COMMONWEALTH OF AUSTRALIA

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SENATE

RURAL AND REGIONAL AFFAIRS AND TRANSPORT REFERENCES COMMITTEE

Reference: Rural water usage in Australia

THURSDAY, 30 OCTOBER 2003

CANBERRA

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SENATE

RURAL AND REGIONAL AFFAIRS AND TRANSPORT REFERENCES COMMITTEE

Thursday, 30 October 2003

Members: Senator Ridgeway *(Chair)*, Senator Heffernan *(Deputy Chair)*, Senators Buckland, McGauran, O'Brien and Stephens

Participating members: Senators Abetz, Boswell, Brown, Carr, Chapman, Colbeck, Coonan, Crossin, Eggleston, Chris Evans, Faulkner, Ferguson, Ferris, Harradine, Harris, Hutchins, Knowles, Lees, Lightfoot, Mackay, Mason, Sandy Macdonald, Murphy, Payne, Santoro, Tchen, Tierney and Watson

Senators in attendance: Senators Colbeck, Heffernan, Lees and O'Brien

Terms of reference for the inquiry:

To inquire into and report on:

1. current rural industry based water resource usage;
2. options for optimising water resource usage for sustainable agriculture;
3. other matters of relevance that the committee may wish to inquire into and comment on that may arise during the course of the inquiry, including the findings and recommendations from other inquiries relevant to any of the issues in these terms of reference.
4. the Committee to make its report to the Senate on this matter by the last sitting day in 2003.

WITNESSES

Committee met at 4.04 p.m.

COSIER, Mr Peter Aubrey, Member, Wentworth Group

CULLEN, Professor Peter, Member, Wentworth Group

YOUNG, Mr Michael Denis, Member, Wentworth Group; Director, Policy and Economic Research Unit, Land and Water, Commonwealth Scientific and Industrial Research Organisation

ACTING CHAIR (Senator Heffernan)—I declare open this public hearing of the Senate Rural and Regional Affairs and Transport References Committee, and I welcome you all here today. The committee is inquiring into rural industry water use. Today I will be chairing the meeting in the absence of the chair, Senator Aden Ridgeway. There will be a *Hansard* transcript of the proceedings. The committee has authorised the recording, broadcasting and rebroadcasting of these proceedings in accordance with the rules contained in the order of the Senate of 23 August 1990 on the broadcasting of committee proceedings.

Before the committee takes evidence, I place on the record that all witnesses are protected by parliamentary privilege with respect to submissions made to the committee and to evidence given. Any act by any person that may disadvantage a witness because of evidence given by him or her before the Senate or a Senate committee is a breach of privilege. While the committee prefers to hear all evidence in public, the committee may agree to take evidence confidentially. If the committee takes confidential evidence, it may still publish or present all or part of that evidence to the Senate at a later date. The Senate also has the power to order the production and/or publication of confidential evidence, but the committee would consult the witness before taking such action. Our first witnesses today are the venerable people from the Wentworth Group. Do you have any comments to make about the capacity in which you appear today?

Mr Cosier—As well as being a member of the Wentworth Group, I am Director of Conservation at WWF Australia.

Mr Young—I am from CSIRO Land and Water, and I am an economist.

Prof. Cullen—I am a visiting fellow at CSIRO Land and Water and a member of the Wentworth Group.

ACTING CHAIR—Would you like to make an opening statement?

Mr Cosier—We would like to make a very brief introductory statement, given that we gave evidence in December last year. Since that time quite a lot has happened with water resource management in Australia, concluding in August with the COAG agreement to establish a national water initiative. We would be keen to add to the evidence we gave last December by focusing on our most recent document, which was published in July, in which we called for a national water plan and produced a blueprint for such a plan. Australia desperately needs a national effort to restore and protect our fresh water resources. The health of our rivers, wetlands, estuaries and ground water systems is fundamental to the future of our cities, industries, communities and agriculture across Australia.

In the *Blueprint for a national water plan* there were three core things that COAG needed to do to advance this urgent national agenda. The first was to protect river health and the rights of all Australians to clean, usable water, and we set out four or five principles on which that should be based. We should establish a new, nationally consistent water entitlement and trading system that provides security both to water users and to the environment by defining water entitlements as a perpetual share of the available resource and clearly articulating ways that water can be used in each catchment to protect both the environment and users. The third element of our plan was to engage local communities and to ensure a fair transition by supporting locally community based catchment, river and estuarine management systems. With the willingness of the chair, I would prefer to leave our opening remarks at that and be available for questions.

ACTING CHAIR—We have instigated some pretty interesting debate out in the community on everything from water harvesting to the interception of run-off from forests. If we come to terms with the fact that the Murray-Darling Basin is seriously overcommitted, given that it has 6.2 per cent of Australia's run-off and the majority of the water farming activity, we must first have an audit of the water that is available for future projects, to plantation forests and to water harvesters.

To that end, we were recently in St George and we had representations from the various bodies there, including some distress calls from people of the Lower Balonne about the water harvesting capacity and the A and B water licensing regime proposed, and which I understand has been put forward by the Lower Balonne Community Reference Group. We were told then that, on the figures available, it was 750,000 megalitres. There are now one million megalitres of water harvesting storage being built between Dirranbandi and the border. Professor Cullen, in your review you state that the rivers and wetlands of the Lower Balonne system are presently in a reasonable ecological condition but that this condition is expected to deteriorate if the present capacity to extract water from the system is exercised. Would you like to reflect on that for the committee?

Prof. Cullen—As you pointed out, there has been a lot of infrastructure development up there, and over the last four or five years they have not had a lot of water so a lot of the infrastructure has not been used. When you look at the aquatic invertebrates in the rivers, you cannot see any signs of degradation. However, our view was that when the additional water that the existing infrastructure could take out was taken out we would expect to see a deterioration. As you realise, we also identified in that report four ecological assets that need to be managed—the marron lakes, the rivers and channels of the Condamine, the Culgoa flood plain and the Darling. We tried to give an estimate of what watering regime they all needed to maintain them and we came up with some watering regimes which we think will hold the condition of those ecological assets. Subsequent to our review of that science, the irrigators have been working with the department and its models to try to work out pumping rules which will protect the ecological assets and cause the least pain to the irrigation enterprises possible. I believe that they have probably got a fairly satisfactory outcome given our current knowledge.

ACTING CHAIR—You are familiar with the Lower Balonne Community Reference Group—

Prof. Cullen—Yes.

ACTING CHAIR—Have you had much to do with the reference group?

Prof. Cullen—The reference group worked in parallel with the scientific review panel. We had the reference group in front of us when we heard all the submissions from the various scientists and the other interest groups, so the community reference group heard all the inputs. It heard us as a scientific review panel interrogating some of those witnesses. We had the community reference group critique our draft report and tell us what they could not understand.

ACTING CHAIR—To the best of your knowledge, who was the author of the Lower Balonne Community Reference Group document? Who actually wrote the words?

Prof. Cullen—I cannot answer that.

ACTING CHAIR—Can you recall who the facilitator was?

Prof. Cullen—Leith Boully was the chair of the group. I know that there were a lot of robust discussions within the group as it was writing its report, but we did not sit in on any of that.

ACTING CHAIR—My understanding is that Leith Boully was actually the paid facilitator.

Prof. Cullen—I cannot answer that. We were told that there was a community reference group to which we were to make all the science accessible. We tried to do that and I believe that we did that to its satisfaction.

ACTING CHAIR—On 7 September 2003 you wrote to Pop Peterson from Brenda Station.

Prof. Cullen—Yes.

ACTING CHAIR—I do not think I have the letter to which your letter refers, but I may have it. There is a letter to you of 4 August from Mr Pop Peterson.

Prof. Cullen—There were a number of letters from those downstream pastoralists concerned about the—

ACTING CHAIR—Would you be able to table them or present them to that committee?

Prof. Cullen—Probably not. I think I referred those letters to the Department of Natural Resources and Mines in Queensland. I sent them back there.

