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MURRAY–DARLING BASIN AUTHORITY

Comparison of watercourse diversion estimates in the proposed Basin Plan with other published estimates

Supporting information for the preparation of the proposed Basin Plan

Murray–Darling Basin Authority technical report 2011/01 Version 2
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Cover image: Rockmelons grown on Moon Rocks farm near St George QLD. Irrigation is by underground drips with plastic cover over top for efficient irrigation. Farmer Geoff Morgan. (photo by Arthur Mostead © MDBA)

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1 INTRODUCTION

In November 2011, the Murray–Darling Basin Authority (MDBA) released the proposed Basin Plan for feedback and consultation with various stakeholders and the community in general. This document summarises and explains the main differences between the diversion estimates under baseline development conditions used in the proposed Basin Plan and estimates published in the past, i.e. in water sharing plans for New South Wales, Cap reports for the Victorian valleys and water resource plans or resource operations plans for Queensland.

The models used by MDBA have been developed by various state agencies, the MDBA itself, Snowy Mountains Hydro-Electric Authority (SMHEA) and CSIRO. In some models MDBA had carried out changes (MDBA, 2010) to include surface-water–groundwater interactions and water recovery.

An earlier version of this report was provided to the NSW Office of Water (NOW), the Department of Environment and Natural Resources, Queensland (DERM), and the Department of Sustainability and Environment, Victoria (DSE) for review and feedback. The review of this report by state agencies does not include review of the validity of the changes made to the models for surface-water–groundwater interaction in the Namoi, Lachlan and Murray systems and changes for water recovery under The Living Murray (TLM) and Water for Rivers in the Murrumbidgee system by MDBA.

A version of this report (MDBA 2010) was released after the Guide to the proposed Basin Plan and some estimates have changed in this version as a consequence of additional work carried out since then, feedback received on the numbers published in the Guide to the proposed Basin Plan, and more updated information on water recovery for The Living Murray and Water for Rivers.

2 PUBLISHED NUMBERS

The diversions numbers published in the proposed Basin Plan for various catchments may be different to those published from time to time in reports from MDBA, states, CSIRO or other consultants for the purposes of the Cap or water sharing plans/resource operations plans. There are a number of reasons why these may be different that vary from valley to valley.

The key reasons for the differences are because the Basin Plan modelling has been undertaken:

- using the climatic data for the period July 1895 to June 2009. This was the common period for which all 24 river systems models had climate data available. Numbers published previously by MDBA, states, CSIRO or consultants for various river systems are not for this period. Usually the results of the previous reports were based on the longest period for which data was available for the individual river system at the time the study was undertaken. This use of different periods means that the initial conditions at the start of modelling periods are also different.
- using updated models which include permanent interstate and intrastate water trade.
- using inflows from tributaries contributing to Barwon–Darling and River Murray that have changed since the estimates of the Cap for these valleys.
- using models that have been updated to include water recovered for TLM and Water for Rivers (for provision of environmental flows to the Snowy and Murray rivers) and environmental works and measures. The estimates of water recovery for TLM and Water for Rivers included for assessment of baseline diversion limits (BDLs) are based on best available information at the time

of preparation of this report. However, these estimates may change due to more updated information on actual water recovery, including additional water recovered under these programs since preparation of these estimates, and any review of estimates of water already recovered.

- using improved or updated versions of models, where available, based on work carried out by states/MDBA since development of water sharing plans in NSW, water resource plans/resource operations plans in Queensland or bulk entitlements in Victoria.
- incorporating best available estimates for the impact of groundwater use on the river systems flows at 2030. These estimates have been included in the Lachlan (17.4 GL/y), Namoi (11.2 GL/y) and Murray (47 GL/y) models.
- using versions of models in which calibrations have been improved since the versions used for development of various water sharing arrangements in the past.
- for the SDL resource units adopted for the Basin Plan. These SDL resource units for some catchments are different to the areas used for reporting diversion estimates for the Cap and water sharing plans.

In this report, assessments have been carried out to estimate the impact of the various changes described above, for the individual river valleys. However, these estimates may not exactly match the differences between the Basin Plan model results and previously published numbers, because:

- in this report, estimates of water recovery are based on entitlement multiplied with Cap factors. Carrying out model runs for all water recovery measures to validate the Cap factor based estimates would have been a major task. These estimates could at times be different to the estimated impacts of various actions based on detailed modelling of each work and due to sequentially assessing incremental impact of each water recovery and trade as they were implemented.
- the sum of assessments carried out to assess impacts of various changes individually will not add up to the net total impact of all the changes included together because of interaction between various impacts and consequent differences in water balances. Therefore, estimates presented in this report for various impacts are indicative to provide details of components which have been included in the baseline conditions for the proposed Basin Plan.

In addition to modelling reasons, the other key reasons for differences in total diversions reported in the proposed Basin Plan are:

- inclusion of interception estimates in the total diversions reported for catchments
- inclusion of unregulated diversions, not in the model, to report for total diversions in the catchments.

This report discusses reasons for differences between watercourse diversions as reported in the proposed Basin Plan (excluding interception) and Cap or water sharing plan estimates published in the past. The Cap and water sharing plan estimates published in the past also exclude interception estimates.

