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Headworks Utilisation Factors for the Logan, Mary Valley and Warrill Valley Water Supply Schemes

26 November 2018

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1 Introduction

1.1 Context

A Headworks Utilisation Factor (HUF) describes the percentage of a WSS's storage headworks volumetric capacity that is effectively utilised by each priority group of water entitlements in that scheme. This factor is a key consideration in, and input to, the allocation of the relevant capital costs (i.e. asset value and renewal costs) associated with Seqwater's bulk water assets.

In March 2012, Seqwater submitted HUFs to the Queensland Competition Authority (QCA) as part of the Authority's five-yearly review of irrigation water pricing for each of Seqwater's WSSs[1]. The QCA subsequently recommended the adoption of HUFs for the Logan, Mary Valley and Warrill Valley Water Supply Schemes (WSSs)[2] that were consistent with Seqwater's submission as follows:

- Logan WSS – 16% for medium priority and 84% for high priority[3]
- Mary Valley WSS – 26% for medium priority and 74% for high priority[4]
- Warrill Valley WSS – 11% for medium priority and 89% for high priority[5].

In April 2018, Badu Advisory was engaged to assist Seqwater in reviewing and updating HUFs for the Logan, Mary Valley and Warrill Valley WSSs in preparation for QCA's next review of irrigation water pricing[6].

1.2 Purpose of this report

The purpose of this report is to:

- summarise the key changes in data inputs since 2012 that are material to the review and updating of HUFs for the Logan, Mary Valley and Warrill Valley WSSs
- present the updated HUFs for the three WSSs.

[1] *Hydrologic Assessment of Headworks Utilisation Factors (HUFs), A Consultancy Report Prepared for Seqwater*, Parsons Brinckerhoff, March 2012.

[2] Although Seqwater made submissions on, and QCA made recommendations about, a HUF for the Central Brisbane WSS in 2012, these are not the subject of this report.

[3] *Seqwater Irrigation Price Review: 2013-17 – Volume 2: Logan Water Supply Scheme*, Draft Report, QCA, December 2012

[4] *Seqwater Irrigation Price Review: 2013-17 – Volume 2: Mary Valley Water Supply Scheme*, Draft Report, QCA, December 2012

[5] *Seqwater Irrigation Price Review: 2013-17 – Volume 2: Warrill Valley Water Supply Scheme*, Draft Report, QCA, December 2012

[6] The updated technical methodology associated with determining HUFs is outlined in *Headworks Utilisation Factors: Technical Paper, Seqwater & SunWater, 24 April 2018.*

2 Logan WSS

2.1 Key changes in data inputs

Appendix 1 presents the data worksheets for determining updated HUFs for the Logan WSS.

The following is a list of the key changes in HUF data inputs (since 2012), and commentary about the relative materiality of those changes to updated HUFs for the Logan WSS:

1. ***Additional water storage capacity in the scheme***

   In December 2012, the Logan Resource Operations Plan was amended to include Wyaralong Dam, Cedar Grove Weir and Bromelton Offstream Storage into the Logan WSS.

   The March 2012 analysis was based only on the performance of Maroon Dam. The updated analysis therefore looked at the combined performance of Maroon Dam, Wyaralong Dam, Cedar Grove Weir and Bromelton Offstream Storage – and associated additional water allocations – which have come on line within the scheme since the previous analysis. The total useable storage volume (i.e. total full supply volumes less dead storage volumes) in the scheme increased from 42,129 ML in the previous analysis to 152,971 ML.

   DNRME's IQQM model was therefore used to determine the 15-year period within the modelled simulation period during which the total volume stored in the combined storages was at its lowest. This resulted in a new 15-year critical period that extended from 1 July 1906 to 30 June 1921. The storage exceedance curve for this period is presented in Appendix 1.

   Although there would be a general increase in the likelihood of water being stored within the scheme during the 15-year critical period than previously assumed, this does not translate to any increase in the HUF for the medium priority HUF. This is because:

   - the volume of high priority water allocations (established as strategic reserves) within the scheme was also increased when the new storages came on line
   - the water sharing rules in the Logan ROP were modified to account for the increased volume of high priority water allocations in the scheme.

