17 December 2010

Rob Freeman
Chief Executive
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ACT, 2601

Re Guide to the Proposed Basin Plan

Dear Rob,

Congratulations to you and the MDBA team in pulling together the Guide to the Proposed Basin Plan and the supporting documents. I understand this has been a significant and complex undertaking in challenging circumstances.

Scientists from the CSIRO Water for Healthy Country Flagship have reviewed this documentation with great interest. Especially those aspects of the Guide which have been directly or indirectly influenced by research the Flagship has undertaken.

As well as reviewing the documentation, we have had the opportunity to meet with key members of the MDBA teams responsible for undertaking or compiling much of the material, which was a great help in progressing to a fuller understanding of the approaches adopted by the Authority and the assumptions made. I am grateful for the time spent by Authority staff in briefing CSIRO on these matters and their willingness to explain more fully and to consider our concerns.

There are a number of areas where our view is that what is documented in the Guide either does not represent best available science, or does not represent appropriate application of best available science in the context of the Basin Plan and the wider context of the National Water Initiative. There are also areas where the explanations in the Guide are either misleading or do not fully articulate key assumptions made by the Authority.

In two areas, methods used by the MDBA could have a significant bearing on the outcomes of the plan, especially SDLs and economic costs. Alternative methods could produce substantially different and possibly better outcomes and therefore the choice and justification of the method is important.

The most important concern is that the Guide lacks a transparent description of how priority environmental assets, environmental outcomes and flows required to achieve those outcomes were derived. The second substantial concern is how downstream flow requirements are distributed among tributary regions. Different ways of distributing SDLs among regions would give very different outcomes.

CSIRO would be very happy to work constructively with the Authority to further discuss these issues, and where deemed appropriate, assist the Authority in revising the technical work.

CSIRO remains confident that all the work we have undertaken for the Authority is robust, and all the publications we have produced detailing this work have been carefully peer reviewed. Nonetheless, CSIRO has some concerns with how the Authority has interpreted or applied this work in the development of key aspects of the Basin Plan.

It is important to stress in this context, that in providing this feedback, CSIRO is not providing comment *per se* on the policy position of the MDBA represented by the Guide. Rather, we are providing feedback on the robustness of the reported technical work and the clarity and completeness with which the explanations and evidence-based justifications for the policy positions have been presented by the Authority.

Attached is a short report outlining CSIRO's technical comments on the guide to the proposed basin plan covering eight areas:

1. *Environmental Water Needs*
2. *Economic Costs*
3. *Downstream Flows*
4. *Uncertainty*
5. *Climate Change*
6. *Intercepting Land Use*
7. *Surface Water Balance and Modelling*
8. *Groundwater*.

These issues all relate in one manner or another to the central aspect of SDL determination. At this point we have given less attention to the other mandatory content of the Basin Plan, as these aspects are in several cases less clearly related to our research.

The Flagship would of course by happy to meet and discuss these issues with you and your staff or the Authority members. Please note however, that Bill Young is on leave until 12 January 2011.

Yours sincerely

Ian Prosser
Science Director,
CSIRO Water for a Healthy Country Flagship
On behalf of Bill Young, Director
CSIRO Water for a Healthy Country Flagship

CSIRO Technical Comments on the Guide to the Proposed Basin Plan

1. Executive summary

CSIRO's report provides technical comments aimed at improving the methods used by the MDBA in developing the basin plan. It identifies a range of issues and proposes practical solutions.

We have identified eight technical areas of concern with the plan:
1. *Environmental Water Needs*: It is unclear if environmental assets and functions have been identified and then how environmental flow needs for those have been determined. This makes the targets and the outcomes of the plan unclear
2. *Economic Costs*: The need for further economic analysis to examine economic benefits as well as costs, to optimise outcomes and to justify acceptable limits to economic costs.
3. *Downstream Flows*: Better methods and exploration of alternative methods to distribute the downstream flow needs among contributing tributaries, noting that alternative methods are likely to produce quite different outcomes.
4. *Uncertainty*: Simpler and more transparent ways of treating the inherent uncertainty in determining environmental flow requirements.
5. *Climate Change*: Better justification for how climate change will be included in the plan.
6. *Intercepting Land Use*: Better and more consistent use of intercepting land uses in the plan.
7. *Surface Water Balance and Modelling*: Correcting overestimates of inflows and their consequences for environmental flow requirements
8. *Groundwater*: Correcting groundwater data and improving how groundwater to surface connections are made.

CSIRO's comments fall into four types of concern:

1. Methods used by the MDBA which have a significant bearing on the outcomes of the plan, especially SDLs or economic costs, and where alternative methods could produce substantially different and possibly better outcomes.
2. Places where the reasoning is either not transparent or appears contradictory so there appears to be no verification of the basis for the findings.
3. Places where CSIRO methods or information have not been appropriately used in our view.
4. Places where the guide claims support from CSIRO research but where at this stage we are unable to provide that support.

