9	4.7	2.1	17.2	12.8	9.7	9.4
Apl.	21.0	4.8	6.0	13.6	12.0	10.8	7.7
May	16.8	22.9	5.3	12.7	11.2	26.2	9.9
June	15.0	15.1	13.0	22.0	21.2	23.1	18.1
July	25.3	17.2	13.2	84.0	55.0	18.7	27.6
Aug.	32.5	12.8	39.9	79.0	55.6	26.2	33.5
Sept.	47.4	10.8	36.5	43.0	73.0	26.4	34.5
Oct.	65.2	12.3	36.1	51.0	72.0	59.0	60.1
Nov.	33.6	11.1	28.1	34.1	52.2	84.0	66.1
Dec.	17.6	7.1	11.0	17.0	34.1	23.4	25.4
Totals	302.7	131.0	198.5	388.9	414.2	349.9	313.1

MONTHLY RUN-OFF OF THE MURRAY RIVER AT MURRAY GATES
(A.R.M. 1562-1)

Monthly Run-off, thousands of acre feet

Month	1950	1951	1952	1953	1954	1955	1956
Jan.	12.0	14.0	9.1	25.3	18.6	12.2	49.7
Feb.	26.2	11.8	6.2	16.1	17.0	11.6	21.6
Mar.	23.1	8.3	12.3	9.4	9.7	13.8	39.5
Apl.	29.6	9.9	18.4	8.7	9.9	9.5	107.0
May	12.9	31.4	37.1	17.5	10.5	16.6	83.5
June	13.9	34.7	136.0	18.5	15.0	27.8	114.0
July	25.6	66.2	73.5	32.6	20.3	31.1	109.5
Aug.	42.6	80.3	55.0	58.2	34.6	126.0	95.8
Sept.	39.9	56.3	105.0	74.9	32.3	82.0	107.0
Oct.	61.0	65.0	82.3	91.0	22.9	104.0	104.0
Nov.	43.5	33.1	93.8	67.1	67.9	52.2	50.2
Dec.	22.4	18.2	82.0	25.6	26.5	38.1	24.2
Totals	352.7	429.2	710.7	444.9	285.2	524.9	906.0

Months	1957	1958	1959	1960
Jan.	11.0	13.2	10.8	9.4
Feb.	8.8	10.4	7.2	5.3
Mar.	8.2	8.0	7.4	4.5
Apl.	6.4	7.9	6.6	6.4
May	8.7	21.4	5.3	34.0
June	18.0	30.1	10.5	26.9
July	35.0	55.0	12.4	93.8
Aug.	35.0	107.3	28.3	73.8
Sept.	31.9	53.7	66.5	77.5
Oct.	44.2	106.0	69.8	64.7
Nov.	24.1	40.8	36.3	35.1
Dec.	15.4	23.4	14.8	34.1
Totals	246.7	477.2	275.9	465.5

MURRAY RIVER AT MURRAY GATES
(A.R.M. 1562.1)

SUMMARY OF MONTHLY RUN-OFF AND EXTREME RECORDED DISCHARGES

Mean, maximum and minimum monthly run-off (in thousands of acre feet)

Month	For the Period, 1905-1960				
	Maximum	Year of Occurrence	Minimum	Year of Occurrence	Mean
Jan.	49.7	1956	2.2	1939	14.19
Feb.	26.2	1950	1.1	1915	9.57
Mar.	39.5	1956	1.2	1915	10.87
Apl.	107.0	1956	1.3	1915	12.71
May	83.5	1956	4.0	1912	18.40
June	136.0	1952	7.4	1912	30.04
July	110.0	1917	10.6	1937	41.13
Aug.	126.0	1955	12.8	1944	50.89
Sept.	141.5	1917	10.8	1944	55.21
Oct.	192.0	1917	10.2	1914	58.45
Nov.	93.8	1952	1.3	1914	38.13
Dec.	82.0	1952	3.9	1938	23.29
Annual	906.0	1956	125.7	1914	362.90