ACTING CHAIR—They might be able to fax them down for us.

Prof. Cullen—They came after my work had finished and I thought they needed to be handled so I asked the department to handle them.

ACTING CHAIR—In the letter of 7 September Mr Peterson wrote to you with some criticisms of the outcome of the community reference group. You say:

The task of the Scientific Review panel was to specify the environmental flows required based on whatever science that was presented to us.

Is it adequate to be able to make that sort of decision?

Prof. Cullen—There had been water management planning decisions going on up there for some time. We were called in when there was a disagreement between the irrigators and the government about Cubbie Station and the extraction of water. The task we were given was to review the science on which those various decisions had been made. We decided to go further than that and we put out a public advertisement asking for anyone with an interest to give us whatever submission on the science that they could. We also solicited science from the various state agencies, both Queensland and New South Wales, and the federal agencies, and we specifically approached a number of scientists whom we knew had worked in those areas so that we got the best information available.

The concern of those pastoralists is that their productivity has decreased, given the capture of upstream water. There was no formal evidence presented on that other than the anecdotal experience of the pastoralists. I have little doubt that it is true. The extent of it was a little more disputable. Some of the pastoralists asserted that they did not get particular floods when we were told that the air photo analysis did suggest that they got floods. So there was some dissention as to just what wetting events they had. But there was no scientific study that was brought before us or that we were made aware of which documented that decrease in productivity. Anecdotally, though, those pastoralists would suggest to you that their production is down 20 or 30 per cent since that irrigation capturing took place.

ACTING CHAIR—I declare an interest: I am familiar with what happens to lower reaches of rivers when there is a lot of harvesting upstream. Further in that letter you say:

I understand your concerns about the impacts of reduced flooding in the downstream sections, but I was under the impression that these interests had been represented on the Community Reference Group, which presented a unanimous report.

How much weight did you put on the unanimous report?

Prof. Cullen—I think there were three representatives of those Lower Balonne properties on the community reference group. We did not put any particular weight on the community reference group report. The community reference group was working in parallel to us and it was reporting to the Queensland government about how effective our scientific review process had been. So we did not comment on the community reference group report. We had some discussions with them about it but basically they were satisfied that they had heard all the science that we had heard, that they had understood the way we were thinking about it and that they had had the chance to ask us questions but we did not critique their report.

ACTING CHAIR—So out of that came the A and B licence proposal?

Prof. Cullen—No, the A and B licences were there long before we were there. I must admit that I have some concerns about that way of allocating water.

ACTING CHAIR—No more than I have.

Prof. Cullen—It seems to me that you create a licence by building a bund. I think there were bunds being built just to create licences, so I thought that was a silly way of allocating water.

ACTING CHAIR—Do you think it would be possible that a community reference group that was constructed in the way that that one was constructed—and amongst the people in the group there were major financial gains to be made—could have conflicting points of view?

Prof. Cullen—There were conflicting points of view in the community reference group, and my understanding is that they had quite a lot of robust discussions about how they should report. But equally I am under the impression that the downstream pastoralists agreed to sign off on a consensus report, so that dissent was not presented in a minority report, to my understanding.

ACTING CHAIR—Given that there is 1,000 gigalitres of storage there and given that we have evidence that at Bourke what used to be a 25 per cent supply of the Culgoa is now at six per cent, do you have any comment to make on what has happened to the Culgoa and its contribution to the Murray-Darling Basin or the rivers from that area in that contribution to the Murray-Darling Basin? We have had some discussions on the health of the Murray and whether it be 350,000 to 750,000 megalitres, and here is a river-harvesting operation which is about to get a tick off and which could take a million megalitres.

Prof. Cullen—The modelling that the Murray-Darling Basin Commission has done indicated to me that the rivers of the Lower Balonne contributed in the order of one per cent of the flow of the Murray at Morgan. So most of that water does not in fact get through to the Murray. I was more concerned about the impacts of the flood-harvesting on the Darling River but there was virtually no science brought before us on that, so we were unable to make very strong views on it, except to note that the two studies we had in front of us indicated reasonable degradation of the Darling due to that flow stress. But we did not have in front of us any science that would give us a very clear view on what flow they needed. I do not think the Lower Balonne really makes much impact on the Murray stem.

ACTING CHAIR—With respect to bunded water, there are some major beneficiaries in that region of the state. Some have up to 380,000 megalitres while someone else who has a joint venture with Cubbie Station and who is also a key determinant person in the process has a benefit of perhaps 7,000 megalitres if it all comes to fruition. The nature of the river up there, Professor Cullen, is that, unlike in some rivers where the water comes out of the river and goes off into the never-never, in this particular river system it comes back into the river system and back out and back in.

Prof. Cullen—In the Culgoa it does.

ACTING CHAIR—Yes. Do you think that there is any justice in being ‘first in best dressed’?

Prof. Cullen—It is not necessarily the way I would allocate a water resource but that is the way we have traditionally done it in this country.

Senator O'BRIEN—When we travel to northern Australia and talk to irrigators in various parts of the country in New South Wales and Queensland an issue that is consistently raised is: what is the point of letting the water go past; it will only end up in the Menindee Lakes? What is the view of individuals within the Wentworth Group about that sort of commentary from northern New South Wales and Queensland with regard to the dynamic of the water flow through the Darling and the impact the Menindee Lakes have on the flow? In other words, how much of the current flow, which is used in a variety of ways further up the river system, is going to get past the Menindee Lakes?

Prof. Cullen—I cannot answer in detail except to say that the Menindee Lakes are a pretty important ecological asset in their own right. They have been impacted by some of the water harvesting activities and I believe they need to be given an adequate supply of water and managed in an appropriate way. I have not personally done detailed studies on the Darling and there have not been very many studies of it.

Senator O'BRIEN—It is important from the point of view of environmental flow. There is an environmental flow into the Menindee Lakes but what understanding do we really have about flows from the Balonne et cetera into the Darling, and their contribution to the Lower Murray?

Prof. Cullen—As I indicated before, the Lower Balonne flows do not get down to the Murray as such but they do provide beneficial waters to the Darling so that is an important ecological asset. A couple of studies have been done on the environmental flow requirements for the Darling. The CRC for Freshwater Ecology has done some work on the ecology of the Menindee Lakes, which is also a fairly important water supply for people in that region. I am just not familiar with a lot of the detail of that.

ACTING CHAIR—Given this million megalitre of proposed water harvesting and storage that has been built, what proportion will remain of the contribution that used to be made to the Darling? How much water is going to go missing because of all this water harvesting? Do you have any idea?

Prof. Cullen—I would not like to have a guess at that. The systems are all different and they have all been changed over the last 50 years by a whole lot of small diversion weirs designed to take water out of the Culgoa and push it out into the others, such as the Narran. We have been changing the flow routes in that system for 50 years. The Culgoa probably used to be much more of a permanent stream than it is now because we are diverting those flood plains.

ACTING CHAIR—Were some of those decisions sort of 'wink and nod' and no science?

Prof. Cullen—I do not think there was much understanding of what we were doing. I think the logic was to spread out the flood waters as much as you could across the flood plain to support the pastoral industry.

ACTING CHAIR—If you were giving advice to the Queensland government on the regime that is proposed for this area of the state, which is allocated water from the water harvesting arrangements earlier on and the A licence and the B licence regime, with the B licence being further water harvesting and the A licence being bunded water, would you be urging them to proceed with extreme caution?

Prof. Cullen—I certainly would. I would be urging all governments in allocating water to go with extreme caution and make sure they understand what they are doing.

ACTING CHAIR—My understanding from the community reference group is that they propose to proceed with this proposition although most people recognise that water harvesting is going to do some pretty serious damage. I think it is an interception of riparian rights for downstream users; it is plain bloody bushranging. My understanding is they want to let it go ahead on the basis that there is going to be a five-year review of the whole system—given it gets a five-year run. In my view, if it is found to be at fault, that would set up a process of compensation for various people. Do you think we have enough knowledge at present to proceed with this proposition?

