sunwater

Irrigation pricing proposal

1 July 2025 to 30 June 2029

Appendix E Headworks Utilisation Factor Technical Paper

Appendix E
Headworks Utilisation Factor Technical Paper

Overview

The Headworks Utilisation Factors (HUFs) first approved by the Queensland Competition Authority (QCA) in 2011 have been reviewed in 2018 and now in 2023. This document outlines the outcomes of the 2023 HUFs review.

A summary of schemes where the HUFs were reviewed is presented in *Table 1*. The table also compares the HUF from the 2020 irrigation pricing review and with current HUF review outcomes. This report will discuss the process of calculating the latest HUF for these water supply schemes.

For schemes not listed in *Table 1*, the HUF has not changed. Details of existing HUF values can be found in the 2020 – 2024 HUF report (on the QCA website).

Table 1: Updated Headworks Utilisation Factors for Water Supply Schemes operated by Sunwater

Water Supply Scheme	Result of HUF Review	Headworks Utilisation Factors (%) for each Water Allocation Priority Group in schemes subject to review					
		2020 Pricing Review			2025 Pricing review		
Chinchilla Weir	*Increased MP ratio*	MP - 12%	HP - 88%		MP - 16%	HP - 84%	
Mareeba - Dimbulah	*Decrease MP ratio*	MP - 46%	HP - 54%		MP - 34%	HP - 66%	
Upper Condamine[1]	*No change*	MP - 8%	HPA - 89%	HPB - 3%	MP - 8%	HPA - 89%	HPB - 3%

Note 1: For Upper Condamine Risk A and Risk B categories have a 0% HUF assigned across both review periods.

1 Introduction

The Headworks Utilisation Factors (HUFs) approach was first approved in 2011 by the Queensland Competition Authority (QCA) and was subsequently reviewed in 2018. HUFs are defined as the percentages of a scheme's storage headworks volumetric capacity able to be utilised by each priority group of water entitlements in that scheme, taking into consideration (a) the application of water sharing rules and other operational requirements set out the relevant Operations Manual and (b) the probability of utilisation of the scheme storages under conditions of relative supply shortage. The HUFs are a key consideration in the allocation of the relevant capital costs (i.e. asset value and renewal costs) associated with Sunwater's bulk water asses.

1.1 Purpose

The purpose of this report is to confirm HUF values ahead of the 2025 irrigation pricing review. It does this by:

- reviewing HUFs 2020 data inputs and identifying nature and materiality of changes
- identifying which schemes require / warrant a review of the HUF
- calculating a new HUF for use in the 2025 irrigation pricing review

The material changes may include, but are not limited to, water sharing rules amendment, storage management or Water Plan hydrologic model updates.

1.2 Methodology

The approved methodology used to calculate the HUFs for the 2020 review remains unchanged. This was used for reviewing the HUFs as part of the 2025 Irrigation Pricing review. The full methodology is provided in Attachment A.

In summary, the technical methodology for deriving HUFs within a water supply scheme considers:

- the volumes and priority groups of water entitlements within the scheme (including the potential for conversion between priority groups where applicable)
- the water sharing and water accounting rules (including taking into account announced allocation and continuous sharing arrangements) defined in the Resource Operations Licence (ROL) Operations Manual (OM).
- the critical water supply arrangements (CWSAs) including storage cut-off rules
- other ROL requirements relating to instream storage infrastructure operations (including discharge release rules, environmental flow requirements as well as inter-storage management arrangements)
- an analysis of hydrologic performance of headworks storages (in terms of the probability of storages actually holding various volumes of water during critical periods).

1.3 Review of Headworks Utilisation Factors considerations for 2025 price path

0 sets out the assessment of the inputs into the HUFs. It compares the inputs into the 2012 and 2020 HUFs against the current situation applying to each WSS and identifies which HUFs required a revision. Table 2 identifies the reasons for revising the HUF for the schemes outlined in this report.

Table 1 Summary of reasons for revising HUF

Water Supply Scheme	Reasons for revisions
Chinchilla Weir	• Model simulation period has changed • New eWater Source hydrologic model
Mareeba Dimbulah[1]	New Water Plan due July 2023 which results in: • New eWater Source hydrologic model • Model simulation period has changed
Upper Condamine	• Model simulation period has changed • New water sharing rules for Medium Priority users • New eWater Source hydrologic model

Note 1 An application to change the purpose of distribution losses (MP type "loss") to purpose any (MP type "any") has been submitted to DRDMW for assessment. Because the allocations are both Medium Priority, this does not impact the inputs to the HUF

Results

1.4 Chinchilla Water Supply Scheme

1.4.1 Input data from water allocation register (Business Queensland)

Water Entitlement Priority Group (in ROL)	Nominal Volume	Water Entitlement Grouping (in HUF calc):		
Medium Priority	2,284 ML	MPA = 2,284 ML	Conversion Factor = N/A	MPAmin = 2,284 ML
High Priority	1165 ML	HPA = 1,165 ML		HPAmax = 1,165 ML

1.4.2 Water sharing rules and operational requirements

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 = NOT APPLICABLE	
Adjustments	storage volume below which HP AA<100% on 1 July according to the water sharing rules (Chinchilla WSS Operations Manual, Chap 10 (1))	6,757 ML
MP0	= max (MP0 AA and CWSA Adjustment)	6,757 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 = NOT APPLICABLE	
Adjustments	Full Supply Volume of Chinchilla Weir	9,780 ML
MP100	= min {MP100 AA, Adjustment Volume (FSV) }	9,780 ML

FSV Hwks	Full supply volume of the major headworks storage/s in the scheme	9780 ML
DSV Hwks	Dead storage volume of the major headworks storage/s in the scheme	120 ML

1.4.3 Probability of utilisation

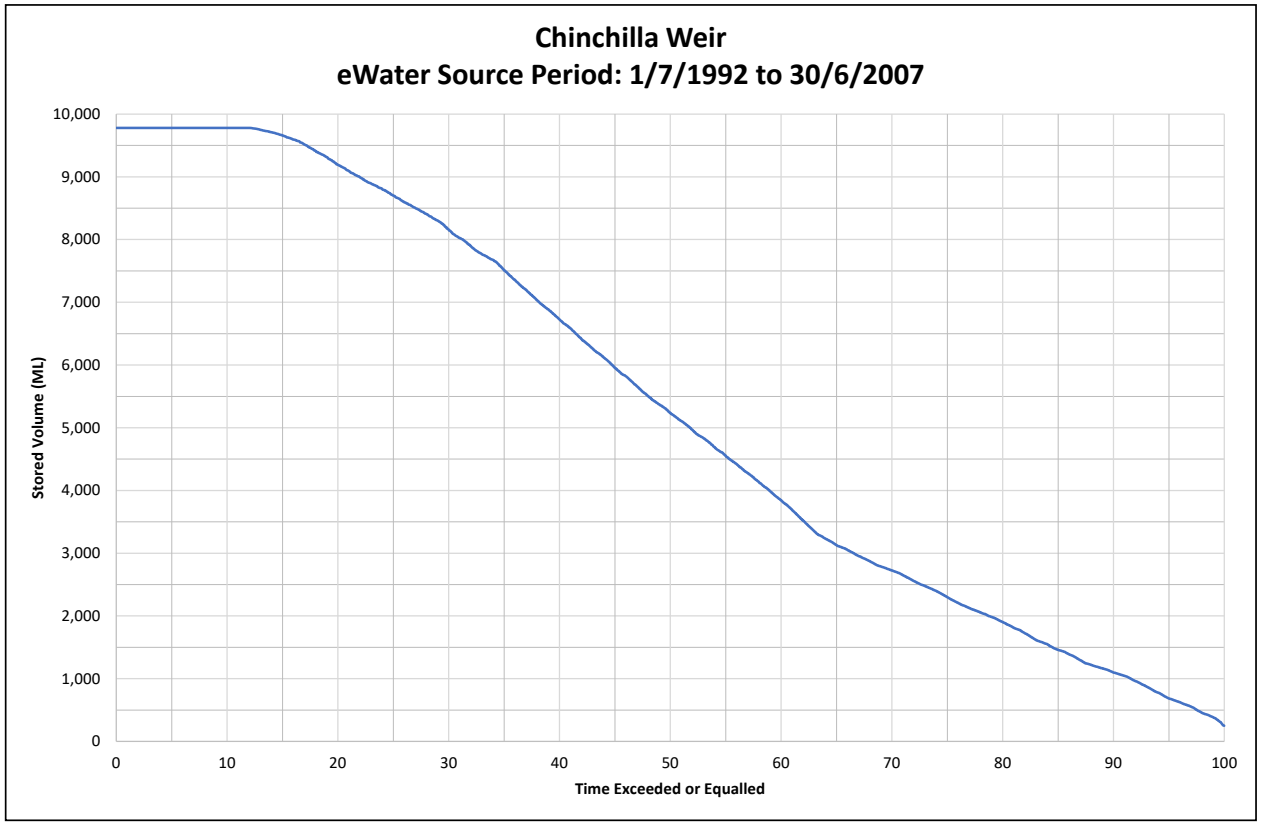
Storage component of capacity volumes:		Probability of Utilisation:	Utilised storage component volumes:	
MP2 = 0 ML	HP2 = 0ML	P3 = 0%	MP2util = 0 ML	HP2util = 0 ML
MP1 = 3,023 ML		P2 = 28%	MP1util = 846 ML	
HP1 = 6,637 ML		P1 = 66%	HP1util = 4,380 ML	