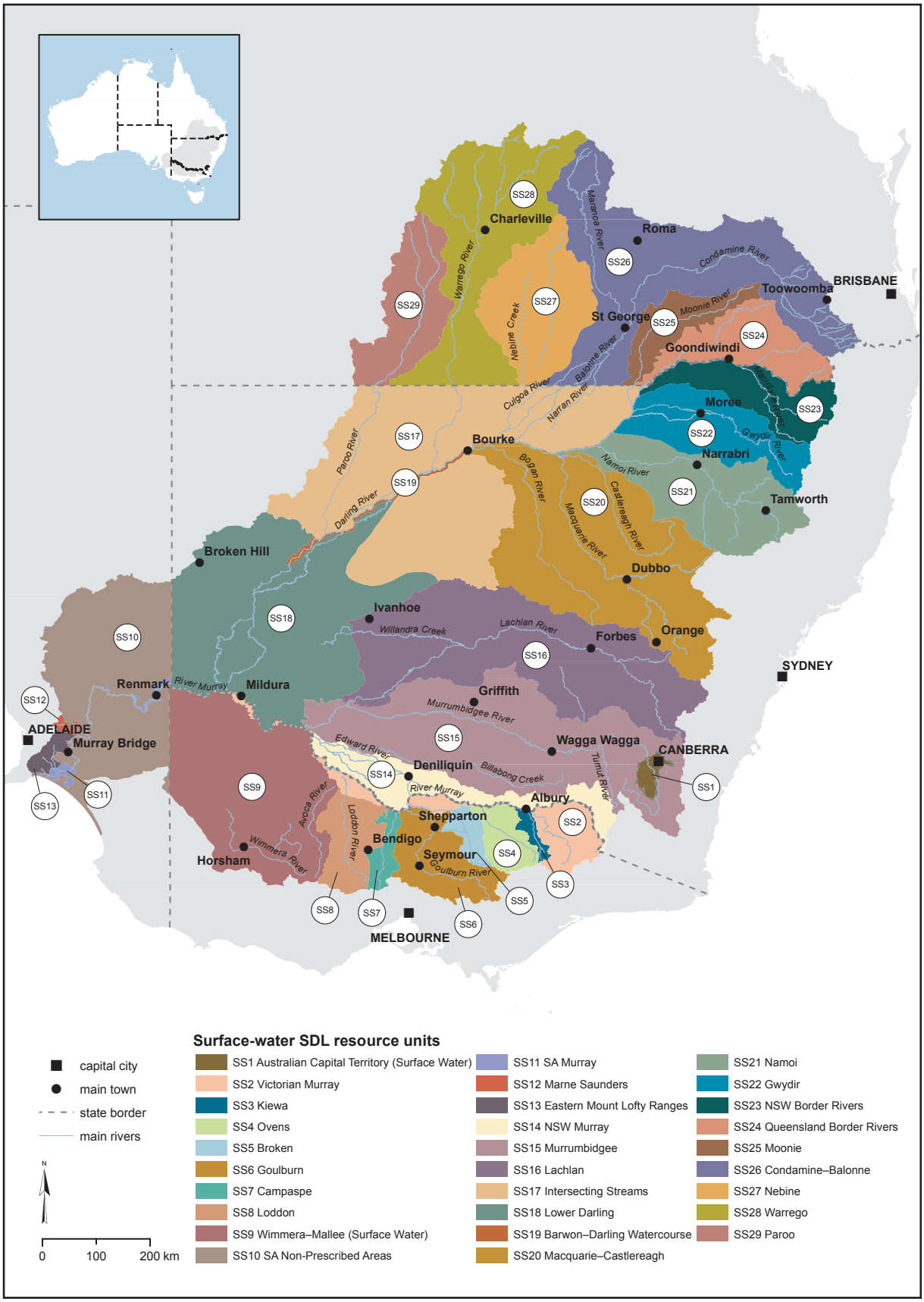

Figure 1 SDL resource units used for the proposed Basin Plan

3 SDL RESOURCE UNITS

For the preparation of the proposed Basin Plan, the Murray–Darling Basin has been divided into 29 surface-water long-term average sustainable diversion limit resource units (or SDL resource units) (Figure 1). These SDL resource units generally cover entire catchments, while models are generally available only for main river systems. To account for total diversions from the catchments, estimates of interceptions in various catchments and unregulated licensed diversions which are not in the model are added to the modelled diversion estimates. As mentioned earlier, since interceptions are not included in the Cap or water sharing plan reporting, this report only discusses comparisons between the Cap/water sharing plans and the water course diversions reported in the proposed Basin Plan.

The key differences in the SDL resource units of the proposed Basin Plan and water sharing plan/Cap/water resource plan boundaries are as follows.

- Macquarie, Bogan and Castlereagh

  The Macquarie, Bogan and Castlereagh catchments form one SDL resource unit under the proposed Basin Plan, while the water sharing plan for the Macquarie River covers only the Macquarie and Cudgegong rivers (including some diversions for stock and domestic and replenishments from the Macquarie to the Bogan), but does not include the Castlereagh River. However, Cap diversions for the Macquarie, Bogan and Castlereagh systems are reported together.
- Queensland catchments

  There are separate SDL resource units for the Nebine, Warrego and Paroo catchments, although these are all included in one Queensland water resource plan and resource operations plan. However, Cap diversions for all these valleys are reported separately.
- Ovens and Kiewa

  The Ovens and Kiewa catchments are separate SDL resource units and the proposed Basin Plan has reported their diversions separately, while for the Cap these are reported along with the River Murray system for Victoria. This report compares total diversions for the River Murray, Kiewa and Ovens reported in the proposed Basin Plan with the total Cap for these valleys.
- Loddon and Broken

  The Loddon and Broken systems are separate SDL resource units in the proposed Basin Plan, while for the Cap, Loddon and Broken diversions are reported along with the Goulburn system.
- Namoi and Peel

  The SDL resource unit for Namoi includes the Peel system and is consistent with Cap reporting, but there are two separate water sharing plans for the Namoi and Peel systems.

4 CATCHMENT COMPARISONS

4.1 Introduction

This section compares numbers published for Cap reporting with the diversion estimates under baseline conditions published in the Schedule 3 to the proposed Basin Plan, for individual valleys, and discusses reasons for the differences. The assessments have been made, where possible, by carrying out two model runs and including one of the various changes leading to the difference. Ideally, the impact of individual actions should be assessed by adding them sequentially and assessing the incremental impact of each action. However, this was not feasible as assessments have been carried out over time with models continually improved or updated with additional data, and not all models and data are available to MDBA.

The impact of individual actions assessed separately and then added together may not have the same cumulative impact as including all actions to the model in one go. This is because interaction between various actions leads to differences in storage volumes, spills and how various demands in the system are met. Therefore, the estimates associated with individual actions as described in this report are approximate and are intended to document actions and measures which have been included in the baseline conditions of the models used for the proposed Basin Plan. Consequently, the discrepancy between diversion impacts of individual actions added together and the diversion estimates published in the proposed Basin Plan are attributed to the model changes and other actions not yet quantified individually.

In instances where it was not feasible to carry out the model run because of non-availability of a model version or data required to estimate the impact of an action, the best available information has been included as the part of the explanation.

4.2 Queensland catchments

4.2.1 Introduction

In Queensland, Cap conditions refer to water usage at the ultimate level of development under water entitlements and water sharing rules established under the relevant resource operations plan (ROP). There are some changes in the model versions used for the proposed Basin Plan and the versions used for the development of ROPs. The key generic reasons for differences in diversion estimates in ROPs and proposed Basin Plan results are as follows.

- The simulation period used for the ROP is from January 1889 to December 1999 for Paroo, Warrego and Nebine, from January 1889 to December 1998 for Moonie and from July 1922 to June 1995 for Condamine-Balonne.
- ROPs make provision for unallocated water which is available for future use within an ROP area. Unallocated water identified in the ROPs is reserved for 'town water supply' or for 'any' other purpose. In baseline scenarios this is not referred to as unallocated water, but is reported in the category for which it is reserved, such as 'town water supply', 'unsupplemented' or 'Commonwealth Environmental Water Holder'.

4.2.2 Paroo

The Paroo resource operations plan was developed based on the modelling period 1889 to 1999, while the proposed Basin Plan model runs have been carried out for the 1895 to 2009 period. The key differences between results for the proposed Basin Plan and the ROP are summarised in Table 1. The published Cap number for the Paroo in the water audit monitoring report (MDBA 2010) is 0, but this is due to rounding of numbers to integers. The actual Cap for the Paroo is 0.2 GL/y. This discrepancy needs to be fixed in the next version water audit monitoring report. The Cap does not include (unmodelled) overland flow diversions which since 2006/07 have been estimated as an average of 2.1 GL/y. This discrepancy between modelled and estimated overland diversions needs to be resolved before development of a water sharing plan compliant with the Basin Plan.

Table 1 Comparison between ROP and Basin Plan diversion estimates for the Paroo system

Description	Diversion (GL/y)
Paroo River diversions as per the Cap (modelling period 1889–1999)	**0.2**
Use of different simulation period for the Basin Plan modelling (1895-2009)	<0.01
Estimated BDL (excluding interception and basic rights)	**0.2**

4.2.3 Warrego

The Warrego ROP was developed based on the modelling period 1889 to 1999, while the proposed Basin Plan model runs have been carried out for the 1895 to 2009 period. The unallocated water and overland flow diversions are included in the unsupplemented diversions in the Basin Plan modelling. The published number for the Cap for Warrego is 47.9 GL, including 0.4 GL/y of modelled overland flow diversions (Bewsher 2010). The only difference between the results for the proposed Basin Plan and the ROP/Cap is due to the different simulation periods (Table 2). The overland flow diversions in the model used for the proposed Basin Plan are 0.4 GL/y as compared to the estimated average diversion of 6.4 GL/y since 2006/07. This discrepancy between modelled and estimated overland diversions needs to be resolved before development of water sharing plan compliant with the Basin Plan.

