ATTACHMENT G – Synthesis of analysis associated with the determination of an environmentally sustainable level of take (ESLT) for surface water and groundwater in the Basin Plan

The Basin Plan aims to provide for the integrated management of Basin water resources in a way that promotes the objects of the Act, including by ensuring that the use and management of the Basin water resources occurs in a way that optimises economic, social and environmental outcomes. In developing the Basin Plan, and in particular the new long-term average Sustainable Diversion Limits (SDLs), the Murray-Darling Basin Authority (the Authority) has considered the water needs of communities, industries and the environment.

The Water Act 2007 requires that these new limits are determined for the water resources of each water resource plan area, as well as for the Basin water resources as a whole. Each SDL must reflect an Environmentally Sustainable Level of Take (ESLT) for the relevant resource. Estimating an ESLT at the Basin-wide scale, and for individual resources, in a Basin as large and diverse as the Murray-Darling is a complex task with many uncertainties. In recognition that there is no simple mechanism to estimate an ESLT the Authority undertook an extensive program of harnessing relevant knowledge, including environmental, social and economic information, to inform its judgement of an appropriate Basin Plan meeting the requirements and objectives of the Water Act and [the purposes of the Basin Plan as required by the Act]. This included ecological, hydrologic and social assessments informed by an extensive array of previous studies, modelling, new research and management plans.

Surface water

The Basin Plan proposes an SDL for the Basin surface water resources as a whole of 10873 GL/y—representing the recovery of 2750 GL/y of water for the environment from the 2009 baseline.

To determine the ESLT on which this SDL is based, the Authority developed a methodology explicitly designed to meet the task set out in the Water Act. This method, termed the indicator site method, describes the environmental water requirements of key locations (indicator sites) along the Basin's rivers, with these water requirements aimed to meet the requirements and objectives of the Water Act and the purposes of the Basin Plan. The indicator sites and the flows described at those sites represent the broader environmental flow needs of river valleys or reaches. The assessment of environmental flow needs at each location utilises the best available science and considers local water management arrangements, opportunities and constraints, coupled with the shared zone SDL reduction amounts where appropriate. Accordingly the Authority is confident that the Basin-wide ESLT translates well to the SDLs for each of the 23 SDL resource units. In the view of the Authority this is the most robust method available for the task and represents the best available science and is an effective overall framework for harnessing existing and new knowledge to the task set for the Basin Plan under the Water Act.

The Authority's approach to the ESLT analysis to determine surface water SDLs in the Basin Plan included the following elements:

- Determine Basin-wide environmental objectives consistent with the requirements of the Water Act.
- Identify key environmental assets and ecosystem functions across the Basin. This work was done with particular reference to declared Ramsar sites in the Basin, and also included consideration of other obligations under the Water Act.
- Determine environmental water requirements of indicator sites by setting local environmental objectives and associated targets to determine site-specific flow indicators. This work is further described in :
    - MDBA 2012, The assessments of environmental water requirements, available at: http://www.mdba.gov.au/draft-basin-plan/science-draft-basin-plan/assessing-environmental-water-requirements
- Select SDL options for assessment against these environmental water requirements, corresponding to different levels of water recovery relative to a June 2009 baseline (this is the date used to determine the baseline diversion limits and is the baseline against which the extent of additional recovery of environmental water is assessed).
- Assess the environmental benefits of the SDL options, as set out in MDBA 2011, The proposed 'environmentally sustainable level of take' for surface water of the Murray-Darling Basin: Method and outcomes, available at:
    - MDBA 2011, The proposed "environmentally sustainable level of take" for surface water of the Murray-Darling Basin: Method and outcomes, available at: http://www.mdba.gov.au/draft-basin-plan/supporting-documents/mdba-eslt
- Assess the socio-economic implications (including benefits and costs) of the SDL options. This work was a significant component of the development of the Basin Plan and is further described in:
    - MDBA 2012, The Socio-economic implications of the proposed Basin Plan, available at: http://www.mdba.gov.au/proposed-basin-plan/socio-economic-implications
    - MDBA 2012, Socio-economic analysis and the draft Basin Plan: Part A – Overview and analysis , available at: http://download.mdba.gov.au/proposed/social_economic_analysis_part_a.pdf
    - MDBA 2012, Socio-economic analysis and the draft Basin Plan: Part B – Commissioned and non-commissioned reports which informed MDBA's socio-economic analysis, available at: http://download.mdba.gov.au/proposed/social_economic_analysis_part_b.pdf
    - KPMG 2011, Review of the MDBA's Socio-Economic Impact Modelling, available at: http://download.mdba.gov.au/proposed/KPMG_Econtech_Report.pdf
    - MDBA 2012, Social and Economic Analysis – key reports, available at: http://mdba.gov.au/draft-basin-plan/socioeconomic-analysis/social-and-economic-analysis-key-reports

