INDEPENDENT REVIEW OF THE QUEENSLAND METHOD AND PLANNING ASSUMPTIONS FOR LONG TERM DIVERSION LIMIT EQUIVALENCE (LTDLE) FACTORS FOR SURFACE WATER and GROUNDWATER ENTITLEMENTS IN THE MURRAY-DARLING BASIN

The Independent Review Panel

Garry Smith and Paul Simpson

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Contents

List of Abbreviations

BDL	Baseline Diversion Limit
CCA	Upper Condamine Alluvium (Central Condamine Alluvium)
DES	Department of Environment and Science - Queensland
DNRME	Department of Natural Resources, Mines and Energy - Queensland
IQQM	Integrated Quantity Quality Model
LTDLE factor	Long Term Diversion Limit Equivalence factor
MDBA	Murray Darling Basin Authority
RRAM	Recharge Risk Assessment Method
SDL	Sustainable Diversion Limit
Tribs	Upper Condamine Alluvium (Tributaries)
UCA	Upper Condamine Alluvium
WRP	Water Resource Plan

Summary

This is an independent review of the planning assumptions and the calculation methodologies used by Queensland to determine their Long Term Diversion Limit Equivalence (**LTDLE**) factors.

The LTDLE factors are important because they provide a mechanism for apportioning the long-term limits on water use for the Sustainable Diversion Limit (**SDL**) resource unit to each licensed entitlement (or class of entitlements) to water.

Consequently, these factors are a key basis for determining whether past and future water recovery under the Basin Plan will 'bridge the gap' from the permitted levels of use under the BDL conditions to the permitted levels of use under the SDLs set in the Basin Plan.

Review Findings

Surface Water

Queensland have prepared revised surface water Baseline Diversion Limit (**BDL**) models using the Source modelling platform, and used the results of this modelling to determine a set of revised LTDLE factors for each relevant surface water entitlement class in the Queensland Murray-Darling Basin or, where more appropriate, for individual entitlements. The models used to support the development of these BDLs and LTDLE factors have been independently assessed as being based on the best available information and suitable for use to support development and management of WRPs in Queensland.

The methodology used to determine the LTDLE factors based on the BDL is consistent with the approach used to inform the Basin Plan, and generally with the methodology used by other states.

Queensland have provided assurance that entitlements have not substantially changed from those on issue in 2009, although there have been some minor variations to the volumes on issue arising from a range of processes including trade and conversions of licences to allocations with a nominal volume.

The methods and assumptions upon which the factors are based have been reviewed and are considered by the reviewers to be appropriate for the Queensland water resource management context and the best available at the current time.

As a result, this review endorses the LTDLE factors developed by Queensland. The factors applicable to surface water entitlement classes have been set out in the Queensland LTDLE report. For unsupplemented licences, Queensland have proposed individual LTDLE factors to better represent the unique combination of flows that arise and move past the extraction site in the catchment and the various conditions governing extraction under the entitlement. The same general principles used in supplemented systems were applied to generate individual LTDLE factors for each of these entitlements. The reviewers have inspected the data used to develop these individual factors and

confirmed that the same methodology used to develop factors for entitlement classes was also applied at the individual entitlement level. Noting that there may be further recovery in some unsupplemented systems, the reviewers are of the opinion that application of the same principles and methods will yield suitable individual LTDLE factors. Queensland DNRME has elected not to publish the LTDLE factors for individual unsupplemented water entitlements as they are considered to represent personal or water market sensitive information.

Groundwater

Queensland has used the BDL volumes in Schedule 4 of the Basin Plan as the basis for development of groundwater LTDLE factors. These BDL volumes were determined based on entitlements on issue or limits under state groundwater management rules, where these provided for extraction limits less than entitlement volumes in place in 2009. The SDL volumes were informed by numerical modelling in the heavily developed management zones of Upper Condamine Alluvium [Central Condamine Alluvium] (CCA)and supported by Recharge Risk Assessment Method (RRAM) analysis elsewhere in the CCA and in the Upper Condamine Alluvium [Tributaries] (Tribs).

The same general approach that was applied to derivation of surface water LTDLE factors was used to calculate the groundwater factors. The BDL share determined for the entitlement class was divided by the total nominal entitlement volume on issue in the system, to give an LTDLE factor for that entitlement class.

The Queensland DNRME considers all of the entitlements within each groundwater SDL resource unit to be of the same class. However, different (lower) announced annual allocations have been made for some of the heavily developed management zones within the CCA and Tribs to address the cumulative impacts of localised pumping and respond to extreme conditions due to drought. For the heavily developed zones of the CCA, these changes largely occurred post the period where the usage component of the CCA BDL was established (2003-2008).

In the less developed zones of the CCA and the Tribs changes to announced allocations occurred from around 2005/06 onwards; however, actual use in these zones was quite low.

The adoption of a single LTDLE factor for each SDL resource unit is accepted as a reasonable overall representation of the net outcome of a complex readjustment process in these groundwater systems.

The methods and assumptions upon which the groundwater factors are based have been reviewed and are considered by the reviewers to be appropriate in the context of Queensland groundwater management for the two SDL resource units where water recovery is required, and effectively represent a consistent method to reduce the use limits across the SDL units .

1 Introduction

1.1 What are LTDLE Factors?

Water allocated to and used under the various classes of entitlement across the Basin varies according to the irrigation crops and practices in each valley, local climate, and water management rules. Long Term Diversion Limit Equivalence (**LTDLE**) factors provide a conversion between the "face value" or nominal volume of a water entitlement and the long-term average water use limit applying to that entitlement over the reference period used to develop the Basin Plan (1895 – 2009). LTDLE factors are generally specific for an entitlement class within each SDL resource unit for which water resource plans (**WRP**s) are being prepared under the Basin Plan.