Table 2 Comparison between ROP and Basin Plan diversion estimates for the Warrego system

Description	Diversion (GL/y)
Warrego River diversions as per the Cap (modelling period 1889–1999)	**47**
Use of different simulation period for the Basin Plan modelling (1895-2009)	-2.6
Estimated BDL (excluding interception and basic rights)	**45**

4.2.4 Nebine

The Nebine ROP was developed based on the modelling period 1889 to 1999, while the proposed Basin Plan model runs have been carried out for the 1895 to 2009 period. The unallocated water and overland flow diversions are included in the unsupplemented diversions in the proposed Basin Plan modelling. The key differences between results for the proposed Basin Plan and the ROP are summarised in Table 3. The published number for the Cap for Nebine is 6 GL and includes overland flow diversion (MDBA 2010).

Table 3 Comparison between ROP and Basin Plan diversion estimates for the Nebine system

Description	Diversion (GL/y)
Nebine River diversions as per the Cap (modelling period 1889–1999)	**6.0**
Use of different simulation period for the Basin Plan modelling (1895-2009)	-0.2
Other model changes since the Cap proposal	0.4
Estimated BDL (excluding interception and basic rights)	**6.2**

4.2.5 Moonie

The Moonie ROP was developed based on the modelling period 1889 to 1998, while the proposed Basin Plan model runs have been carried out for the 1895 to 2009 period. The unallocated water and overland flow diversions are included in the unsupplemented diversions in the proposed Basin Plan modelling. The key differences between results published in the proposed Basin Plan and the ROP are summarised in Table 4. The published number for the Cap for the Moonie system is 34 GL including overland flow diversions (MDBA 2010).

Table 4 Comparison between ROP and Basin Plan diversion estimates for the Moonie system

Description	Diversion (GL/y)
Moonie River diversions as per the Cap (modelling period 1889–1998)	**34**
Use of different simulation period for the Basin Plan modelling (1895-2009)	-1.1
Other model changes since the Cap proposal	0.3
Estimated BDL (excluding interception and basic rights)	**33**

4.2.6 Condamine–Balonne

The ROP was finalised in April 2010 and the Cap proposal for the Condamine–Balonne system was submitted in November 2010. The long-term extractions (1922–1995) for the Condamine–Balonne catchment as proposed for the Cap are 729 GL/yr. The Cap results are based on the final ROP version of the model, whereas the results presented in the proposed Basin Plan are based on the model version used for the draft ROP version. In the final ROP version of the model there were changes in all four of the models. Changes include removal of all stock and domestic uses and some changes in pumping rules of water harvesters in upper and middle Condamine. The share volume has been changed for unsupplemented users in St. George. In the Lower Balonne, the unsupplemented without flow condition has been removed and flow rules for some of the irrigators were corrected. Table 5 below explains the differences between the long-term extractions Cap for the Condamine–Balonne catchment and those published in proposed Basin Plan.

Table 5 Comparison between ROP and Basin Plan diversion estimates for the Condamine–Balonne system

Description	Diversion (GL/y)
Condamine–Balonne diversions as per the Cap proposal (modelling period July 1922 – June 1995	729
Use of different simulation period	-4.5
Other reasons, including version of model supplied to MDBA versus final version used for ROP	-11.5
Estimated BDL (excluding interception and basic rights)	**713**

4.2.7 Border Rivers (QLD) including Macintyre Brook

The long-term diversions (1890–2000) for the Queensland Border Rivers as published for the Murray–Darling Basin Cap (including Macintyre Brook) are 250 GL/y (MDBA 2010). This includes an estimate of 22 GL/y of overland diversions. The Border Rivers and Macintyre Brook models have 2.14 GL/y and 0.49 GL/y respectively of floodplain harvesting (i.e. a total of 2.63 GL/y). It has been estimated that diversions not included in the Border Rivers and Macintyre Brook models is 24.6 GL/y (consisting of 22.2 GL/y of overland flow diversions less 2.63 GL/y diversions already included in the models, plus 5 GL/y of unallocated diversions in Granite Belt area). The modelled diversions for the 1895 to 2009 period for Border Rivers plus Macintyre Brook are 217.5 GL/y. Hence, the total modelled plus unmodelled diversions for the Queensland Border Rivers are estimated as 242 GL/y (i.e. 217.5 + 24.6 GL/y). Table 6 below explains the differences between the long-term diversions Cap for the Queensland Border Rivers, and the diversions published in the proposed Basin Plan.

Table 6 Comparison between ROP and Basin Plan diversion estimates for the Queensland Border Rivers system

Description	Diversion (GL/y)
Border Rivers Queensland diversions as per the Cap (modelling period 1890–2000)	**250**
Use of different simulation period for the Basin Plan modelling (1895–2009)	-7.1
Other reasons, e.g. different starting storage volumes, and refinements to the model carried out prior to supply to MDBA	-0.8
Estimated BDL (excluding interception and basic rights)	**242**

4.3 New South Wales catchments

4.3.1 Introduction

The models used for NSW catchments (except the Barwon–Darling and Lower Darling systems) for the preparation of the proposed Basin Plan were the water sharing plan versions of the models, with any improvements or updates that the New South Wales Office of Water (NOW) had carried out. Models for the Namoi, Lachlan and River Murray systems were updated by MDBA to include additional losses that would occur by 2030 due to groundwater development in these valleys. This inclusion of additional groundwater losses is based on the results of surface-water and groundwater interaction results from the Murray–Darling Basin Sustainable Yields project (CSIRO 2008).

The diversion estimates published in the proposed Basin Plan have been compared with the estimated long-term average annual diversions published in the water sharing plans. The long-term average diversions published in the water sharing plans are estimates of diversions that would occur on average under the rules of the plan and the specified climatic conditions. These estimates would be different if the water sharing plan rules are tested under climatic conditions of a different period.

The Lower Darling modelling is based on Cap conditions while Barwon–Darling modelling is based on water sharing plan inflows from NSW tributary catchments and Cap conditions for Queensland catchments and Barwon–Darling itself.

The NOW had supplied the without-development and water sharing plan valley integrated quantity and quality models (IQQMs) to MDBA for the NSW regulated rivers within the Basin. The NOW has also provided some technical advice to MDBA on the use and of the IQQM models for Basin Plan water management objectives. However, this technical advice does not mean that NSW accepts the Basin water management objectives being modelled.

4.3.2 Gwydir

The water sharing plan specifies the long-term average diversion from the plan area as 392 GL/y based on an IQQM model run (DIPNR 2004a). The proposed Basin Plan estimates water course diversions as 326 GL/year. The key reasons for the differences between these two diversion estimates are as follows.

