Chapter 2
Surface Water

Introduction

2.1 The management of surface water resources in the Murray-Darling Basin is a key aspect of the Basin Plan. The central feature of surface water management was the development of the Basin's surface water and the associated quantities of sustainable diversion limits (SDLs) and baseline diversion limits (BDLs). The setting of the SDLs and BDLs will be discussed in turn.

2.2 The quantity of water set for the SDLs and BDLs has a major impact on the way in which water in the Basin will be managed under the Basin Plan. As a result, these items have been a major focus of the public debate regarding the Basin Plan. This chapter examines the modelling and key assumptions that informed the Murray-Darling Basin Authority's (MDBA) setting of the SDLs and BDLs for surface water in the Basin Plan. The chapter also identifies some key areas of concern regarding the MDBA's modelling including:

- the MDBA's lack of clarity in presenting information about the modelling to stakeholders and the public;
- the lack of information available about the alternative scenarios for a reduction in take other than the 2750 GL/y figure proposed by the MDBA;
- reliance on historical data for the modelling;
- inadequate treatment of predicted impacts of climate change in the modelling; and
- inadequate treatment of water interception in the modelling.

2.3 The SDLs and BDLs for groundwater resources and the issue of surface water and groundwater connectivity are discussed in the following chapter.

2.4 Although modelling of scenarios for 3200 GL/y return of take is discussed in this chapter, the additional return of 450 GL/y to the Murray River that was proposed by the Government in October 2012 is dealt with in chapter four.

Surface water resources

SDLs and BDLs

2.5 The MDBA established a baseline from which to measure diversion reductions, known as BDLs. In general, a specific BDL is:

> …a combination of limits established by state law (e.g. existing water resource plan limits), defined levels of take where there are no established

> limits, and in some cases, the limits established by the Murray–Darling Basin cap arrangements where these establish the lowest limit.[1]

2.6 Schedule 3 of the Basin Plan determines the BDL for the various individual resource units in the Basin. The MDBA determined the total, Basin-wide BDL to be 13 623 GL in the baseline year of 2009.[2]

2.7 The Basin Plan also establishes SDLs. The Basin Plan's explanatory statement notes that an SDL:

> …is defined in section 1.07 [of the Basin Plan] to mean the long-term average sustainable diversion limit. 'Long-term average sustainable diversion limit' means the maximum long-term annual average quantities of water that can be taken, on a sustainable basis, from the Basin water resources as a whole, and the water resources, or particular parts of the water resources of each water resource plan area (item 6 of subsection 22(1) of the Act [*Water Act 2007*]). Each long-term average sustainable diversion limit must reflect an environmentally sustainable level of take (subsection 23(1) of the Act). An environmentally sustainable level of take (ESLT) is the level of take at which water can from be taken from a water resource without compromising key environmental assets, key ecosystem functions, the productive base or key environmental outcomes for the water resource (subsection 4(1) of the Act).

2.8 The long-term average SDLs across all the Basin's catchments will come into effect in 2019.[3] This is currently estimated as 10 873 GL/y.[4]

2.9 The difference between the Basin wide BDL and the Basin wide SDL is 2750 GL/y. This is the total return of water to the Basin system for environmental purposes. The northern basin is to contribute 390 GL/y, the southern basin 2289 GL/y and the disconnected tributaries contribute the remaining 71 GL/y to the total 2750 GL/y.[5]

2.10 In addition, the final Basin Plan contains a mechanism to adjust the reduction amounts, therefore the 2750 GL/y figure becomes a range of total reduction of

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1 MDBA, www.mdba.gov.au/draft-basin-plan/draft-basin-plan-chapter-summary/glossary (accessed, 5 March 2013).

2 SEWPaC, *Environmental Water Recovery Strategy for the Murray-Darling Basin: Draft for Consultation*, November 2012, p. 8.

3 Basin Plan, section 6.04 (1)

4 Basin Plan, section 6.04 (2)

5 The northern Basin consists of Paroo, Warrego, Gwydir, Nebine, Condamine-Balonne, intersecting streams (including NSW Warrego), Moonie, Namoi, Macquarie-Castlereagh, Queensland Border Rivers, NSW Border Rivers, and Barwon-Darling; the southern Basin consists of Ovens, Goulburn, Broken, Loddon, Campaspe, Murrumbidgee-NSW, Kiewa, Eastern Mount Lofty Ranges, NSW Murray, Victorian Murray, SA Murray, Lower Darling, Murrumbidgee – ACT, Marne Saunders; Disconnected Tributaries consist of Lachlan and Wimmera-Avoca. SEWPaC, *Environmental Water Recovery Strategy for the Murray-Darling Basin: Draft for Consultation*, November 2012, p. 22.

2750 GL/y plus or minus 5 per cent of the long-term Basin wide SDL.[6] This adjustment mechanism is discussed further below.

SDL adjustment mechanism

2.11 In November 2012, the *Water Act 2007* (Water Act) was amended to allow the final Basin Plan to include an adjustment mechanism to change SDLs 'based on new initiatives which achieve better environmental outcomes, or reduced social and economic impacts, relative to those considered in setting initial SDLs.'[7] Although the surface water recovery figure in the Basin Plan remains at 2750 GL/y, the SDL adjustment mechanism allows for changes to this figure of plus or minus 5 per cent of the Basin-wide SDL. As noted in the explanatory statement to the Basin Plan:

> SDL adjustments resulting from application of the SDL adjustment mechanism must operate in the net range of plus or minus 5% of the surface water SDL for the Basin. Adjustments resulting from supply and efficiency measures will be netted against one another to provide the total adjustment amount while maintaining the plus or minus 5% limit.[8]