   These are discussed in turn below.

2. ***Increased volume of high priority water allocations***

   The volume of high priority water allocations in the scheme was increased from 9,856 ML in the March 2012 analysis to 46,546 ML as a result of:

   - new allocations being created associated with the addition of Wyaralong Dam, Cedar Grove Weir and Bromelton Offstream Storage
   - the transfer and conversion of a small volume of medium priority water allocations to high priority allocations in Wyaralong Dam (which had the effect of decreasing the volume of medium priority water allocations from 13,557 ML in the 2012 analysis to 11,833 ML in the updated calculation).

   The latter point also highlights the shortcomings in the March 2012 analysis in not making provision for further potential conversions of water allocations from medium to high priority. Although a conversion factor is not explicitly specified within the ROP, the boundaries and mechanism for water users to apply for, and secure, such conversions exists under the WRP and ROP. In the case of the Logan WSS, the Logan ROP specifies that the

volume of medium priority water allocations in the scheme must not be less than 4,070 ML[7]. This means that the corresponding maximum volume of high priority water allocations potentially available within the scheme under the current water sharing rules is 55,081 ML. These volumes were included in the updated HUF analysis.

3. ***Changed sharing rules***

   The Logan ROP also updated the water sharing rules to provide preferential access by the newly created high priority water allocations to the water stored in the scheme's combined storage. Analysis found that under the updated water sharing rules, medium priority water allocations do not receive an announced allocation at the start of a water year unless scheme storage exceeds 67,866 ML.

   The combined effect of the additional water storage capacity in the scheme, the increased volume of high priority water allocations and the corresponding changes in the scheme's sharing rules has been to significantly reduce the HUF for medium priority water allocations from 16% in the previous analysis to 2% in the updated assessment.

4. ***Correction and updating of 15-year critical period***

   The 15-year critical period used in the March 2012 analysis was from 1 July 1912 to 30 June 1926[8]. This period only effectively represented a critical period of 14 years. This was corrected in the development of an updated storage exceedance curve for the combined storages discussed above but is considered likely to have a negligible effect when compared to the changes discussed above.

2.2 Updated HUFs

Based on these changes, the updated HUFs for the Logan WSS are 2% for medium priority water allocations and 98% for high priority water allocations (as presented in Appendix 1).

[7] Logan Resource Operations Plan, Table 15, Attachment 5, March 2014.

[8] Parsons Brinckerhoff, Figure C-2.

3 Mary Valley WSS

3.1 Key changes in data inputs

Appendix 2 presents the data worksheets for determining updated HUFs for the Mary Valley WSS.

The following is a list of the key changes in HUF data inputs (since 2012), and commentary about the relative materiality of those changes to updated HUFs for the Mary Valley WSS:

1. ***Accounting for cut-off rule in Borumba Dam***

   The HUF methodology proposes additional steps to address situations where a water supply scheme's water sharing rules are subject to "within water-year headworks storage cut-off rules"[9] (that have the effect of disallowing continuing access to announced allocation within a water year once headwater storage water levels have fallen below a defined trigger level). Cut-off rules of this type effectively impact the volume of medium priority water that is actually available to be taken by irrigators within a water year (irrespective of the initial announced allocation percentage calculated and published at the start of the water year).

   The 2012 analysis did not take into account the medium priority cut-off rule that applies to water supplied from Borumba Dam. This rule requires that the resource operations licence holder not release water from Borumba Dam to supply medium priority water allocations whenever the water level in Borumba Dam is less than or equal to 123.74 metres AHD (or 22.8% of the dam's full supply volume). This rule also means that medium priority water allocations' access to water supplies may be cut-off during a water year if:

   - the volume in Borumba Dam at the start of a water year is less than 74.3% of full supply volumes and
   - there is an extended period of low inflows into the dam during that period.

   These conditions will almost certainly be met during a critically dry period. Accounting for this effect by applying the steps outlined in the HUF methodology therefore results in a significant reduction in the HUF for medium priority water allocations from 26% in the 2012 analysis to 11% in the updated assessment.