- The model used for preparation of the proposed Basin Plan is the water sharing plan version of the IQQM model for the Gwydir River system, but used over a different modelling period,

Table 7 Comparison between water sharing plan and Basin Plan diversion estimates for the Gwydir Valley

Description	Diversion (GL/y)
Gwydir Valley diversions as per water sharing plan (modelling period 1892-2000)	**392**
Use of different simulation period for the Basin Plan modelling (1895–2009)	-17.1
Floodplain harvesting in the model has been updated based on irrigator surveys, which reduced floodplain harvesting from 80 GL/y to 17.7 GL/y	-62.3
Unregulated diversions not in the model	11.2
Difference due to other reasons such as changes to Copeton Dam inflows, starting storage level assumption and other improvements to the model	1.2
Estimated BDL(excluding interception and basic rights)	**325**

i.e. from 1 July 1895 to 30 June 2009, whereas the modelling period for the water sharing plan model is for the water years from 1892 to 2000.

- Since publication of the water sharing plan, NSW has undertaken a survey of irrigators regarding practices of on-farm storage use and floodplain harvesting versus rainfall-runoff harvesting from the farm. As a consequence of this additional work, floodplain harvesting in the model was revised and this revised model is currently used for Cap implementation, as well as for the determination of the long-term Cap.

The impact of the difference in modelling period, changes to on-farm storage management and other changes to the model, such as Copeton Dam inflows, are summarised in Table 7. The Cap for the Gwydir system based on the updated version of the Gwydir model is 344 GL/y (MDBA 2010). The Cap estimate as reported in the water sharing plan is 415 GL/y. These differences are also due to changes in modelling of floodplain harvesting and differences in simulation period.

4.3.3 Namoi including Peel

An assessment of the long-term extraction limit of 238 GL/y for the upper Namoi and lower Namoi regulated water source is published in the water sharing plan for the Namoi regulated rivers water source (DIPNR 2003). This long-term average annual extraction was estimated under development conditions for water storages, private water management infrastructure and cropping mix that existed in 1999/2000.

Similarly, for the Peel valley the water sharing plan limit for regulated and unregulated river diversions has been assessed as 15.1 GL/y (DECCW 2010). This makes the total diversion limit for the regulated Namoi plus Peel systems under the two water sharing plans 253.1 GL/y (238+15.1). The watercourse diversions for the Namoi and Peel systems in the proposed Basin Plan are 343 GL/y. A summary of key reasons for the difference between the two published numbers is provided in Table 8. The key reasons for the differences are:

- The model used for the proposed Basin Plan is the Namoi water sharing plan version of the model at 1999/2000

Table 8 Comparison between water sharing plan and Basin Plan diversion estimates for Namoi including the Peel Valley

Description	Diversion (GL/y)
Namoi Valley diversions as per water sharing plan (modelling period 1892–2000)	238
Peel Valley diversion as per water sharing plan (1892–2001)	15.1
Total diversion limit as per water sharing plans (Namoi + Peel)	**253**
Use of different simulation period by the Basin Plan (1895–2009)	-9.1
Unregulated diversions not in the model (estimate)	78
Town water supply and stock and domestic demands not included in water sharing plan	1.56
Impact of inclusion of surface-water and groundwater interaction at 2030	-1.9
Difference due to other reasons such as changes in models including recomputing of inflows, changes to supplementary access rule since water sharing plan, starting storage level assumption and model improvements carried out since water sharing plan estimates.	21.5
Estimated BDL (excluding interception and basic rights)	**343**

level of development, but used over a simulation period from 1895 to 2009, whereas the water sharing plan was developed by carrying out modelling over the period 1892 to 2000.

- At the time of development of the Namoi water sharing plan, there was no Peel model and long-term synthesised flows for the Peel River at Carol Gap gauge were used for modelling for the Namoi water sharing plan. For the Basin Plan studies, the Peel model used for the water sharing plan has been linked with the Namoi model. This gives better estimates of the Peel River flows at Carol Gap gauge as a consequence of the use of modelled flows corresponding to the water sharing plan for the Peel River system.
- The diversion estimates reporting includes an additional 1.56 GL/y of town water supply and stock and domestic diversions that are not in the water sharing plan version of the model.
- An additional loss of 11.2 GL/y from surface water by 2030 due to groundwater development has been included in the Basin Plan. This is based on the surface-water–groundwater interaction studies carried out as part of the Sustainable Yields project (CSIRO 2007).
- The Peel valley model has been updated since its use for the Sustainable Yields project including the following improvements:
  - river losses have been recalibrated with data from recent years (1982–2008)
  - Dungowan Dam inflows have been recomputed
  - Tamworth water restriction policy has been included in the model

4.3.4 Macquarie–Castlereagh and Bogan rivers

The long-term extraction limit in the water sharing plan for the Macquarie–Cudgegong regulated water source was estimated at 391.9 GL/y (DIPNR 2004c). This long-term average annual extraction was estimated under the development conditions for water storages, private water management infrastructure and cropping mix that existed in 1999/2000 and the maximum crop area and the crop planting behaviour representative of baseline conditions used for assessment of the Cap. The watercourse diversions published in the proposed Basin Plan are 424 GL/year (i.e. 372.3 GL/y in Macquarie regulated + Cudgegong rivers and 7.97 GL/y in Bogan River + 44 GL/y unmodelled diversions). The key reasons for these differences are summarised in Table 9.

Table 9 Comparison between water sharing plan and Basin Plan diversion estimates for the Macquarie–Castlereagh–Bogan valleys

Description	Diversion (GL/y)
Macquarie Valley diversions as per water sharing plan (modelling period 1890–2001)	**391.9**
Use of different simulation period by the Basin Plan (1895–2009)	-17.9
Modelled Bathurst town water supply, not included in water sharing plan	6.6
Unregulated diversions not in the model	44.0
Difference due to other reasons such as different starting storage level assumption and other improvements to the model including loss estimates in some river reaches, Burrendong inflows and modelling of on-farm storages.	-0.6
Estimated BDL (excluding interception and basic rights)	**424**

4.3.5 Barwon–Darling including lower Darling

The Barwon–Darling system is modelled using two models; the Mungindi to Menindee Lakes section is modelled using the Barwon–Darling IQQM (supplied by NOW) and the Menindee Lakes and lower Darling system is modelled using the MDBA's Murray simulation model (MSM). The water sharing plans for the upper Barwon–Darling and lower Murray–Darling unregulated and alluvial sources are under various stages of development. The Cap for the Barwon–Darling and lower Darling is therefore not yet finalised and models for Cap purposes are not yet accredited. Consequently, Cap targets can be considered as preliminary and subject to change. The preliminary estimate of the long-term average diversions under the Cap for the Barwon–Darling is reported as total for the upper Barwon–Darling and lower Darling together and is estimated as 354 GL/y. The diversions published in the proposed Basin Plan for the Barwon–Darling and lower Darling are 198 GL/y and 55 GL/y, i.e. a total of 253 GL/y. The key reasons for the differences in the two published numbers are due to the following factors and are summarised in Table 10:

- The preliminary estimate for the Barwon–Darling Cap (NOW 2011) is based on use of inflows from catchments contributing to the Barwon–Darling at 1993/1994 level of development for NSW catchments and ROP conditions for Queensland. However, the proposed Basin Plan is based on inflows from contributing tributaries based on the water sharing plan for NSW and the ROP for Queensland. In the case of NSW, valley diversion limits under water sharing plans are lower than the 1993/1994 level of development and thus use of Cap conditions flows from tributaries will show higher diversions for the Barwon–Darling system.