Prof. Cullen—The works are in place and water harvesting has been taking place; it is just that in the last three years there has been no rain. There has been a lot of economic development based on that water extraction. The critical factor, on which we felt there was a reasonable amount of information, is the Narran Lakes—a Ramsar wetland. Given the experience of other terminal wetlands around Australia that have been seriously degraded by the overextraction of water up stream, we were concerned about it. The natural wetting regime of the Narran Lakes before this development was every two years. With the development in place it was going to be every seven years. Given that this is a pretty variable climate, that could mean 14 or 20 years without rain. We talked to the various wetland ecologists we could find, and we took the view that a wetting regime of seven years would destroy the Narran Lakes. They would not survive. Wetland vegetation would be replaced by terrestrial vegetation.

We then probed as many experts as we could to find out how frequently we would need to give the wetland a wetting to maintain it. The best advice we could get was that it should probably be every 3½ years. We then said in the scientific review report that the small floods were not of great importance to the Narran Lakes, because they would not get through to the Narran Lakes, and the irrigators would not be doing anything with the large floods, because they are very big floods; they are about every 12 years. What needed to be done to protect the Narran Lakes was make sure they had a share of the medium floods, particularly if they had not had a wetting for a couple of years. We gave those requirements to protect the Narran Lakes to the irrigators and asked them to come up with a system—with the pumping rules and the models—whereby this could be delivered with the least pain for irrigators. To their credit, in a relatively short time they did that.

During that time, we learnt a lot more about the Narran Lakes, because they had commissioned a hydrographic survey and we got to understand the volumes a bit better. Of course, it was not as simple as we thought. There are two parts to the Narran Lakes. The first part is where the birds nest and breed, and that will get its wetting regime on a 3½-year cycle as we had said was necessary—that was met. What would not be quite met was the second part of Narran Lakes, which appears to be less important for bird breeding but more important for bird feeding. I think that gets a wetting every 4½ years or so, which was not quite what we wanted. We talked to people about alternative sources of feeding for the birds. The view was put that they could feed in the other part of the Narran Lakes—at the same place where they were roosting. Our general feeling was that this would be adequate.

During this time, before we started, the Murray-Darling Basin Commission had commissioned a serious ecological study of the Narran Lakes which is now underway and will report in 3½ or four years. So we have said that these judgments on the wetting regime are interim judgments based on our knowledge before this study was commissioned, and the study will be reporting in that period and those judgments should be reviewed when that report is in. That is the basis for the review.

ACTING CHAIR—If all this turns to custard, the people up stream that have all these huge water harvesting licences are going to lose them and they are going to be pretty unhappy. Could you give your view of the environmental phenomena?

Mr Young—I think there is a very important issue, which goes back to the Wentworth plan, in terms of how you define licensing systems all over Australia. Professor Cullen has stressed the importance of defining entitlements as shares. We go on to really scope out the world's best practice in terms of setting up accounts that are transparent. If you are going to have A licences and B licences, it is critically important that the licensing system links back to something that is available for consumptive use. If there is climate change or if there are seasonal changes, then a lot of the concerns that I think you are signalling must be put into the licensing system in the way that shares and use entitlements are defined. We have stressed very much the importance of doing that, and we are particularly excited that the national water initiative is signalling that governments are interested in going for what I would describe as best practice.

Our licensing systems, almost throughout the nation, are miles from best practice. The clues are known. If you go right through all the world, there are all of the obvious solutions. Nobody has assembled them all together. I think many of the issues that you are concerned about are reflected in the fact that we have been prepared in this nation in the past to roll out licensing systems on a five-year basis, hoping they are going to work, promising we will fix them up when they start to go wrong but then actually discovering that the equity and wealth implications and the problems that start to emerge are so difficult that people put it off because it is too difficult at five years—

ACTING CHAIR—That is the promise of the community reference group: 'We'll have a look in five years and see if it works and unwind it if it doesn't.'

Mr Young—One of the things that we have identified in our work and which is also actually in the national water initiative is a proposal to fully assign risk to make it very clear to a person who invests in construction of a dam or whatever exactly what their risks and liabilities are and what their entitlements—if any—to compensation are. The proposal is to do that transparently up front. We have not been doing that and the issues that you are raising flow along those lines. If we have already allocated water to pastoralists downstream and they do hold an entitlement—if they do, and that is a question—and then somebody else harvests it, then there are models around the world where, as you put in a dam you would have to buy a share from people who have already had it. You can find examples of systems like that in the south-east of South Australia.

If governments want to manage water resources forever then they need robust systems to do that, and that is part of the vision that the Wentworth Group has been articulating. We really do need to talk about shares, talk about assignment of risk and articulate very carefully how water

can be used in each catchment in ways that actually protect both the environment and other users and give security to investors—or an understanding of the extent of security you can have, given there is also a need to give security to the environment. Our systems that we have at the moment do not do that in a transparent way. We use the wrong language often. We imply things that are not meant to be implied just because of the labels that are attached.

ACTING CHAIR—There are obvious risks with the amount of water you harvest out of the system. We already know there is 1,000 gigalitres of storage built. Would you like to give a reflection, for the panel, on any of the risks or outcomes or possible unforeseen circumstances surrounding the principle of bunded water?

Prof. Cullen—There may be risks with that amount of water, and ground water implications and salinity, but there has been quite a lot of intensive work investigating salinity and I think the current feeling is that it is probably not likely to be an unmanageable problem. I think the biggest risk that I can see in that system is delivering adequate flood flows to the Culgoa flood plain, which certainly does not wet now as frequently as it did prior to development.

I think we have just had a lesson from the Murray, where we have lost so many river red gums downstream of Euston. Those red gums appeared to not get a flooding over a period of about a decade. So we had a natural drought come at the end of a fairly long man-made drought with our extractions on the Murray. That seems to have killed a lot of mature red gums.

The coolibah vegetation on the Culgoa is certainly not as sensitive as river red gums. This is the issue: we do not have a hard number that says, 'Well, that vegetation needs to be wet every 15 years or we will lose it.' We did not know we were going to lose those river red gums. We have lost them and we will not get them back. So that is the risk factor that worries me. We have so little knowledge about the long-term wetting frequency for some of those floodplain communities. Every time we make a mistake, it is irretrievable.

Senator LEES—I want to ask some difficult questions.

Senator O'BRIEN—So do I. I have a couple of questions. The first one relates to some evidence we took in the Griffith area from the rice industry about what they describe as improved utilisation of water. The production of a hectare of rice has seen the necessary input of water go down from 19 to 13 megalitres over a decade. Do not hold me to that precise figure, but that is the sort of range that they were talking about. How should we treat that evidence in the context of your paper, *Blueprint for a living continent*? We are receiving evidence from significant water using agricultural industry sectors about improving productivity. What sort of recommendations should we make in relation to that evidence? Should we value that? Should it be rewarded? Should it be a requirement? How should we treat the water released in circumstances of those productivity improvements?

Prof. Cullen—I am not sure that any water is being released because of it as much as additional production is taking place. I think it is good to see that, over the last five years, there has been a greater focus on efficiency of water use in all of our irrigation industries as people try to reduce some of the excessive irrigation and some of the wastage. I applaud that across all of the industries where it is happening. I think also that there is a fair disparity between the best producers and the worse producers and the amount of water they use per hectare. So I think one

of our objectives is to try to keep squeezing the water use efficiency so that all users are moving up to a higher standard. I am aware of the rice industry attempting to become more efficient with their use of water; I am not exactly sure of what they have achieved. But they are still using a hell of a lot of water. I think the land and water audit said they were using 11 or 12 megalitres per hectare, and up to 13. That is probably double what some of our other crops are using. So they are big water users.

Senator LEES—As we see them becoming more efficient and dropping down to 11 or 12 megalitres is any of that water that they are not using actually staying in the river or are they in fact diverting that water off to the crop over the hill?