1.4.4 HUF Results

Water Entitlement Grouping (in HUF calc):	Headworks Utilisation Factor for Grouping	Water Entitlement Priority Group (in ROL):	Headworks Utilisation Factor for Priority Group
MPA	16%	Medium Priority	16%
HPA	84%	High Priority	84%

The results show an increase in the MP HUF and decrease in the HP HUF. This is due to the updated hydrologic model (eWater Source) generally reflecting more base flows to the weir during the critical period compared to the previous IQQM model. Despite the new model also incorporating updated, higher storage evaporation rates, the overall result of increased baseflows is for water levels within the weir to remain higher during critical periods, and improved water availability for MP water allocations during such periods.

1.4.5 Exceedance curve used for Chinchilla WSS



1.5 Mareeba- Dimbulah Water Supply Scheme

1.5.1 Input data from water allocation register (Business Queensland)

Water Entitlement Priority Group (in ROL)	Nominal Volume		Water Entitlement Grouping (in HUF calc):		
Medium Priority	204,425 ML	→	MPA = 204,425 ML	ROL Conversion Factor = N/A	MPAmin = 176,034 ML
High Priority*	14,026 ML	→	HPA = 14,026 ML		HPAmax = 33,900 ML

Note: An application to change the purpose of distribution losses (MP type "loss") to purpose any (MP type "any") has been submitted to DRDMW for assessment. Because the allocations are both Medium Priority, this does not impact the performance of the inputs to the HUF

1.5.2 Water sharing rules and operational requirements

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	99,481 ML
Adjustments	Volume of Tinaroo falls Dam required to supply hydro releases in first month of Water Year (Mareeba-Dimbulah WSS ROL s4 (2))	24,700 ML
MP0	= MP0 AA volume and hydro release volume adjustment	124,4181 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 = 329461 ML	329,461 ML
Adjustments	Volume of Tinaroo falls Dam required to supply hydro releases in first month of Water Year (Mareeba-Dimbulah WSS ROL s4 (2))	24,700 ML
MP100	= MP100 AA volume and hydro release volume adjustment	354,161 ML

FSV Hwks	Full supply volume of the major headworks storage/s in the scheme	438,920 ML
DSV Hwks	Dead storage volume of the major headworks storage/s in the scheme	1,300 ML

1.5.3 Probability of utilisation

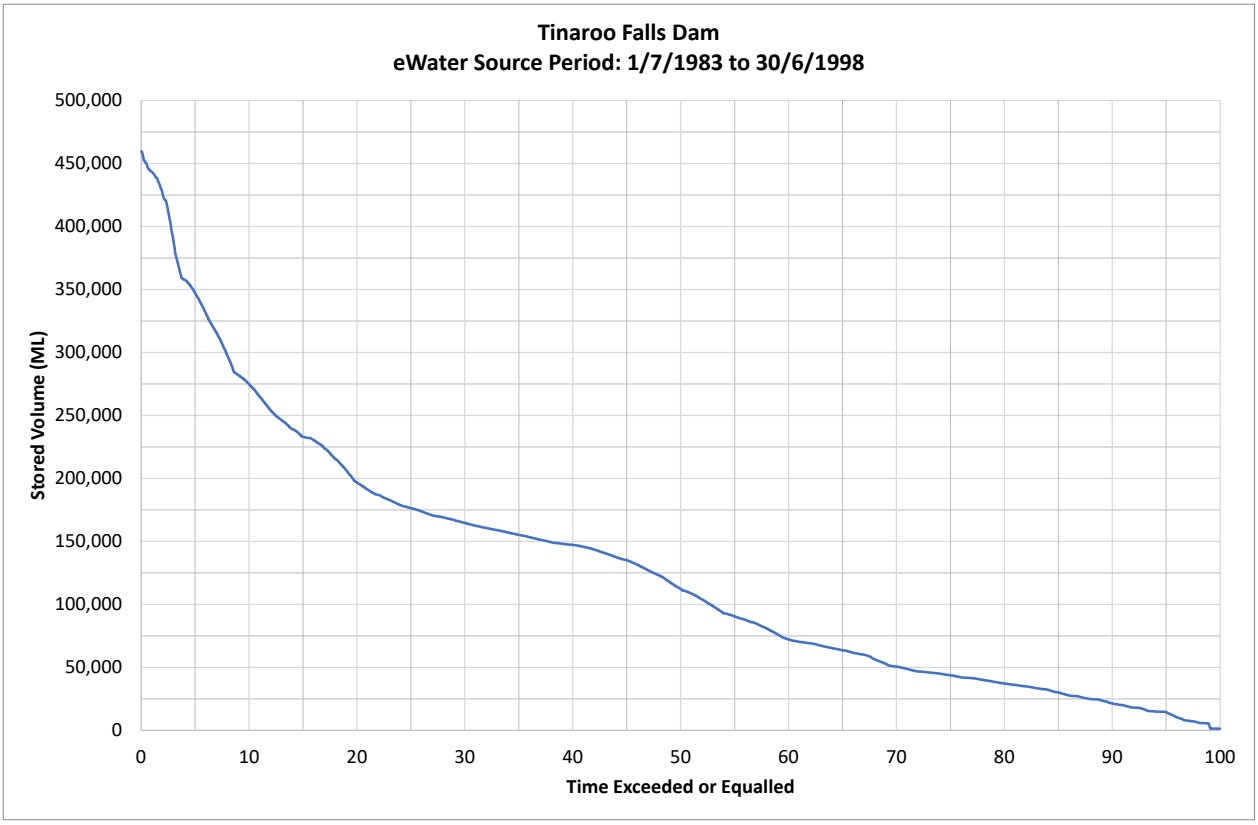
Storage component of capacity volumes:		Probability of Utilisation:	Utilised storage component volumes:	
MP2 = 71,072 ML	HP2 = 13,687 ML	P3 = 3%	MP2util = ,2132 ML	HP2util = 411 ML
MP1 = 229,980 ML		P2 = 18%	MP1util = 41,396 ML	
HP1 = 122,881 ML		P1 = 68%	HP1util = 84,788 ML	

1.5.4 HUF Results

Water Entitlement Grouping (in HUF calc):	Headworks Utilisation Factor for Grouping	Water Entitlement Priority Group (in ROL):	Headworks Utilisation Factor for Priority Group
MPA	34%	Medium Priority	34%
HPA	66%	High Priority	66%

The results show a significant decrease in the MP HUF (previously 46%) and this is understood to be due to the updated hydrological model (eWater source). As part of the revisions to the model, updated approaches for estimating storage evaporation rates were adopted which ultimately resulted in more rapid drawdown in the lake levels in Tinaroo Falls Dam. This, in turn, impacts on water availability for MP water allocations during the critical period.