This is an independent review of the planning assumptions and the calculation methodologies used to determine the LTDLE factors for all Queensland SDL resource units where water recovery was required, which comprise the:

Surface water SDL resource units:

- Condamine-Balonne
- Queensland Border Rivers
- Moonie
- Warrego
- Nebine
- Paroo

Groundwater SDL resource units:

- Upper Condamine Alluvium (Central Alluvium)
- Upper Condamine Alluvium (Tributaries)

These LTDLE factors have been prepared by the Queensland Department of Natural Resources, Mines and Energy (**DNRME**), utilising modelling undertaken by the Department of Environment and Science (**DES**).

1.2 Why are LTDLE Factors Required?

The Basin Plan sets new Sustainable Diversion Limits (**SDL**s) for major river valleys and groundwater systems across the Murray-Darling Basin. For surface water these SDLs are set relative to a Baseline Diversion Limit (**BDL**), which is defined by the Basin Plan for most valleys as the diversions that could be taken under existing state arrangements on 1 July 2009. For Queensland Murray-Darling Basin valleys, the BDL is equivalent to the agreed level of diversions under the Murray-Darling Basin Ministerial Council Cap on diversions. In some Queensland valleys, current levels of use are below

the BDL, which means that some growth in use is permissible under the existing Cap, and also under future SDLs.

For groundwater systems, BDLs were determined based on entitlements on issue or limits under current or proposed state groundwater management plans or rules, where these provided for extraction limits less than entitlement volumes (refer also to Section 2.4.2).[1] SDLs were set based on the environmentally sustainable level of take from the resource unit based on the best available information.

To implement these SDLs, the Commonwealth has committed to recover water from consumptive users by purchasing entitlements and to fund water savings projects, with the aim of reducing the permitted long term water use to the SDL, or 'bridge the gap' from the permitted levels of use under the BDL conditions to the permitted levels of use under the SDLs set in the Basin Plan.

LTDLE factors provide the key basis for determining whether the recovered water entitlements will 'bridge the gap' between BDL and SDL in the future under the WRPs.

1.3 Existing LTDLE Factors

Prior to 2019 there have been other factors developed to reflect the conversion between a surface water entitlement and its long-term average water use limit. These factors were referred to as 'Cap Factors' as they were originally developed under conditions reflecting the 'Cap' on diversions established under Schedule E of the Murray-Darling Basin Agreement. These factors were used to calculate volumes of environmental water recovered as a result of The Living Murray (**TLM**) program.

The Murray-Darling Basin ministers approved the use of a set of LTDLE factors to estimate water recovery in 2011 (known as version 2.05 or 'v2.05' factors), which are still formally being used by the Commonwealth. Recognising that these factors could be improved, Basin ministers subsequently requested each state to bring forward appropriate factors in 2015.

For Queensland, the initial 2011 surface water factors suffered from a range of limitations and inconsistencies. They were found to be unable to accurately represent permissible water use limits at BDL levels.

For groundwater systems, two Queensland SDL resource units were the only areas across the basin where the BDL was higher than the SDL and water recovery under the Restoring the Balance program was proposed to bring usage down to SDL levels. No factors had previously been developed to assess long term average water use limits for these groundwater entitlements.

In order to address these problems, new LTDLE factors, which are the subject of this review, have been developed.

[1] Refer to "*The proposed Groundwater Baseline and Sustainable Diversion Limits: methods report"*, MDBA publication no: 16/12, Murray-Darling Basin Authority, Canberra, 2012, for further details on development of BDLs and SDLs.

1.4 Documents Examined and Review Tasks Undertaken

This review was initially commenced in March 2019. The reviewers requested additional information on a number of issues, and an updated final report addressing these issues and expanded to cover groundwater LTDLE factors was provided in March 2020. The reviewers also requested the provision of further information on groundwater LTDLE factors.

The review was undertaken based on the documents available at the time. Prior to the review commencing, the reviewers understand various discussions about Queensland's approach to the calculation of LTDLE factors took place between the Murray Darling Basin Authority (MDBA) and the Queensland government including exchange of some preliminary documentation.

The calculation of surface water LTDLE factors is primarily based on the simulation of the long-term permitted water use behaviour using various hydrologic models. The reviewers have checked the credentials of the models upon which DNRME relies to ensure they are the most recent and up to date versions that are available. As part of the development of WRPs, Queensland has developed new models using the Source modelling platform, using updated modelling methodologies and better data wherever it was available. These most recent models used have been used for the calculation of surface water LTDLE factors, but it has not been within the scope of the review to undertake an assessment of the accuracy of any of these models.

To undertake this review, the MDBA have made available a number of documents and calculation spreadsheets prepared by DNRME of which the following were the most significant:

- *Derivation of LTDLE Factors in Queensland*. Draft technical Report for submission –DNRME, Feb 2019. (**LTDLE Report**);
- *Derivation of LTDLE Factors – Queensland Murray-Darling Basin*. DNRME, Feb 2020. (**Final LTDLE Report**)[2];
- *Border Rivers – Queensland Border Rivers Model Results to Support Basin Plan Requirements,* November 2018. (**Border Rivers Modelling Report**);
- *Upper Condamine – Upper Condamine Model Results to Support Basin Plan Requirements*
- *Middle Condamine – Middle Condamine Model Results to Support Basin Plan Requirements*
- *St George system – St George Model Results to Support Basin Plan Requirements*
- *Lower Balonne Distributary System – Lower Balonne distributary Model Results to Support Basin Plan Requirements*
- *Moonie – Moonie Model Results to Support Basin Plan Requirements*
- *Charley Creek – Charley Creek Model Results to Support Basin Plan Requirements*

[2] As part of the review process, and in response to reviewers' questions, Queensland DNRME staff identified some further inclusions and edits that were required to update their "final" LTDLE factors report. The proposed updated final LTDLE factors report for Queensland was not available to the reviewers at the time of preparation of this review report.