- Select an ESLT, and associated SDL for the Basin water resources and for each surface water SDL resource unit coupled with the shared zone SDL reduction amounts where appropriate, informed by modelling and assessment of outcomes.
    - MDBA 2011, The proposed "environmentally sustainable level of take" for surface water of the Murray-Darling Basin: Method and outcomes, available at: http://www.mdba.gov.au/draft-basin-plan/supporting-documents/mdba-eslt
    - MDBA 2012, Hydrologic modelling to inform the proposed Basin Plan: Methods and results , available at: http://download.mdba.gov.au/proposed/Hydro_Modelling_Report.pdf

The method to set the ESLT underwent a number of peer reviews, including the CSIRO-led scientific review in 2011, which concluded that these methods are robust and are sufficient to provide a suitable starting point for an adaptive management process, see:

- CSIRO 2011, Science review of the estimation of an environmentally sustainable level of take for the Murray–Darling Basin, available at: http://download.mdba.gov.au/proposed/CSIRO_ESLT_Science_Review.pdf

An initial ESLT option of a Basin-wide reduction for surface water of 3,000 GL/y, with a distribution of the reduction amount of 650 GL/y from the northern connected Basin, 2,350 GL/y from the southern connected Basin and 45 GL/y from the disconnected rivers, was used as the basis for further detailed analysis through the hydrologic indicator site method. This option was chosen after consideration of previous assessments of Basin scale water needs including those undertaken for The Living Murray, by the Wentworth Group, the Victorian Government, and the Authority's end-of-system flow analysis. Feedback from communities, the potential costs for irrigation dependent communities and the need to optimise economic, social and environmental outcomes provided additional input into this judgement.

This initial ESLT option was reduced to 2,800 GL/y overall, with changes in the northern Basin made to reflect the nature of the river systems in that part of the Basin.

- MDBA 2011, The proposed "environmentally sustainable level of take" for surface water of the Murray-Darling Basin: Method and outcomes, available at: http://www.mdba.gov.au/draft-basin-plan/supporting-documents/mdba-eslt

The Authority then assessed the level of sensitivity of reaching ecological targets by assessing reductions of 2,400, 2,800and 3,200 GL/y with current river constraints included. These assessments maintained the same ESLT volume in the northern Basin and subsequently focussed on the southern connected system which is more heavily regulated, and environmental outcomes in the lower end of the Murray which are the most difficult to achieve.

The Authority's modelling and analysis of the benefits of 2,800 GL/y of additional environmental water, compared with higher and lower SDL options identified that:

- At a whole-of-Basin scale, positive environmental outcomes would be achieved with water recovery of 2,800 GL/y.
- With the recovery of 2,400 GL/y under current operating arrangements, some important environmental outcomes would be compromised. Further, the ability to manage salinity levels within the Coorong, maintain an open Murray Mouth, and maintain the resilience of

lower elevation parts of the lower River Murray floodplain and associated wetlands (i.e., River Murray downstream of the Murrumbidgee junction, including the Coorong, Lower Lakes and Murray Mouth) during dry periods, is likely to be compromised with the 2,400 GL/y option.

- The recovery of 3,200 GL/y showed incremental improvements in some indicators compared to the other options. However, the Authority's overall assessment was that 3,200 GL/y delivered few additional environmental benefits relative to the 2,800 GL/y option whereas there were greater social and economic impacts. A significant contributing factor to not meeting the few additional environmental benefits is a result of a range of constraints that increasingly inhibit the delivery of environmental water as environmental flows increase. These constraints include limits to river heights to prevent the flooding of private property, roads and bridges.