1.5.5 Exceedance curve used for Mareeba-Dimbulah WSS



1.6 Upper Condamine Water Supply Scheme

1.6.1 Input data from water allocation register (Business Queensland)

Water Entitlement Priority Group	Nominal Volume
Medium Priority	22,328 ML
High A Priority	3,262 ML
High B Priority*	125
Risk A**	7,320
Risk B**	925

Water Entitlement Grouping (in HUF calc):		
MPA = 22,328 ML	ROL Conversion Factor = N/A	MPAmin = 22,328 ML
HPA = 3,387 ML		HPAmax = 3,387 ML

Note * With reference to water sharing rules for UCWSS (Upper Condamine Operations Manual 2019, Chapter 3), High Class A Priority and High Class B Priority are considered to be comparable products for the purposes of this HUF analysis. These are both intended to be urban supplies.

Note ** With reference to water access rules for UCWSS (Upper Condamine Operations Manual 2019, Chapter 3) , Risk Class A Priority and Risk Class B Priority are considered to be comparable products for the purposes of this HUF analysis. Risk Class A is a streamflow product (available on an opportunistic, run-of-the-river basis and is not related to storage capacity). Risk Class B is a low value water product which is not expected to result in significant access to water over the period of analysis.

1.6.2 Water sharing rules and operational requirements

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	15,861 ML
Adjustments	= 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 (460.35 mAHD which equates to volume in storage of 15,000 ML) on the last day of that water year assuming minimum inflows (based on Leslie Dam Forecast Storage Model) This parameter is only relevant to storages that have an MP cut-off rule such as Leslie Dam.	40,697 ML
If MP0 nom > MP0 AA	= MP0 nom	40,697 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	60,930 ML
Adjustments	None	
MP100	= min (MP100 AA, Adjustment)	60,930 ML

FSV Hwks	Full supply volume of the major headworks storage/s in the scheme	106,200 ML
DSV Hwks	Dead storage volume of the major headworks storage/s in the scheme	2,130 ML

1.6.3 Probability of utilisation

Storage component of capacity volumes:	
MP2 = 39,307ML	HP2 = 5,963 ML
MP1 - B = 21911 ML	
MP1 - A = 12, 418 ML	HP1 = 12,418 ML
HP1 = 38,567 ML	

Probability of Utilisation:
P3 = 0%
P2 - B = 6.9%
P2 - A = 20.2%
P1 = 55.8%

Utilised storage component volumes:	
MP2util = 0 ML	HP2util = 0 ML
MP1-B_util = 1,396 ML	
MP1 - A_util = 2,409 ML	HP1-A_util = 2,409 ML
HP1util = 21,520 ML	

1.6.4 HUF Results

Water Entitlement Grouping (in HUF calc):	Headworks Utilisation Factor for Grouping
MPA	7%
HPA	93%

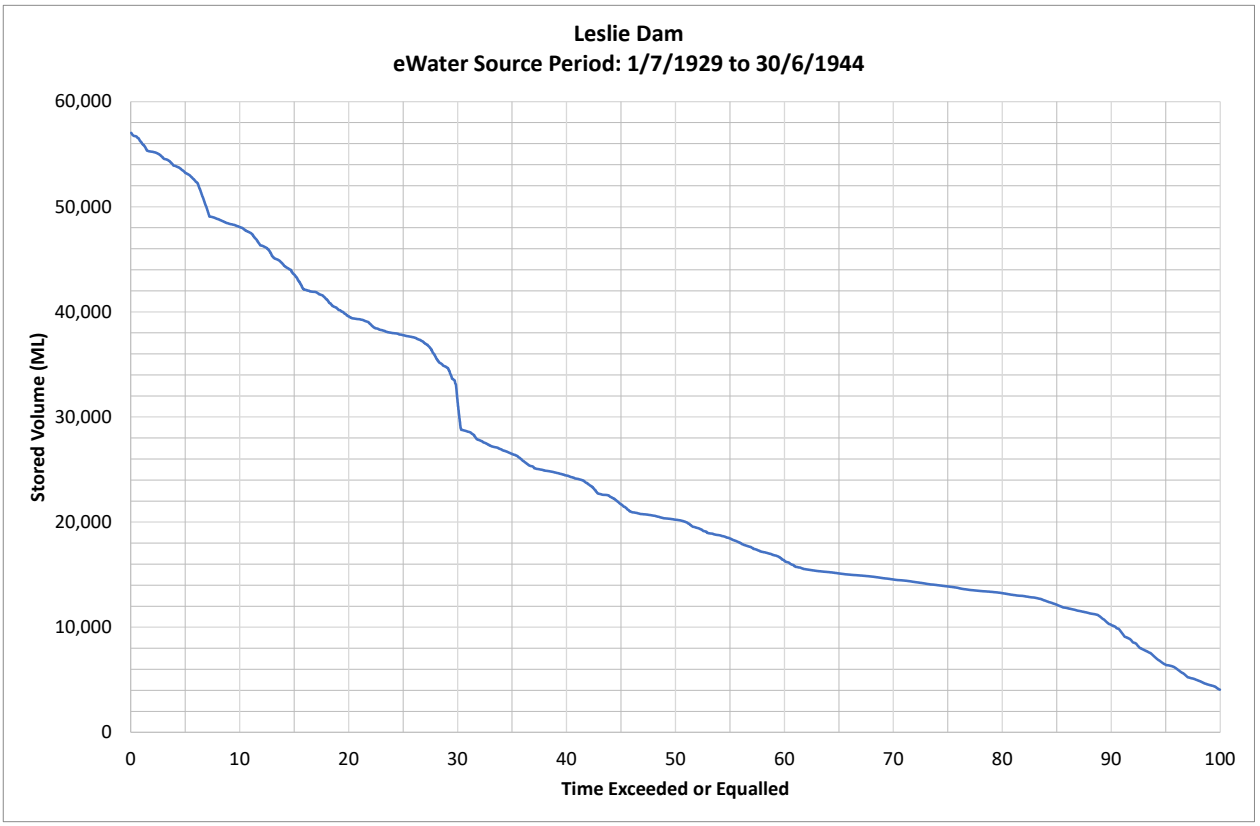
Water Entitlement Priority Group (ROL):	Headworks Utilisation Factor for Priority Group
Medium Priority	7%
High A Priority	89%
High B Priority*	3%
Risk A	0%
Risk B	0%

* HUF RESULTS DISAGGREGATED IN PROPORTION TO THE VOLUME OF WATER ENTITLEMENTS IN THE RESPECTIVE GROUPING

The updated HUF calculations do not result in a material change (<1%) to the previously calculated HUFs from 2018, therefore the previous HUFs are retained as follows:

Water Entitlement Priority Group (ROL):	Headworks Utilisation Factor for Priority Group
Medium Priority	8%
High A Priority	89%
High B Priority*	3%
Risk A	0%
Risk B	0%

1.6.5 Exceedance curve used for Upper Condamine



Attachment A

Headworks Utilisation Factor methodology

A.1 Rationale

Background to water entitlements and priority groups

Each water user that draws water from a supplemented water supply scheme is able to do so because either:

- they own or lease a water entitlement that authorises the holder to take water subject to certain conditions, or
- they have secured access within a water year by way of a seasonal water assignment from the owner of a water access entitlement.