- *Granite Belt – Granite Belt Model Results to Support Basin Plan Requirements*
- Oakey-Gowrie Creek – *Oakey-Gowrie Creek Model Results to Support Basin Plan Requirements*
- *Queensland's approach to hydrologic modelling Murray Darling Basin Plan*, 4 October 2016 (updated 25 March 2019).

The MDBA has also facilitated teleconferences with MDBA and Queensland Government (DES and DNRME) staff to assist with the review. DNRME and the MDBA have also provided supplementary material in response to questions raised as part of the review. This included:

- *Response to reviewers' questions* **(further material)**. A range of further information was provided to the reviewers via email in response to various questions and issues raised during the teleconferences.

The reviewers have relied on the information provided in these reports, the further material and in verbal advice provided by Queensland departmental staff in formulating the conclusions provided in this report. The MDBA and DNRME have also been given the opportunity to review a draft of the report for factual accuracy prior to its finalisation.

2 Method Proposed by Queensland

2.1 Entitlement classes which require LTDLE Factors

LTDLE Factors are required for all entitlement classes or entitlements where water purchases have occurred or are likely to occur under the Basin Plan. In addition, LTDLE factors are needed where water entitlements have been created through savings projects including those currently underway or proposed to occur.

These entitlement classes for which LTDLE Factors are required are summarised in **Table 1**.

Table 1:Entitlement classes where LTDLE Factors are Required

WRP Area	SDL Resource Unit	Entitlement Class	Currently required for water recovery estimate[1]
Condamine-Balonne	Condamine-Balonne	Supplemented High - Upper Condamine WSS	Yes
		Supplemented High - Chinchilla Weir WSS	Yes
		Supplemented High - St George WSS	Yes
		Supplemented Medium - Maranoa River WSS	Yes
		Supplemented Medium - Upper Condamine WSS	Yes
		Supplemented Medium – Chinchilla WSS	Yes
		Supplemented Medium - St George WSS	Yes
		Supplemented - Risk Class A - Upper Condamine WSS	Yes
		Supplemented - Risk Class B - Upper Condamine WSS	Yes
		Unsupplemented with flow conditions - Nominal Volume	Individual
		Unsupplemented with flow conditions – Overland flow/floodplain harvesting	Individual
		Unsupplemented without flow conditions - Nominal Volume	Individual
Qld Border Rivers - Moonie	Moonie	Unsupplemented with flow conditions - Nominal Volume	Individual
		Unsupplemented without flow conditions - Nominal Volume	Individual
	Qld Border Rivers	Supplemented High - Border Rivers WSS	Yes
		Supplemented Medium - Border Rivers WSS	Yes
		Supplemented High - Macintyre Brook WSS	Yes
		Supplemented Medium - MacIntyre Brook WSS	Yes
		Unsupplemented with Flow Conditions - Nominal Volume	Individual
		Unsupplemented with no Flow Conditions – Nominal Volume	Individual
Warrego-Paroo-Nebine	Warrego	Unsupplemented with flow conditions - Nominal Volume	Individual
		Unsupplemented without flow conditions - Nominal Volume	Individual
		Supplemented Medium - Cunnamulla WSS	Yes
	Paroo	Unsupplemented without flow conditions – Nominal Volume	Individual
	Nebine	Unsupplemented with flow conditions – Nominal Volume	Individual
		Unsupplemented without flow conditions – Nominal Volume	Individual

WRP Area	SDL Resource Unit	Entitlement Class	Currently required for water recovery estimate[1]
Condamine-Balonne *(groundwater component)*	Upper Condamine Alluvium (Central Condamine Alluvium)	Unsupplemented water licences	Yes
	Upper Condamine Alluvium (Tributaries)	Unsupplemented water allocations	Yes

Notes to table:

1. *LTDLE factors are modelled at the individual licence level for unsupplemented surface water entitlements, rather than using a single factor for each of these classes of entitlements.*

2.2 Use of BDL Models

Queensland have set out their methodology for determining LTDLE factors in their LTDLE Report. For surface water, the methodology uses the BDL model in each surface water WRP area to estimate water availability and maximum permissible diversions, and hence calculate a maximum permissible utilisation, for each entitlement class. Queensland have generally used "entitlement modelling" (see Section 2.4) for the Resource Operations Plans first made by Queensland to establish the Cap on diversions, and also the BDL.

As part of the development of Water Resource Plans as required under Chapter 10 of the Basin Plan, Queensland has transitioned its surface water resource models from the IQQM to the SOURCE modelling platform. The updated WRP modelling has also incorporated additional or improved data that has become available since the development of the initial BDL models.

The updated BDL models also incorporate any water allocations dealings (including transfers, subdivisions, amalgamations etc.) of water access entitlements that may have occurred. In a number of cases, where the quality of data on overland flow harvesting is poor, this form of take has been excluded from the models, although it is represented indirectly via losses to maintain the water balance at downstream gauging locations. As overland flow certification is completed, and reliable data on this form of take is available, it will be incorporated in subsequent updates of the model.

Queensland advised that, under its statutory water plans, no growth has been allowed in overland flow storages and the take of overland flow is controlled either by licensing (e.g. when buyback has occurred) or by not allowing changes in the infrastructure (called 'hooked' authorisations). Permitted take of overland flow is not determined by the model but by other methods in these circumstances. The surface water BDL models used are shown in Table 2.