In passing we have also noted other minor issues and corrections listed in Appendix 1.

2. Introduction

CSIRO is a national research agency with a long history of conducting research on water resources, ecosystems, natural resource economics and policies. We have a proud record of research on the Murray-Darling Basin and have research facilities within the Basin. Many of our researchers live or have lived in the basin and are part of basin regional communities.

A substantial amount of work has gone into the guide and it draws upon extensive data, information and prior research. The research and the history of the basin clearly demonstrate the need to meet the objectives of the basin plan. CSIRO recognises the immense task of accessing and utilising all available knowledge to produce the plan, and recognises the practical constraints of time and resources to do this. Nevertheless CSIRO believes that the technical methods used to develop the plan can be improved and most critically we believe this could result in quite different outcomes among regions of the basin and quite possibly lessen economic impacts if the improvements are made.

This report focuses on those areas of the plan where we believe improvements can be made. It is not a comprehensive review of the plan. In focusing on areas of improvement it is inherently biased toward the topics over which we have concern and does not dwell on areas where we believe the guide does well. We have tried to be practical in this by identifying the problem, explaining why it matters to the outcome of the plan, and most importantly by providing solutions which could be implemented in the timeframes of the plan. In fact, in several places we recommend that the more robust and defensible method, which could produce a better outcome, is actually easier to implement than the methods used. In other cases our concerns are over interpretation and communication of CSIRO research. In those cases we either do not believe our research has been used correctly (for example interception) or we are unable to agree to statements that the guide has incorporated our research (for example climate change).

It is not possible to describe our reasoning in detail in this document, or to outline our solutions in detail. We would be happy to have discussions on these matters with technical staff of the MDBA and to provide further details.

3. Environmental water requirements

Fundamental to the basin plan is providing the water required to restore the health of ecological assets and the ecosystem functions of the rivers. This is one of the primary considerations for setting sustainable diversion limits. In contrast, the guide is not clear on what the important assets and functions are in the Basin; what is their current condition; and by how much will that condition be improved by returning flows to rivers. It is hard to see how decisions can be justified, agreed to by communities, and defended without these fundamental targets and outcomes.

3.1.1 Ecological Health outcomes

The ecological outcomes for different amounts of water and the basis for determining the environmental water requirements are unclear.

The description of the ecological health outcomes (Chapter 13, Vol.1) are qualitative and largely aspatial. There is no clear description of desired or expected future condition or health for key environmental assets (or key ecosystem functions), and no description of the differential or incremental benefits from the additional volumes of environmental water (or greater reductions in consumptive use) at a site, region or basin level. Without these descriptions, it is difficult for stakeholders to comment on the relative merits of the alternative scenarios presented (3000, 3500, 4000 or 7600 GL/yr average reduction in water use) and thus consider the trade-offs implied.

3.1.2 Identification of key significant ecosystems

A crucial step in the plan is to identify the key ecosystem assets to protect or restore. The 18 indicator assets are clearly ecosystems of national and international significance that need protection and restoration. Yet they are described as indicators and not as priority assets. Appendix A of Volume 2 gives the full list of environmental assets in the Basin. While criteria are given for inclusion of an asset on this list it appears to be an almost complete inventory of watercourses and lakes (including reservoirs) in each region. Many of the smaller watercourses are highly degraded by land degradation processes such as erosion, water quality pollution, removal of habitat, invasion of weeds and pests. These are relatively unimpacted by water management and extraction, and are not identified as assets in catchment plans. It is hard to imagine how these are ecosystem assets and how reducing water use in the basin will improve their ecological condition. A more useful list of environmental assets, which reflects societal values could be produced from interpretation of prior ecological assessments and catchment plans.

3.1.3 Targets for ecological conditions

The next step would be to set target ecological conditions for these assets. Ideally these conditions would be ones that can be related to flow requirements. This has been done for the eighteen indicator sites. It does not appear to have been completed for the river ecological functions. There is no relationship given between any particular flow requirement (such as 80% of natural baseflow) and an environmental outcome (such as prevention of algal blooms or dilution of salinity). The Sustainable Rivers Audit (SRA) hydrological classification seems to be the main basis for setting 60-80% of natural flows as the target for river ecological function. The SRA report is quite clear that this classification should not be used to set management objectives. This is because there are better ways of relating ecological outcome to flow requirement.

Initially, MDBA determined environmental water requirements by considering flow regime requirements at 18 ecosystem asset locations and at 88 locations to indicate ecosystem function. For the assets, detailed environmental objectives and targets were developed, and detailed modelling undertaken to establish flow regime targets.

The above approach is reasonable for the assets in light of the time constraints placed on the development of the plan. However, more defensible methods exist for most of key assets, involving more detailed spatial modelling of inundation and ecosystem response. Use of these models and approaches would provide (i) a more defensible basis for environmental water requirements, and (ii) a more comprehensive description of environmental outcomes and benefits from changed flow regimes. State agencies are likely to undertake such analyses in evaluating the plan and its implications for individual SDLs.