2. ***Correction and updating of 15-year critical period***

   The 15-year critical period used in the 2012 analysis was from 1 July 1932 to 30 June 1946[10]. This period only effectively represented a critical period of 14 years.

   DNRME's IQQM model was therefore used to determine the 15-year period within the modelled simulation period during which the total volume stored in Borumba Dam was at its lowest. This resulted in an updated 15-year critical period extending from 1 July 1932 to 30 June 1947. The storage exceedance curve for this period is presented in Appendix 2.

   Comparing the updated storage exceedance curve with that used in 2012, this change results in a small increase in the likelihood of water being stored for middle levels within the Borumba Dam storage (i.e. between 35,000 ML and 48,000 ML) during the 15-year critical

[9] *Headworks Utilisation Factors: Technical Paper, Seqwater & SunWater, 24 April 2018, pp 13-14.*

[10] Parsons Brinckerhoff, Figure C-5.

period than was previously assumed. This in turn results in a small increase in the probability of utilizing the upper-middle level of the dam (parameter P2-B in the calculation). This level within the storage tends to be utilized by medium priority water allocations. However, the very low probability associated with this level being utilized (compared to the lower levels of storage) means that this change is likely to have minimal impact on the HUF percentages in this scheme.

3.2 Updated HUFs

Based on these changes, the updated HUFs for the Mary Valley WSS are 11% for medium priority water allocations and 89% for high priority water allocations (as presented in Appendix 2).

4 Warrill Valley WSS

4.1 Key changes in data inputs

Appendix 3 presents the data worksheets for determining updated HUFs for the Warrill Valley WSS.

The following is a list of the key changes in HUF data inputs (since 2012), and commentary about the relative materiality of those changes to updated HUFs for the Warrill Valley WSS:

1. ***Reduction of 3,500 ML of high priority water allocations***

   A volume of 3,500 ML of high priority water allocations was returned by Seqwater to Moogerah Dam in 2014. The updated analysis was therefore based on accounting for 5,950 ML of high priority water allocations (compared to 9,450 ML of high priority water allocations in the 2012 analysis). This accounts for a reduction in the HUF for medium priority water allocations from 11% in the 2012 analysis to 10% in the updated assessment.

2. ***Correction and updating of 15-year critical period***

   The 15-year critical period used in the 2012 analysis was from 1 July 1906 to 30 June 1920[11]. This period only effectively represented a critical period of 14 years.

   DNRME's IQQM model was therefore used to determine the 15-year period within the modelled simulation period during which the total volume stored in Moogerah Dam was at its lowest. This resulted in an updated 15-year critical period extending from 1 July 1911 to 30 June 1926. The storage exceedance curve for this period is presented in Appendix 3.

   Comparing the updated storage exceedance curve with that used in 2012, this change results in a small increase in the likelihood of water being stored at lower levels within the Moogerah Dam storage (i.e. between 2,000 ML and 45,000 ML) during the 15-year critical period than was previously assumed. This in turn increases the probability of utilizing the lower levels of the dam (parameters P1 and P2 in the calculation). As the lower levels within the storage tend to be utilized more by high priority water allocations, this means that this change is likely to have the effect of slightly increasing the HUF percentage for high priority allocations and slightly reducing the HUF percentage for medium priority allocations.

4.2 Updated HUFs

Based on these changes, the updated HUFs for the Warrill Valley WSS are 10% for medium priority water allocations and 90% for high priority water allocations (as presented in Appendix 3).

[11] Parsons Brinckerhoff, Figure C-8.

5 Conclusions and recommendations

5.1 Summary of changes

The types of changes applicable to each WSS and their materiality in changing the HUF percentages are summarised in Table 1.