Table 2: Surface water BDL models

WRP Area	SDL Resource Unit	Model used (model scenario identifier)	Comments*
Condamine-Balonne	Condamine-Balonne	Condamine Balonne - Upper Condamine (1901B)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2013
		Condamine Balonne - Middle Condamine (1901B)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2013
		Condamine Balonne - St George (1902H)	Represents all of the Water Allocations and licences in the basin reflecting trades up to November 2018. Covers inflows over the period 1889-2013.
		Condamine Balonne - Lower Balonne (1902H)	Represents all of the Water Allocations and licences in the basin reflecting trades up to November 2018. Covers inflows over the period 1889-2013.
		Condamine Balonne – Oakey-Gowrie (301A)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2013.
		Condamine Balonne – Charleys Creek (1812D)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2011.
Qld Border Rivers - Moonie	Moonie	Moonie (MS-190207A)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2015.
	Qld Border Rivers	Queensland Border Rivers (BRS-181015A)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1895-2009.
		Queensland Border Rivers – Granite Belt (GBS-181128A)	Represents all of the existing water allocations as well as the conversion of area licences to water allocations. Covers inflows over the period 1895-2015.
Warrego-Paroo-Nebine	Warrego	Warrego (1601A)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2011.
	Paroo	Paroo (1601A)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2011.
	Nebine	Nebine (1601A)	Represents all of the Water Allocations and licences in the basin. Covers inflows over the period 1889-2011.

** Note: Whilst the surface water models cover an extended period, the BDLs were determined using modelling results based on historical climate over the Basin Plan reference period 1895 – 2009.*

Modelling was not used for development of updated groundwater LTDLE factors. DNRME advised that the BDL volumes in Schedule 4 of the Basin Plan have been used as the basis for development of LTDLE factors. Numerical modelling and Recharge Risk Assessment Method (RRAM) analysis were used to inform the development of groundwater SDLs.[3]

[3] Refer to "*The proposed Groundwater Baseline and Sustainable Diversion Limits: methods report"*, MDBA publication no: 16/12, Murray-Darling Basin Authority, Canberra, 2012, for further details on development of BDLs and SDLs.

2.3 Cross-check of entitlements

The LTDLE Report provides information on the quantum of the entitlements in each class on issue in 2019. Based on comparisons with data provided by Queensland, some generally small changes have occurred to the volumes of entitlements in some classes from 2009 to 2019.

In the further material provided to reviewers, Queensland advised that a detailed reconciliation of individual changes was not available, but indicated that the changes were due to four factors:

1. Queensland has not been able to replicate the 2009 entitlements. e.g. in the Condamine-Balonne a significant volume of entitlements in the Lower Balonne were converted to a volumetric basis in April 2010.
2. Conversions of water licences which have no nominal volumes to water allocations (a volumetric entitlement) with nominal volumes have occurred in in some water plans (e.g. Oakey Gowrie Creek, Granite Belt Area Licences).
3. Previously unallocated water has been allocated. For example, unallocated water in some valleys has been transferred to the Commonwealth Environmental Water Holder
4. Trading of water entitlements have resulted in a movement from one entitlement class to another. i.e. a water entitlement with no flow condition receives a flow condition as part of the trade, and hence moves between water entitlement classes. There is no change to the volume of water that can be taken under the entitlement, it is merely a move between the two entitlement classes.

The volumes of entitlements used in the derivation of LTDLE factors is based on the most accurate data available from the Queensland Water Allocation Register or water licence database in 2019, and was also used as the basis for developing the revised BDL estimates in Queensland's approved WRPs.

2.4 LTDLE factors

2.4.1 Background to entitlement modelling

Entitlement modelling is the approach Queensland have taken to set water use limits in each surface water valley or water plan area and has been undertaken in conjunction with the development of its water resource plans.

Entitlement modelling assumes that all licence holders will take water whenever they are permitted to, and diversions are only limited by the availability of water, the plan rules and the entitlement conditions. The performance of current entitlements is modelled using historical climate conditions over the Basin Plan reference period 1895-2009. The intent of this modelling approach is to test whether the water allocation security objectives and environmental flow objectives in the relevant Queensland water resource plan can be met if all licence holders take water whenever flows occur, up to the maximum permitted under their entitlement.

The water resource plan rules and licence conditions have been set so that the entitlement modelling results in these various objectives being met, even if water users take water whenever they are able, up to the maximum permitted under their entitlement.

This approach means that the entitlement volume, the rules of the plan and the conditions on all licences (all of which are represented in the model) will ensure that water use does not exceed the BDL. If all licences comply with their licensed volume, any conditions that they have, and the water resource plan rules, then they are compliant with the BDL.

This approach to modelling represents an estimate of the upper limit of water use that can be permitted, rather than an estimate of what might be used under current levels of irrigation development. Queensland have indicated that they do not undertake modelling of existing levels of irrigation development, and no additional data has been provided for this review to indicate what the difference in long-term diversions would be between the entitlement modelling and current levels of use (or those when the BDL was set in 2009). However, Queensland have advised that entitlement modelling is expected to produce diversions that are close to current levels of water use for the Queensland Border Rivers and the Lower Balonne, which accounts for the majority of the water use in the Queensland portion of the Murray Darling Basin.

2.4.2 Calculation of LTDLE factors

Surface Water:

The entitlement modelling represents the maximum amount of water that is permitted to be taken under a Queensland water resource plan. This modelling was undertaken as part of the development of water resource plans in the Queensland Murray Darling Basin, with the exception of the Queensland Border Rivers, which was based on agreed irrigation development levels as part of a cooperative process with NSW. All of these plans were in place by 1 July 2009 and represent the BDL for each water resource plan area.