2.12 As a result, with 'an initial surface water SDL of 10 873 GL this limits the net adjustment to 544 GL.'[9]

2.13 Importantly, the primary way of achieving changes from the 2750 GL/y figure are through either efficiency measures or supply measures. An efficiency measure is a measure that 'makes savings in the amount of water required for consumptive purposes. Examples include investment in more efficient irrigation infrastructure.'[10] A supply measure is:

> …a measure that increases the quantity of water available before consumptive take. The measure may do this either by making water available for environmental use without reducing the volume of water available for consumptive take (e.g. through reducing evaporation losses at suitable storages) or by allowing environmental managers to achieve the same environmental outcomes more efficiently, thus reducing the volume of water needing to be recovered for the environment. Supply measures allow equivalent environmental outcomes to be achieved without needing to reduce consumptive take as much as originally anticipated in the Basin Plan.[11]

2.14 The amendment to the Water Act that provided for the adjustment mechanism was inquired into by the Senate Environment and Communications Legislation

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6 Basin Plan Explanatory Statement, p. 32.

7 Basin Plan Explanatory Statement, p. 43.

8 Basin Plan Explanatory Statement, p. 32.

9 SEWPaC, *Environmental Water Recovery Strategy for the Murray-Darling Basin: Draft for Consultation*, November 2012, p. 10.

10 Basin Plan Explanatory Statement, p. 43.

11 Basin Plan Explanatory Statement, p. 43.

Committee.[12] That committee's report stated that '[m]any submitters were generally supportive of an adjustment mechanism'.[13] However, the report also identified three concerns with the amendment as it was initially proposed in Parliament:

- lack of opportunity for public participation in and consultation on the adjustment mechanism;
- lack of ministerial discretion as to whether to adopt an adjustment amendment to the Basin Plan; and
- whether such an amendment to the Basin Plan is a disallowable instrument.[14]

2.15 On 30 October 2012, the House of Representatives made amendments to the bill and the Environment and Communications Committee was of the view that the amendments addressed the above concerns.[15] The bill with amendments was enacted on 21 November 2012.

2.16 As noted above, the Senate Environment and Communications Committee's report stated that many stakeholders supported the enabling legislation for the adjustment mechanism.[16] This is reflective of the views raised by witnesses in this committee's inquiry that the 2750 GL/y should be considered as a 'starting point' for reduction in take and that future flexibility was required.[17]

2.17 This was also the view of the MDBA at the time of Basin Plan (November 2011 and May 2012), that the 2750 GL/y figure should be viewed as a 'starting point for an adaptive process' and it could shift following future reviews, proposals to

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12 Senate Environment and Communications Legislation Committee, Report on *Water Amendment (Long Term Average Sustainable Diversion Limit Adjustment) Bill 2012 [Provisions]*, 19 November 2012.

13 Senate Environment and Communications Legislation Committee, Report on *Water Amendment (Long Term Average Sustainable Diversion Limit Adjustment) Bill 2012 [Provisions]*, 19 November 2012, p. 11.

14 Senate Environment and Communications Legislation Committee, Report on *Water Amendment (Long Term Average Sustainable Diversion Limit Adjustment) Bill 2012 [Provisions]*, 19 November 2012, p. 11.

15 Senate Environment and Communications Legislation Committee, Report on *Water Amendment (Long Term Average Sustainable Diversion Limit Adjustment) Bill 2012 [Provisions]*, 19 November 2012, pp 14–15. Another stakeholder expressed more caution to this committee, noting that '[w]e have not yet seen how the adjustment mechanism will work in practice.' Ms Perin Davey, Executive Officer, Murray Group of Concerned Communities, *Committee Hansard*, 23 November 2012, p. 12.

16 Senate Environment and Communications Legislation Committee, Report on *Water Amendment (Long Term Average Sustainable Diversion Limit Adjustment) Bill 2012 [Provisions]*, 19 November 2012, p. 11.

17 For 2750 GL/y as a good starting point and/or flexibility see: the Hon Dean Brown, Lower River Murray Reference Group, *Committee Hansard*, 3 April 2012, p. 53; Ms Cheryl Rix, General Manager, Western Murray Irrigation Ltd, *Committee Hansard*, 3 April 2012, p. 14; and Mr Laurie, President, National Farmers Federation, *Committee Hansard*, 23 April 2012, p. 34.

address constraints, efficiencies gained through environmental works and measures and as new science or other knowledge is gathered.[18]

2.18 More detail on the adjustment mechanism (specifically in terms of supply measures and efficiency measures) is included in chapter four.

Modelling of surface water sustainable division limits and the 2750 GL/y

2.19 To determine the Basin SDLs and as a consequence arrive at the 2750 GL/y reduction in take, the MDBA undertook significant modelling of surface water in the Basin. Initial work undertaken by the MDBA included assessing the water needs of species, communities and areas of diversity, in particular 'those recognised under international agreements such as the Ramsar Convention' and the *Environment Protection and Biodiversity Conservation Act 1999* throughout the Basin.[19]

2.20 However, the modelling techniques for surface water SDLs have also shifted over time. The modelling of surface water in the Guide involved an 'end-of-system flow model'. For the development of the various iterations of the Basin Plan, the MDBA moved to a 'hydrological indicator flow model' which 'targets a range of sites up and down the basin' to capture flow issues across the basin.[20]

2.21 The MDBA argued that the hydrological modelling approach for surface water SDLs was the best available approach to test a range of scenarios and variable factors:

> Hydrological models have been used to represent and test environmental water requirements and flow regimes. They are the best available tools for representation of long term flow regimes in the Basin under current water sharing arrangements (baseline conditions) and without development conditions.[21]

2.22 The MDBA further explained that the surface water resources of the Basin were represented by linking 24 individual river system models developed by the MDBA, CSIRO and Snowy Mountains Hydro into an Integrated River Systems Modelling Framework (IRSMF). The IRSMF allowed the MDBA to assess responses across the Basin, to changes in flow regime, over time and with different scenarios of water recovery.[22] The MDBA noted:

> The Basin Plan scenario modelling was carried out by simulating a reduction in consumptive water use, and making an equivalent volume of

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18 MDBA, answer to question on notice, 24 April 2012, (received 7 June 2012)

19 MDBA, *Plain English summary of the proposed Basin Plan – including explanatory notes, Appendix A – Outline of the Scientific Knowledge*, November 2011, p. 109.