The Basin-wide recovery amount changed from 2,800 to 2,750 GL/y as a result of changing the SDL of the Condamine-Balonne catchment. There is less uncertainty about the hydrology and impact of growth in water use on the environmental needs of the Culgoa floodplain in the Condamine-Balonne catchment and the Barwon Darling because development is more recent in these areas compared to southern parts of the Basin. An SDL of 150GL was initially set for the Condamine-Balonne catchment, however, new scientific assessment and analysis commissioned by the Queensland Government, and subsequent remodelling by the MDBA (see MDBA 2012, Hydrologic modelling to inform the proposed Basin Plan: Methods and results) indicated that an SDL of 100GL/y would water the catchment's key environmental assets, such as the Narran Lakes. Some uncertainty remains about the impact of this SDL on the Culgoa floodplain and the Barwon-Darling, and therefore, the MDBA has established the Northern Basin Advisory Committee to undertake a work program to gain a better understanding of the environmental needs of the Culgoa Floodplain, Barwon Darling and the Northern Basin generally.

Recovery of an average of 2,750 GL/y of water for the environment will achieve significant environmental outcomes (further detailed in *The proposed "environmentally sustainable level of take" for surface water of the Murray-Darling Basin: Method and outcomes report* and Chapter 5 of the *Regulation Impact Statement)*, including the ability to reinstate more frequent and variable flow regimes to provide healthy wetland habitats and support the role that these systems play in the productivity of the river system more broadly, for example providing breeding and feeding habitats for birds and fish, and carbon/nutrient inputs to support instream productivity.

The Authority's socioeconomic analysis of implications (including benefits and costs) of the SDL options found that:

- The socioeconomic impacts of the Basin Plan include reductions in irrigated agricultural production (partially offset by a small substitution towards dryland agriculture), impacts on agricultural service and supply businesses, and flow-on effects for the non-agricultural sectors of the Basin economy.
- Overall, the impacts on the Basin economy will be modest. The Basin economy is still expected to grow under the Basin Plan, but at a slower rate than would be the case without the Basin Plan.

- The extension of time to 2019 to recover environmental water substantially reduced the impacts and enabled a measured transition to the SDLs.
- Infrastructure investments under Water for the Future substantially reduce the impacts of water recovery.
- While the overall impact of the Basin Plan is expected to be modest, some communities will likely be relatively more vulnerable to impacts from moving to SDLs. The most vulnerable regions include:
    - communities in the cotton growing areas of the Lower Balonne
    - communities in the rice growing areas of the Murrumbidgee and NSW Murray
    - smaller dairying communities in northern Victoria
    - horticultural communities in Sunraysia and the South Australian Riverland.

In 2012, the Authority undertook further modelling to assess what additional environmental benefits could be achieved with water recovery of 2,800 GL/y and 3,200 GL/y if eight key river operating constraints in the southern connected system were relaxed. This modelling found that significant additional environmental outcomes could be achieved if constraints were relaxed, particularly with water recovery of 3,200 GL/y. This included the ability to maintain the resilience of mid to higher parts of the lower River Murray floodplain during dry periods. Due to these operational and physical constraints, providing flows to the higher parts of the floodplains is limited. The results referred to here and further consideration of the issues relating to river management, including constraints, is provided at:

- MDBA 2011, River Management and Opportunities, available at: http://www.mdba.gov.au/files/bp-kid/1870-River-mangement-discussion-paper.pdf
- MDBA 2012, Hydrologic modelling of the relaxation of operational constraints in the southern connected system: Methods and results , available at: http://download.mdba.gov.au/altered-PBP/Hydrologic-modelling-relaxed-constraints-October-2012.pdf

The additional work on the effect of relaxing constraints confirmed for the Authority the extent to which relaxation of constraints and other factors could change environmental outcomes. Recognising the significance of current system constraints, the Basin Plan requires the Authority to prepare a constraints management strategy in the first year of the Basin Plan, which will guide future investment in removing or relaxing constraints on the delivery of environmental water.