For supplemented licence classes, the simulated diversions by each entitlement class within the entitlement models are divided by the total nominal volume of entitlement on issue for that class to calculate an LTDLE factor. This effectively provides each entitlement with a share of the total simulated water use from the entitlement modelling, which is a share of the BDL.

In the case of unsupplemented water allocations and overland flow licences, the amount of water that can be taken under a water entitlement depends on the combination of the location of the extraction site in the catchment, the flows that arise and move past that point and the various conditions governing extraction under the entitlement. Because the combined effect of these factors varies widely across unsupplemented systems, a single LTDLE factor is not relevant to a particular class of entitlement. Queensland have incorporated unsupplemented water entitlements into their modelling, and using the same general principles as were applied in supplemented systems, they have been able to generate individual LTDLE factors for each of these entitlements.

Groundwater

The same general principles were applied to determine LTDLE factors for groundwater systems where water recovery is required. The BDL for each groundwater SDL resource unit is nominated in Schedule 4 of the Basin Plan. The BDL for the central, heavily developed zones of the Upper Condamine Alluvium [Central Condamine Alluvium] (CCA) was based on metered water use from 2003 – 2008 under the extraction limits that applied at that time, and on the entitlement volume for the remaining zones of the CCA where water use was not metered, together with an estimate of

water use under basic landholder rights for domestic and stock purposes. The BDL for the Upper Condamine Alluvium [Tributaries] (Tribs), where water use was not metered, was based on the entitlement volumes on issue, plus estimated use under basic landholder rights.

The BDL was adopted as the basis for determining groundwater LTDLE factors. The BDL share was determined for the entitlement class by excluded the estimated water use domestic and stock rights. The BDL share was then divided by the total nominal entitlement volume on issue, to give an LTDLE factor for that entitlement class.

DNRME considers all of the entitlements within a groundwater SDL resource unit to be of the same class. The CCA and Tribs systems were each divided into a number of local management zones. Announced annual allocations were generally similar across the zones within each system where significant water use was occurring in the period used for the establishment of the BDL (pre-2009). There were some higher levels of restriction in several zones in response to local aquifer impacts and low recharge in drought; however, overall it is reasonable to consider the entitlements within each SDL resource unit as being of the same general class in the lead up to establishment of the BDL. These issues are discussed further in Sections 3.5 and 3.6.

3 Using LTDLE factors to 'bridge the gap' – review of key assumptions

3.1 Assumptions and uncertainties in calculating LTDLE factors

The Commonwealth government will use LTDLE factors to provide confidence that the water recovery will reduce the BDL levels of permitted take to SDL levels of permitted take in each valley (i.e. 'bridge the gap').

The MDBA has noted that, in some locations (such as in Queensland and South Australia) the surface water BDL was set at levels higher than the actual use in 2009. This reflects arrangements previously negotiated as part of the Murray-Darling Basin Cap on diversions and is represented within the BDL models used to underpin the BDL estimates.

The aim of water recovery is to reduce the diversion limit (as opposed to diversions as they were in 2009) from the baseline to the sustainable diversion limit, noting that some allowable growth in actual take may occur up to those limits over the life of the WRP.

Within Queensland, the areas where water use is generally at lower levels, such as the Moonie, Warrego, Nebine and Paroo valleys, have a BDL that has been set at higher than the level of actual water use at 2009. However, for the valleys with significant levels of water use (the Condamine-Balonne and the Queensland Border Rivers), Queensland have advised that the BDL is closer to actual water use by configuring its modelling based on the level of actual irrigation development permitted under Queensland's moratorium on the construction of irrigation infrastructure at September 2000.

This means that the LTDLE factors may not directly represent the change in current actual diversions that occurs as a result of water recovery in those cases where the BDL is higher than current use. However, the entitlement modelling approach means that entitlements have a more direct relationship with the valleys' use limits, and the 'planning assumptions' relating to entitlement utilisation levels used elsewhere in the basin are less significant. Water recovery in these valleys will reduce the use limit below the BDL in line with the LTDLE factors developed, which will in turn reduce use or prevent future increases in use that would have been permissible under the original BDL.

The intention is to ensure the resultant LTDLE factors provide a consistent measure of the relative contribution of different entitlements to 'bridging the gap' (i.e. reducing the use limits), both within and between valleys, and that the best available information has been used. Given that the Basin Plan water recovery was developed on the basis of modelled BDL conditions, the most consistent approach to calculating LTDLEs is with respect to the BDL, being the *diversion limit* under state law at that time.

Across the Basin, LTDLE factors have generally been established for an entitlement class and not for an individual entitlement. This assumes that all entitlements share the diversion limit attributable to that class of entitlement under the BDL equally. This involves distributing the use limits across individual licences based on their share of the entitlements for an entitlement class within a valley.

Using an average factor for each entitlement class is appropriate for entitlements recovered from consumptive use, where the estimate of long-term average use from models is also aggregated, and all of the entitlement holders have equal access to their entitlements and an equal right to utilise their entitlements. This is the situation that generally applies in regulated (or supplemented) water sources. However, for some classes of entitlement such as unsupplemented allocations and overland flow licences, the location of each individual licence will uniquely influence their access to water. Where these entitlements are modelled individually, these variations in water access can be accounted for and their share of the use limit can be estimated directly from the modelling, and there is a case for using individual LTDLE factors based directly on the modelled reduction in water use. Queensland has modelled many of these entitlements individually as part of its entitlement modelling, and individual LTDLE factors have been determined for entitlements with unique local characteristics, such as overland flow licences.

3.2 Representativeness of surface water BDL models

All models are only approximations, and to the extent that these models contain approximations of reality, this creates some uncertainties in the models' results.