Each water entitlement in a scheme belongs to a "priority group" which is defined under the Water Act 2000 to mean water allocations that have the same water allocation security objective.[1]

A water entitlement's priority group is important both in:

- determining the volume of water that may be made available to the water entitlement under the scheme's water sharing rules, and
- identifying the conditions under which supply to that water may be allowed or restricted.

These rules and other operational requirements are defined in statutory catchment-based Resource Operations Licence (ROLs) and Operations Manual (OMs) which are prepared by the Department of Natural Resources, Mines and Energy (DNRME) and approved by the Governor-in-Council in accordance with Water Resource Plan provisions under the Water Act 2000.

The performance, numbers, types and names of priority groups differ between each of the water supply schemes reflecting the unique arrangements that have been defined within the applicable ROP. Most schemes have just two water entitlement priority groups, namely High Priority, and Medium Priority[2] although some schemes have just one priority group (Julius Dam WSS) and others may have as many as five (Upper Condamine WSS).

Generally, the water sharing rules within the OM provide a holder of a high priority water entitlement with superior access to the nominal volume[3] specified on their water entitlement. That is, a holder of a high priority water allocation will usually be able to access a quantity of water equal to their nominal volume more frequently and with less restriction on their water availability than the holder of a water entitlement within a medium or other lesser priority group.[4]

This superior performance is achieved through a number of mechanisms including:

- sharing rules that give high priority water entitlements first access to available water
- reserve volumes that specify volumes of stored water to be set aside for future use by high priority water entitlements.

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1 A water allocation security objective (WASO) is based on the probability of being able to obtain water. Target values of WASO (usually in terms of minimum mandatory values and/or target ranges) are specified in a Water Resource Plan for each priority group of water entitlements within a catchment.

2 Although the names of priority groups generally give an indication of their relative access to water supplies within a scheme, this is not always the case, particularly in supplemented groundwater schemes where both groundwater and surface water allocations exist.

3 The term "nominal volume" is defined in the Act to mean "the number used to calculate the allocation's share of the water available to be taken by holders of water allocations in the same priority group".

4 Exceptions to this may occur in some supplemented groundwater schemes where medium priority allocations accessing groundwater and surface water supplies may be able to access water supplies more often than high priority water allocations that are entirely reliant on surface water supplies.

- storage cut-off rules that restrict access to water supplies by medium priority water entitlements once water storage levels fall below defined levels.

In addition, there may be Critical Water Supply Arrangements (CWSAs)[5] that, once triggered, effectively replace the "normal" water sharing rules and other operational requirements during extended drought periods. The CWSAs therefore give further priority to reserving or allocating dwindling supplies to high priority entitlements. In such situations, environmental flow provisions are also typically suspended by the CWSAs. These arrangements mean that medium priority entitlement holders may be cut off from accessing stored water supplies for extended periods of time during extended droughts, while high priority entitlement holders continue to access the water stored by the headworks.

In very severe water shortage situations, the Minister may exercise powers under the Water Act to disallow all water entitlements from accessing water, and restrict water use to "essential" purposes only (such as domestic/drinking, power generation etc.).

When to use Headworks Utilisation Factors?

The Headworks Utilisation Factors are used to apportion headworks-related costs in accordance with the benefit or "level of service" attributable to each water entitlement priority group.

The discussion in the previous section regarding water sharing arrangements illustrates how high priority water entitlement holders clearly derive more benefit from bulk water infrastructure than other lesser priority water entitlement holders. Indeed, the proportion of the overall benefit derived from storage headworks by high priority water entitlements is typically greater than their proportion of the total nominal volume of entitlements in a scheme. In other words, the benefits derived from bulk water assets are not shared uniformly between all water entitlements.

It follows that high priority water entitlements should therefore be apportioned a share of the storage assets that is proportionate to this increased utilisation.

Headworks Utilisation Factors are defined as "the percentages of a scheme's storage headworks volumetric capacity able to be utilised by each priority group of water entitlements in that scheme, taking into consideration:

- the application of operational requirements, water sharing rules and Critical Water Supply Arrangements associated with the relevant Water Planning instruments; and
- the probability of utilisation of the scheme storages under conditions of relative supply shortage".

A Headworks Utilisation Factor does not represent a priority group's proportional share of a scheme's overall "hydrologic yield" nor reflect any proportional demand for – or usage of – operational services. In general, the HUF allocates a greater proportion of capital costs to high priority due to a more detailed assessment of the storage required to service high priority entitlements.

For supplemented water supply schemes, the benefit derived from bulk water assets essentially relates to the ability of the storage headworks to store flows during wet periods and then subsequently make releases during dry periods and combine with (i.e. supplement) natural flows within a scheme thereby ultimately meeting the water demands of water entitlement holders.

Headworks Utilisation Factors specifically exclude water entitlement groups that are not included in the scheme's water sharing rules thereby deriving little or no benefit from the scheme's bulk water infrastructure (e.g. "risk-A priority" in some schemes).

[5] CWSAs are approved by DRDMW in accordance with processes and requirements established within OMs.

Water Management Protocol Conversion Factors

It should also be noted that a few Water Plans or related water planning instruments contain "conversion factors". Conversion factors represent the rate at which medium priority water entitlements may be converted to high priority water entitlements and vice versa. However, where conversion factors are specified, there are also limits placed on the maximum volumes of each priority group of water entitlements that may exist at any one time. These limits are usually very restrictive.

Conversion factors and their associated restrictive limits are designed to allow for limited conversion from one priority group to another without causing unintended third-party impacts on either the performance of other water entitlements or on riverine environmental flow regimes.[6] The conversion factors are not designed for apportioning bulk water asset costs between different priority groups of water entitlements within a scheme.

When not to use Headworks Utilisation Factors

It is appropriate at this point to advise caution against the broad-scale adoption of HUF's as the basis of the allocation of other non-headworks and non-asset related headworks costs.

Bulk water operational costs are not related to extent to which storage headworks volumetric capacity is able to be utilised by a priority group of water entitlements. Such costs are driven by operational elements such as scheduling and delivering water, meter reading and maintenance, environmental management obligations, data management, compliance reporting, customer support and billing.

Such functions relate to the entire bulk water scheme (including those only accessing a share of natural flows) and not just the headworks. Furthermore, these costs will not change if the amounts of high or medium priority entitlements in a scheme change.

A.2 Methodology

Overview

The following section provides a detailed step-by-step guide to the approach for deriving Headworks Utilisation Factors. This approach may be summarised as involving the following main steps:[7]

1. **Identify the water entitlement groupings** – for each water supply scheme, establish which water entitlement priority groups are to be considered in the "high priority" versus "medium priority" groupings for the purposes of this analysis.

   In most schemes where there are high and medium water entitlement priority groups this step is straightforward. However, in some schemes there are more than two types of priority groups with a variety of names, some of which may (for the purposes of this analysis) utilise scheme headworks to a similar extent and therefore may be assembled together under either the high or medium priority group.

   The conditions attached to some other water entitlement priority groups may be such that they utilise storage headworks to either little or no extent (such as those entitlements with access that is wholly conditional on the existence of run of river flows) and therefore excluded from the analysis (and assigned a HUF of zero).

[6] The criteria and mandatory performance standards for assessing such impacts are specified in terms of Water Allocation Security Objectives and Environmental Flow Objectives within Water Resource Plans.

[7] For water supply schemes where continuous sharing has been implemented through a ROL (viz. St George and Macintyre Brook Water Supply Schemes, steps 1 through 4 do not apply because the volumes of headworks storage attributable to each water entitlement priority group can be directly inferred from the Continuous Share Volumes stated in the relevant OM).

2. **Determine the volumes of the identified water entitlement groupings** – for each water entitlement grouping that has been identified in a water supply scheme, establish the total volume of water entitlements included in each grouping.