Table 1 - Summary of changes to data inputs and their materiality in changing the HUFs

	Logan WSS	Mary Valley WSS	Warrill Valley WSS
Cut-off rule that prevents released from headworks storage under defined conditions	×	✓ Significant impact on HUFs	×
Additional water storage capacity in the scheme	✓ Significant impact on HUFs (combined effect)	×	×
Changed volume of high priority water allocations		×	✓ (small reduction only) Minor impact on HUFs
Significant changes to water sharing rules		×	×
Conversion (or potential for further conversion) of water allocations from medium to high priority		×	✓ (small volume only) Immaterial impact on HUFs
Correction and updating of 15-year critical period	✓ Immaterial impact on HUFs	✓ Immaterial impact on HUFs	✓ Minor impact on HUFs

5.2 Recommendation

It is recommended that the HUFs for the Logan, Mary Valley and Warrill Valley WSSs be updated as per Table 2 below.

Table 2 - Updated Headworks Utilisation Factors for the Logan, Mary Valley and Warrill Valley WSSs

Water Supply Scheme	Previous Headworks Utilisation Factors		Updated Headworks Utilisation Factors	
	Medium Priority Water Allocation	High Priority Water Allocation	Medium Priority Water Allocation	High Priority Water Allocation
Logan	16%	84%	2%	98%
Mary Valley	26%	74%	11%	89%
Warrill Valley	11%	89%	10%	90%

Appendix 1 – Logan Water Supply Scheme

A. INPUT DATA FROM WATER ALLOCATION REGISTER (DNRME)

Water Entitlement Priority Group (in ROP or IROL):	Nominal Volume:	Water entitlement grouping (in HUF calc.) :	ROP Conversion Factor	
Medium Priority	11833 ML	= MPA 11833 ML	Not specified in ROP. Assume value of 2.5 when converting (55081 – 46546) from MP to HP, but with MPAmin not less than 4070 as specified in Table 15, Attachment 5, Logan ROP, March 2014	MPAmin = 4070 ML
High Priority	9546 ML	= HPA 46546 ML	HPAmax taken from Table 15, Attachment 5, Logan ROP, March 2014	HPAmax = 55081 ML
High Priority Strategic Reserve	37000			

B. WATER SHARING RULES & OPERATIONAL REQUIREMENTS (ROP)

MP0 AA	Announced allocation water sharing rules give minimum storage volume in the scheme above which medium priority announced allocation is greater than 0% at the commencement of the water year = 67866 and with inflows equal to zero. Assume Maroon and Wyaralong dams drawn down proportionally (balanced percentages).	
Adjustments	• None	
MP0	= max {MP0 AA , CWSA Adjustment}	67866 ML

MP100 AA	= Water sharing rules give minimum storage volume in the scheme at which medium priority announced allocation is at a maximum (100%) at the commencement of the water year = 74591 ML	
Adjustments	• None	
MP100	= min (MP100 AA, Adjustment Volume)	74591 ML

FSV Hwks	= to the full supply volume of the major headworks storage/s in the scheme Wyaralong: 102883; Maroon: 44319; Bromelton O: 8210; Cedar Grove: 1144	156556 ML
DSV Hwks	= to the dead storage volume of the major headworks storage/s in the scheme Wyaralong: 264; Maroon: 2090; Bromelton O: 1131; Cedar Grove: 100	3585 ML