Unfortunately it appears the approaches initially adopted by MDBA were abandoned and analyses reverted to simply setting targets of 60% to 80% of natural flows across the full ranges of flows using exceedance curves at end-of-system locations. This is not a robust approach for two main reasons. Firstly, the flow duration curve is only a probabilistic view of flow variability and does not describe important seasonal variations in flow, or other longer-term variations including ecologically critical flow sequences such as inter-flood periods and drought duration. Using equal targets for every flow magnitude does not reflect the generally accepted view that different flow magnitudes are important for different ecological processes/functions and that different levels of protection across the flow range are likely to be required. Secondly, moving from assessments at asset locations and at a reasonable number of ecological function indicator locations to a small number of end-of-system locations is a retrograde step. These analyses are restricted to lowland, floodplain reaches where flow changes are not representative of the range of flow changes driving ecological change across the river network and associated floodplains and wetlands. The use of end-of-system locations is further complicated for reasons of hydrologic data and model quality. End-of-system locations are typically defined by the most downstream gauge within a region/catchment. Gauges at these locations are typically less reliable as rating curves are often uncertain and records lengths are usually comparatively short. There are often multiple end-of-system locations for a region and an unknown but probably significant fraction of important flow flows bypass these gauges across floodplains and through ungauged wetland channels. For these reasons, river models are seldom calibrated to these gauge records and so modelled flows are subject to high uncertainty. These gauges are thus not the best basis for environmental flow assessments and hence SDL determinations.

These problems can be solved by clearly identifying ecological assets in each region; and determining the ecological functions required to maintain ecological health. Then an appropriate flow metric and location can be identified for each asset. The flows can be modelled under different extraction levels to specify particular ecological outcomes for each level of diversions. Only then is their transparency in relating diversion limits to ecological condition. The transparent outcomes for particular diversion limits would inform stakeholder comment on the plan.

4. Economic costs

4.1 Assessment of the economic benefits of the plan

There will be economic and social benefits of environmental protection and restoration within the Basin. To maximise net economic return to the Australian community consideration of benefits accruing to the Australian community is required as well as costs. There is no evidence that attempts have been made to quantitatively assess the economic value of the plan benefits or formally weigh benefits against costs (or impacts) in a full cost-benefit framework. Benefits do not seem to have been included in the overall economic analysis although they are contained in an MDBA commissioned report.

In addition the net cost of the plan should be compared to the net cost of not having a plan. The recent extended drought had significant economic costs to some water users, particularly downstream, because of over use of water upstream. The plan offers the potential to address this problem and reduce these costs. This would be part of the net benefit of the plan.

The Commonwealth is committed to continue with market water entitlement purchasing, infrastructure investment and potentially other transfer payments to impacted communities to achieve the required reductions in diversions. However, no consideration of these positive income streams to basin communities is reported in the Guide.

Such investments will provide the opportunity for an acceptable solution to a difficult problem. More work is required to identify water payment, investment or adjustment packages that most effectively stimulate regional economic activity and employment should be an area for more future socioeconomic work.

Inclusion of benefits estimates should be a feature of future socioeconomic assessments undertaken. Economic valuation of environmental benefits is an area of economics that remains challenging, and that some benefits will always be difficult to value in monetary terms. Nonetheless, environmental economists have been working on this for over three decades and there are plethora of feasible methods and relevant estimates available. The advantage of this approach is that it requires discipline and systematic consideration of all relevant costs and benefits in a way that should lead to more transparency in consideration of trade-offs between environmental and economic outcomes.

4.2 Proportionate economic costs to environmental water returns

The MDBA concluded that economic costs were unacceptably high when any more than 4000 GL/y was returned to the environment. The Guide suggests that economic costs increase in proportion to increased return of water to the environment. There is no reason given to why incremental costs above 4000 Gl/y are so unacceptable.

4.3 Costs of changes to reliability

There may be significant changes to the reliability of water entitlements under the plan which could have significant economic impacts. The plan should report on implications for entitlement reliability as providing reliability is one of the objectives of the plan and it should describe likely economic costs or benefits of changes to reliability. For all the scenarios fundamental aspects of a rigorous economic impact assessment include a consideration of:

(i) changes to the reliability of annual allocations for each entitlement type across the Basin, and
(ii) changes to multi-year duration of reduced allocations.

Significant changes to reliability are possible because of the required temporal patterns of environmental flow regimes, especially during dry periods and under a likely future drier climate. Reliability will be impacted by the requirement that the impacts of climate change are shared equally by all users. The CSIRO Sustainable Yields project clearly showed that current water sharing plans place the greater impacts on the environment during dry times – especially extended dry sequences; this is further exacerbated under drier future climates. To counteract this affect will alter reliability of allocations leading to potentially very significant economic consequences for irrigated agriculture. It appears that the economic costs of changes to reliability have not been investigated. in fact, changes to reliability of allocations themselves may not have been investigated. One of the big tests of the plan is whether it would have made any difference to unacceptable water allocations during the drought.