   Again, for most schemes this step is straightforward with the volume simply being equivalent to the total nominal volume of the relevant water entitlement priority group (or groups, where more than one has been assembled together under one grouping).

   However, some Water Plans provide for the conversion of limited volumes of water entitlements from medium priority to high priority using a conversion factor. Where this is the case, the analysis takes account of this by setting the high priority nominal volume to the maximum allowable under the rules and calculating the reduced medium priority nominal volume by applying the conversion factor.

   This step ensures that the headworks utilisation factors take account of the effect of converting medium priority water entitlements to high priority water entitlements.

3. **Determine the extent to which water sharing rules, critical water sharing rules and other operational requirements give the different water entitlement priority groups exclusive or shared access to components of storage capacity** – the rules and requirements are analysed to establish the (bottom) volume of storage that is effectively reserved for supplying high priority water entitlements, the (next) volume of storage (above that effectively reserved for high priority) that is available for use by medium priority water entitlements, and the (top) volume of storage shared between priority groups. This is shown conceptually in the following section.

   Examples of rules and requirements that influence these volumes include the water sharing (i.e. announced allocation) rules, split/joint sub-scheme provisions, critical water supply arrangements (including storage cut-off and trigger rules), and other Water Plan requirements relating to instream storage infrastructure operations including discharge release rules, low-flow environmental release requirements, hydro release rules as well as inter-storage water level management requirements.

4. **Assess the hydrologic performance of each component of headworks storage** – Water Plan based hydrologic models (based on Integrated Quantity Quality Models or IQQM) are used to assess the probabilities of each component of headworks storage being accessible to the relevant water entitlement priority group during periods of relative supply shortage. These probabilities are used to determine the volumes of components of headworks storage effectively utilised by different water entitlement priority groups.

   This is an important step because the probability of the lower layers of the headworks storage storing water is likely to be greater than the probability of upper layers of headworks storage storing water. This in turn means that high priority water entitlements effectively have access to – and therefore are able to utilise – headworks storage capacity more often and with less restriction than medium priority water entitlements.

   Probabilities were derived by extracting the modelled headworks storage levels for the driest contiguous fifteen-year critical period (the "standard period"). Recent storage levels actually observed were also checked for the driest fifteen-year period. A fifteen-year period was considered an appropriate duration for the purposes of this analysis and is consistent with short and medium term planning periods used in contemporary climate scenario modelling in Australia.[8] A fifteen-year period is also representative of the typical horizon over which irrigation enterprises plan for and base their business investment decisions.

1. **Determine the Headworks Utilisation Factors** – using the parameters established and derived in steps 1 to 4 above, calculate the Headworks Utilisation Factors for each of the medium and high priority water entitlement groups.

[8] See Chiew FHS, Cai W and Smith IN, 2009. Advice on defining climate scenarios for use in Murray-Darling Basin Authority Basin Plan modelling, CSIRO report for the Murray-Darling Basin Authority.

In some instances, water sharing rules are common to two water supply schemes (such as the Lower Fitzroy and Fitzroy Barrage Water Supply Schemes) or to water entitlement priority groups arising from specific headworks infrastructure within a scheme (such as pre-existing and new groups of water entitlements in the Bundaberg Water Supply Scheme). In such cases, Headworks Utilisation Factors are disaggregated and apportioned to the relevant headworks storage capacity.

In those schemes where different priority groups of water entitlements were (for the purposes of analysis) assembled together under either the "high" or "medium" priority group, the Headworks Utilisation Factors are disaggregated in proportion to the nominal volumes of the priority groups that were assembled together

A sensitivity analysis was undertaken to assess the effect of changing the duration of the standard period by performing HUF calculations using both ten year and twenty year critical periods. The summary results of the sensitivity analysis was presented in the original version of this methodology.

For the calculations using a ten year critical period, the HUFmp in 15 schemes (out of a total 23 schemes) varied by 2% or less from the HUFmp calculated using the standard 15 year critical period. Twenty-two schemes varied by less than 10% from the standard period results and only one scheme varied by greater than 10% (16%).

For the calculations using a twenty-year critical period, the HUFmp in 17 schemes varied by 2% or less from the HUFmp calculated using the standard 15 year critical period. Twenty-two schemes varied by less than 10% from the standard period results and only one scheme varied by greater than 10% (12%).

A.3 Guide to determining the Headworks Utilisation Factor

Identify the water entitlement groupings

1. Establish the existing volumes of the highest (typically described as high) priority group of water entitlements
    a. Referenced from DRDMW's water entitlement register
    b. Usually equivalent to the nominal volume of high priority water entitlements (with any exceptions to be noted)
    c. = "HPA"
2. Establish the existing volume of the second highest (typically described as medium) priority group of water entitlements
    a. Usually equivalent to the nominal volume of medium priority water entitlements (with any exceptions to be noted)
    b. Where more than two priority groups of water entitlements exist in a scheme, the purpose, water sharing rules and other characteristics differentiating the groups are taken into account in determining whether to include them in the HPA, MPA or neither group
    c. = "MPA"

Determine the volumes of the identified water entitlement groupings

1. Establish the medium priority to high priority conversion factor (if applicable)
    a. Only applicable where a includes a medium priority to high priority water entitlement conversion factor
    b. = "CF"
    c. Note that CF is normally specified in terms of a number greater than one, where 1 ML high priority is worth (1* CF) ML medium priority. In some ROPs the CF is specified as less than one (e.g. Section 22 Burdekin Basin Water Management Protocol where CF= 0.565), in which case 1 ML high priority is worth (1/ CF) ML medium priority
    d. Also note that some Water Plans allow conversion in both directions i.e. medium to high and vice versa. However, the current water market trend is for conversion from medium to high and hence this approach has been adopted for the purposes of this HUF analysis.
2. Determine the maximum volume of high priority water entitlement that can exist (if applicable)
    a. Only different from HPA where a Water Planning instrument specifies the maximum allowable volume of high priority entitlements that may be converted from medium priority water entitlements in a scheme
    b. = "HPA max"
3. Determine the volume of medium priority water entitlements corresponding to the maximum volume of high priority water entitlements determined above (if applicable).
    a. (if applicable) based on reducing the volume of medium priority water entitlements by the volume of the increase in high priority water entitlements multiplied by the conversion factor
    b. = "MPA min" = MPA – (HPA max – HPA) x CF (or x 1/CF for those ROPs that specify the CF as a number less than 1)

Determine exclusive or shared access of water entitlement groupings

1. Determine the volume of scheme storage below which the water sharing rules effectively make water unavailable to medium priority water entitlements by reserving for high priority entitlements

a. Calculated as the minimum storage volume in the scheme above which medium priority announced allocation is greater than 0% at the commencement of the water year

b. Calculation based on applying water sharing rules to HPA max ML of high priority water entitlements and MPA min ML of medium priority water entitlements, with previous year's carryover and projected inflows both assumed to be zero

c. = "MP0 AA"

2. Check existence of any critical water supply arrangements, storage cut-off rules or other operational requirements likely to increase the volume effectively reserved for high priority entitlements (and therefore unavailable to medium priority water entitlements)

a. Despite the "normal" water sharing rules, the critical water supply arrangements or other operational rules may increase the storage volume below which access to medium priority water entitlements is effectively cut-off;[9]

b. Where future (non pass-through) low-flow environmental release provisions, hydro releases or other reserve volumes outlined in a ROL are not explicitly or fully included as a term in the water sharing rules, the total volume of the required release is added to the volume effectively reserved for high priority entitlements and therefore unavailable to medium priority water entitlements;

c. = "MP0"