C. PROBABILITY OF UTILISATION

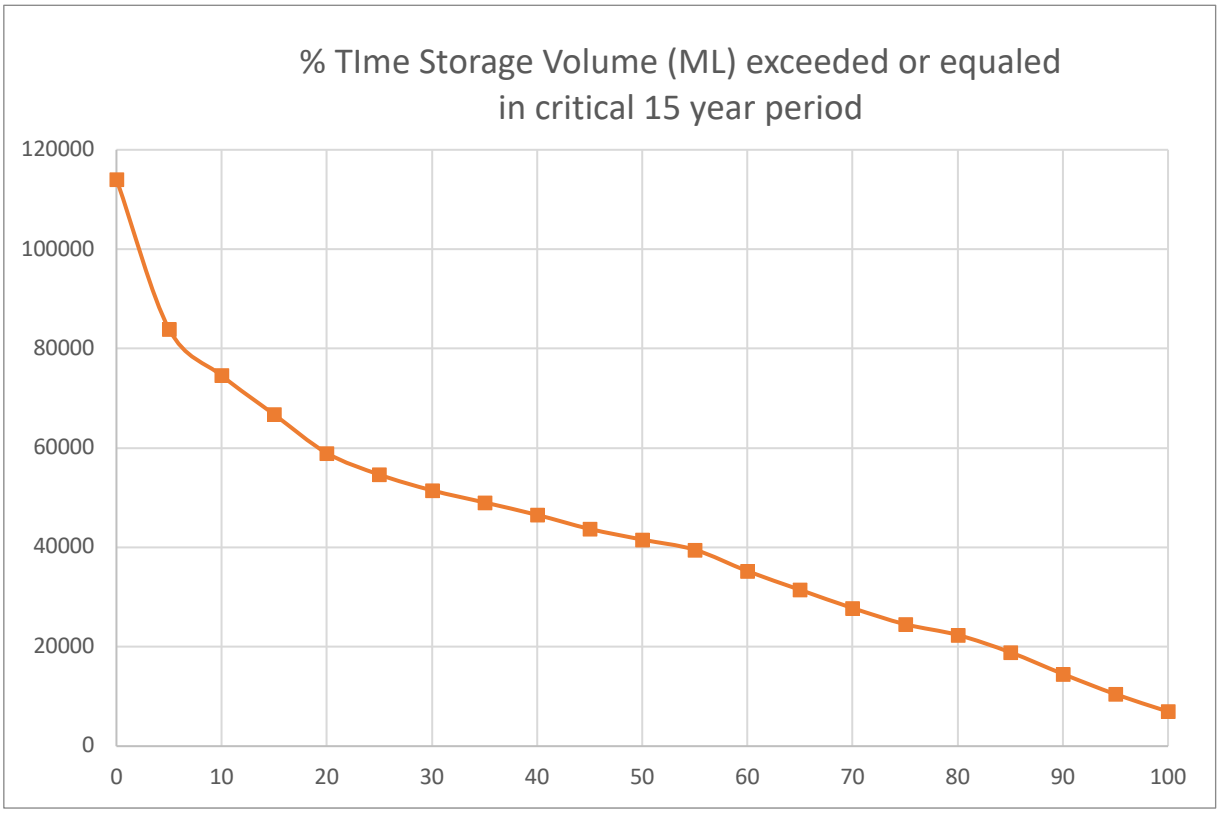
Storage component capacity volumes:		Probability of Utilisation	Utilised storage component volumes	
MP2 = 5640 ML	HP2 = 76325 ML	P3 = 2%	MP2util = 100 ML	HP2util = 1351 ML
MP1 = 6725 ML		P 2 = 12%	MP1util = 816 ML	
HP1 = 64281 ML		P1 = 58%	HP1util = 36968 ML	

D. HUF RESULTS

Water entitlement grouping (in HUF calc.) :	Headworks Utilisation Factor for Grouping	Water Entitlement Priority Group (in ROP or IROL):	Headworks Utilisation Factor for priority group
MPA	2%	Medium Priority	2%
HPA	98%	High Priority	98%

IQQM STORAGE EXCEEDENCE CURVE – COMBINED MAROON DAM, WYARALONG DAM, CEDAR GROVE WEIR AND BROMELTON OFF-STREAM STORAGE

15 YEAR CRITICAL PERIOD from 01/07/1906 to 30/06/1921



Appendix 2 – Mary Valley Water Supply Scheme

A. INPUT DATA FROM WATER ALLOCATION REGISTER (DNRME)

Water Entitlement Priority Group (in ROP or IROL):	Nominal Volume:		Water entitlement grouping (in HUF calc.) :	ROP Conversion Factor	
Medium Priority	21829 ML	→	= MPA 21829 ML	Not specified in ROP. Assume conversion value of 2.5 when converting (10284 – 10264) from MP to HP	MPAmin = 21779 ML
High Priority	10264 ML	→	= HPA 10264 ML	HPAmax taken from Table 9, Attachment 4, Mary Basin ROP, Sept 2011	HPAmax = 10284 ML