Prof. Cullen—I think that is what is happening. I have come to the view that all leaving environmental water in the river does is improve the security of supply for other irrigators. What we really need to do, as the Wentworth Group has said, is start moving to formal licences for the environment. We have argued that the $500 million that COAG have agreed to should be for getting water back—that means buying water on the water market, getting environmental licences and then, I think, using the regional catchment management authorities that all the states are now moving towards to actually manage that water to protect the environmental assets we have. I think we have to get environmental licences rather than just leave it in the river because it just gets siphoned out.

Senator LEES—But also, following on from Senator O'Brien's question, will that particular farmer who has reduced their usage from 13 to 11 megalitres or whatever not have simply planted more? As I drive across the Hay plains I have seen the area planted to corn expand. The next time I drive across it will probably be right down to the road. How do we stop that? These people have a right to this water. We can get as efficient as we can be, but all we are doing as I see it is worsening the problem, because the more locked in these people become with even more of their land developed and more grape vines planted the less likely we are to get water back off them.

Mr Young—There are three very important concepts here. We have to be careful as we move from irrigation system to irrigation system, as the preciseness with which entitlements are defined varies from area to area. Almost all licences in Australia are actually defined in gross terms at the farm level; so you have an entitlement, say, to pump a thousand megalitres of water—

Senator LEES—Or in South Australia to irrigate 50 hectares.

Mr Young—We could argue over quantities, but the important thing is that, when it is used inefficiently, a lot of the water which is not evaporated goes somewhere else, and often it will go through drains back into the river system or through ground water back into the system. Some licensing systems at the bulk level have an arrangement whereby there is an account made of how much goes back through surface drains, so there is actually a cut across everybody's licence when you upgrade water use efficiency. That comes in in places like around Griffith where there is a high security licence and a general security licence. As the people who hold high security licences become more efficient, there is a reduced allocation to general security licences, so what you are really doing is having a reallocation of water within the community in some areas.

In all of the systems there is no account for the reduction in ground water flows back to the river. Where ground water goes either to a wetland or back into the river, there is a loss somewhere. An example I have often put on the table is, if you imagine a situation where we traded water from somewhere around Swan Hill, where it is being flood irrigated onto a pasture at about 40 per cent or 50 per cent efficiency, half of the water would have ended up back in the river. If you traded it through into South Australia and pumped it into the Barossa Valley, totally outside the entire return system, you would have doubled the amount of water being extracted from the system. So somebody loses.

This is part of the whole water use efficiency process that is going on, and there are some serious consequences in not having a robust accounting system which understands exactly the point you were making: when water is used more efficiently, if it is more efficient in a net sense—you are actually using smarter technology and there is then a saving in evaporation by having better channels or something, and also there is less evaporation or less transpiration—then that is a real saving. If the saving is saving by taking water from other irrigators or from the environment—and it might be the river or it might be an important wetland, which is not connected to the river but is still important—then there is an important issue to be considered.

I think it is very important to understand that in many parts of Australia's ground water system the wetlands that are connected with that are a function of how high or low the watertables are. If small changes or increases in so-called efficiency really mean that there is less ground water recharge then wetlands can be severely compromised and other irrigators can also be compromised in terms of the opportunities that they thought they had.

Mr Cosier—To add to that, particularly in response to your question, Senator, the Wentworth Group strongly support water efficiency and we strongly support water efficiency going to increased production, which creates further wealth. However, it has to be underpinned—and I think we gave similar evidence to this committee in December—by securing the environmental health of the river first. So one of the core principles that we put in our blueprint was that protecting river health means:

... ensuring that the environmental needs of our river systems have first call on the water required to keep them healthy ...

Once you satisfy that basic environmental need, once that is achieved, water efficiency from that point on can produce economic as well as environmental improvement. We were very pleased that that principle was picked up in the national water initiative that was agreed to by COAG in August. In the communique they put out, they said:

A key element of the framework will be a nationally-compatible system of water access entitlements including—

and this is the first point that they make—

firm pathways and open processes for returning overallocated surface and groundwater systems to environmentally sustainable levels of extraction;

Once you satisfy those basic environmental needs then you can let the market move water more efficiently and improve production outcomes at the same time.

Senator O'BRIEN—Really you want a system where there are agreed minimum environmental flows and proportional allocation above that?

Mr Young—Not quite. There is a subtly different interpretation. It is not an agreed quantity; it is an agreed arrangement which will ensure health as water resources change. I am sure the committee has had the evidence pointed out to it that the quantity of water in Western Australia in the first three-quarters of last century was double what it has been in the last quarter. If that happens in any system where you lose 50 per cent of the water, as happened in Western Australia in a period of two years, then the environmental requirement changes significantly. Entitlements for the environment and for irrigation must understand the risks we are talking about and ensure that adjustment happens automatically without the need for complex government inquiries and procrastination. Best practice puts in place arrangements that look after the environment automatically rather than putting it at the discretion of parliaments.

Senator O'BRIEN—What do you say to those who would say: 'Historically, we've looked at the Murray and there have been periods when it hasn't flowed and periods when it has. There have been floods and droughts. That is the history of river flows in Australia.' How do we deal with that in the model you are talking about?

Prof. Cullen—The Murray would be much healthier if it did dry out from time to time. That was a great system. We would not have a carp in it if it had those dry spells. I think the point to understand is that the biota, the fish for instance, had mechanisms for surviving those droughts. They used to be able to go into the deeper pools or they would go into permanent wetlands and whatever. Now we have blocked off all those drought refuges. We have put weirs in so that they cannot go upstream and downstream. Most of those deeper pools in the river have been filled in due to catchment erosion, so we have taken away the refuges that would have supported those fish through a drought. Therefore, we need to have somewhat higher environmental flows in the regulated river than we would have had in the unregulated river. That is the argument for minimum flows during a drought.

Senator O'BRIEN—If possible.

Prof. Cullen—If possible. But that is not a huge part of the environmental flow. I think most of the environmental flow regime is in the wetter periods when you are trying to wet the flood plain and the wetlands. You are not talking about a large minimum flow during a drought, but there is an enhanced need over the natural because we have taken away those mechanisms, if you want to protect those species.

Senator O'BRIEN—I have questions on a slightly different aspect of this matter.

Senator COLBECK—I would like to follow on from the natural adjustment that you were talking about with respect to the entitlements and the flows. One of the problems that I see is that a lot of times you do not necessarily know what those are until you are looking at it in hindsight. How do you see that being managed?

Mr Young—The discipline of defining entitlements as shares means that somebody has to go through a due diligence process prior to announcing the allocation. You start to create through that process an expectation that it might change in the same way as a company, when a dividend

is announced, is very careful in terms of what it promises people they are going to receive because that affects the value of the resource. If you have a system where you describe an entitlement as a fixed volume and year after year for 20 or 30 years you say it is fixed and nobody is required to come out every year and say, 'It is the same as last year' and why it is the same, then you ultimately end up in trouble. That is where Australia has now got to because we did not design a system which required the managers of the river to inform people every year why they had made the judgment that it could be the same as last year.

Senator LEES—Is this not going to be done on a catchment management by catchment management area?

Mr Young—It would have to be done on a system by system basis. In some cases that would be a catchment, in some cases an aquifer, and in some cases it would be part of a dam system. It depends very much on the nature of the systems. There are some important scale issues in this. But unless you force people every year to look at the data and understand the risks that they are asking industry to take, we have a system which can overinvest and that actually removes opportunities for the nation to put its water to its best use.

Senator LEES—Catchment by catchment, have we got a map that shows every point of extraction and all the storage capacities so we know exactly what we are dealing with now? Are sleeper licences mapped? Are dozer licences mapped? Do we know what people are taking out? I am trying to find a decent map of where it all goes and where it all comes from in South Australia. South Australia Water reckons they have all this excess water that they are now going to pipe to the Clare Valley. No-one can tell me where it is coming from or where it is, because we certainly do not seem to have anything actually in the river.