3. Determine the minimum volume of scheme storage required before water sharing rules effectively give medium priority water entitlements maximum water availability

a. Calculated as the minimum storage volume in the scheme at which medium priority announced allocation is at a maximum (usually 100%) at the commencement of the water year

b. Calculation again based on applying water sharing rules to HPA max ML of high priority water entitlements and MPA min ML of medium priority water entitlements, with previous year's carryover and projected inflows both assumed to be zero

c. = "MP100 AA" (cannot exceed scheme full supply volume)

4. Check existence of any operational requirements likely to increase the minimum volume of scheme storage required before water sharing rules effectively give medium priority water entitlements maximum water availability

a. Despite the "normal" water sharing rules, the critical water supply arrangements or other operational rules may increase the storage volume at which medium priority water entitlements can access their full water availability;

b. = "MP100" (cannot exceed scheme full supply volume)

5. Establish full supply volume of the major headworks storages in the scheme

a. Generally equivalent to the cumulative full supply volume of the major headworks storage/s (dam/s and weir/s) in the scheme. Note that the storage volumes of downstream weirs are included in the HUF analysis only when these are specifically included in the relevant ROL (or IROL) water sharing rules

b. Where there is no major dam in a scheme, the sum of the full supply volumes of the weirs is used (such exceptions should be noted)

c. = "FSV hwks"

6. Establish dead storage volume of the major headworks storage in the scheme

[9] In the case of the Pioneer Valley Water Supply Scheme, the water sharing rules provide some access to high-B priority water entitlements below the level at which high-A priority announced allocations equal 100%.

a. Generally equivalent to the cumulative dead storage volume of the major headworks storage/s (dam/s and weir/s) in the scheme

b. Where there is no major dam in a scheme, the sum of the dead storage volumes of the weirs is used (such exceptions should be noted)

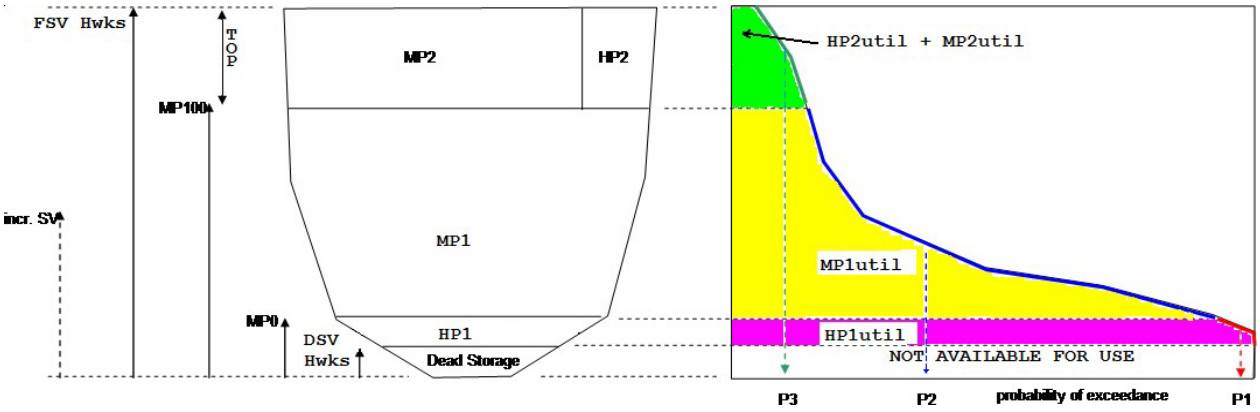
c. = "DSV hwks"

7. Calculate the capacity volume of the bottom horizontal layer of the headworks storage effectively reserved for high priority

a. Figure 1 shows conceptual breakdown and apportionment of headworks storage capacity

b. = "HP1" = MP0 - hwks

Figure 1 Relationship between parameters used in the calculation of Headwords Utilisation Factors



8. Calculate the capacity volume of the next horizontal layer of the headworks storage effectively available for medium priority

a. See Figure 1

b. = "MP1" = minimum of { (MP100 – MP0) and (FSV hwks – MP0) }

9. Calculate the capacity volume of the top horizontal layer of the headworks storage effectively available for sharing between medium and high priority

a. = "TOP" = maximum of { (FSV hwks-MP100) , 0 }

b. The top layer is apportioned between medium and high priority in the same proportions as the respective nominal volumes of each priority group used in the above analysis[10]

10. Calculate the proportion of the capacity volume of the top horizontal layer of the headworks storage effectively available for high priority

a. See Figure 1

b. = "HP2" = HPAmax/(MPAmin+HPAmax) x TOP

11. Calculate the proportion of the volume of the top horizontal layer of the headworks storage effectively available for medium priority

a. See Figure 1

b. = "MP2" = MPAmin/(MPAmin+HPAmax) x TOP

[10] This incorporates changes to the original methodology as recommended by the QCA in 2011.

Assess the hydrologic performance of each component of headworks storage

1. For each water supply scheme, extract multiple 15 year sequences of combined daily storage volume data (for those dams and weirs referred to in the scheme's water sharing rules) starting each of the 15 year sequences on the first day of the water year (defined in the corresponding ROL) from:
    a. The long-term IQQM simulation of the scheme under the current ROL conditions; and
    b. The recent recorded daily storage data (if available) which mostly corresponds to the last 30- 40 years.

    Then for each of these fifteen year sequences, calculate (b) through (j) below.
2. Assess the probability of the headworks storage being in the bottom (high priority) horizontal layer of the headworks storage volume
    a. = "P1"
3. Assess the probability of the headworks storage being in the next (medium priority) horizontal layer of the headworks storage volume
    a. = "P2"Assess the probability of the headworks storage being in the top (shared medium and high priority) horizontal layer of the headworks storage volume
    b. = "P3"
4. Determine the utilised volume of the bottom horizontal layer of the headworks storage by applying the high priority probability for that bottom layer
    a. = "HP1util" = HP1 x P1
5. Determine the utilised volume of the next horizontal layer of the headworks storage by applying the medium priority probability in that next layer
    a. = "MP1util" = MP1 x P2
6. Determine the utilised proportion of the volume of the top horizontal layer of the headworks storage effectively available for high priority, by applying the high priority probability in that top horizontal layer
    a. = "HP2util" = HP2 x P3
7. Determine the utilised proportion of the volume of the top horizontal layer of the headworks storage effectively available for medium priority, by applying the medium priority probability in that top horizontal layer
    a. = "MP2util" = MP2 x P3

Determine the Headworks Utilisation Factors

1. For each of the fifteen-year sequences analysed in Step 4, calculate the medium priority and high priority Headworks Utilisation Factors
    a. = "HUFmp" = (MP1util + MP2util) / (MP1util + MP2util + HP1util + HP2util) %
2. Set the HUFmp to equal the minimum of these HUFmp values. Note that the adopted 15 year critical period may not always correspond to the driest rainfall period due other factors such as OM rules, headworks water storage levels at the start of the water year, etc. The adopted period exceedance curves for the headworks storages in each scheme should be documented.
3. Calculate the high priority Headworks Utilisation Factor
    a. "HUFhp" = 1 – HUFmp
4. (If applicable) Disaggregate the Headworks Utilisation Factors to apportion subsets of water priority water entitlements to the relevant headworks storage capacity (such exceptions should be noted where applicable). For example:

a. The overall HUF results for **Bundaberg WSS** are disaggregated into two separate sets of results:

   (i) water allocations associated with the original scheme (pre Paradise Dam); and

   (ii) water allocations associated with Burnett Water Pty Ltd (based on Paradise Dam)

   For Bundaberg WSS, the process of disaggregation is simply based on an apportioning of the overall scheme HUF factors each into two components on the basis of the water allocation volumes in the relevant grouping (SunWater vs. Burnett Water). A similar approach is used for the Upper Burnett WSS since it also has infrastructure owned by Burnett Water Pty Ltd.

b. The operational rules outlined in the Fitzroy Basin ROL necessitated the calculation of overall HUF results for the combined Lower Fitzroy and Fitzroy Barrage schemes. The overall HUF results were then disaggregated so that only the results for the water allocations in the **Lower Fitzroy WSS** (operated by SunWater) are provided. Results for Fitzroy Barrage WSS (operated by Fitzroy River Water) are not provided.