The BDL models used to prepare the Basin Plan 2012 have been previously reviewed and adopted as the best estimates of BDL conditions at the time. Nevertheless, over the last seven years or so, improvements to these models have been identified and upgraded BDL models have been prepared by Queensland. Queensland has moved from the previous Integrated Quantity Quality Model (IQQM) platform to the Source platform (the Australian National Hydrologic Modelling Platform). As part of this process, Queensland have recalibrated each of the models to make use of additional flow and climate data, and improved methods to configure and calibrate models. Queensland have advised that these models have been independently reviewed as part of the transition from IQQM to Source.[4] As these upgraded models have been prepared by making improvements with respect to the original models, their performance is of a better standard than the original models. The reviewers have assumed this to be the case, noting that any assessment of these models is outside the scope of this review.

Queensland have attributed most of the change in the proposed LTDLE factors compared to the previous factors to the various method and data updates, some trade of entitlements between the different classes, and the change from IQQM to Source, rather than to any change in the rules or conditions governing water extraction. The key differences between the previous modelling and the updated Source models are documented in the relevant modelling report for each valley (refer Section 1.4 of this report for a listing of these modelling reports). The development of individual LTDLE factors for some types of unsupplemented entitlements has also contributed to differences compared to the earlier 2011 factors.

[4] *Independent Review of Generation 2 Hydrological Models for: Border Rivers, Condamine-Balonne and Moonie Valleys*, Bewsher Consulting, April 2019.

3.3 Changes in surface water management rules

If a jurisdiction was to change the management rules in a water system, this could potentially lead to a change in the reliability of water availability for some or all entitlement classes in a system.

DNRME have advised that there has been no material change in management rules since the implementation of ROPs/WRPs, which generally occurred between 2003 and 2009. It is also noted that all Queensland valleys already have accredited WRPs that set out the management rules. This limits the potential for any future management rule changes that may affect entitlement reliability, as changes to WRPs need to undergo extensive scrutiny as part of the accreditation process.

3.4 Water recovery in unsupplemented surface water systems

Purchase of unsupplemented water entitlements represents a significant proportion of water recovery in Queensland, whereas supplemented water entitlements represent the majority of water recovery elsewhere in the basin. This reflects the fact that the majority of water use in the Queensland portion of the basin is unsupplemented or unregulated. To provide confidence that water recovery will "bridge the gap" without undue reliance on future compliance actions to achieve the SDL, a key assumption that underpins LTDLEs for unsupplemented water entitlements is that the water previously taken by entitlements purchased by the Commonwealth does not simply increase water availability and use by the remaining consumptive entitlements.

In order to ensure that the water previously used by recovered water entitlements does not just increase access to water for other consumptive users of water downstream, there is a need to protect any additional environmental flows occurring as a result of the purchase of entitlements from extraction. Once these management rules are developed and fully implemented, they can then be incorporated in water system modelling.

The reviewers note that whilst Queensland has obligations to implement suitable measures to protect environmental flows as part of their accredited Water Resource Plans and has also committed to do this as part of its implementation of the Basin Compliance Compact, detailed consideration of these matters is outside the scope of this LTDLE factors review.

It is also noted that there are flow sharing arrangements in some areas, such as the Lower Balonne, that do provide protection for the share of flows apportioned to recovered entitlements.

3.5 Groundwater LTDLE assumptions

The Condamine Balonne water resource plan area includes the Upper Condamine Alluvium [Central Condamine Alluvium] (CCA) and the Upper Condamine Alluvium [Tributaries] (Tribs) SDL units. These are somewhat unique, in that they are the only groundwater SDL resource units across the Basin where the SDL was lower than the BDL and intervention was required under the Restoring the Balance program to reduce usage.[5]

[5] It is acknowledged that the BDL for the Lower Lachlan Alluvium was 6.4 GL above the SDL of 117 GL when the Basin Plan was made, however as noted in Schedule 4 of the Basin Plan, an adjustment process were already being implemented at that time and that "*the Water Sharing Plan for the Lower Lachlan Groundwater Source 2003 of New South Wales will reduce the long-term average limit to 117 GL by June 2018*".

Whilst a similar approach used in the development of surface water LTDLE factors has been applied to the development of groundwater factors, there are a number of different considerations that apply to groundwater management which influence the final approach taken. In surface water systems, the direction of flow is always downstream and highly predictable. Flow not taken by one user can be readily extracted by another user within relatively short travel times, and with no net change in the overall water balance or end of system flows from the catchment. In groundwater systems, extraction from an aquifer can change the pattern of piezometric pressure and can change the direction of flowlines in the formation. Despite users being in connected groundwater systems, groundwater levels can also take significant time to adjust in response to changes in patterns of extraction. Reducing groundwater levels in the aquifer through extraction can also induce greater recharge from surrounding formations, including drawing poorer quality recharge into the aquifer.

Managing and sharing access to groundwater sustainably requires consideration of impacts and management actions at a number of scales:

- Regional scale: This includes consideration of the sustainability of the resource, including the overall balance between entitlements on issue, recharge at a seasonal (or longer) timeframe and management of groundwater levels within acceptable bounds at a regional scale.
- Local scale consideration is also required to ensure that the cumulative impacts of pumping within a local management zone are sustainable and acceptable. Limits on the density of extractions (and hence the density of entitlements authorised for use) in a local zone may be required to manage groundwater levels, flow, quality and maintain base flows in streams and groundwater dependent ecosystems.
- Neighbourhood scale consideration of the impacts of extraction is also required to ensure that the drawdown created by a pumped bore does not unacceptably interfere with or impact on nearby features including other bores, streams and groundwater dependent ecosystems.