B. WATER SHARING RULES & OPERATIONAL REQUIREMENTS (ROP)

MP0 AA	= Announced allocation water sharing rules give minimum storage volume in the scheme above which medium priority announced allocation is greater than 0% at the commencement of the water year = 19188 ML	
MP0 nom	= 34178 ML (or 74.3% FSV) which is the maximum headworks storage volume at the start of the water year below which the headworks storage volume is forecast to reach the medium priority cut-off level (22.8%) on the last day of that water year (based on Historical Storage Performance for Borumba Dam between 11/10/2001 to 11/10/2002) **This parameter is only relevant to storages that have an MP cut-off rule[12].**	
IF MP0 nom > MP0 AA	= MP0 nom	34178 ML

MP100 AA	= Water sharing rules give minimum storage volume in the scheme at which medium priority announced allocation is at a maximum at the commencement of the water year = 46000 ML	
Adjustments	• None	
MP100	= min (MP100 AA, Adjustment Volume)	46000 ML

FSV Hwks	= to the full supply volume of the major headworks storage/s in the scheme	46000 ML
DSV Hwks	= to the dead storage volume of the major headworks storage/s in the scheme	1200 ML

[12] The resource operations licence holder must not release water from Borumba Dam to supply medium priority water allocations when the water level in Borumba Dam is less than or equal to 123.74 metres AHD

C. PROBABILITY OF UTILISATION

Storage component capacity volumes:	
MP2 = 0 ML	HP2 = 0 ML
MP1-B = 11822 ML	
MP1-A = 7495 ML	HP1-A = 7495 ML
HP1 = 17988 ML	

Probability of Utilisation
P3 = 0%
P2-B = 4%
P2-A = 21%
P1 = 78%

Utilised storage component volumes	
MP2util = 0 ML	HP2util = 0 ML
MP1-B_util = 458 ML	
MP1-A_util = 1545 ML	HP1-A_util = 1545 ML
HP1util = 14041 ML	