20 Mr Knowles, Chair, Murray-Darling Basin Authority, *Committee Hansard*, 23 April 2012, p. 2.

21 MDBA, *Hydrologic modelling to inform the proposed Basin Plan: methods and results*, February 2012, p. iii.

22 MDBA, *Hydrologic modelling to inform the proposed Basin Plan: methods and results*, February 2012, p. 6.

> water available for environmental use within the water sharing and water management rules and constraints as prescribed under baseline conditions. The environmental water requirements were assessed at 122 hydrologic indicator sites across the Basin.[23]

2.23 The MDBA summarised the 'basic approach' to determining the SDLs in the following four step process:

> 1. Determining Basin-wide environmental objectives that reflect the requirements of the [Water] Act;
> 2. Determining environmental flows required to achieve these objectives, using a group of hydrological indicator sites at key locations across the Basin;
> 3. Modelling options for water recovery and environmental water use targeted at delivering these flow requirements; and
> 4. Address the model results to determine the effectiveness of the options in achieving objectives, and iterate as required until an option is found that achieves an appropriate balance in environmental, social and economic outcomes.[24]

2.24 Therefore, to determine the 2750 GL/y for surface water, the MDBA modelled key reduction scenarios ranging from 2400, 2800 and 3200 GL/y. Modelling documentation released by the MDBA explains the 2750 GL/y figure:

> Key scenarios modelled are 'without development' (a near-natural condition scenario); 'baseline' (reflecting water sharing arrangements and levels of infrastructure as per June 2009); and a reduction of 2800 GL across the Basin. Sensitivity analysis was carried out for the Southern Connected System (Murray, Murrumbidgee and Goulburn-Broken catchments), where two further diversion reduction scenarios were modelled to represent a Basin-wide reduction of 2400 GL, and 3200 GL to gauge the sensitivity of the proposed scale of change. Some initial sensitivity testing has also been undertaken for the Condamine-Balonne, exploring alternative water recovery volumes and strategies. The results of this sensitivity analysis led to a further increase of 50 GL in SDL for the Condamine-Balonne system and consequently a total proposed reduction of 2750 GL across the Basin has been proposed in the draft Basin Plan.[25]

2.25 The MDBA further explained the results of the modelling of 2400 GL/y and 3200 GL/y reduction scenarios and why this directed it towards the 2750 GL/y figure:

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23 MDBA, *Hydrologic modelling to inform the proposed Basin Plan: methods and results*, February 2012, p. v.

24 The Hon Craig Knowles, Chair, Murray-Darling Basin Authority, *Response to the Chair of Senate Regional and Rural Affairs and Transport References Committee*, 19 April 2012, www.aph.gov.au/Parliamentary_Business/Committees/Senate_Committees?url=rrat_ctte/mdb/submissions.htm (accessed 23 August 2012).

25 MDBA, *Hydrologic modelling to inform the proposed Basin Plan: methods and results*, February 2012, p. v.

> MDBA also conducted sensitivity testing of 2400GL and 3200GL reduction scenarios. The analysis showed a number of key ecological targets and objectives of the proposed Basin Plan might not be achievable with the 2400 GL/y scenario, whereas the 3200 GL/y achieved some marginal improvements over the 2800 GL/y scenario, but not sufficient to justify the potential additional socioeconomic impacts. In addition, flow delivery constraints such as roads, bridges, or rules to avoid flooding private property, limit the capacity to actively use extra environmental water available under the 3200 GL/y scenario.[26]

2.26 Despite criticisms about the MDBA's modelling discussed below, the MDBA defended the scientific basis for development of the Basin Plan. As Dr Rhondda Dickson, Chief Executive, MDBA stated:

> We challenge any assertion that the plan is not based on firm science. The modelling that we have done is far more detailed and more robust than any previous scientific work carried out, either by the authority or by any other independent groups.[27]

Additional modelling scenarios

2.27 In October 2012, the MDBA released the details of further modelling which considered the possibility of 'relaxing' a number of constraints in the southern part of the Basin system. In this modelling, eight river operating constraints were relaxed 'to increase the peak rate at which environmental flows can be delivered'. In addition, an 'altered environment watering strategy was adopted, necessitated by and taking advantage of the relaxation of constraints.'[28] Of the eight constraints relaxed:

> Seven of these represent an increase in the allowable discharge to pass key river reaches in the southern Basin. The eighth represents the inclusion of a new regulator on the Darling Anabranch to accommodate efficient delivery of Menindee releases made to contribute to environmental flows to the Murray.[29]

2.28 The new modelling predicted results for achieving environmental outcomes for scenarios of 2800 GL/y and 3200 GL/y reduction in take with relaxed constraints. The results for 2800 GL/y relaxed constraints were summarised as:

> Overall, the model results indicate that combining 2800 GL/y of recovered water with constraint relaxation would have a positive effect on the ability to deliver high-flow events; enabling greater areas of mid- to high-elevation parts of the River Murray floodplain to be inundated for longer periods and at a greater frequency. However, in order to detect changes using the flow indicators developed by MDBA to assess modelling scenarios, the

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26 MDBA, *Answer to Question taken on Notice*, 24 April 2012 (received 7 June 2012).