The reviewers have been advised that as part of the design of the water recovery program for the Upper Condamine Alluvium (UCA), consideration was given to a range of strategic environmental objectives. These included:

- stabilising and possibly increasing groundwater levels to ensure groundwater is available in the future and to protect the structure of the aquifers;
- reducing the risk of aquifer salinisation;
- restoration of base flows to streams; and
- improving the health of wetlands, springs and vegetation that depend on groundwater (groundwater dependent ecosystems).

The Queensland government's approach to sustainable management of the UCA was informed by analysis using numerical modelling in the more heavily developed zones of the CCA and recharge risk assessment modelling in other zones, and in the Tribs. The same modelling was also used to develop the SDLs for the CCA and Tribs. It is understood that the design of the water recovery program was also informed by this modelling, together with the management actions and restrictions that Queensland DNRME had been developing and implementing prior to the Basin Plan in this area. This led to a targeting of recovery in the CCA towards the zones where most of the useable groundwater resource was located, which was where existing use was the highest, and where water entitlement

recovery would have the greatest effect in returning groundwater back to sustainable levels at both a local or zonal scale and at the regional or SDL resource unit scale.

It is noted that, unlike surface water systems, water recovered under the Restoring the Balance program will not be extracted or diverted directly into environmental assets. Rather, the water associated with these entitlements will remain in the aquifer and the resultant recovery in groundwater levels will help to protect the structure of the aquifer and to restore base flows to streams and groundwater dependent ecosystems.

Whilst the SDLs for these two systems have been set at a regional scale, and sufficient water recovery will enable compliance with SDLs at this scale, it is important that the SDLs are the cumulative result of planned outcomes at a zonal level. To ensure sustainable management of the groundwater resource and avoid re-emergence of problems, there will still be a need for Basin States to manage groundwater to maintain acceptable target groundwater levels at a zonal scale as well as achieving compliance with SDLs at a regional scale.

3.6 Changes in groundwater management rules

The Queensland DNRME considers all of the entitlements within a groundwater SDL resource unit to be of the same class, and DNRME has advised that there has always been an intent to provide the same announced allocation for all entitlements in a system. However, following the emergence of overallocation issues within these systems, different (lower) announced annual allocations have been made for some of the heavily developed management zones within the CCA and Tribs to address the cumulative impacts of localised pumping and respond to extreme conditions due to drought and limited recharge at a local or zonal scale.

For the CCA in particular, there were significant changes to announced allocations for all of the central, heavily developed zones where the majority of water use occurs. These changes largely occurred post the period where the usage component of the CCA BDL was established (2003-2008), as an immediate response to local impacts to the aquifer. There were also significant restrictions to allocations applied in some of the less developed zones of the CCA and Tribs from around 2005/06 onwards, but subsequent assessment of actual use in these zones showed that total use was quite limited. Subsequent water recovery in the CCA has effectively reduced the likelihood of further long-term reductions to announced allocations.

It could be argued that the different restrictions across the zones in the BDL baseline period could suggest that the entitlements were of a different reliability, and therefore could benefit from different LTDLE factors. However, DNRME were strongly of the view that the underlying reliability of the entitlements in each SDL unit were the same, and restrictions were used to address zonal groundwater level declines. The recovery of water in the CCA has reduced the intensity of extractions in the heavily developed zones and a common allocation policy now applies across all zones, confirming that they are the same class.

The reviewers note that to date there has only been limited water recovery in the Tributaries; however, provided that recovery is undertaken in a planned manner using the same principles as applied to the CCA, it is believed that a single LTDLE factor will also effectively represent the

reduction in use limits across the SDL unit and support sustainable groundwater management at a zonal level.

Since the recovery of water under the Restoring the Balance program, DNRME advises that there have been some adjustments to management rules in the UCA systems:

- Urban entitlements receive an announced allocation of 100% each year
- Productive base entitlements (i.e. the water recovered through the Restoring the Balance program) also receive an announced allocation of 100% each year.
- Entitlements with a purpose of "Any" (i.e. other consumptive entitlements) will all receive the same announced allocation, unless a differential announced allocation is required at the management zone level in response to growth in long-term use. DNRME advise that once water recovery is completed, it is expected that announced allocations for these entitlements will be 100% in the majority of years.

Given the complexities of the groundwater management challenge in the UCA, the limitations on available information of groundwater behaviour, the fact that recovered water remains in the aquifer to support sustainable groundwater levels, and that in future all entitlements will generally attract the same nominal announced allocation (with only consumptive irrigation entitlements expected to be restricted in extreme conditions), the adoption of a single LTDLE factor for each SDL resource unit is accepted as a reasonable overall representation of the net outcome of a complex readjustment process in these groundwater systems.

4 Conclusions

Surface water LTDLE factors

Overview:

Queensland have prepared revised surface water BDL models using the Source modelling platform, and used the results of this modelling to determine a set of revised LTDLE factors for each relevant surface water entitlement class in the Queensland Murray-Darling Basin or, where more appropriate, for individual entitlements. The models used to support the development of these BDLs and LTDLE factors have been independently assessed as being based on the best available information and suitable for use to support development and management of WRPs in Queensland.

The methodology used to determine the LTDLE factors based on the BDL is consistent with the approach used to inform the Basin Plan, and the methodology used by other states.

Queensland have provided assurance that entitlements have not substantially changed from those on issue in 2009, although there have been some minor variations to the volumes on issue arising from a range of processes including trade and conversions of licences to allocations with a nominal volume.

The methods and assumptions upon which the factors are based have been reviewed and are considered by the reviewers to be appropriate for the Queensland water resource management context and the best available at the current time.