4.4 Lack of integrated modelling capacity

The Guide does not provide convincing evidence that sufficient integrated modelling capacity exists to allow for development of criteria that will lead to optimisation of social, environmental and economic outcomes of Basin water management. Such capability could be quickly built from existing tools.

Given that Basin states will be required to develop strategic environmental watering plans within 12 months of the Plan being adopted, more detailed description of criteria for plan accreditation and shared integrated modelling framework to test Plans would seem to be an urgent need. There is a risk of failing to achieve social, economic and environmental optimisation, absence of a set of criteria and modelling frameworks that allows transparent explanation of costs, benefits and trade-offs amongst objectives inherent in choice of criteria and State Plan approaches to meeting criteria.

5. Sustainable diversion limits to meet downstream requirements

For several regions the SDLs largely reflect the flows required to meet the needs of downstream regions. Thus how the contribution of water is shared among upstream tributaries is critical. Inclusion of additional factors in this analysis may lead to quite different options which are easier to justify, more equitable, and of lower economic cost.

The two key components to determining the SDLs for each surface water SDL area are
(i) determining the water use reductions required to meet ecological needs within the region, and
(ii) determining the water use reductions required to contribute water to meet ecological needs of downstream regions.
The first can be undertaken at an SDL area level as was dealt with in Section 1 above. The second requires consideration of the contributions of flows from across the Basin to downstream regions and how to share the required flows between tributary regions. We have some concerns over how those flow requirements have been shared.
The Guide suggests that a single principle has been used to determine contributions of tributaries to downstream flow requirements. Contributions will be made proportional to current levels of use with maximum limits imposed because of unacceptable local economic costs.

We do not support the approach that has been adopted and would not be defensible if contested. Issues are:

(i) calculations of the reductions in use required include interception use even though it is acknowledged that it is impractical to reduce interception use. This is addressed in Section 8 below.
(ii) the simple principle of even reductions does not reflect other important factors such as delivery efficiency and the very different condition and level of use among regions, so it would be hard to argue that the sharing between regions optimises environmental and economic outcomes or is equitable.
(iii) There is no basis given for the maximum limits on diversions (see also Section 4 on economic analysis).

5.1 Water delivery efficiency

The Guide notes that account has been taken of the fact that some regions are essentially hydrologically disconnected from downstream regions. Beyond that however, no account appears to have been taken of the differing levels of hydrological connectivity between regions. Simple information of these levels of connectivity was published in the CSIRO Sustainable Yields project and the hydrologic modelling framework used by the MDBA provides detailed information about the expected efficiencies of delivery of recovered water across the Basin. Ignoring these efficiencies of delivery means the Guide is proposing that water use reductions in some of the poorly connected valleys (like the Warrego and Macquarie) are being asked to reduce water use by three to five times the volumes required to meet within-region environmental needs, and yet these reductions will deliver relatively small additional flows to downstream regions. For the Macquarie the proposed reductions deliver less than half of the recovered water to downstream regions. The reporting of the results for the Warrego appears to be incorrect, as the (locally) significant reductions to provide for downstream environmental needs are reported as in fact delivering zero additional outflows from the region. The solution is to include delivery efficiencies as a second factor in the calculations of how much each region is required to contribute to downstream flow requirements. This will provide a solution that better meets the Water Act requirement for an optimal solution.

5.2 Base contributions to flow on level of use

The current level of use and hydrological condition is a third factor which should be included in the calculations. The MDBA argue that 80% of natural flow is required for good ecological condition, yet the three scenarios proposed still fall well short of achieving that in some valleys while forcing the same percentage reductions in use in valleys which have over 90% of natural flow under current use and thus have no problems of over use, by the MDBA’s definition, either locally or downstream. It is the valleys with very high levels of use which pose problems not only within the valley but for water provision to regions downstream. The required reductions among tributary regions would better be based upon their relative contribution to the problem through current level of use of water not through even reduction in use. That is regions in which 50% of water is used should experience a greater reduction in use than those where the level of use is less than 10% of water. Again this will produce more optimal outcomes because all regions will be closer to the required state of 80% of natural flow.

5.3 Allow market mechanisms to find the optimal solution

The above solution would be more equitable between regions than that proposed at present but is still may not be economically optimal. Better economic solutions and more regionally acceptable solutions may be found using detailed regional planning or using regional water trade. This can be facilitated by allowing between inter-region negotiation of SDLs as long as the overall requirements of downstream and within valley flow targets were met.