Prof. Cullen—One of the things we have been calling for is transparent water accounts. The agencies all claim they have water accounts, but they are not transparent and they are not on the web so that you and I can go and look at them. We believe that those accounts should show the available water. They should also show every licence both for extracted licences and environmental licences so that we can see whether they add up. When you go into some of the land use changes that I know you are going to be exploring on, say, forestry, if there is a reduction in the flow then everyone should be able to see that those licences are going to be reduced because of those upstream decisions. I do not believe we are anywhere near that, although the COAG agreement of August did say that we were going to be moving towards that sort of open account system—the sooner the better.

Mr Young—And that should be one where you can clearly see debits and credits and if somebody secures some water from somebody else then at the time one account is credited the other account is debited. These sorts of things are well established in the banking industry. All of us understand how each person can have their personal account and then all of the accounts for a branch can be added up to give a report of the branch, and then bank by bank and then all the banks of Australia. We have very well designed computing systems that enable everybody to see where our entire financial system is at, but nobody has ever created a similar system for water. The software exists. The knowledge exists on how to do it. The challenge is to build that system for water. That requires what you are talking about: somebody to go through and work out exactly what we have catchment by catchment.

ACTING CHAIR—To that end, in trying to come to terms with what we are dealing with, do you blokes have any comment to make on the 2020 forestry vision—I am at odds to know why none of this has been given consideration before now—and the effect of climate change on what might be available in the river system?

Mr Cosier—A short answer to that question is that it is one of a number of issues that have not been built in to our robust system. It is an example of the consequence of piecemeal institutional policy on water reform. It is one of the reasons that the Wentworth Group have been so vocal in this debate. Because of the fate of the institutional arrangements we have in Australia, we have two losers: the environment has clearly been a loser in our southern river systems and the water users are clearly losers because they have no certainty about the titles they have.

An example is forestry operations in catchments. Some forestry operations in some parts of some catchments can result in less run-off running into a river system. The consequences of that are that either the environmental flows of that river are diluted or water users lose water. The whole concept of a robust nationally consistent water titles system is to build certainty into that process. In the blueprint we put out, we had a 13-point plan of how to put that system in place. If you do not build certainty into the institutional arrangements, there will always be these one-off problems—that is the negative. The positive is that COAG has recognised that fundamental flaw that our current water titles systems do not integrate rainwater—that is run-off—with river water and ground water. One of the things that we are very excited about in the COAG reforms is that they recognise that failure to have the hydrological cycle built into the institutional arrangements. That is part of the communique that is in the COAG reform.

Mr Young—It is wider than the 2020 vision. Farm dams are another example. There are some major issues associated with increasing water use efficiency, which we have already talked about, and with ground water development. Ground water and river systems are frequently connected, and if you develop ground water then in some areas—not everywhere, but in some areas—you will then actually reduce flows in the river. The flaw runs right through the whole system. Until we address that, we cannot give irrigators security. We could think we are going about restoring health when in fact all we are really doing is holding decline.

ACTING CHAIR—Is there a reflection that you would like to make—I think you made an earlier one in December—on climate change?

Mr Cosier—Climate change is another uncertainty. I am not qualified to speak on the science of what is expected in terms of water use in climate change but, as I understand it, the predictions are a likely decline in overall rainfall patterns in the southern part of Australia as a result of climate change. At the moment that is not accounted for in any system. Again, the losers will be both the environment and water users.

Mr Young—If I may, I suggest to the committee that later this evening you are having the Murray-Darling Basin Commission before you. They have just started talking at public meetings about the nature of all of these issues we are talking about. They have commissioned some consulting work to quantify the extent and the range of issues or likely impacts associated with issues like climate change and return flows that I have been talking about or increases in water use efficiency, development of ground water, forestry, farm dams—the whole suite. It is a very

important piece of work which will challenge your committee as it is challenging the minds of a lot of people interested in these issues in Australia.

Senator COLBECK—Just going back to the issues that Senator Lees spoke to moment ago about where all the water is going and whether it is mapped, what kind of work is available and might be required to understand a lot of the hydrological characteristics of some of the systems? You have mentioned those that are being irrigated at a fairly low efficiency level where a lot of the water is going back into the systems through the ground and things of the nature. How well is that understood and/or mapped within the overall systems and how much work do you see needs to be done to understand that properly?

Mr Young—You probably should take that up with CSIRO. I am from CSIRO but I am the economist. I have been unable to find anything that resembles a really good system which you could hang an allocation framework off, and I think this is one of the big challenges. A lot of the science that I have seen shows we have enough information to build really good accounting and modelling systems to understand what is going on, but it is the journey that the nation is about to start. I would urge you to take that up with CSIRO.

Senator O'BRIEN—On page 12 of your *Blueprint for a living continent* it says that farming systems, based around the annual crops and pastures, do not work well in Australia's very flat continent that has accumulated enormous amounts of salts in the soils, lakes and ground water. How does a tree crop with a rotation of 10 to 15 years compare with annual crops? I am interested in a number of factors such as interception of run-off by the crop, difference in water quality resulting from different uses of fertilisers and herbicides, and the rotation and effects on aquifer recharge.

Prof. Cullen—I think that there are some people working in those specific areas from CSIRO who will be appearing before you as soon as we have finished. They have done the actual research on those hydrological changes and the run-off. I would rather not answer those questions given that you are going to get better expertise immediately on that.

Senator O'BRIEN—You also talk about a fourth foundation on top of Landcare and HT and the NAP. Can you elaborate further on the role for this fourth foundation?

Mr Cosier—You are testing our memory here, Senator.

Senator O'BRIEN—I thought it would be burned into your brain.

Mr Cosier—The point we were making in the original blueprint was that we have a landscape that is interconnected. You cannot disaggregate issues of land clearing, for example, from water reform, from the river flows, from land management. That has been part of the problem in Australia for the last century. We have disaggregated systems for management and one agency does not know what the other agency is doing.

We have been very strongly advocating, and it has been accepted—for example, through the Carr government's reforms—that the establishment of catchment management authorities as the basic planning unit is the path forward for natural resource management in Australia. Through that process you achieve two things: firstly, you are managing the natural resources at the scale

at which the landscape processes work; and, secondly and profoundly importantly, it will be managed by local people who have the greatest self-interest in protecting that resource and also have a lot of local knowledge.

We see the flaws at the moment as being that, firstly, those catchment management bodies do not have the powers and authorities to make responsible decisions and, secondly, they have not been given access to the best available science on which to base best decisions. So really the fourth foundation is about the social science of how we manage this 7½-million-square-kilometre continent with 40,000 farms—that is, that we engage the farming community to be part of that solution. We know from our collective experience in the Wentworth Group that not only are the rural communities willing to do that but they certainly, if given the skills and resources, are more than capable of doing so. And that is really what the fourth foundation is about.

Mr Young—I might add that it is about resources in two types. One is the financial resource, but there is actually also the opportunity to make final decisions. Basically, what has happened in many parts of Australia is they have produced draft plans and those have gone up and down hierarchies and been renegotiated and played around with. Communities put a lot of effort into working out a way forward. There is a very big difference between a plan which is expected to be implemented as a final plan and one which is then going to go through a process of negotiation for what has sometimes been several years as people argue about what the right plan is. While that process goes on, the environment and the community keep on losing.

ACTING CHAIR—I was amused, I have to say, to see that the Murrumbidgee draft plan does not have one line in it about future forestry. Do you have any more questions, Senator O'Brien?

Senator O'BRIEN—My other questions are probably going to be directed to the CSIRO people whom my earlier question was referred to.

Senator LEES—I have just got a general question relating to the water that we have been advised we need to find for the environment. What would be your priorities in terms of the ease of finding water but also in terms of the environmental benefits? Where should we find the water? As individual farmers upgrade we see that water is just used somewhere else on-farm or is sold and we see, as state governments upgrade irrigation schemes such as Loxton in South Australia, water now being piped to the Barossa. How can we actually get the water left in the river? What are the priority issues that need to be dealt with?