The Basin Plan also includes an SDL adjustment mechanism. This adjustment mechanism will allow the SDLs in the Basin Plan to be adjusted, based on new initiatives which achieve equivalent environmental outcomes, with neutral or improved social and economic impacts, relative to those considered in setting the SDLs contained in the Basin Plan.

Through the SDL adjustment mechanism:

- SDLs could be adjusted upwards (i.e. less water would need to be recovered to achieve an environmentally sustainable level of take) through the implementation of environmental works and measures ('supply measures')
- SDLs could be adjusted downwards (i.e. more water would be recovered for the environment) through the implementation of measures that increase the efficiency of water

use for irrigation ('efficiency measures') or by another method agreed by the Authority and the Basin Officials Committee.

Taking into account the evidence on benefits and costs, the diminishing capacity to achieve additional benefits as water is recovered above 2,800 GL/y in the context of existing system constraints, and further analyses undertaken in the Condamine-Balonne region, the Authority considers that water recovery of 2,750 GL/y on a long-term average will result in environmentally sustainable levels of take in the surface water resources, returning enough environmental water to the Basin to achieve most environmental objectives, while also ensuring that social and economic effects are best managed..

Groundwater

The Authority has determined a total groundwater SDL of 3,334 GL/y, which reflects an environmentally sustainable level of take for groundwater resources for the 66 groundwater SDL resource units assessed under the Basin Plan. The total of groundwater SDLs can be compared to a Basin-wide baseline diversion limit (BDL) which represents the Authority's determination of the limits on groundwater use under existing water management arrangements. The baseline diversion limit is 2,386 GL/y

To meet the ESLT requirements for groundwater, the Authority determined that a groundwater SDL must: maintain key environmental assets that have any dependence on groundwater; maintain base flow groundwater contributions to rivers and streams; ensure that productive use of the aquifer is sustainable without compromising the hydrogeological integrity of the aquifer; and protect against decreasing groundwater quality, in particular salinisation of the groundwater resource.

The groundwater SDL for each SDL resource unit was informed by numerical groundwater models, or where these were not available, an analytical risk assessment developed for the Basin Plan. Both the numerical groundwater modelling and the analytical risk assessment provide the potential volume of water available for consumptive use. The Authority then applied a groundwater assessment framework that considers this volume against other information to determine the groundwater SDLs.

In response to submissions on the draft Basin Plan (November 2011) as well as the consultation with Basin States and groundwater experts, the Authority undertook a review of the methods and assessments that were used to determine the groundwater SDLs. The review determined that a consistent and more precautionary approach to groundwater should be adopted across the Basin and is reflected in the SDLs in the Basin Plan.

In the later part of 2012, a number of minor refinements were made to groundwater SDLs to incorporate updated data made available by Basin State about several groundwater systems. A requirement to review the groundwater BDLs and SDLs in 3 aquifer systems (2 in NSW and 1 in Victoria) within 2 years was also added to allow further consideration of the SDLs in relation to aquifers where the relevant States had expressed the view that higher levels were justified, but the Authority was not, without further work over an appropriate time, prepared to accept a higher level as reflecting an ESLT.

Supporting information can be found in:

- CSIRO and SKM 2010, The groundwater SDL methodology for the Murray-Darling Basin Plan, Murray–Darling Basin Authority, Canberra. Available at http://www.mdba.gov.au/files/bp-kid/1056-MDBA-Groundwater-SDL-Methodology.PDF
- MDBA 2012, The proposed Groundwater Baseline and Sustainable Diversion Limits: methods report, available at: http://download.mdba.gov.au/proposed/Proposed-BP-GW-BDL-SDL.pdf
- MDBA 2012, The addendum to groundwater methods report , available at: http://download.mdba.gov.au/revised-BP/Addendum-to-Groundwater-Methods.pdf
- MDBA 2012, The Groundwater Sustainable Diversion Limit Resource Unit Summary Report cards , available at: http://download.mdba.gov.au/proposed/GW-reportcards.pdf