Table 10 Comparison between water sharing plan and Basin Plan diversion estimates for the Barwon–Darling and lower Darling valleys

Description	Diversion (GL/y)
Estimate of Barwon–Darling Valley diversions as per the Cap (modelling period 1895–2009)	216.8
Preliminary estimate of lower Darling Valley diversions as per the Cap (modelling period 1891–2006)	137
Preliminary estimate of total Cap for Barwon–Darling and lower Darling	**354**
Use of different simulation period by the Basin Plan (1895–2009) for lower Darling system	-7
Updating the calibration of irrigation demands and inclusion of rainfall-runoff harvesting	-18.7
TLM water recovery including purchase of 250 GL supplementary water and Darling Anabranch pipeline savings[1]	-67
Difference due to other reasons, such as model improvements in lower Darling model	-8.3
Estimated BDL (excluding interception and basic rights) (Barwon–Darling 198 GL/y + lower Darling 55 GL/y)	**253**

[1] TLM water recovery is estimated as 71 GL long-term Cap equivalent but it is reduced by 4 GL. This is because model improvements in the lower Darling model and its recalibration. In particular, usage of Nettlegoe Lake for irrigation purpose has been removed in the baseline model. This requires further review before development of a water sharing plan compliant with the Basin Plan

- The model for the lower Darling includes water recovery undertaken under the Living Murray program including purchase of 250 GL supplementary licences and anabranch pipeline savings.
- The Barwon–Darling model has been improved to account for the floodplain flows since the version supplied to MDBA and the revised model is being reviewed by an independent auditor for accreditation for use for the implementation of the Cap. Further, water sharing plan diversion estimates include rainfall-runoff harvesting. The Basin Plan has not included rainfall-runoff harvesting in diversion estimates for any valley, because of lack of data to estimate it and potential of double counting in the interception estimates.
- The lower Darling model was improved to take into account recommendations of the auditor for the Cap models and the Basin Plan estimates are based on this improved model.

4.3.6 Lachlan

The long-term extraction limit in the water sharing plan for the Lachlan regulated water source was estimated at 305 GL/y (DIPNR 2004e). This long-term average annual extraction was estimated under development conditions for the water storages, private water management infrastructure and cropping mix that existed in 1999/2000 and the maximum crop area and the crop planting behaviour representative of baseline conditions used for assessment of the Cap. The water course diversions published in the proposed Basin Plan are 302 GL/year. The key reasons for the difference between the estimates published in the water sharing plan and the proposed Basin Plan are summarised in Table 11.

4.3.7 Murrumbidgee

The long-term extraction limit in the water sharing plan for the Murrumbidgee regulated river water source was estimated at 1,925 GL/yr, reducing to 1,890 GL/yr after the fifth year of the plan, when updated Balranald end-of-system targets were to be introduced (DWE 2009). This assessment was carried out for the climatic period of 1892 to 2000. In the proposed Basin Plan watercourse diversions for

Table 11 Comparison between water sharing plan and Basin Plan diversion estimates for the Lachlan Valley

Description	Diversion (GL/y)
Lachlan Valley diversions as per water sharing plan (modelling period 1898–2000)	**305**
Use of different simulation period by the Basin Plan (1895–2009)	-22.4
Impact of inclusion of surface-water and groundwater interaction at 2030	-6.2
Unregulated diversions not in the model	15.7
Difference due to other reasons, such as different starting storage level assumption and other improvements to the model carried out by NOW since publication of the water sharing plan	10.6
Estimated BDL (excluding interception and basic rights)	**302**

the Murrumbidgee have been reported as 2,000 GL/y. The key components leading to the difference in Murrumbidgee diversions reported in the proposed Basin Plan as compared to the water sharing plan are summarised in Table 12. The key reasons to note are as follows.

- The Basin Plan modelling for current conditions includes TLM water recovery equivalent to 52.1 GL/y reductions in long-term water use. Table 13 provides details of TLM purchases as modelled.
- The water sharing plan does not include any Lowbidgee diversions, while the Basin Plan assumes that 150 GL/y of diversions into the Lowbidgee (under baseline conditions) are used for irrigation purposes and the rest for environmental use.
- For the Basin Plan modelling, Burrinjuck inflows are derived using the upper Murrumbidgee, ACT and Snowy models, while the NOW model as used for the water sharing plans uses back-calculated Burrinjuck inflows based on relationships between observed flows at Gundagai and Wagga, and releases from the Snowy Scheme.
- The model run period for the water sharing plan estimate is different (1892–2000) to that of Basin Plan modelling (1895-2009).

Table 12 Comparison between water sharing plan and Basin Plan diversion estimates for the Murrumbidgee Valley

Description	Diversion (GL/y)
Murrumbidgee Valley diversions as per water sharing plan (modelling period 1892–2000)	**1,925**
Run period changed to 1895–2009	-38.9
New inflow sequence (linkage to upper Murrumbidgee and Snowy model)	20.5
Updating end-of-system flow requirement after 5 years as per water sharing plan	-35.0
TLM water recovery	-52.1
Update of Finley Escape, Lake Victoria storage volume and Murray effective allocations from MDBA Murray model output	0.9
Changes to model for operation of Hay, Maude and Redbank weirs	4.2
Water sharing plan does not include Lowbidgee diversions but proposed Basin Plan includes 50% of Lowbidgee diversions as irrigation diversions	149.5
Unregulated diversions	42.4
Water recovery by Water for Rivers for Snowy (Only market purchase and infrastructure programs which would lead to reduction in diversions from river. No correction made for additional 52.2 GL water recovery which has been achieved through infrastructure works and measures Table 14).	-43.8
The inter-valley trade adjustment of 25 GL made to water sharing plan model estimates is included in the model used for the Basin Plan	25.0
Difference due to other reasons, such as different starting storage level assumption and other improvements to the model carried out by NOW since publication of the water sharing plan	2.4
Estimated BDL (excluding interception and basic rights)	**2,000**

- During discussions with the Murrumbidgee stakeholder groups, the issue of reporting diversions as gross diversions in the Guide to the proposed Basin Plan was raised, and as a consequence, reporting for Murrumbidgee diversions have now been changed to net reporting. This is consistent with diversion reporting under the water sharing plan and the Cap.
- Murrumbidgee modelling does not include Water for Rivers purchases, but these are accounted for after the model is run. Table 14 provides details for water recovered under the Water for Rivers program included in the baseline conditions.

Table 13 Murrumbidgee TLM purchases

The Living Murray	Entitlement (GL/y)	LTCE[1] (GL/y)
Infrastructure	3.5	2.2
Market purchase	78.4	49.9
TOTAL	**81.9**	**52.1**

[1] Long term Cap equivalent

4.3.8 NSW Border Rivers

The NSW Border Rivers regulated river water sharing plan quotes a long-term annual extractions volume for Queensland and NSW states of 399.4 GL/year (based on the inter-governmental agreement model) (NOW 2009). Out of 399.4 GL/y average annual diversion limit for both states, NSW's long-term annual extraction volume is 194.5 GL/y. This estimate is based on Pindari Dam's capacity increasing from 37.5 GL (pre-enlargement) to 312 GL (post-enlargement). The model used for the Border Rivers system is the version used for the inter-government agreement on the Border Rivers between NSW and Queensland.

The water sharing plan does not include water diversions from the unregulated system not in the model and these diversions are currently estimated as 16.3 GL/y for NSW. Table 15 outlines the differences between the proposed Border Rivers water sharing plan and the diversions published in the proposed Basin Plan.