   For the Fitzroy, the process of disaggregation is simply based on an apportioning of the combined Lower Fitzroy WSS and Fitzroy Barrage WSS HUF factors each into two components on the basis of the water allocation volumes in the relevant water supply scheme.

Adjustment to Headworks Utilisation Factor Method to address 'within water-year headworks storage cut-off rules'

Alternative steps should be taken to address the situation where a water supply scheme's water sharing rules are subject to "within water-year headworks storage cut-off rules" (i.e. 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).

Explicit cut-off rules within scheme sharing rules have been found to 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). For example, this occurs in:

- the Upper Condamine (Leslie Dam)
- the Boyne Tarong (Boondooma Dam)

In these schemes, the water utility may develop arrangements for allowing a start-of-water-year announced allocation to be made that applies for a period of less than 12 months. These arrangements are applied when forecasts suggest that the headworks cut-off levels are likely to be reached within the coming water year. This suggests that in such instances, headworks utilisation is effectively being shared between high and medium priority water allocations within a definable band of storage volume values.

It is therefore recommended that the HUF methodology be adjusted to recognise this band of shared benefit as follows:

1. calculate the maximum headworks storage volume at the start of a water year below which the headworks storage volume is forecast to reach the medium priority cut-off level on the last day of that water year (referred to here as MP0-nominal or "MP0 nom'). It is suggested that water utilities might use either their forecast storage models to estimate this volume, by assuming minimum inflows throughout the water year and other assumptions as published online for the relevant dam forecast storage model (e.g. Leslie Dam Storage Forecast Model or the Boondooma Dam Storage Forecast Model) or historical storage drawdown information where forecast models are not available. If the value of MP0-nom is greater than MP0 AA, then proceed with the following steps to calculate the adjusted HUFs (if not, then no adjustment is recommended to the existing HUF calculations):

   a. Set MP0 = MP0 AA;

   b. Calculate MP100 AA and MP100 in the usual way;

   c. Record FSV Hwks and DSV Hwks in the usual way;

d. Calculate HP1 in the usual way;

e. Calculate MP2 and HP2 in the usual way;

f. Calculate MP1-B to = MP100 – MP0 nom;

g. Calculate MP1-A to = 0.5 x (MP nom – MP0);

h. Calculate HP1-A to = 0.5 x (MP nom – MP0);

i. Calculate P1 and P3 in the usual way

j. Calculate P2-A and P2-B for the ranges between MP0 to MP0 nom and MP0 nom to MP100 respectively

k. Calculate MP2util, HP2util and HP1util in the usual way

l. Calculate MP1-Autil to = MP1-A x P2-A

m. Calculate HP1-Autil to = HP1-A x P2-A

n. Calculate MP1-Butil to = MP1-B x P2-B

o. Calculate MPA = (MP2util + MP1-Autil + MP1-Butil) /

p. (MP2util + MP1-Autil + MP1-Butil + HP2util + HP1util + HP1-Autil) x 100%

q. Calculate HPA = (HP2util + HP1util + HP1-Autil) /

r. (MP2util + MP1-Autil + MP1-Butil + HP2util + HP1util + HP1-Autil) X 100%

s. Disaggregate into priority groups in the usual way.

2. Note that the reserve (RE) parameters used in calculating MP0 AA values should be those published in the OM (i.e. not modified to be the cut-off volumes).

3. The new MP0 nom volume represents the start-of-water-year headworks volume below which:

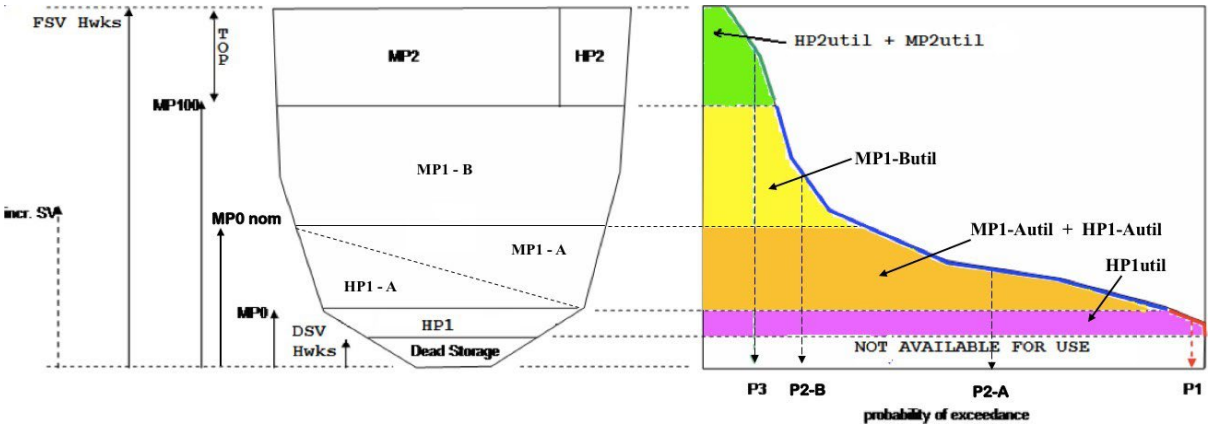
   a. supply of a twelve-month period medium priority announced allocation might be considered to be at risk of being cut-off during the water year as a result of the headworks storage volume reaching the medium priority cut-off level during that water year;

   b. sharing arrangements would apply whereby a start-of-water-year announced allocation would be made that would apply for a period of less than 12 months

4. Supply to medium priority announced allocation might be considered unlikely to be cut-off during the water year in years when the start-of-water-year headworks volume is above the new MP0 adjustment volume.

5. A revised conceptual diagram that describes the above is presented in Figure 2below.

Figure 2 Relationship between parameters used in the calculation of Headworks Utilisation Factors for situations where in a 'in-year MP cut-off rule' applies



Attachment B

Review of Headworks Utilisation Factor considerations for the 2025 price path

Comparison of Headworks Utilisation Factor considerations, 2018–2023

Water Supply Scheme	Water Entitlement Groupings		Exclusive and shared access of storage capacity		Hydrological Performance (Simulation Period)		Review Recommended	Comments
	2018	2023	2018	2023	2018	2023		
Barker Barambah WSS	Medium Priority (32079 ML)	Medium Priority (32079 ML)		No change from 2018	1890-2008	No change	û	• No significant change
	High Priority (2236 ML)	High Priority (2236 ML)			New IQQM due to revision of Water Plan (Burnet Basin) 2014			
Bowen Broken WSS	Medium Priority (5676 ML)	Medium Priority (5676 ML)		No change from 2018	1890-2004	No change	û	• No significant change
	High A1 Priority (11649 ML)	High A1 Priority (11649 ML)						
	High A2 Priority (21605 ML)	High A2 Priority (21605 ML)						
Boyne River and Tarong WSS	Medium Priority (9485 ML)	Medium Priority (9485 ML)		No change from 2018	1890-2008	No change	û	• No significant change
	High Priority (33920 ML)	High Priority (33920 ML)			New IQQM due to revision of Water Plan (Burnett Basin) 2014 (Qld)			
Bundaberg WSS	Medium Priority (335957 ML)	Medium Priority (252597 ML) [Quarantined MP of 83,360 ML due to Paradise Dam Improvement Project]	• Bucca Weir release rule amended to approximately 484 ML/year • New water sharing rules • 1 July High Priority reserve of 44372 ML	Reduced Paradise Dam Full Supply Level (61.8 mAHD)	1890-2008	1890 - 2008	û	• No *permanent* significant change • Temporary changes listed below are expected to revert to pre-reduction status during the 2025 price path period • New (**temporary**) water sharing rules to represent quarantined water due to the Dam Improvements Project (DIP)