Prof. Cullen—I think we have got to change our thinking and not just talk about leaving it in the river. I think we have got to move to the formal environment licenses. I think that when we are looking at public investments in any overstretched river, the priority for any public investment should be to recover a formal licence for the environment. I think there are several ways you can do it. We have advocated the market mechanism of just going into the market. That has got the advantage of taking water away from people who want to sell it—who are making the least return from it and causing no impact on the high-value production people who are getting a lot of value from the water.

The other part of it is that there are some systems that are fairly run-down and the existing water agencies do not want to refurbish some of those end-of-channel type systems—they are not worth refurbishing. In those it would be a good thing to just make the hard decision and close them and buy the water from those particular properties. They are the two best mechanisms, I think, to recover water: tag it as an environmental licence and then I think the logic is that you identify the environmental assets you are trying to protect—and there will be a string of those along the Murray and its tributaries—and then I would go to the regional catchment authorities and say: 'Here are so many megalitres of water that can be held in a storage and released when you need it. The task is to protect this asset with this sort of wetting regime, and we expect you to report on how you used that water.'

Mr Young—I think Professor Cullen is right. I will add a little more depth to that. One of the most powerful options to do this has just been placed in the mailboxes of thousands of Australians. This is the method being used to run the Telstra buyback tender process. If you write to people who hold water licences and invite them to offer to give some of their water back to the environment at a reasonable price and ask them what volume they would be prepared to give and at what price, I think you would be quite surprised by how many people would willingly be prepared to sell a volume of their water at quite reasonable prices. You would inspect all of the offers when they are in, announce the buyback price, and all people who offered to sell it at less than that buyback price would, in fact, receive the buyback price.

We have worked out how to do it in the commercial world, and it has often been done. We are doing it right now with a larger number people across Australia than there are irrigators without any complication, without any public debate about whether this is fair or if there is any problem. Doing the same thing with water is not such a radical step forward. The water could well be placed in a trust, particularly in the interim period while we are going through entitlement reform. It would be declared, as Professor Cullen has suggested, as an environmental allocation, but it would be held in a trust where it could be used wisely. For example, some of it may even be sold back to irrigators in a drought period and then enhanced by using the resultant money to actually secure more water.

In fact, one of the biggest challenges is to design some institutional arrangements so we can manage environmental water in a way that makes Australia wealthier and improves the environment simultaneously. There are some very big opportunities to use market mechanisms and some institutional structures that ask people to get on with the job.

There is a tremendous interest in investing in, and trying to find, marvellous schemes that are going to drive water use efficiency and to broker complicated deals. If you are an economist and you are after the greatest gain for the dollars that are put into this, there is a very simple observation you can make as an irrigator—that is, if it is cheaper to upgrade infrastructure than to sell your water then you would do that anyway. It would be irrational for you to do a deal with the government, because you would make more money by selling them the water than actually doing the upgrade yourself.

Conversely, if the reverse applies and a private irrigator is looking at the trade-off of upgrading the infrastructure rather than just selling the water, it is actually a poor investment for the government to be involved in. What they are really doing is asking for a subsidy. If you go in with a voluntary mechanism, you find all of the water and you empower people with the money

to upgrade, without having to spend a lot of taxpayers' dollars involved in designing complicated schemes and having lots of negotiations backwards and forwards with planners an engineers trying to work out whether it is going to work. The discipline of the marketplace in the design process will solve our environmental flow problems at half the cost if we just use a very simple process rather than using thousands of consultants like me and organisations across Australia to try to design schemes that do not make sense economically.

Having said that, I must also observe that there is an issue around the way infrastructure is defined for the supply of water. If an irrigation company that has a bulk water entitlement can upgrade water, I would think it would be reasonable that if they can reduce losses that they own those losses. They might then sell those losses back to a buyback process or sell it to other irrigators. If there is a market in place, it does not matter who you buy it from, the market will make the subsequent adjustments.

Senator O'BRIEN—That raises the question where areas are talking about a scheme upgrade. Everyone has heard of the Wimmera Mallee who are talking about channel upgrades with the potential to return a significant amount of water that now goes into the channel system back to the Murray as a quid pro quo for investment. Are you saying that that is not the sort of thing we should be pursuing?

Mr Young—No, I think that is exactly what you should be pursuing, but all the government needs to know is that someone is prepared to sign a contract to actually return the water back. How much the community profits or loses out of doing the upgrade is for them to work out.

If they were confident that the scheme was really good and would return, for example, five gigalitres of water to the system, you would say, 'This is very exciting; we'd like to have a public signing of the agreement whereby we go ahead and agree on the price.' You might even advance the money up front, but on the understanding that at a certain point in time the entitlements will be reduced and the water will go back to the river.

This is what the Council of Australian Governments have said: 'We are going to assign risk.' If you are serious and if all the state Premiers and the Prime Minister are serious about what they have said, my interpretation is that private risk is private risk and it would no longer be the business of government to worry about whether or not such investment as is being talked about makes financial sense.

ACTING CHAIR—Professor Cullen, would you be able to make available to us the correspondence you have received from various people quizzing you about the Lower Balonne? Can you retrieve it from the Queensland department?

Prof. Cullen—I can ask the Queensland department to make it available.

ACTING CHAIR—Thanks very much for that. In your review you say:

... this condition—

referring to the condition of the Lower Balonne—

is expected to deteriorate if the present capacity to extract water from the system should actually be exercised—

and bear in mind that 1,000 gigalitres of storage has been built. We were led by people representing the community reference group to believe that you had given the whole A/B bunded water thing a big tick. Would it be fair to say that you have put a question mark there instead?

Prof. Cullen—I certainly have not given the A and B licensing system any endorsement. That was a given; it was there. We were asked what had to be done to protect those critical environmental assets and what the science behind those assets was, and that is what we did. We did not explore the relative production costs of different pastoralists. That is a key part of the decision but it was not part of our terms of reference. We were not trying to critique the overall licensing system that is in place there. What we were trying to do was identify what you would have to do with that system to give you a chance of maintaining those critical ecological assets.

ACTING CHAIR—There are three regimes there: the water harvesting system at present which they are going to convert to allocation; the A type, bunded; and the B type, further water harvesting. Would it be fair to say that there should be a 'proceed with caution' sign on that?

Prof. Cullen—Certainly.

ACTING CHAIR—The government has announced the allocation of some money to go towards looking at a northern agricultural frontier with all the water that is available in the north. Do you want to comment on that?

Prof. Cullen—We know that there is a lot of water in the north of Australia. I have argued, and the Wentworth Group has argued, that we need to have a decade of knowledge acquisition to understand those rivers before we leap in and develop them. Some people, seeing the constraints on irrigation in the south, believe that we should just start moving irrigators up north and use that water. My argument is that there is a tonne of water in the Ord and if anyone knows how to use it effectively to make a profit they can get on and demonstrate it there. But we need to have a decade of knowledge acquisition to understand those rivers. We know that they are different to the southern rivers. They are floodplain pulse rivers that flood out over their floodplain every year and put a lot of water into the estuary, and that estuarine water drives pretty important fisheries, including a prawn fishery. It is one of those situations where you would hate to make gung-ho development decisions without understanding the impacts of those pulses of water on the floodplain and on the estuary, because you could easily cause great damage to those important fisheries. It is not something you can understand from one- or two-year studies; that is why I have been arguing for a decade of knowledge of those northern rivers.

ACTING CHAIR—Sounds good to me.

Mr Young—The committee might also like to go back to the National Land and Water Resources Audit. When that audit was being established it was requested to commission the development of some guidelines for the development of Australia's water resources, particularly the northern ones. Mini-proposals for the establishment of dams, turning rivers inland and many other schemes have been put together as a result of that. A set of financial guidelines and process guidelines were put together as to whether or not there was sufficient knowledge to go ahead. Those guidelines were signed off by a series of government committees. I think it would be very

useful to get them back up. They are now about five years old but they certainly provide some sober reading.