Table 14 Murrumbidgee Water for Rivers purchases

Murrumbidgee Water for Rivers purchases	Entitlement (GL)	LTCE (GL/y)
Infrastructure		
Forest Creek Stage 2	23.4	22.2
Forest Creek Stage 1 — alternative stock and domestic supply	11.3	10.7
Barren Box Swamp water recovery*	20.0	19.3
Total	**54.7**	**52.2**
Market purchase and infrastructure programs which would lead to reduction in diversions from river		
NSW regulated general security market water purchase	40.4	25.7
On-farm reconfiguration	21.5	13.7
Coleambally Irrigation Co-Op Ltd.	3.5	3.4
Hay private irrigation district stock and domestic pipeline	1.0	1.0
Total	**66.4**	**43.8**
Sum of infrastructure and market purchases	**121.1**	**96.0**

* This has been incorrectly included in the infrastructure program but should be part of infrastructure programs that lead to a reduction in diversions from the river and thus the BDL should be reduced by this amount.

Table 15 Comparison between water sharing plan and Basin Plan diversion estimates for NSW Border Rivers

Description	Diversion (GL/y)
NSW Border Rivers diversions as per water sharing plan (modelling period 1890–2004 and Oct–Sept water year)	**194.5**
Use of different simulation period by Basin Plan modelling (1895–2009)	-3.1
Current estimate of unmodelled diversions	16.3
Estimated BDL (excluding interception and basic rights)	**208**

4.3.9 NSW Murray

The estimate of the long-term average annual diversions for the Murray system has not been published in the water sharing plan for the Murray regulated water source. However, long-term diversions under the Murray water sharing plan are less than the Cap by about 3%. In this section, the published numbers in the proposed Basin Plan have been compared with the Murray NSW Cap with the unexplained component attributed to the Murray NSW Plan and other actions not quantified. The key reasons for the difference are as follows.

- For NSW Murray, the long-term averaged Cap on diversions is 1,880 GL/yr (Bewsher 2008; MDBA 2009). The water sharing plan for the NSW Murray and lower Darling regulated rivers water sources limit on long-term average extraction limit is based on 2000/2001 development conditions less 17.8 GL/yr for the purchase of 100 GL Murray Irrigation Limited supplementary water share (100 GL equivalent to 17.8 GL long-term Cap equivalent [LTCE]) through TLM. This is different to the Cap which is based on 1993/1994 level of development and the impact of water sharing rules is not documented in the water sharing plan. However, this impact was assessed as 3% reduction in long-term average diversions from the Cap.
- The Murray model used for the Basin Plan development includes interstate and intrastate permanent trades up to 2009, which are -2 GL and 0 GL net transfers to NSW Murray and lower Darling respectively.
- The model includes not only 100 GL supplementary water purchased from Murray Irrigation Limited as mentioned earlier, but also other projects. It includes recovering of the full 500 GL for the Living Murray and Water for Rivers for the Snowy and Murray (Table 16). NSW components of the LTCE of the water recovery programs included in the baseline model for the Basin Plan are 114 GL (72 GL LTCE for TLM excluding 17.8 GL LTCE for Murray Irrigation Limited supplementary licence purchase and 24 GL for Water for Rivers). In addition, 7 GL of water recovery through works constructed under the Water for Rivers program to reduce evaporation losses and water logging in Millewa and Gulpa Island Estate Forest is also included in the baseline conditions.
- The difference in simulation period used for Cap estimation (1891–2006) and the period used for the proposed Basin Plan (1895–2009) is also a reason for a reduction in the long-term average diversions. This reduction is quantified by examining a run of the Basin Plan current diversion limit model with the same simulation period to the audited Cap model (run no. 21939) leading to a reduction in long-term average diversion of around 48 GL/y for NSW Murray.

- There is still a 36 GL difference between the published Cap estimate and proposed Basin Plan which is due to combination of reasons including:
  - implementing the water sharing plan rules which include 2000/2001 level of development and rules, changes in water allocation policy, reduction in maximum storage capacity for Menindee Lakes, recent recalibration of the lower Darling system, use of Barmah Millewa environmental allocation and Lake Victoria operation rules
  - the additional ground losses (47 GL/yr), which are accounted for equally between NSW and Victoria
  - TLM water delivery and inclusion of detailed icon site models
  - changes in internal spill
  - various model improvements.

Table 16 Environmental water recovery from NSW Murray in the Basin Plan model but not included in the Cap model

Water recovery	Project	Category of Entitlement	Entitlement (GL/y)	Proponent
TLM	Murray Irrigation Limited	Supplementary	100.0	NSW
	Wetland Water Recovery Stage 1	High	1.0	
	Pipe lt	General	0.2	
	NSW Market Purchase	High	1.1	
		General	69.2	
	NSW Package B	Poon Boon	-	
		High	3.7	
	Water through efficiency tender	General	0.2	Australian Government
	RGA on-farm water efficiency project Round 1	General	1.3	MDBA
	RGA on-farm water efficiency project Round 2	General	5.2	MDBA
	Pilot market purchase	General	13.0	MDBA
	Total 90 GL LTCE (excluding 9 GL recovered from Poon Boon Lakes)			
Water for Rivers	Market purchase	General	30.0	NSW
	Reconfiguration	General	0.2	
	Edward Gulpa Wetland works		7.0	
	Total 24 GL LTCE (excluding 7 GL recovered by Edward Gulpa Wetland Works)			

Table 17 Comparison between Cap and Basin Plan diversion estimates for the NSW Murray

Description	Diversion (GL/y)
NSW Murray Cap (1891–2006)	**1,880**
Living Murray water purchase from Murray Irrigation Limited supplementary license[1]	-18
Other TLM water recovery in model [1]	-72
Water for Rivers in model[1]	-24
Permanent trade	-2
Use of different simulation period by the Basin Plan (1895–2009)	-48
Other components, including implementation of water sharing plan[2], changed tributary inflows, e.g. increased flows from Murrumbidgee due to TLM and Balranald flow target, model changes including detailed modelling of icon sites, added groundwater losses and changed internal spills from Victoria to NSW	-36
Unmodelled diversions	28
Estimated BDL (excluding interception and basic rights)	**1708**

[1] Calculated by comparing against TLM baseline model, which runs from 1895 to 2003.

[2] Additional modelling is needed to quantify reduction due to adoption of water sharing plan for the Murray and lower Darling regulated water sources 2003.

4.4 Victorian catchments

4.4.1 Introduction

The baseline conditions for Victorian valleys are based on the Cap. Therefore, the diversion numbers as published in the proposed Basin Plan have been compared with the Cap and the reasons for the differences are discussed in the following paragraphs. The main reasons for the differences are that the baseline for the Basin Plan includes water recovery for the Living Murray and Water for Rivers programs and significant volumes of permanent trade from the Goulburn–Broken system to the Victorian Murray.

4.4.2 Goulburn–Broken, Campaspe and Loddon rivers

The long-term average annual diversion Cap for the Goulburn–Broken–Loddon system is 2,034 GL/y and for the Campaspe system it is 122 GL/y (MDBA 2010). The annual average watercourse diversions published in the proposed Basin Plan are 1,580 GL for the Goulburn, 13 GL/y for the Broken, 89 GL/y for the Loddon (i.e. 1,682 for Goulburn–Broken–Loddon together) and 113 GL/y for the Campaspe system. The reasons for the differences in these numbers are summarised in Table 18.