Water Supply Scheme	Water Entitlement Groupings		Exclusive and shared access of storage capacity		Hydrological Performance (Simulation Period)		Review Recommended	Comments
	2018	2023	2018	2023	2018	2023		
	High Priority (44372 ML)	High Priority (27,221 ML) [Quarantined MP of 17,151 ML due to Paradise Dam Improvement Project]				New IQQM due to lowering of the Paradise Dam Full Supply Level due to the Dam Improvement Project		• Reduced (**temporary**) full supply volume of Paradise Dam
Burdekin Haughton WSS	Medium Priority (979594 ML) High Priority (99998 ML)	Medium Priority (979594 ML) High Priority (99998 ML)		No change from 2018	· 1890-2004	No change	û	• No significant change
Callide Dam WSS	Medium Priority Groundwater (13558 ML) High B Priority (1066 ML) Risk Priority Surface water (514) High A Priority Surface water (4311 ML)	Medium Priority Groundwater (13558 ML) High B Priority (1066 ML) Risk Priority Surface water (514) High A Priority Surface water (4311 ML)		No change from 2018	· 1889-2007 · New IQQM due to revision of Water Plan (Fitzroy Basin) 2011	No change	û	• No significant change
Chinchilla Weir WSS	Medium Priority (2884 ML) High Priority (1165 ML)	Medium Priority (2884 ML) High Priority (1165 ML)		No change from 2018	· 1895-2006	· 1889-2013 New eWater Source model due to the revision of Water Plan (Condamine Balonne) 2019	ü	• Model simulation period has changed • New eWater Source hydrologic model
Cunnamulla WSS	Medium Priority (2612 ML) High Priority (0 ML)	Medium Priority (2612 ML) High Priority (0 ML)		No change from 2018		No change	û	• Scheme is all Medium Priority

Water Supply Scheme	Water Entitlement Groupings		Exclusive and shared access of storage capacity		Hydrological Performance (Simulation Period)		Review Recommended	Comments
	2018	2023	2018	2023	2018	2023		
Dawson Valley WSS	Medium Priority (36719 ML) Medium A Priority (19339 ML) High Priority (5679 ML)	Medium Priority (36719 ML) Medium A Priority (19339 ML) High Priority (5679 ML)		No change from 2018	· 1889-2007 · New IQQM due to revision of Water Plan (Fitzroy Basin) 2011	No change	û	• No significant change
Eton WSS	High A Priority (3089 ML) High B Priority (58970 ML) Risk (504 ML)	High A Priority (3089 ML) High B Priority (58970 ML) Risk (504 ML)			· 1890-1996	No change	û	• No significant change
Lower Fitzroy WSS	Medium Priority Lower Fitzroy WSS (3101 ML) Medium Priority Fitzroy Barrage WSS (11610 ML) High Priority Lower Fitzroy Barrage (25520 ML) High Priority Fitzroy Barrage WSS (50483 ML)	Medium Priority Lower Fitzroy WSS (3101 ML) Medium Priority Fitzroy Barrage WSS (11610 ML) High Priority Lower Fitzroy Barrage (25520 ML) High Priority Fitzroy Barrage WSS (50483 ML)		No change from 2018	· 1889-2007	No change	û	• No significant change
Macintyre Brook WSS	Medium Priority (24509 ML) High Priority (488 ML)	Medium Priority (24509 ML) High Priority (488 ML)		No change from 2018		· 1889-2013 New eWater Source model due tot the revision of Water Plan (Border Rivers and Moonie) 2019	û	• No significant change
Mareeba Dimbulah WSS	Medium Priority (190399 ML) High Priority (14026 ML)	Medium Priority (190399 ML) High Priority (14026 ML)		No change from 2018	· 1913-1995	1889 - 2019 New eWater Source model due to the	ü	• New Water Plan due July 2023 which results in:

Water Supply Scheme	Water Entitlement Groupings		Exclusive and shared access of storage capacity		Hydrological Performance (Simulation Period)		Review Recommended	Comments
	2018	2023	2018	2023	2018	2023		
						revision of Water Plan (Barron) (DRAFT) – due July 2023		• Model simulation period has changed • New eWater Source hydrologic model due July 2023
						Represents 11,508 ML of MP type 'Loss' as MP type 'Any'		An application to change the purpose of distribution losses (MP type "loss") to purpose any (MP type "any") has been submitted to DRDMW for assessment. Because the allocations are both Medium Priority, this does not impact the total nominal volumes used as an input to the water sharing rules
Maranoa WSS	Medium Priority (805 ML) High Priority (0 ML)	Medium Priority (805 ML) High Priority (0 ML)		No change from 2018			û	• · All medium priority
Lower Mary River WSS	Medium Priority (32650 ML) High Priority (1809 ML)	Medium Priority (32650 ML) High Priority (1809 ML)		No change from 2018	· 1890-1999	No change from 2018	û	• New water sharing rules
Nogoa Mackenzie WSS	Medium Priority (185732 ML) High Priority (46127 ML)	Medium Priority (185732 ML) High Priority (46127 ML)		No change from 2018	· 1889-2007 · New IQQM due to revision of Water Plan (Fitzroy Basin) 2011	No change from 2018	û	• No significant change
Pioneer River WSS	High B Priority (47357 ML) High A Priority (30753 ML)	High B Priority (47357 ML) High A Priority (30753 ML)		No change from 2018	· 1900-2008	No change from 2018	û	• No significant change
Proserpine River WSS	Medium A1 Priority (27876 ML) Medium A2 Priority (3000 ML)	Medium A1 Priority (27876 ML) Medium A2 Priority (3000 ML)		No change from 2018	1890-2004	No change from 2018	û	• No significant change

Water Supply Scheme	Water Entitlement Groupings		Exclusive and shared access of storage capacity		Hydrological Performance (Simulation Period)		Review Recommended	Comments
	2018	2023	2018	2023	2018	2023		
	Medium A3 Priority (10000 ML) High A Priority (22000 ML)	Medium A3 Priority (10000 ML) High A Priority (22000 ML)						
St George WSS	Medium Priority (81575 ML) High Priority (3000 ML)	Medium Priority (81575 ML) High Priority (3000 ML)					û	• Continuous sharing scheme • No significant change
Three Moon Creek WSS	Medium Priority Surface Water (1940 ML) Medium Priority Groundwater (12621 ML) High Priority Groundwater (580 ML)	Medium Priority Surface Water (1940 ML) Medium Priority Groundwater (12621 ML) High Priority Groundwater (580 ML)		No change from 2018	· 1890-2008	No change from 2018	û	• No significant change
Upper Burnett WSS	Medium Priority (34991 ML) Low Priority (10469 ML) High Priority (1530 ML)	Medium Priority (34991 ML) Low Priority (10469 ML) High Priority (1530 ML)		No change from 2018	· 1890-2008 · New IQQM due to revision of Water Plan (Burnett Basin) 2014	No change from 2018	û	• No significant change
John Goleby WSS	Medium Priority (1560 ML) High Priority (0 ML)	Medium Priority (1560 ML) High Priority (0 ML)		No change from 2018		No change from 2018	û	• All medium priority
Upper Condamine WSS	Medium Priority (22328 ML) High A Priority (3262 ML) High B Priority (125 ML) Risk A Priority (7320 ML) Risk B Priority (925 ML)	Medium Priority (22328 ML) High A Priority (3262 ML) High B Priority (125 ML) Risk A Priority (7320 ML) Risk B Priority (925 ML)		New water sharing rules for MP users	· 1895-2006	1889-2013 New eWater Source model due to the revision of Water Plan (Condamine Balonne) 2019	ü	• Model simulation period has changed • New water sharing rules for Medium Priority users • New eWater Source hydrologic model