As a result, this review endorses the LTDLE factors developed by Queensland. The factors applicable to surface water entitlement classes have been set out in the Queensland LTDLE report. Queensland DNRME has elected not to publish the LTDLE factors for individual unsupplemented water entitlements as they are considered to represent personal or water market sensitive information. The reviewers have inspected the data used to develop these individual factors and confirmed that the same methodology used to develop factors for entitlement classes was also applied at the individual entitlement level. Noting that there may be further recovery in some unsupplemented systems, the reviewers are of the opinion that application of the same principles and methods will yield suitable individual LTDLE factors.

In detail:

Queensland has clearly set out how LTDLE factors have been calculated, and its approach is consistent with the approach taken by other states, with appropriate adjustments to reflect the particular water management situation in the Queensland MDB.

The surface water BDL is the use limit under state law as at 1 July 2009, which is equivalent to the Murray-Darling Basin Ministerial Council Cap on diversions for Queensland valleys. It is noted that, for some Queensland valleys, this Cap is higher than current actual use. However, for the Lower Balonne and the Queensland Border Rivers, where the majority of the water recovery has occurred, Queensland have advised that the actual 2009 level of diversions is expected to be close to the BDL.

The entitlement modelling approach taken by Queensland that underpins the calculation of LTDLE factors sets a use limit that is virtually independent of irrigator behaviour, as entitlement volumes were established through the original ROPs/WRPs to be consistent with the Cap on Diversions and entitlement modelling assumes that entitlement holders fully utilise their entitlements. This simplifies modelling and reduces reliance on planning assumptions.

It is noted that the entitlements recovered for the environment are unlikely to be taken from the river in the way that consumptive entitlements are, and this may lead to increased water availability for downstream entitlements, if any additional environmental flows are not adequately protected.

It is noted that the quantum of water recovered in the valleys where the BDL based on entitlement modelling is higher than current water use (Moonie, Warrego, Nebine, Paroo) is relatively small compared to water recovery in the Condamine Balonne and Queensland Border Rivers. Any changes to LTDLE factors for these areas are unlikely to make a significant difference to the overall water recovery volume. Nevertheless, water recovery in these valleys will reduce the use limit below the BDL in line with the LTDLE factors developed, which will in turn reduce use or prevent future increases in use that would have been permissible under the original BDL.

Groundwater LTDLE factors:

Overview:

Queensland has used the BDL volumes in Schedule 4 of the Basin Plan as the basis for development of groundwater LTDLE factors. These BDL volumes were determined based on entitlements on issue or limits under state groundwater management rules, where these provided for extraction limits less than entitlement volumes in place in 2009. The SDL volumes were informed by numerical modelling in the heavily developed management zones of Central Condamine Alluvium and supported by Recharge Risk Assessment Method (RRAM) analysis elsewhere.

The same general approach that was applied to derivation of surface water LTDLE factors was used to calculate the groundwater factors. The BDL share determined for the entitlement class was divided by the total nominal entitlement volume on issue in the system, to give an LTDLE factor for that entitlement class.

The Queensland DNRME considers all of the entitlements within each groundwater SDL resource unit to be of the same class. However, different (lower) announced annual allocations have been made for some of the heavily developed management zones within the CCA and Tribs to address the cumulative impacts of localised pumping and respond to extreme conditions due to drought. For the heavily developed zones of the CCA, these changes largely occurred post the period where the usage component of the CCA BDL was established (2003-2008).

In the less developed zones of the CCA and in the Tribs, changes to announced allocations occurred from around 2005/06 onwards; however, actual use in these zones was quite low.

The adoption of a single LTDLE factor for each SDL resource unit is accepted as a reasonable overall representation of the net outcome of a complex readjustment process in these groundwater systems.

The methods and assumptions upon which the groundwater factors are based have been reviewed and are considered by the reviewers to be appropriate in the context of Queensland groundwater management for the two SDL resource units where water recovery is required, and effectively represent the reduction in use limits that can be achieved across the SDL units.

In detail:

Whilst the same general approach used in the development of surface water LTDLE factors was applied to the development of groundwater factors, there are a number of different considerations that apply to groundwater management which influence the detail of the approach taken in developing these factors.

DNRME considers all of the entitlements within groundwater SDL resource unit to be of the same class. The Upper Condamine Alluvium systems were each divided into a number of local management zones and it is understood that restrictions were primarily used to address localized, zonal groundwater level declines. Review of announced water availability in the period prior to establishment of the BDL showed they were generally similar across most of the CCA zones with high water use. There were some higher levels of restriction in other zones in the CCA and Tribs, although there was generally a very low level of water use in relation to the announced allocations. Overall, the reviewers are of the view that, for the purposes of managing to an overall SDL in each of the two SDL resource units, it is reasonable to consider the entitlements within each SDL resource unit as being of the same general class in the lead up to establishment of the BDL.

Managing and sharing access to groundwater sustainably requires consideration of impacts and management actions at regional, local and neighbourhood scales. Achieving environmentally sustainable levels of take requires consideration of a range of factors including current and future potential levels of extraction, groundwater levels, water quality, connections to surface water and the presence of groundwater dependent ecosystems at a localised scale. In general terms, these environmental objectives will be achieved by stabilising and restoring sustainable groundwater levels through targeted reduction of extractions.

SDLs for these two systems have been set at a regional scale, and water recovery is intended to ensure sustainable management of the groundwater resource and avoid re-emergence of problems at a zonal scale, and to achieve compliance with SDLs at a regional scale.

Given the complexities of the groundwater management challenge in the Upper Condamine Alluvium systems, the limitations on available information of groundwater behaviour, the fact that recovered water remains in the aquifer to support sustainable groundwater levels, and that in future all entitlements will generally attract the same nominal announced allocation, the adoption of a single LTDLE factor for each SDL resource unit is accepted as a reasonable overall representation of the net outcome of a complex readjustment process in these groundwater systems.