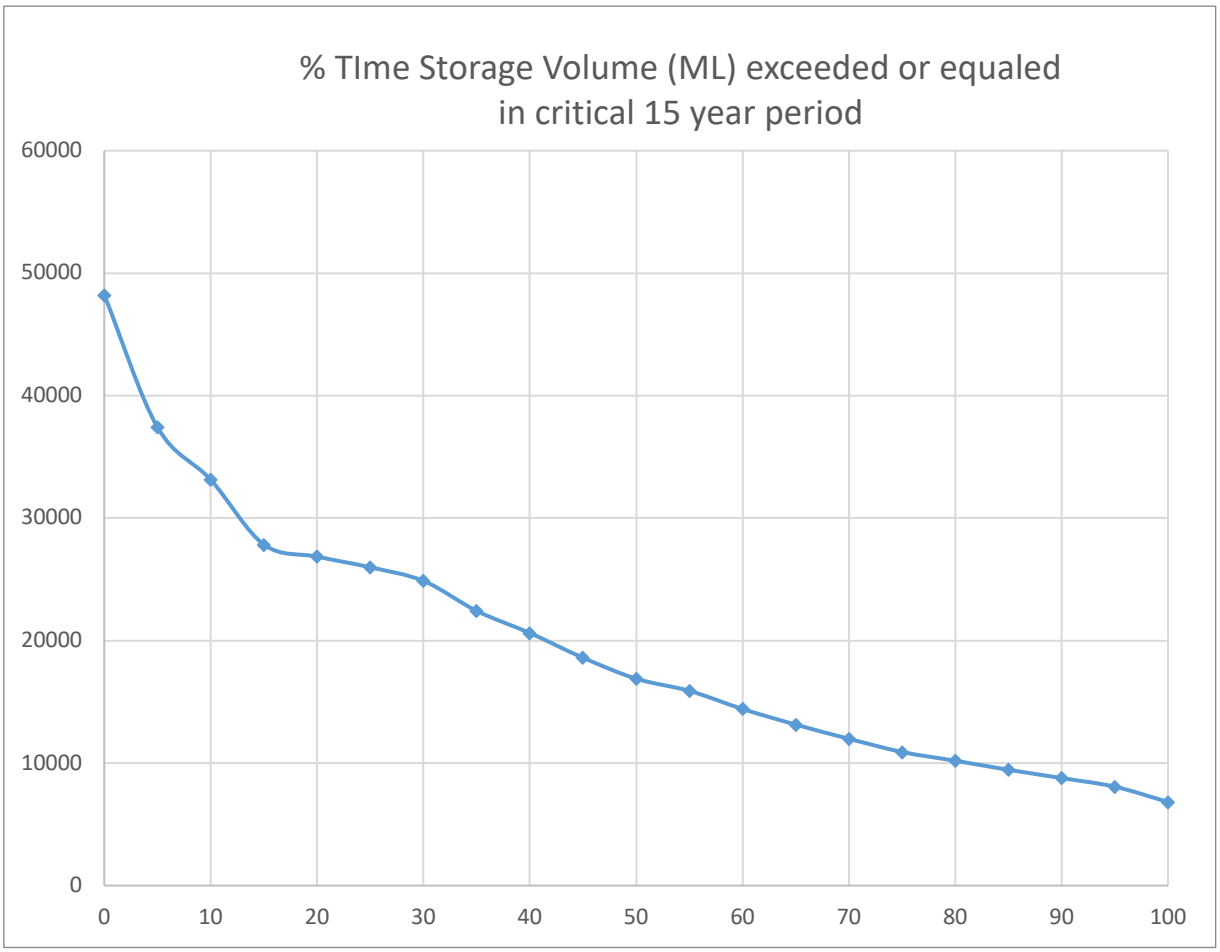
D. HUF RESULTS

Water entitlement grouping (in HUF calc.) :	Headworks Utilisation Factor for Grouping
MPA	11 %
HPA	89 %

Water Entitlement Priority Group (in ROP or IROL):	Headworks Utilisation Factor for priority group
Medium Priority	11 %
High Priority	89 %

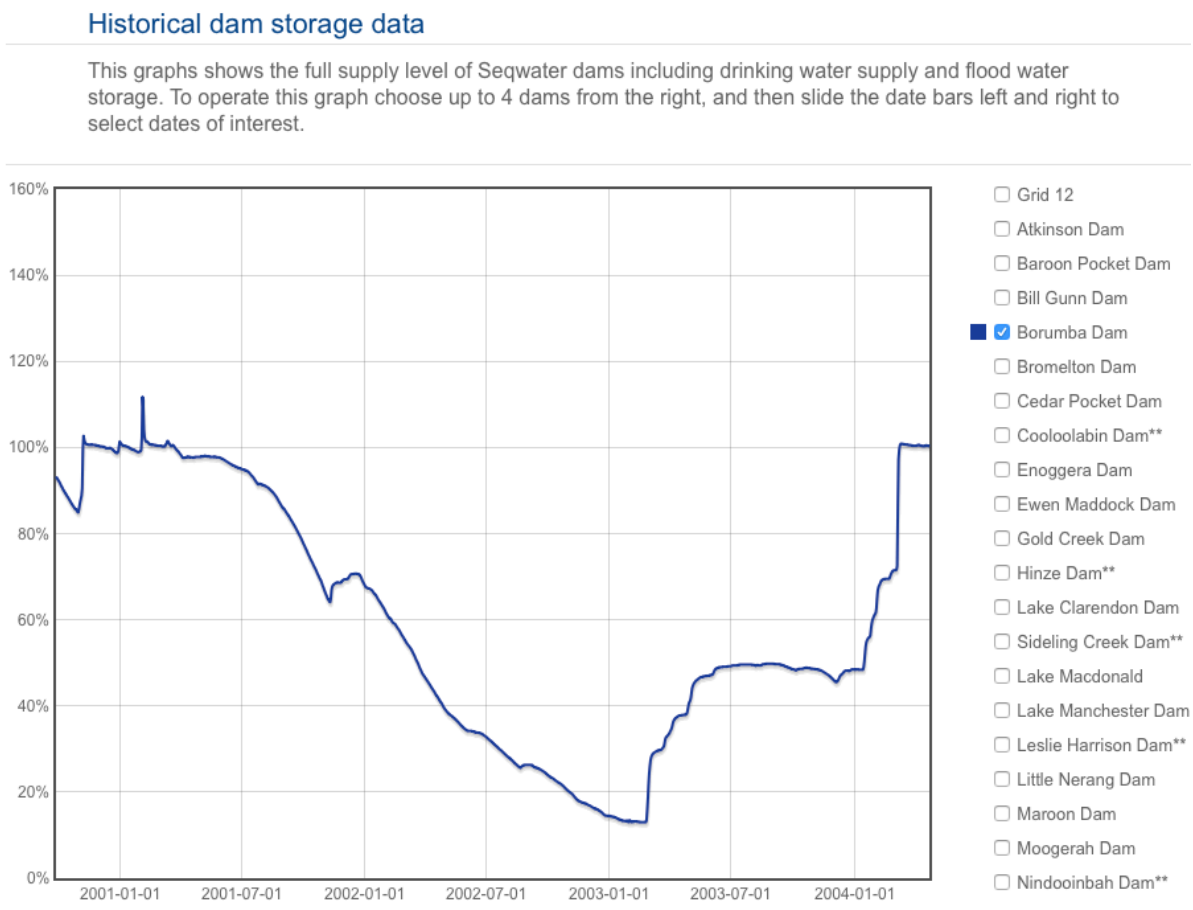
IQQM STORAGE EXCEEDENCE CURVE – BORUMBA DAM