5.4 Upper limits to SDL reductions

The other component of the SDL determination process that is poorly explained and justified is the placing of an upper limit on the percentage reduction in diversions. For the 3000 and 3500 GL/yr scenarios this upper limit is set at 40% and for the 4000 GL/yr scenario the upper limit is set at 45%. No analysis is presented to make this case. The upper limit on the percentage reduction in region diversions needs to be justified. It could potentially be justified on social or economic grounds at a regional level. Such an approach would lead to different upper limits for each region (a region-level trade-off) unlike the Basin-wide value used in the Guide as an upper limit. It should be noted that if interception is removed from the calculations of required reductions in use, because it is a basic use which cannot be reduced (see Section 8), then the need for arbitrary maximum limits on reductions to watercourse diversions is greatly reduced. Again, consistent use of clearly stated principles across the process would results in a methodology that requires less assumptions, is more defensible and leads to less perverse and more equitable and optimal outcomes.

5.5 Test alternative approaches

The approach of using proportional cuts to use is not unreasonable, but it does mean that greater cuts in water use are required to deliver the necessary environmental water than under different approaches. Importantly, the Guide does not justify why their approach is better than alternatives.

Some test cases we have examined suggest that the distribution across the Basin of SDLs could change significantly with changes in guiding principles. The social and economic impacts of the proposed plan would consequently change a lot with different distribution of SDLs to meet the same downstream ecological need.

A range of alternative approaches to distributing the water use reductions should be explored, applied to different levels of total water use reduction and assessed for the associated social and economic impacts, thus providing a fuller suite of Basin Plan scenarios and greater confidence that close to optimal solutions have been found.

6. Dealing with uncertainty

Even if the poorly justified targets of 60-80% of without-development flows are used there are what appear to be arbitrary “confidence limits” in achieving environmental outcomes with these levels. There is a better approach to incorporating uncertainty.

The confidence limits do not come from statistical analysis or other means of objectively assessing scientific uncertainty. They are merely arbitrary uncertainty ranges superimposed on the uncertainty range already quantified by allowing a target range from 60-80% of without-development flows. For unstated reasons, a +/-20% uncertainty range has been applied to the reduction required to meet the 60% target, while only a +/-10% uncertainty range has been applied to the reduction required to meet the 80% target. On this basis the assessed reduction for the 60% target (3856 GL/yr) has been reduced to 3000 GL/yr (a 22% reduction) and the assessed reduction for the 80% target (6983 GL/yr) has been increased to 7600 GL/yr (a 9% increase). The differences between, and reasons for, the two uncertainty assessments are not well explained. In spite of the simplistic nature of the assessment method there is no apparent justification for the compounded uncertainty assessment, nor more importantly, for focusing on the extreme lower end of the reduction range described by both uncertainty assessments. This is analogous to focussing only on the dry extreme end of the range of climate change projections.

Using a standard 20% uncertainty on the reductions for both the 60% and 80% targets leads to a range in basin-wide reductions in diversions of between 28% and 77% for the same set of environmental objectives and outcomes. Although the knowledge base to guide these determinations is less robust than is desirable, the uncertainty is not as high as is implied by the MDBA analyses.

A more reasonable and balanced implementation of the simplistic EOS approach would be to set a target of 70% of without-development and allow a +/-20% uncertainty range on the result. This would mean reduction of 40-60% or around 4300-6500 GL/yr, with a “best estimate” of 5400 GL/yr. The statement that a “supplying additional water to the environment of between 3,000 GL/y and 7,600 GL/y will achieve an environmentally sustainable level of take… but with different certainty that the objectives will be met” is misleading and should read “**may** achieve an environmentally sustainable level of take…”.

7. Climate change

SDLs have been determined considering the full available historical record (114 years of data from 1895 to 2009). The use of this long hydroclimate baseline, as advised by CSIRO, is very sensible as it considers the variability in the water resource over different time scales including the recent prolonged drought.

However, modelling of the impacts of potential climate change has not been used to determine the SDL. The explanations of climate variability and climate change considerations in the Guide are vague, and different interpretations are possible.

There are three main issues:
(i) The guide tries to justify why the climate projections to 2030 are not fully included in the plan. This justification does not appear correct or defensible.
(ii) Climate projections show variable impacts will occur across the basin and this variation has not been included.
(iii) The guide advocates that climate change be dealt with in regional water sharing plans but the methods to do that appear impractical and in fundamental conflict with other objectives of regional water sharing plans. The conclusion for this is that projected climate change has not been fully included in the plan or any subsequent processes.

7.1 Incomplete inclusion of climate change

The first issue is the assertion that a 3% reduction in surface water inflow caused by climate change is accounted for in determining the SDL. This is less than one third of the projected 11% decrease in inflows by 2030 against a 1990 climate. There are flaws in the reasoning for the 3% reduction and it is certainly not based on CSIRO science or advice. It is not possible to understand how this '3% reduction' is accounted for in the report. It does appear that it is accounted for only in the environmental water requirement. This is inadequate as climate change will impact first on inflows and then have flow-on consequences for all uses. These consequences may not be the same reductions as the change in inflows because of non-linearities in hydrology not just water management rules. Then, if any impacts of climate change are unacceptable, management of water can be changed, either through the basin plan and SDL's or through water sharing plans. At the very least some discussion should be provided of the expected environmental consequences of climate change and the implications for water planning and SDLs. Analysis and discussion of without-development flow regimes under future climate would provide a basis for this.