27 Dr Rhondda Dickson, Chief Executive, MDBA, *Committee Hansard*, 24 April 2012, p. 71.

28 MDBA, *Hydrological modelling of the relation of operational constraints in the southern connected system: methods and results*, October 2012, p. v.

29 MDBA, *Hydrological modelling of the relation of operational constraints in the southern connected system: methods and results*, October 2012, pp v–vi.

> improvements in flow have to meet specified flow rate and durations before environmental outcomes can be inferred. The BP-2800-RC [the Basin Plan 2800 GL/y relaxed constraints reduction in take] modelling showed that while, in general, the duration and peak of existing events could be extended (providing environmental benefits), the events were not enhanced sufficiently to achieve additional flow indicator targets for mid- to high-level floodplains.[30]

2.29 The results for the relaxed constraints model of 3200 GL/y return of take were noted as:

> The BP-3200-RC [the Basin Plan 3200 GL/y relaxed constraints reduction in take] scenario indicates that the combination of constraint relaxation and an additional average of 400 GL/y of available environmental water:
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> - can substantially increase environmental benefits, with many more flow indicators being met for the River Murray… [and]
> - could provide the capacity to water mid- to high-level parts of the floodplain in the Lower Murray (with the potential to benefit large areas of natural wetlands and floodplains).[31]

2.30 In order to demonstrate the improved environmental outcomes, the MDBA produced the following table for key environmental targets for the Murray River. It shows 'achievement of 'actively managed' river channel and floodplain environmental flow indicators achieved on the River Murray for the baseline and Basin Plan scenarios.'[32]

Table 2.1—Environmental Outcomes (River Murray) for Modelled Scenarios of Reduction in ESLT[33]

Scenario	Baseline	BP-2800	BP-2800-RC	BP-3200	BP-3200-RC
Number of flow indicators achieved – River Murray	0/18 (0%)	11/18 (61%)	11/18 (61%)	13/18 (72%)	17/18 (94%)

30 MDBA, *Hydrological modelling of the relation of operational constraints in the southern connected system: methods and results*, October 2012, p. vii.

31 MDBA, *Hydrological modelling of the relation of operational constraints in the southern connected system: methods and results*, October 2012, p. ix.

32 MDBA, *Hydrological modelling of the relation of operational constraints in the southern connected system: methods and results*, October 2012, p. ix.

33 Information reproduced from: MDBA, *Hydrological modelling of the relation of operational constraints in the southern connected system: methods and results*, October 2012, p. ix.

Criticisms of the modelling for the Basin Plan

2.31 Many stakeholders criticised the modelling process undertaken by the MDBA, first for the iterations prior to the final Basin Plan and even after additional modelling for the 2800 GL/y and 3200 GL/y relaxed constraint scenarios was complete. At a general level, some of these criticisms questioned the fundamentals (or assumptions) of the MDBA's approach to the modelling and why other modelling scenarios (such as 4000 GL/y return of take) had not been undertaken. These general criticisms will be discussed in turn.

2.32 The concerns about the limited modelling of alternative scenarios were expressed to the committee. Conservations Councils across Australia called for further modelling and specified 4000 GL/y should be modelled to demonstrate that this would 'meet the ecological objectives set by the MDBA.'[34] The Wentworth Group supported this and advised the committee:

> The science seems to indicate that you need to be up around 4 000 gigalitres if you want to just achieve the minimum targets to have a functioning system. Obviously that is going to have social and economic impacts.[35]

2.33 The Commonwealth Science and Industrial Research Organisation (CSIRO), in its science review of the MDBA modelling, stated that the 2800 GL/y reduction scenario was 'not consistent with the stated environmental targets' and recommended that scenarios above this figure be modelled.[36] When questioned (regarding Basin Plan (November 2011)) about what scenarios greater than the 2750 GL/y figure the MDBA had modelled, CSIRO representatives explained:

> [The MDBA] have published, as you are probably aware, some limited information around a 3200 gigalitre scenario, and that shows some incremental improvements. I guess it comes back to whether people think those incremental improvements are worth the incremental costs and what the value proposition is for the different scenario. The modelling [the MDBA] have done for the 3200 gigalitre scenario, as I understand it, is only for the Murray system. [The MDBA] have not run the connected models for the entire basin in assessing that; [the MDBA] have just made some additional modifications and water recovery in the Murray system and looked at the consequences of those for the environmental outcomes at the bottom end of the system.[37]

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34 Ms Juliet Le Feuvre, Environment Victoria, *Committee Hansard*, 24 April 2012, p. 25, see also Mr Tim Kelly, Chief Executive, Conservation Council of South Australia, *Committee Hansard*, 24 April 2012, p. 30.

35 Mr Tim Stubbs, Environmental Engineer, Wentworth Group of Concerned Scientists, *Committee Hansard*, 23 April 2012, p. 17.

36 CSIRO, *Science Review of the Estimation of an Environmentally Sustainable Level of Take for the Murray Darling Basin*, November 2011, p. 29.