ACTING CHAIR—Thank you very much to the members of the Wentworth Group. Congratulations and keep up the good work.

[5.16 p.m.]

COTTERILL, Dr Paul Percival, Chief, Forestry and Forest Products, Commonwealth Scientific and Industrial Research Organisation

HAIRSINE, Dr Peter Brian, Research Director, Integrated Catchment Management, Land and Water, Commonwealth Scientific and Industrial Research Organisation

WILLIAMS, Dr John, Chief, Land and Water, Commonwealth Scientific and Industrial Research Organisation

YOUNG, Mr Michael Denis, Director, Policy and Economic Research Unit, Land and Water, Commonwealth Scientific and Industrial Research Organisation

VERTESSY, Professor Robert Alexander, Chief Executive Officer, Cooperative Research Centre for Catchment Hydrology

ACTING CHAIR—Welcome.

Mr Young—I have a special request. I am about to leave for Ethiopia for almost three months. I would like to leave early tonight. It will mean that I will not be able to check the evidence I give tonight before it goes out in *Hansard*. I will leave my colleagues to proof that if I may.

ACTING CHAIR—That is fine. Would you like to make an opening statement?

Dr Williams—Yes. Thank you very much for this opportunity to speak with you. The inquiry is very wide, so obviously you will lead us to what you need to know. However, I guess the forestry, land and water areas in CSIRO are in a position to provide some of the knowledge on how we might think of our landscapes, the landscape mosaic and land uses that impact very directly on the rural water that we have in our rivers and irrigation systems. There are some really important issues here that are high on the agenda, particularly with respect to the way we change our land use. We are confronted in Australia with the fact that we have a number of major issues that we need to deal with, most of which are impacted on by the way we use our land—for example, the dryland salinity issue, the water yield issue in our rivers, the climate change issue, the carbon sequestration, the biodiversity and, of course, probably the most important issue, regional employment and development and healthy communities. What we believe we can offer by way of a solution to that is some vision of what we think are some of the changes that we will need to work through to assure our rural and regional communities that our water is turned to the greatest degree of wealth, consistent with a sustainable environment.

So our vision is a landscape mosaic and our attention and focus in this discussion at the moment is on the Murray-Darling. I know there are many others areas we need to talk about, and I would be happy to do that, but the first picture we would like to paint is of the Murray-Darling Basin. In that system 37 per cent of the water comes from about one or two per cent of the area, most of which is forested and most of which gets more than 800 millimetres of rainfall. So in the upper catchments, which get more than 800 millimetres, we do not believe that the required

change in land use will be enormous. We think the required change will be small, but it is really important to manage that area which gets above 800 millimetres very carefully because that area delivers so much of the water to the system.

We believe that in areas which get less than 700 millimetres of rainfall there will be a need to build a pattern and mosaic of land use that will address the issues I earlier outlined. One important feature of this lower rainfall pattern will be a greater role for trees in the way we earn our living. Those tree systems will take different forms and be harvested in sequential and different ways, and there will be a diversity of plantation forms and farms. The landscape mosaic would deliver food and fibre at the same time as it delivered a suite of ecosystem services like clean water, carbon sequestration, biodiversity and habitat. Dr Cotterill and our other folk will add to this image in a moment.

In relation to that pattern, I would like to table a document, which was compiled by CSIRO for the Murray-Darling Basin, that is called 'The Revolution in Land Use: Emerging Land Use Systems for Managing Dryland Salinity'. On page 3 of that document we outline a range of land use options that will need to be developed. Some of the options have had very little development and others are well developed, but the document draws together a mosaic from these and that is the issue. I think we need to focus a little attention on this issue if it is within your scope and interest—and from looking at the terms of reference we believe it is. The document looks at high rainfall tree products and low-rainfall tree products and what they might be. I would like be able to put that document forward as a means of helping the discussion.

I will move on to a document that suggests some solutions and some ways forward in the low to medium rainfall areas—that is, areas that receive less than 700 millimetres of rain. The document is titled 'The Contribution of Mid to Low Rainfall Forestry and Agroforestry to Greenhouse and Natural Resource Management Outcomes'. It is an overview and analysis of opportunities. On page 41, table 4.2 of that document tries to set out an assessment of non tangible benefits—that is, benefits other than the traditional commercial forestry products—for various product industries in the mid to low rainfall areas. The table looks at the salinity benefit, the carbon benefit, the biodiversity benefit and the local employment benefit. Those sorts of possibilities—and we think their integration is important—range from solid timber products through to pulp and paper, export woodchips, composites, firewood, electricity generation, charcoal, activated carbon and essential oils. There is a whole long list but I think it is useful because when we look at the land use changes that we will probably work towards—and I think there are some signals, solutions and signs of the directions we need to take—we will be looking at the whole system and the water cycle as a whole. The irrigation, the land use and the river system need to be thought of as one. We have tried to do that in these documents which I will pass to you. You may well have seen them already but I think they will provide some framework for the discussion.

We can then start to deal with some of those tricky issues of the balance between having true vegetation and industries built around trees, integrated with our traditional agriculture and other forms of new agriculture, where those trees contribute to salinity in situations by reducing the deep drainage recharge but, at the same time, are positioned in the landscape so they minimise the loss of water yield. That is a key issue for you to ask about if that is within your interest. I invite you, Paul, to show where you see the forest industry sitting in terms of environmental benefit and the thrust of your division's work in that area.

Dr Cotterill—I do not have that much to add to the opening statement that John has made. I believe that, certainly in this medium to low rainfall area below the 700 millimetres limit, we have very interesting opportunities for trees and plantations to be part of a solution. The thing I would highlight from what John has said is that, if you look towards the economic value of those trees in terms of our traditional wood products, we certainly have work to do on the high end of that product value. I am particularly happy to expand on that later if you would like. We certainly have issues around the marketing of those products because, generally speaking, the species, the improved hybrids or the clones that we would be growing would be new to the global marketplace.

We have issues around helping that tree growing industry to be part of the economic fabric of the rural communities and having processing facilities or end use facilities that are in the range of capital outlay that you would imagine would be present in those rural communities. But trees in medium to low rainfall areas for wood products alone are probably not going to be the answer. You have the other, wider role of trees in that landscape: the environmental. That avers the salinity, the carbon sequestration, the erosion, the wind erosion and so on and the social issues in terms of regional employment and biodiversity issues.

Finally, I would just like to comment that our vision is that some of those trees planted in those types of landscapes would actually be planted for nonforestry uses. They would be there for environmental purposes. Others that were planted in the larger blocks on farms would be there for commercial purposes but, of course, the harvesting and the management of those would be an incremental thing. You would imagine that, like in other parts of the world, farmers would get some annual harvest out of that and there would be some annual replanting, but it would be year after year so you are not disturbing the landscape by large blocks of clear-felling. I will leave it there.

Senator LEES—I must apologise that I have to go, but I will be reading the *Hansard* with great interest. My question may not be quite on the track that the committee wishes to go but it relates to the high rainfall area in the Murray-Darling Basin. I wondered whether the CSIRO had done any work on the issue of the likely effect of the fires, because I understand that some of those catchment areas have been burnt by 70 per cent or 80 per cent. Have you done any work on issues perhaps relating to the volume of water we could expect by way of run-off or recharge of the aquifer or the quality of water if it does run off, in terms of turbidity and salinity?

Prof. Vertessy—I thought Mike alluded in the last session to the analysis that had been done for the Murray-Darling Basin Commission on threats to future inflows to the River Murray. I undertook the analyses on the fire impacts for that. My estimates were confined to the upper Murray part of Victoria and, depending on the assumptions used—and I have used a variety of assumptions—the mean annual reduction in yield from those catchments, 20 years out from the present day, ranges between 430 gigalitres per year for a conservative estimate up to 1,300 for a worst-case estimate.

Senator LEES—Thank you.