7.2 Variable projections between regions

The second concern is that the projected climate change to 2030 from the MDB Sustainable Yields program are very different for different regions. There will be much greater impact on water resources in the southern basin than the northern basin. This is easy to incorporate because the time series of changed inflows have been made available by CSIRO. However these regional patterns and the requirements of each regional plan do not seem to have been included in the guide.

7.3 Using regional water plans to adapt to climate change

The third concern is that the proposed solution of requiring regional water plans to accommodate for climate change is impractical. The requirement is for the water sharing plans to demonstrate that if inflows did decrease during the life of a plan then the impact of decreased inflows would be shared evenly between users. This is a laudable principle but the proposed way of implementing it is in fundamental conflict with the purpose of water plans to provide a reliable supply to users that smooths out natural variability in inflows through the operation of storages and river systems. The conflict arises because it is impossible to tell in advance if reduced inflows are the result of climate variability (a short-term drought) or climate change. The requirement in the guide would mean that if during the life of the plan, below average inflows were experienced then reduced allocations would have to be given to all users just in case these inflows were never balanced in future by higher than average flows. This is fundamentally in conflict with the purpose of using reservoirs and water plans to provide a reliable supply under a variable climate.

The solution is to either prove that there are ways of avoiding this fundamental conflict in regional water plans; or include the best estimate of climate in advance by setting SDL's using projected climate change; or acknowledge that climate change will not be dealt with until subsequent plans when we have a better of understanding of whether inflows are reducing.

In the absence of much information about ecological responses to climate change, one reasonable approach to consider would be to require water resource plans to demonstrate that SDLs provide a similar level of achievement (i.e. relative departure from without-development conditions) of environmentally critical hydrologic indicators such as floodplain inundation frequency under future climate scenarios.

8. Intercepting land uses

The Water Act requires that intercepting activities be covered as a use of water. However, the way intercepting uses have been used to calculate new diversion limits in the guide is logically inconsistent and produces artificially high reductions to watercourse diversions in regions that have high interception.

The MDBA recognises that to remove current interception may be impractical. It will also be undesirable in some cases producing damagingly high levels of runoff that cause land degradation, and poor water quality. Thus current intercepting activities should not be used in calculations to determine how reductions in use are to be shared between regions, as this produces inequitable sharing of reductions when only the diversions can be reduced. Only watercourse diversions should be used so that an equitable outcome is achieved between watercourse diverters. At present watercourse diverters are effectively penalised for existing interception in their regions, over which they have no control and for which there is no real disbenefit. This is of particular importance in the Ovens, Broken and Kiewa valleys. Table 1 illustrates the differences in percentage reductions in diversions when interception is brought into the calculation by comparing calculations across four valleys in the Murray. This is for ease of illustration of the concept only. It is recognised that for the Murray River there are additional regions that need to be considered and additional factors, such that these do not directly represent SDLs proposed in the Guide.

Current interception does not produce a conflict between current diversions and the environment because it is implicitly included in the water availability calculations of the current plans and is using water in the landscape that was used under natural conditions anyway. It is only future interception in a fully allocated region that is of concern. The National Water Initiative is precise about this and the Guide to the Basin Plan is inconsistent with the NWI.

The Guide also adds existing intercepting activities to existing inflows to create a baseline level of inflows. This gives artificially high inflows in places, which are higher than natural flows, and cannot be referenced to any part of a catchment or any historical time period. Flows increased sharply upon clearing of catchments. This was recognized as undesirable in places, and early plantations and many farm dams were used to reduce the damage from clearing and high runoff. Flows have decreased in the least few decades due to these intercepting activities but are still well above natural levels. Water plans are set to the recent levels of interception not past higher levels of flow or the lower flow of natural conditions. Adding interception to measured inflows adds unnecessary uncertainty to the baseline condition for no real benefit.

Inflow calculations may not matter much in setting SDLs but artificially and uncertain estimates of inflows risk public confusion and loss of confidence in the calculations. They also inflate the amount of water going to the environment. CSIRO research on intercepting activities has been misused. Even though we contributed to the confusion through poor communication in the report describing this work, the use should now be corrected.

While the issue is small, the solution is even simpler. It is not sensible to add existing interception in inflows because (i) it assumes all intercepting uses replaced low water use pasture; (ii) it inflates inflows above likely natural and observed historical levels; and (iii) it implies that intercepting uses all represent undesirable reductions on past inflows.