15 YEAR CRITICAL PERIOD from 01/07/1932 to 30/06/1947



BORUMBA DAM MP0NOM CHART (BASED ON HISTORICAL PERFORMANCE)

Draw down from 74.3% on 11/10/2001 to 22.8% on 11/10/2002:



Appendix 3 – Warrill Valley Water Supply Scheme

A. INPUT DATA FROM WATER ALLOCATION REGISTER (DNRME)

Water Entitlement Priority Group (in ROP or IROL):	Nominal Volume:	Water entitlement grouping (in HUF calc.) :	ROP Conversion Factor	
Medium Priority – river losses	3714 ML	= MPA 23883.5 ML	Not specified in ROP. Assume value of 2.5 when converting (6326 – 5950) from MP to HP	MPAmin = 22943.5 ML
Medium Priority – purpose = "any"	20169.5 ML			
High Priority	5950 ML	= HPA 5950 ML	HPAmax taken from Table 12, Moreton ROP, June 2014	HPAmax = 6326 ML

B. WATER SHARING RULES & OPERATIONAL REQUIREMENTS (ROP)

MP0 AA	Announced allocation water sharing rules give minimum storage volume in the scheme above which medium priority announced allocation is greater than 0% at the commencement of the water year assuming zero inflows= 18864 ML	
Adjustments	• River losses added to MP0AA as this volume must be available first before water can be delivered from storage to other MP water allocations	
MP0	= max {MP0 AA , CWSA Adjustment}	22578 ML

MP100 AA	= Water sharing rules give minimum storage volume in the scheme at which medium priority announced allocation is at a maximum (100%) at the commencement of the water year with zero inflows = 47109 ML	
Adjustments	• None	
MP100	= min (MP100 AA, Adjustment Volume)	47109 ML

FSV Hwks	= to the full supply volume of the major headworks storage/s in the scheme	83765 ML
DSV Hwks	= to the dead storage volume of the major headworks storage/s in the scheme	1200 ML

C. PROBABILITY OF UTILISATION

Storage component capacity volumes:		Probability of Utilisation	Utilised storage component volumes	
MP2 = 28734 ML	HP2 = 7922 ML	P3 = 0%	MP2util = 0 ML	HP2util = 0 ML
MP1 = 24531 ML		P2 = 4%	MP1util = 908 ML	
HP1 = 21378 ML		P1 = 39%	HP1util = 8231 ML	

D. HUF RESULTS

Water entitlement grouping (in HUF calc.) :	Headworks Utilisation Factor for Grouping
MPA	10%
HPA	90%

Water Entitlement Priority Group (in ROP or IROL):	Headworks Utilisation Factor for priority group
Medium Priority	10%
High Priority	90%

IQQM STORAGE EXCEEDENCE CURVE – MOOGERAH DAM

15 YEAR CRITICAL PERIOD from 01/07/1911 to 30/06/1926