37 Dr Bill Young, Director, Water for a Healthy Country Flagship, CSIRO, *Committee Hansard*, 23 April 2012, p. 65.

2.34 The Wentworth Group advised the committee that the MDBA could model other scenarios with the current tools available:

> **Dr Williams:** Scientifically and technically it is possible to do. I think the guide had set in place the range of requirements to give you levels of confidence in returning the river to sustainability. I think that is still a very valid means of saying it because the science can give you some indication. If you use this amount of [water], what level of confidence can you have as a taxpayer that you will get a sustainable functioning river? To do that with 4000 gigalitres, we did some preliminary work that suggests it is entirely feasible. I think the modelling capacity is there, from my background in CSIRO and also my background in the CRCs [Cooperative Research Centres].
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> …
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> **Mr Stubbs:** …The [MDBA] has the tools and has some very good people doing a very good job at the level of modelling. It would take them approximately two months to run the model for a different scenario. If we were not on this deadline of getting everything wrapped up by the end of [2012], we could do a range of scenarios and get a very full understanding of the different outcomes—environmental, social and economic—and also of the constraints in a relatively short time so that parliament could make a very well informed decision on the future of the basin.[38]

Concerns about the modelling assumptions

2.35 The committee heard evidence of a number of other concerns about the assumptions used in the MDBA's modelling. This included, general concerns about the lack of scientific justification for the final 2750 GL/y[39] or that the MDBA's approach would simply embed existing management practices in the Basin. As Ms Beverly Smiles, President, Inland Rivers Network, explained:

> The MDBA changed the hydrological-modelling approach adopted in the [Guide] to one that is more closely aligned with current river operations and management. This approach has effectively locked in the poor management and ecological outcomes currently entrenched in state water planning and implementation processes.[40]

2.36 More specifically, the committee identified several themes that emerged in evidence about the assumptions used in the MDBA's modelling which will be discussed in turn and included:

- modelling (and its assumptions) is reflected in complex and technical reports;
- modelling is based on historical data, and does not include recent wet years;

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38 Dr John Williams, Founding Member, and Mr Tim Stubbs, Environmental Engineer, Wentworth Group of Concerned Scientists, *Committee Hansard*, 23 April 2012, p. 19.

39 Wentworth Group of Concerned Scientists, *Evaluation of Proposed Plan*, August 2012, p. 3.

40 Ms Beverley Smiles, President, Inland Rivers Network, *Committee Hansard*, 24 April 2012, p. 17.

- predicted impacts of climate change are not captured in the modelling; and
- interception activity has not been adequately reflected in the modelling.

Modelling reflected in highly complex and technical reports

2.37 The committee heard evidence that the technical nature of the material that supports the modelling remains unclear and difficult to understand, for both technical experts and the public alike. Mr Stubbs from the Wentworth Group reflected on the complexity of the modelling and explained that the science had not been clearly explained when it could have been:

> [W]e cannot understand the outcomes of the modelling run they [the MBDA] have done. It is very opaque. It does not clearly state what the outcomes are for Ramsar [wetlands] or for [other environmental] assets. It could have been clearly and easily stated [this information]. Even with just one scenario [2750 GL/y], we cannot understand the costs and the benefits of other scenarios, what we could actually achieve and why we are locked at this one scenario. So we really have a complete dearth of information not just for the scenario that has been looked at but even for other scenarios to understand what could be achieved.[41]

Committee view

2.38 Notwithstanding this Plain English Summary, the modelling and assumptions behind the plan have never been set out concisely, in an easy to understand format. Despite many calls by the committee to have the methodology clearly articulated, the MDBA have failed to do so. This remains a key concern for the committee. Although the following recommendation applies to the MDBA's modelling of surface water, they align with the concerns noted in chapter seven about the MDBA's consultation process and stakeholder engagement.

Recommendation 1

2.39 The committee recommends that the Murray-Darling Basin Authority develop a concise and non-technical explanation of the hydrological modelling and assumptions used to develop the 2750 GL/y return of surface water to the environment, to be made publicly available.

Modelling based on historical data

2.40 The modelling that informed the Basin Plan is based on 114 years of historical data, which the MDBA has argued captures climate variability over an extensive period. As the Chair of the Authority, Mr Knowles explained:

> For the Basin Plan, the proposed new arrangements have been applied to the historical climate period of July 1895 to June 2009, which covers periods of drought as well as floods.[42]

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41 Mr Tim Stubbs, Environmental Engineer, Wentworth Group of Concerned Scientists, *Committee Hansard*, 23 April 2012, p. 21.

42 MDBA, *Hydrologic modelling to inform the proposed Basin Plan: methods and results*, February 2012, p. v.

2.41 However, this historical data does not take capture the significant rainfall experienced in the years beyond 2009. This approach has been heavily criticised and some have argued that the long-term SDLs may have been different if the modelling captured the recent wet years:

> **Senator JOYCE:** But what your data set does not include is the La Nina substantial wet period that basically started in 2010—or 2009, to be precise. If you amended you data set you would get a substantial change in the assessment of the water profile, would you not? In fact, we have done it—about 500 gigs.
>
> **Dr Dickson:** I cannot comment on that. We have not done that assessment. I would just repeat that the amount of variability in the historic record is sufficient to be able to estimate the scale of change that we use for the Basin Plan modelling.[43]

2.42 The MDBA did subsequently review the impact of the recent flood years and maintains that including two additional years in this data would have no impact on the SDLs and that the 2009 baseline would not change:

> Estimating SDLs is not a simple averaging and subtraction exercise… If we changed the climate baseline to include 2010 and 2011 data, the relativities between the SDL scenarios would not change. The last two years have been very wet but no wetter than the very wet periods already included in the 114 year period we have used to test the scenarios.[44]

2.43 The MDBA reiterated that, although it has not used future projections in its modelling, it is confident that the historical record generates appropriate estimates for future management of the Basin. As Dr Rhondda Dickson from the MDBA explained:

> …what we have done in the plan is, as the chairman said, used as the starting point the best available information where we do have confidence, which is the historical record. Because it is a 10-year planning framework that gives us the opportunity to get a lot more certainty about some of those estimates.
>
> **CHAIR:** So is it fair to say you have not used the future at this point?
>
> **Dr Dickson:** We have not used the future as far as our modelling, given the range of uncertainty.[45]

Committee view

2.44 Due to the reliance on historical data in the MDBA hydrological modelling, the committee questions the claim by the MDBA that the Basin Plan was developed on the basis of the best available scientific knowledge. The committee considers that

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43 Environment and Communications Legislation Committee, *Additional Estimates Committee Hansard*, 14 February 2012, p. 41.