The long-term Cap on diversions was based on a simulation period from 1891 to 2004, while the baseline for the proposed Basin Plan is based on the 1895 to 2009 period. The long-term Cap calculated for the proposed Basin Plan simulation period is 44 GL/y lower for the Goulburn–Broken–Loddon system and 4.3 GL/y lower for the Campaspe (Table 18).

The Basin Plan baseline includes the decommissioning of Lake Mokoan, which represents a reduction in the long-term Cap of 17 GL/y.

The volumes of water recovery and inter-valley trade (IVT) entitlements included in the Basin Plan baseline model are summarised in Table 19. The associated reductions in diversions are estimated based on the annual average use of the environmental and IVT accounts in the baseline model and are presented in (Table 18) and is estimated as 290 GL/y in total. However, the estimated LTCE of water

Table 18 Comparison between Cap and Basin Plan diversion estimates for the Goulburn–Broken, Loddon and Campaspe systems

Description	Goulburn–Broken–Loddon	Campaspe
Published long-term average annual Cap	**2034**	**122**
Use of different simulation period by the Basin Plan (1895–2009)	-44	-4.3
Decommissioning of Lake Mokoan	-17	
TLM water recovery*	-147	-3.6
Water for Rivers recovery and inter-valley trade*	-140	
Victorian government water recovery in Loddon*	-3	
Remaining difference due to other model changes/improvements and updated estimate of unmodelled diversions	-1	-1
Estimated BDL (excluding interception and basic rights) (Goulburn 1580 GL/y + Broken 13 GL/y + Loddon 89 GL/y)	**1682**	**113**

* Diversion reduction estimate is based on *modelled use* of entitlements; Water for Rivers and IVT are modelled using one account.

Table 19 Environmental water recovery and trade in the Basin Plan model, but not included in the Cap model

Description	HRWS[1] (GL)	LRWS[2] (GL)	Total (GL)
Goulburn-Broken			
Water recovery for TLM			
Living Murray account reconfiguration	19.2		19.2
Shepparton modernisation[3]	26.0	9.4	35.5
Purchase	5.6		5.6
20% sales water		141.2	141.2
Water for Rivers water recovery			
Normanville	3.9		3.9
IMSVID	10.9		10.9
Strategic Measurement project	0.5		0.5
Water share purchases (incl. Madowla Park)	4.2	17.9	22.1
Inter-valley trade:			
Permanent trade	110.2		110.2
Loddon			
Victorian government water recovery			
Boort Wetlands	2.0		2.0
20% of sales water		2.0	2.0
Total Goulburn/Broken/Loddon	**182.5**	**170.5**	**353.0**
Campaspe			
Water recovery for TLM			
Account reconfiguration	0.1		0.1
20% of sales water		5.0	5.0
Inter-valley trade			
Exchange rate trade till June 2007[4]	1.2		1.2
Total Campaspe	**1.4**	**5.0**	**6.4**

[1] High Reliability Water Share

[2] Low Reliability Water Share

[3] These numbers represent TLM entitlements as included in the model at the time the Basin Plan scenarios were run. However, these numbers do not exactly represent the TLM entitlements resulting from the Shepparton modernisation and will be corrected in the model to 20.5 GL HRWS and 15.8 GL LRWS for future scenarios.

[4] No Cap adjustment required, as it is still modelled as a diversion from Campaspe in Baseline Model.

recovery and IVT based on the Cap factors would only be 275 GL/y (138 GL/y TLM, 29 GL/y Water for Rivers, 105 GL/y for IVT and 3 GL/y Loddon) for the Goulburn–Broken–Loddon system and 3.6 GL for the Campaspe system. The higher reduction in diversions for TLM water recovery in the model is due to a higher level of use by the environment as compared to the level of use adopted for computing Cap factors.

There are various other reasons why the long-term Cap and the Basin Plan diversion estimates are different. These include various other model changes and improvements (e.g. improved loss functions and changes to the calculation of allocations and the Waranga Western Channel supplements), as well as a different estimate of unmodelled diversions. Overall, the remaining differences between Cap and Basin Plan diversions estimates as shown in Table 18 is only 1 GL/y for both the Goulburn–Broken–Loddon and the Campaspe systems.

4.4.3 Wimmera

The long-term Cap for the Wimmera–Mallee is 159 GL/y (W&D 2009; MDBA 2010). This includes 0.9 GL/y of unmodelled diversions. The modelled diversions were determined by the Cap model run over the period from July 1891 to June 2008. The Cap model represents the 1993/1994 level of development, which only includes Stage 1 of the Northern Mallee Pipeline Project.

The Wimmera model used for the baseline conditions for the proposed Basin Plan includes stages 1 to 7 of the Northern Mallee pipeline and includes supply systems 1 to 6 (i.e. all supply systems) of the Wimmera–Mallee pipeline. The model includes supply to the Horsham Irrigation District (28 GL/yr entitlement), which has since been proposed to be decommissioned. The total annual average diversions published in the proposed Basin Plan are 66 GL/y, which includes 0.8 GL/y of unmodelled diversions.

Table 20 summarises the reasons for differences between proposed Wimmera Cap and the diversions estimate published in the proposed Basin Plan. The difference is due to the different simulation period and is minor (0.5 GL/y). The main difference is due to the Northern Mallee and Wimmera–Mallee Pipeline projects. Other model changes that may contribute to the difference include the following.

- The Cap model is based on the allocation policy predating the bulk entitlements (W&D 2009), while the Basin Plan model makes use of the current allocation policy.
- The Cap model includes a long-term Goulburn supply volume through the Waranga Western Channel of 8 GL/y. While this supply is not part of the Wimmera–Mallee Cap, it may have an effect on modelled diversions from the Wimmera. The Basin Plan model does not include a Goulburn supply.

Table 20 Comparison between Cap and Basin Plan diversion estimates for the Wimmera system

Description	Diversion (GL/y)
Published long-term average annual cap	**159**
Difference due to different simulation period	-0.5
Water savings due to Northern Mallee and Wimmera Mallee pipelines and model changes	-92
Estimated BDL (excluding interception and basic rights)	**67**

4.4.4 Victorian Murray (including Kiewa and Ovens)

The long-term average annual diversion limit for the Victorian Murray including Kiewa and Ovens is 1,702 GL/y. For the Basin Plan, the baseline adopted is the Cap for the Victorian Murray including Kiewa and Ovens with a reduced annual limit for water recovery undertaken under the Living Murray and Water for the Rivers programs. The key reasons for the difference between the published Cap estimate and water course diversions published in the proposed Basin Plan are described below and summarised in Table 21.

- The Basin Plan diversion estimates include net permanent trade into the Victorian Murray until 2009 of 74 GL.
- Water recovery measures included in the baseline model are 124 GL LTCE in total including 50 GL water recovered through infrastructure works and measures, 85 GL from TLM and 39 GL from Water for Rivers (Table 22).
- The impact of the difference in the simulation period used for estimating the Victorian Murray Cap (1891–2006) versus the period used for the Basin Plan (1895–2009) is reduction in average long-term diversion of 22 GL/y (run no. 21939000).
- The diversion demands for the Kiewa catchment are calculated using a regression equation with a trend component in it. This trend was computed based on analysis of diversion data from the 1983 to 2000 period. The Cap model only uses the trends up to 1994 (when the Cap on diversions was agreed). The Basin Plan model uses the trend up to 2006, which is the same as the TLM benchmark. This extending of the trend to 2006 in the Basin Plan model leads to a 4 GL/y increase in water usage. The recent analysis shows that Kiewa regression models need to be reviewed using post-2000 diversion data.