It is more sensible to fully accept interception as a fixed use, much as basic rights uses are accepted, and to consider diversions not interception when balancing uses with environmental need. It would also be sensible to allow any future reduction in interception as an offsetting of use by deeming its current level of use at an appropriate level. Note that intercepting activities are only relevant for base flows and inflows to reservoirs not to flood flows so in many cases the "entitlement" would need to be discounted or limited in its trade to reflect its limited benefit. All new interceptions should be within SDLs and included in water plans, consistent with the NWI.

Current interception can be identified as a separate use without adding it to inflows. It is a use above the point of inflows that is already implicitly included in the inflows of water plans. It only comes into the balance sheet of water availability and use when the activity is removed and the additional inflows are liberated.

	Ovens	Kiewa	Goulburn	Broken	Total
Interception	53	14	109	43	224
Diversions	25	11	1593	14	1643
Total use	**83**	**25**	**1702**	**57**	**1867**
% of total use	4	1	91	3	100
% of total diversions	2	1	97	1	100
Diversions as % of total use	30	44	94	25	88
3000 Reduction SDL Scenario	73	20	1260	51	1404
Reduction	10	5	442	6	463
Reduction weighted on use	21	6	422	14	463
% Reduction in diversions	82	56	26	101	
Reduction weighted on diversions	7	3	449	4	463
% Reduction in diversions	28	28	28	28	

Table 1. Comparison of the difference between reductions in diversions between when they are based upon existing diversions and on total use (diversions plus interception).

9. Surface water balances and modelling

The reporting of surface water balances in the Guide is misleading, largely because of the way intercepting water uses are treated, as discussed above in Section 8. Thus the statement that “the amount of rainfall that ends up in the river system, which is referred to as inflow, is about 32,800 GL/y” – as a long-term average – is misleading, as this is certainly not the current average volume of inflow, and there is no evidence to suggest that historically, this was ever the average volume of inflow. The fact that these assessments are not based on integrated modelling calibrated against observed streamflow is not clear to the reader. The statement that “the average amount of that inflow that is used for consumption is 15,400 GL/y” is misleading as this total includes intercepting water uses, which in many cases are intercepting runoff before it actually becomes inflow to the river system.

The statement that the approach adopted in the CSIRO Sustainable Yields project “has the disadvantage of making it difficult to compare the water used between current conditions and possible future conditions” is incorrect. CSIRO demonstrated a robust approach to comparing water use under current conditions to water use under possible future conditions in the reporting from that project. CSIRO clearly articulated in the Sustainable Yields project reports the shortcomings of using total inflows as a measure of the resource, including the fact that a large fraction of the inflows are not measured and must be estimated for ungauged catchments and that several river models in the northern basin are known to significantly over-estimate inflows, with these inflated inflows then corrected for using loss nodes such that modelled flows are far more reliable at downstream main stem gauges.

The over estimate of inflows leads to misleading presentations of the environmental water requirements and water use. For example, Table 6.2 in Vol.1 is misleading for a number of reasons. Firstly, it refers to “water available to the environment”; whereas the numbers presented for this are actually estimates of “water used by the environment” (i.e. losses) – as labelled in the Appendix. The numbers are misleading in some cases because their derivation is based on subtracting water use and outflows from total inflows, and as noted earlier these values are unrealistic for some models. Hence for example, the quoted water environmental use for the Gwydir of 506 GL/yr is the order of 50% too high due to exaggeration of inflows. Using this approach leads to estimates of the total environmental water use required in the Basin (22,100-26,700 GL/yr) that are close to or exceed the average natural flow in the system assessed at the locations of maximum flow. Losses and beneficial environmental use should be separated. The baseline water availability should be corrected to either the calibrated inflows or the gauged point of maximum flow in each region (as was done for MDBSY).

Reporting of baseline water use should include the streamflow impacts of groundwater use. For three of the baseline models, the MDBA decided to include the impacts by 2030 of current levels of groundwater use. These uses of surface water (though induced leakage to groundwater) should be reported as a component of baseline use. The failure to report these in the surface water balance means these volumes are incorrectly attributed to “environmental water” as they appear as a loss term.

The guide claims that “the integrated model ….used to develop the Basin Plan was first tested by the CSIRO….”. It is true that the MDBA used CSIRO’s integrated model but there is no evidence that the model results were a major input to the proposals in the Basin Plan. Instead, as argued in Section 1 above and in the guide to the plan, much simpler methods were used based upon flow duration curves and no further use of the integrated model was made in setting SDLs and exploring different scenarios. CSIRO believes that more effective use should be made of the integrated model as it provides more precise evaluation of SDLs. CSIRO does not accept that the Basin Plan at present is heavily reliant on that model.

10. Groundwater

CSIRO, together with SKM, supported the MDBA's groundwater analyses through provisions of technical information. The technical information provided, as filtered through a number of MDBA policies, is well reflected in the Guide. Some State data on groundwater yields brought late into the analysis was not incorporated into the guide but has been provided to the MDBA and could be included in the draft plan.

The total cut in groundwater use below the current level represents a relatively small fraction of total use in the MDB. This reflects the history of groundwater development and the implementation of schemes such as the ASGE that have already reduced entitlements in major groundwater systems.