44 MDBA, *Myth busting website*, www.mdba.gov.au/draft-basin-plan/mythbusting#inflow-data, 2012, (accessed 20 August 2012).

45 Dr Rhondda Dickson, Chief Executive, Murray-Darling Basin Authority, *Committee Hansard*, 23 April 2012, p. 2.

the MDBA's claim is undermined by excluding recent flooding in the development of the Basin Plan and, as discussed in the remainder of the chapter, by not appropriately addressing the predicted impacts of climate change and water interception.

Climate change projections not captured in modelling

2.45 The treatment of the predicted impacts of climate change in developing the Basin Plan was another key concern identified in the inquiry. Previous reports have indicated that climate change will have a significant impact on water runoff in the Basin. For example, the CSIRO also conducted extensive analysis on this issue in 2008, including modelling rainfall run-off to the year 2030. According to the report, the likely impact would be significant:

> The best estimate or median indicates that the future mean annual runoff in the MDB in ~2030 relative to ~1990 will be lower, by 5 to 10 percent in the north-east and southern half [of the Basin], and by about 15 percent in the southernmost parts. Averaged across the entire MDB, the best estimate or median is a 9 percent decrease in mean annual runoff.[46]

2.46 In addition, the Garnaut Review on climate change stated that 'a decrease in rainfall can result in a two- to three-fold decrease in streamflow.'[47] Therefore, the impact for water run-off is far more significant than the change in rainfall due to a multiplier effect.

2.47 Prior to the release of the Basin Plan, climate change was identified by the MDBA as a significant issue and stated in the Guide that it was 'essential that the proposed Basin Plan appropriately addresses the impacts of climate change.'[48] Furthermore, the Guide details the predicted impact of climate change as follows:

> In light of the various issues associated with climate change, the Authority has determined that 3% is an appropriate allowance to account for the effect of climate change in the proposed Basin Plan. That is, the reduction being considered as necessary to achieve an environmentally sustainable level of take is inclusive of a 3% reduction in the current surface-water diversion limit in the Basin.[49]

2.48 Despite allowances being made in the Guide for projected climate change impacts, the MDBA advised the committee that projected climate change impacts are not in the modelling that informed the Basin Plan:

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46 Chiew FHS, Vaze J, Viney NR, Jordan PW, Perraud J-M, Zhang L, Teng J, Young WJ, Penaarancibia J, Morden RA, Freebairn A, Austin J, Hill PI, Wiesenfeld CR and Murphy R, *Rainfall-runoff modelling across the Murray-Darling Basin. A report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project*. CSIRO, 2008, p. 13.

47 Professor Ross Garnaut, *The Garnaut Climate Change Review: Final Report*, Cambridge University Press, 2008, p. 109.

48 MDBA, *Guide to the proposed Basin Plan*, 2010, Canberra, p. 33.

49 MDBA, *Guide to the proposed Basin Plan*, 2010, Canberra, p. 34.

> [Future climate change] was never in the modelling. In the guide it was not in the modelling, and we have not included it in our modelling. We have modelled the historical sequence, as we have said before. The approach to climate change is one of adaptive management as well as putting various requirements in state water resource planning as part of the basin plan and investing in information that is going to improve our understanding of climate change in the future and how we might model those futures for climate change.[50]

2.49 However, the MDBA have also argued that under an adaptive management framework, the Basin Plan will account for future climate change as new information emerges. This approach is reflected in the MDBA's factsheet about managing climate change under the Basin Plan:

> The Basin Plan lays the foundation for future adaptation to climate change as we learn more about its impact on environmental water needs, other water requirements, water availability and communities.[51]

2.50 The future impact of climate change has also been acknowledged in the final Basin Plan by being identified as a risk to be managed. These risks are outlined in Chapter 4 of the Basin Plan and, as described in the Explanatory Statement, the MDBA must have regard to certain strategies when carrying out its functions. In the case of climate change, such strategies are to 'improve knowledge of water requirements within the Murray-Darling Basin, including…the impact of climate change on environmental water requirements' and also to 'improve knowledge of the impact on Basin water resources from…climate change'.[52]

2.51 The MDBA's general approach to climate change in the various iterations of the Basin Plan was criticised by some witnesses before the committee. For example, the Wentworth Group claimed the Basin Plan (November 2011) set SDLs on an 'assumption that there was no risk to river health from climate change'[53] and that it ignores climate change:

> We know that the CSIRO modelling suggests that climate change is likely to result in significant reductions in rainfall and runoff in south-eastern Australia over the next 20 years. Yet the draft plan ignores these effects even though it is intended to guide water use in the basin over much of the same time period.[54]

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50 Dr Rhondda Dickson, Chief Executive Officer, Murray-Darling Basin Authority, *Committee Hansard*, 23 April 2012, p. 10.

51 MDBA, *Climate Change and the Basin Plan*, 2011, p. 1, http://download.mdba.gov.au/proposed/FS_ClimateChange.pdf, (accessed 4 September 2012).

52 Basin Plan Explanatory Statement, pp 24–25.

53 Wentworth Group of Concerned Scientists, *Statement on the 2011 Draft Murray-Darling Basin Plan*, January 2012, p. 1.

54 Wentworth Group of Concerned Scientists, *Statement on the 2011 draft Murray-Darling Basin Plan*, November 2011, p. 19.