Table 21 Comparison between Cap and Basin Plan diversion estimates for the Victorian Murray

Description	Diversion (GL/y)
Victorian Murray including Kiewa and Ovens Cap (1891–2006)	**1,702**
Use of different simulation period by the Basin Plan (1895–2009)[1]	-22
TLM water recovery in model (in addition 28 GL has been recovered through infrastructure works and measures)[2]	-57
Reduction in diversions due to Water for Rivers water recovery (in addition 22 GL has been recovered through infrastructure works and measures)[2]	-17
Permanent trade	74
Different Ovens model	2.0
Kiewa model trend changed from 1994 to 2006	4.0
Other components including changed tributary inflows, e.g. model changes including detailed modelling of icon sites, added groundwater losses and changed internal spills.	7
Unmodelled diversions	5.5
Estimated BDL (excluding interception) (Murray 1662 GL/y + Kiewa 11 GL/y + Ovens 25 GL/y)	**1,698**

[1] Comparison of the Cap model with different modelling periods (1891–2006 and 1895–2009).

[2] Calculated by comparing against TLM baseline model which runs from 1895 to 2003.

- The Cap on diversions for the Ovens catchment is computed using a regression equation to calculate irrigation demands and are restricted according to water availability. However for the Basin Plan model, Ovens diversion estimates are based on diversions used in the Ovens REALM model, which results in long-term average diversions that are 2 GL higher.
- The unexplained difference between Victorian Murray diversions estimated for the Cap and for the Basin Plan is 7 GL/y which could be due to:
  - changed tributary inflows
  - model changes.

Table 22 TLM and Water for Rivers water recovery for the Victorian Murray

Water recovery	Project	Category of Entitlement	Entitlement (GL/y)	Proponent
TLM	Sales unbundling	LRWS	98.8	Vic
	Reconfiguration	HRWS	5.7	
	Lake Mokoan	-	34.3	
	Pilot market purchase	HRWS	1.9	MDBA
	Living Murray water purchase	HRWS	7.2	
	Sustainable Soils and Farms on-farm reconfiguration	HRWS	3.2	
	NSW Wetland Water Recovery Stage 1	HRWS	0.3	NSW
	NSW Package B	HRWS	3.7	
	Total 57 GL LTCE (excluding 28 GL recovered from Lake Mokoan)			
Water for Rivers	Market purchase	HRWS	6.4	Vic
		LRWS	5.1	
	Lake Mokoan	HRWS	22.1	
	Others	HRWS	9.0	
		LRWS	0.5	
	Total 17 GL LTCE (excluding 22 GL recovered from Lake Mokoan)			

4.5 South Australian Murray

The long-term diversion Cap for the Murray–Darling system is specified in Schedule E to the Murray–Darling Basin Agreement as:

- metropolitan Adelaide and associated country areas supplied through Swan Reach Stockwell, Mannum–Adelaide and Murray Bridge – Onkaparinga pipelines not to exceed 650 GL over any five year period; this Cap is non-tradeable
- Lower Murray Swamp irrigation not to exceed 94.2 GL/y
- water supply to country towns not to exceed 50 GL/y
- all other purposes not to exceed 449.9 GL/y

The administration of the diversions by South Australia so as to remain within the Cap is carried out based on climate adjusted annual diversion targets with further adjustment for trade and an allowance for imposition of restrictions. The allowance for imposition of restrictions was recommended by the Independent Audit Group in 2007–2008 and for last two years this has been included in the calculations for annual diversion targets. The original assessments of the long-term annual Cap were carried out using climatic data prior to the millennium drought and recent low inflow years have shown that this allowance for imposition of restrictions will result in average annual diversions to be lower than the Cap target assessed without use of recent climatic data.

Specific reasons for differences in South Australian diversions reported in the proposed Basin Plan as compared to the Cap are summarised in Table 23. The key points to note are as follows.

- Average annual diversions for Adelaide (100 GL/y) in the Cap model are based on diversions at 2001 level of development. These diversion estimates are based on the best available data and models for these demands and are within the requirements that metropolitan Adelaide and associated country areas through the Swan Reach–Stockwell, Mannum–Adelaide and Murray Bridge – Onkaparinga pipeline systems do not exceed a total diversion of 650 GL over five years.
- The country town diversions are based on the level of development as per the year 2000, but factored up to give 50 GL/y diversions on average when these town water supplies are not restricted. This resulted in long-term average country town diversions of 48 GL/y.
- There is net increase in the long-term Cap for all other uses and Lower Murray swamp of 32 GL/y due to permanent trade until June 2010.
- There is a 42 GL/y reduction in the long-term Cap due to water recovery under TLM.
- The total difference of 59 GL/y between long-term average annual diversions of 724 GL/y (which includes 32 GL/y inter- and intra-state permanent trade) and 665 GL/y SA diversions reported in the proposed Basin Plan is due to TLM water recovery (43.9 GL/y entitlements and 42 GL LTCE, Table 24), the difference in modelling period (11 GL/y) and a range of other reasons (6 GL/y) including improvements to the model for detailed modelling of icon sites and works and measures, and implementation of SA's restriction policy.

The annual climate-adjusted Cap model for metropolitan Adelaide is still being developed and in its absence, the best available estimate of diversions under Cap conditions and historical diversion information has been used to estimate BDLs for South Australia. On completion of the Cap model for metropolitan Adelaide, the BDL estimates for South Australia will be updated.

Table 23 SA diversions for different model runs over different modelling periods

	Water Act 2007	Cap model		Current conditions modelled with improvements[1]	Basin Plan current diversion limit model run	
	Schedule E to Murray–Darling Basin Agreement	Without permanent trade adjustment	With Permanent Trade Adjustment		SA TLM water recovery	Extension of modelling period to 2009
		(1)	(2)	(3)	(4)	(5)
Modelling period		1891–2006		1891–2006	1891–2006	1895–2009
Lower Murray Swamps and all other purposes	544.1	544	576	570	528[2]	518
Country towns[3]	50	48	48	48	48	47
Metro Adelaide	650[4]	100	100	100	100	100
Total		**692**	**724**	**718**	**676**	**665**
Difference		**-**	**32**	**-6**	**-42**	**-11**

[1] Improvements included level of detail for icon sites, SA restriction policy and model recalibration.

[2] TLM water recovery of 42 GL LTCE from all other purposes and lower Murray swamps.

[3] Long-term average annual country town diversions in the model are 2 ~ 3 GL/y less than the Cap.

[4] Not to exceed 650 GL over a 5 year period.

Table 24 TLM water recovery — SA components

Proponent	Measure	Entitlement volume (GL)
SA	Securing government held water for environmental use	13.0
SA	Purchase from willing sellers	4.3
		1.1
SA	Securing government held water and purchases from willing sellers	5.9
		12.3
MDBA	TLM water purchase project	7.3
TOTAL 42 GL LTCE		

5 CONCLUSIONS

The reasons for differences in the diversions estimates and water sharing plans/water resource plans/Cap as relevant for New South Wales, Victoria and Queensland have been discussed and explained as far as possible with the information and models available to MDBA. To account for reasons for each individual action would require a major joint effort from both state agencies and MDBA to sequentially analyse actions and model improvements or changes that have occurred over the years. However, this report documents the best available information for the reasons for the differences and has attempted to provide an approximate estimate of likely impacts of various individual actions.

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