A potential point of ambiguity is how the groundwater SDL volume relates to water quality. Generally, the SDL volume related to the total for all beneficial categories, but if applied to the freshest water could lead to problems of over-extraction. The water planning requirements contained in the Guide do not appear to address this.

The Guide avoids groundwater management undermining the surface water SDLs through capping groundwater use in connected systems. It also appears to address double accounting, where significant, although the methodology is not well documented. However, the impacts of groundwater use on streamflow should be considered as a surface water use rather than a loss. Also, the groundwater impacts in the calibrated model do not appear to be accounted for in defining without-development streamflow.

Trading – particularly between groundwater and surface water – may lead to confusion should SDLs not be truly integrated, ie surface water SDLs and groundwater SDLs defined separately.

11. Conclusion

The technical comments provided in this submission are to encourage the further development of the proposed Basin Plan. We have tried to provide practical suggestions which could be implemented in the timeframe of the plan and which lead to a better plan and a better understanding of the basis for the plan.

CSIRO is keen to continue working with the Basin Authority and other stakeholders in providing strong technical expertise to support appropriate decision making for the long term sustainability of the Basin and its communities.

Appendix 1 Other Minor Considerations

Figure 6.7 in Vol.1 is misleading, as the hydrologic indicator sites for assets that are shown are in some cases actually the asset locations. Flow conditions for these assets are inferred from the models usually using the closest reliable gauge. Hence the three assets in the lower Lachlan are all best described by flows at the Booligal gauge. Conversely, for the Wimmera, the gauge location appears to be indicated rather than the asset location.

The undeveloped flow regime used to produce flow duration curves did not include the intercepted volumes included as inflows in the tables of inflows and uses for the basin. Again this is inconsistent use of interception volumes. The interception volumes should not be added to gauged inflows in the tables.

There appear to be some inconsistencies between the results presented for this simplistic approach in the published documents. Specially, Figure 6.6 in Vol.1 seems to be inconsistent with Table 4.5 in Vol.2. For example, Figure 6.6 Vol.1 suggests no reduction in water use is required in the Warrego to meet EOS targets, while Table 4.5 in Vol.2 indicates a 13-28% reduction is required. Conversely, Figure 6.6 Vol.1 suggests a large reduction in water use is required in the Wimmera, while table 4.5 in Vol.2 indicates no reduction is required.

The reported coefficient of variation for water availability in the Barwon Darling (Table 2.8, Vol.2) appears far too high; all previous published studies show the highest variability being in the Moonie, Namoi and Warrego.

Figures 6.8 and 6.9 are also misleading. There is significant variation of the flow regimes across the Basin and to simply characterise all rivers in the southern Basin using the flow pattern at Wentworth and all rivers in the northern Basin using the flow pattern at Bourke is a gross over-simplification. These graphs are also misleading as they confuse two hydrologic concepts: firstly, the monthly pattern of flow averaged across years, and secondly, different categories of flow events (base-flow, freshes and overbank). These cannot sensibly be presented on the same graph. Further, the graphs purport to indicate the monthly pattern of the "base-flow regime", but appear to actually indicate the pattern of mean or median monthly flows.

The reported outflow for the entire basin under without-development conditions (at 12,500 GL/y) is misleading as this includes nearly 1000 GL/y of inter-basin transfers. This is clear in Chapter 5, but not where presented in the introductory material. The modelled without-development flow regimes used for determining environmental requirements (including for the CLLAMM region) do not include these IBTs. It is unclear, but it may be as a result of different treatment of IBTs that the Darling contribution to the Murray is reported as either 17% or 18% of the total flow in the Murray at the junction.

Given CSIRO has recently published comprehensive water balances for the Basin under without-development and current (baseline) conditions, it would assist the reader if the MDBA documentation explained the differences in the models used. MDBA has prepared a comprehensive technical report describing these differences and the reasons for them, but has not, as yet, published this report. Key issues here are firstly that the states have revised their models subsequent to MDBSY – including significant changes to the without-development models, which imply a larger water resource and yet these model changes have not been well documented by the states or subjected to a peer review process. (The MDBA Cap Model audit process does not scrutinise the without-development models, in spite of the importance of these models for resource assessments and environmental water determinations.) Secondly, greater clarity is needed about whether Cap or water sharing plan versions of the models have been used. Thirdly, greater clarity is warranted in Vol.1 around environmental water and infrastructure for improved efficiency is included in the models. Some information is provided in the Table notes to Appendix C and fuller description is provided on pg180 of Vol.2, but a summary of this could be more prominent. While it is stated that all TLM and Water for Rivers water is included in the baseline (which as not the case for MDBSY), there is no tabulation of these volumes by catchment. It is not stated whether the NVIRP is represented in the modelling (including the north-south pipeline) or how TLM works and measures are treated in the modelling in terms of operational rules.