2.52 The committee also heard evidence that predicted climate change is likely to have significant impacts on the outcomes to be expected from returning water to the basin through setting the SDLs.[55] Ms Juliet Le Feuvre, Healthy Rivers Campaigner, Environment Victoria also summarised the concerns about relying on historical climate conditions to the committee:

> The MDBA makes a risky assumption that future climate will fall within the range of past climate variability, flying in the face of the huge body of climate change research and projections for a dryer future, particularly in the southern basin and here in Victoria.[56]

2.53 The Wentworth Group has consistently criticised the lack of consideration of climate change projections in later versions of the Basin Plan and have stated that this position actually 'conflicts with Government Policy on climate change.'[57]

2.54 A similar criticism was noted following the modelling of the relaxed constraint scenarios just prior to the release of the final Basin Plan. The response from the Australian Conservation Foundation to a question about the improved environmental outcomes achieved through this modelling states:

> **Senator RUSTON:** ...What is the increase from that 57 per cent [of the MDBA's environmental targets achieved] once you add the 450 [GL/y additional reduction in take] onto it?
>
> **Mr La Nauze:** According to the authority's modelling, it goes up to 67 per cent [of the MDBA's environmental targets achieved]. But that excludes any undermining by excessive groundwater extraction or diminished inflows due to climate change. That is [the MDBA's] modelling based on historical climate data.[58]

2.55 The call, noted above, for incorporating predicted climate change impacts into the SDLs is not new. Following the release of the Guide, the House of Representatives Standing Committee on Regional Australia's report *Of drought and flooding rains: Inquiry into the impact of the Guide to the Murray-Darling Basin Plan* (Windsor Report) emphasised the importance of considering the forecast impacts of climate change in developing the SDLs for the Basin Plan:

> **Recommendation 2**: The Committee recommends that the Murray-Darling Basin Authority apply greater rigour to the assumptions made to develop

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55 See for example, Ms Juliet Le Feuvre, Healthy Rivers Campaigner, Environment Victoria, *Committee Hansard*, 24 April 2012, p. 25; and Wentworth Group of Concerned Scientists, *Statement on the 2011 draft Murray-Darling Basin Plan*, November 2011, p. 19.

56 Ms Juliet Le Feuvre, Healthy Rivers Campaigner, Environment Victoria, *Committee Hansard*, 24 April 2012, p. 25.

57 Wentworth Group of Concerned Scientists, *Evaluation of Proposed Basin Plan*, August 2012, p. 4.

58 Mr Jonathan La Nauze, Healthy rivers Campaigner, Australian Conservation Foundation, *Committee Hansard*, 23 November 2012 p. 22.

> the proposed sustainable diversion limits, including the forecast impact of climate change, taking into account regional variability.[59]

Committee view

2.56 The committee is of the view that the Windsor report's recommendation regarding the forecast impact of climate change has not been adequately addressed in the Basin Plan. This is consistent with the number of criticisms noted above that the Basin Plan does not appropriately address predicted impacts of climate change in its modelling of reduction of take scenarios.

2.57 The committee acknowledges that incorporating the predicted impacts of climate change into the relevant risk management strategies (as per chapter 4 of the Basin Plan) is the most realistic option for managing the predicted impacts of climate change given the Basin Plan has now come into effect. As a result, the committee urges that the MDBA specifically include the predicted impacts of climate change when implementing these strategies. The committee also considers that further research into the predicted impacts of climate change on water runoff in the Basin is necessary to properly implement the Basin Plan.

Recommendation 2

2.58 The committee recommends that the MDBA specifically include the predicted range of impacts of climate change on water runoff when implementing the relevant risk management strategies under chapter 4 of the Basin Plan.

Recommendation 3

2.59 Consistent with recommendation 20, the committee recommends that the government develop a clear research strategy on the future impacts of climate change on water runoff in the Basin. The strategy should also include a process for integrating the results of the research into the adaptive management process under the Basin Plan.

Interceptions have not been adequately reflected in modelling

2.60 Related to the issue of predicted climate change and the reliance on the historical data, the committee heard evidence that the treatment of water interception in the Basin Plan could be improved. Commenting on the Basin Plan (November 2011) Dr Rhondda Dickson, Chief Executive, stated:

> …the plan itself was based on...the best available estimate of interceptions that we have at the moment. We would be the first to acknowledge that the estimate of interceptions can be improved, and there are large areas of uncertainty about future interceptions, about the interplay of climate change and losses to the ground, between temperature as well as the interception changes. However, what we have done in the plan is…used as the starting

59 House of Representatives Standing Committee on Regional Australia, *Of drought and flooding rains: Inquiry into the impact of the Guide to the Murray-Darling Basin Plan*, May 2011, p. xvii.

> point the best available information where we do have confidence, which is the historical record.[60]

2.61 The MDBA noted further that interception activity has only been captured in the modelling in a 'point in time' approach. As Dr Dickson explained:

> There are a whole range of projections out there—what future irrigation use might be and future interceptions from farm dams and from a whole range of things. That is the future. All we have done is set a limit which is the best idea of what we have now and any future changes will need to be within that limit. If there is going to be a huge expansion of plantation forestry that is going to [increase] interceptions further that would have to be traded off against an irrigation entitlement in a water resource sharing plan.[61]

2.62 Despite this, the MDBA advised the committee that interception activity by commercial plantations and runoff dams have been 'taken into account' in the modelling through 'developing the baseline diversion limits for the proposed Basin plan.'[62]

2.63 The *Plain English Summary of the proposed Basin Plan* also outlined that interception activity needs to be captured in the water resource plans which will be managed by Basin states:

> The water resource plan must list the classes of interception activity that have been identified. When deciding whether an activity needs to be listed, consideration must be given to the location of the activity, its likely impact and likely growth over time. If there is interception by a runoff dam, a commercial plantation, mining activity (including coal seam gas mining) or floodplain harvesting, in the water resource plan area, those activities must be included on the list.
>
> Where such a list is included, the water resource plan must set out how the impacts of each class of interception activity will be monitored. The plan must also state what action will be taken if monitoring shows that the impacts of the activities have a significant impact on an environmental watering requirement, or there is an increase in the quantity of water being intercepted by an activity.[63]

2.64 The committee heard evidence that the Basin Plan also appears to fail to account for interceptions from biodiversity planting projects. Professor Mike Young provided information to the committee that stated:

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60 Dr Rhondda Dickson, Chief Executive, MDBA, *Committee Hansard*, 23 April 2012, p. 2.

61 Dr Rhondda Dickson, Chief Executive, MDBA, *Committee Hansard*, 23 April 2012, p. 11. In this quote Dr Dickson is recorded in Hansard as saying ' If there is going to be a huge expansion of plantation forestry that is going to *decrease* interceptions...' (emphasis added), however the committee understands Dr Dickson to mean that increasing plantation forestry would *increase* interceptions.

62 MDBA, *Answer to question taken on notice*, 23 April 2012 (received 7 July 2012).

63 MDBA, *Plain English summary of the proposed Basin Plan – including explanatory notes*, November 2011, p. 49.

> Under the [Basin Plan (November 2011)], States will be required to adjust for the adverse effects on water availability of increased forestry, increases in farm-dam interception and increases in the capture of overland flows...
>
> Missing from the [Basin Plan (November 2011)] is a requirement for the adverse interception effects of biodiversity plantings to be fully accounted for.[64]

2.65 The MDBA's response to this issue was that although the Basin Plan (November 2011) listed some types of interception activities, like commercial plantations or runoff dams, this was not intended to be an 'exclusive list'.[65] The MDBA explained that the Basin Plan had an 'assessment of how much interception is going on at the moment'[66] and that if the level of interception increases in the future, that it must be monitored by states and that this process was contained in the Basin Plan. Specifically, Mr Russell James, Executive Director, Policy and Planning, MDBA advised the committee:

> [I]n the future there needs to be monitoring arrangements put in place and in future the interception increases regardless of what is causing that—whether it is biodiversity plantings or other things. Those are things that will have to be taken into account in the way in which water is kept within the diversion limit.[67]

2.66 In the final Basin Plan, there is the obligation for water resource plans to:

> specify whether there are any types of interception activity in the water resource plan area which have the potential to have a significant impact on:
>
> (a) the water resources of the water resource plan area; or
>
> (b) water resources which are hydrologically connected to the water resources of the water resource plan area…[68]

2.67 However, the following note for guidance is also added to the relevant section, with biodiversity planting not specifically listed:

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64 Professor Mike Young, "Droplet No. 20: Which is better – The Existing or Proposed Administrative Arrangements for the MDB Basin?", April 2012, p. 3. This quote above was also read into the Hansard by Senator Nick Xenophon on 24 April 2012. See *Committee Hansard,* 24 April 2012, p. 8.

65 Mr Russell James, Executive Director, Policy and Planning Division, MDBA, *Committee Hansard,* 23 April 2012, p. 10. Note, the MDBA's response was based on a similar questions raised by the committee the day prior to the reading of Professor Young's quote into the Hansard.

66 Mr Russell James, Executive Director, Policy and Planning Division, MDBA, *Committee Hansard,* 23 April 2012, p. 11.

67 Mr Russell James, Executive Director, Policy and Planning Division, MDBA, *Committee Hansard,* 23 April 2012, p. 11.

68 Basin Plan, Part 5, section 10.23(1), p. 99.

> The following are types of interception activity which may have the potential to have a significant impact on the water resources of a water resource plan area:
>
> (a) interception by runoff dams;
>
> (b) interception by commercial plantations;
>
> (c) interception by mining activities, including coal seam gas mining;
>
> (d) interception by floodplain harvesting.[69]

Committee view

2.68 The committee understands and accepts that future intercepts will need to fall within each state's water resource plan. In the committee's view this must include all forms of interceptions (such as runoff dams, commercial plantations and biodiversity planting, mining activities (including coal seam gas mining) and floodplain harvesting) so that the overall water diversion cap is not compromised. The committee notes that although biodiversity planting has not been specifically listed, the final Basin Plan refers to 'any types of interception activity...which have the potential to have a significant impact'[70] which appears sufficiently broad to capture biodiversity plantings.

2.69 Nevertheless, the committee has concerns regarding the modelling of historical change in rain water run-off and the lack of appropriate modelling of interceptions. In taking this approach, the MDBA continues to ignore calls from stakeholders, including from parliamentary committees, to consider all factors in its modelling, particularly the interception activities.

Recommendation 4

2.70 The committee recommends that the MDBA model a range of possible future intercept scenarios and publish the results so that each state can better plan for the impacts of the interception on its overall consumptive water allocation.

Recommendation 5

2.71 The committee recommends that, in undertaking its adaptive management approach to the Basin Plan, the Murray Darling Basin Authority clearly considers, assesses and incorporates all elements that could impact environmental watering requirements. This includes climate change, interception activities, coal seam gas mining, surface-groundwater connectivity and possible negative effects such as over watering caused by increased river flows. This information should be clearly set out in non-technical language and be made publicly available in a timely manner.

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69 Basin Plan, note to Part 5, section 10.23, p. 100.

70 Basin Plan, Part 5, section 10.23.