ACTING CHAIR—On the lower rainfall question there is some, shall I say, disturbance in the forests lobby—they think that somehow we are 'antiforest' in putting a proposition forward that we might have to come down to the lower rainfall. Of course, we are very supportive of the

forest industry. Do you extend your proposition? I am all for getting the salinity correct and all those other benefits in protecting the run-off. Can we go down to 500 millimetres—20 inches, in other words—or is that too far down the scale?

Dr Cotterill—That is certainly an interesting question and it is one that I do not feel completely confident in answering, but if you—

ACTING CHAIR—Is more time required?

Dr Cotterill—Yes. If you take the case of growing trees for timber use then, of course, one very important factor of the economics of that is the speed at which they grow.

ACTING CHAIR—What we perhaps ought to be doing with the national action plan salinity money is identifying the areas. There is such a thing as a 50-year snapshot of future salinity hotspots and, certainly, if you run the 32-inch line and the 20-inch line you just about capture the lot. By using the CSIRO and other people, we could say, 'This is where we need to go. Let's tender what assistance people require out of a national action plan to grow the trees.' Do you have any comment on that sort of proposition?

Dr Cotterill—Only that I believe it is a very important issue, as you have said. I agree. Within CSIRO I have certainly done a lot of work over the last year to assemble our combined resources together in trying to answer those kinds of questions—that one in particular.

Senator O'BRIEN—According to the paper by the National Association of Forest Industries, *Future water supplies for Australia's rural industries and communities*, they have discovered findings by the CRC for catchment hydrology, which indicates that tree crops covering less than 20 per cent of a catchment will exhibit little effect on water yields. Do you recall that work? Can you provide the committee with some details of the study conducted?

Prof. Vertessy—Yes, I recall the comment, and it is a misinterpretation of a fact that is in the paper here called 'Plantations, river flows and river salinity'. That paper was published in the *Australian Journal of Forestry*. This is actually a common misinterpretation of a remark I made: that in small experimental catchments, which are the foundation of the understanding that I have described in this paper, it is difficult to detect an effect, unless they are affected by more than 20 per cent—sometimes it is 10 per cent; however there are many instances where there might be a catchment that is only affected by two or three per cent where there is a detectable change. The common mistake that is made is to extrapolate that up to the large scale and propose that unless you plant plantations in 20 per cent of the Murray-Darling Basin, for instance, there will not be an effect. So it is a misunderstanding and a misinterpretation.

Dr Williams—But I think it highlights a really important issue that Peter might like to comment on, and that is that the question of how to put the trees back into the landscape in the lower rainfall zone in the positions where we get the best salinity benefit and the best benefit in terms of water yield is critical to all that Senator Heffernan mentioned.

Prof. Vertessy—Yes, that is right. In fact we have the tools that enable the appropriate spatial location or siting of the plantations. We can tell you how to maximise the salinity reduction

benefit and how to minimise the yield benefit and where the appropriate optimal location would be, just using those biophysical considerations.

Senator O'BRIEN—What do you mean by 'how to minimise the yield'?

Prof. Vertessy—Well, we know that you will get a greater yield reduction when you afforest in the wetter uplands, for instance, so a way to minimise it is to bring it down into the drier areas. We know that. The other thing is that there is the potential to actually worsen the salinity situation if you afforest in the wet areas, because you then rob the rivers of those fresh dilution flows. So the modelling capability that has been assembled within the CSIRO and the CRC also gives consideration to that effect, and it can tell you where you will actually improve EC, or electrical conductivity, in the rivers, as opposed to worsening it by plantation location.

Dr Williams—If you are interested, there is a nice piece of work, as part of healthy country and what was called the Heartlands Initiative, in the upper Murray, where this has actually been done. You can have a look at the sums and the analysis. I guess we can table that information to your committee, if that is of interest to you.

ACTING CHAIR—Great. I think it is the Murray-Darling Basin Loddon catchment. Is that the sort of thing you are talking about? Have you seen the Loddon catchment modelling?

Dr Williams—Yes.

Mr Young—I would like to expand on that. We are starting to understand quite well where optimal locations are, in terms of where you put trees. One of the next bits of work to be done really is to work out how to create a suite of incentives so that what is optimal for society and for the catchment as a whole and for each community, community by community, is what actually happens.

Senator O'BRIEN—So you would be directing land use?

Mr Young—You can direct land use if you want to, or else you can set up a suite of incentives to do this. This is difficult for many people to handle, but the answer from work that particularly Jim McColl and I have undertaken, points to the importance of separation of all of the things that you are trying to get control of. So you set up robust ways so that people account for water fully and properly; similarly, you set up robust ways of accurately defining salinity impacts and accountability for salinity and giving people credits for when they produce real solutions and giving them debits when they do not—and similarly with issues like greenhouse. If you put the whole suite together and design your pricing, quota and allocation systems, whether for water or salinity or whatever, then you can have optimal allocation through market processes without having to have tighter planning controls. Alternatively, you can use zoning type models where you just prohibit people from doing things at specific locations.

The tricky problem we have here, in the case that is before the committee at the moment, is that you have both benefits from salinity and you have debits in terms of water yield. What we need is a suite of mechanisms that optimise the location of trees to get the greatest gains in terms of salinity at the least equity cost in terms of water yield and also the greatest profit to those people who plant the trees.

ACTING CHAIR—Bear in mind that you are competing with lucerne.

Mr Young—I understand that we can compete with lucerne, and many other things, including your investments!

Senator O'BRIEN—They are in trouble!

Mr Young—But surely your committee could show us the way forward, Chair!

ACTING CHAIR—I know that lambs fatten better on lucerne that they do on trees.

Dr Williams—Except if it is a very cold night. We have put some of these arguments out in a one-page document that is on the web, but I will put that forward because it might help summarise the trade-offs. Both Peter Hairsine and a member of Paul's division, Phil Polglase, have been working on this. It is a fundamentally important issue. Mike's work is to find policy and other mechanisms that can move us towards that balance and those solutions we are seeking. Peter, you might want to add something to what I have said.

Dr Hairsine—Yes. There is a sophistication in the spatial targeting, a sophistication in the location, associated with new plantations—either conventional plantations or these new farm forestry based systems—that we should give priority to through incentives. That arises from the issue of ground water systems. Although the Australian landscape is relatively simple in terms of its rainfall regime and the land use patterns associated with it, we actually have quite complex ground water systems—some of which are very fresh, some of which are naturally salty and some of which have become saline through man's activities. This introduces a further spatial texture as to how we should target and encourage people to put plantations in the right place. CSIRO, with its colleagues at the Bureau of Rural Sciences, have recently developed a methodology to enable this kind of regional prioritisation to occur. That is the scientific basis behind the tools that Professor Vertessy mentioned before, where we can enable some good decisions to be made concerning the environmental benefits of both water yield and stream salinity.

ACTING CHAIR—Do you have any proposed examples for pointing to a place and saying, 'We shouldn't be growing trees here, for this reason, but we should be growing them there'?

Dr Hairsine—Yes, we do have some examples—

ACTING CHAIR—Is there a conflict in the scientists' minds about what is happening with the interception of run-off? Is there sometimes an overarching problem with what it is doing to the ground water? Is there any conflict there?

Dr Hairsine—Yes, there are some sophisticated scientific arguments around meeting a range of environmental objectives. In very plain terms, putting trees in any landscape does change the way water flows through that landscape. Generally, it reduces the amount of run-off that ends up in the streams, and it also reduces the amount of water that flows to the ground water system. So, if that ground water system is a fresh system and of value as a water resource, then that reduction can be viewed in a negative sense.

ACTING CHAIR—So if you are putting trees up on the recharge area, which also happens to be the high-rainfall area, you get the worst of both worlds?

Dr Hairsine—That can be the case, yes.

ACTING CHAIR—So sometimes when they say, 'Plant the trees on the bloody hilltops over there,' it is bad advice.

Senator O'BRIEN—You said that 'can' be the case.

Dr Hairsine—That can be the case; it is not always the case.

ACTING CHAIR—I understand that.

Dr Hairsine—It is important to realise that the nature of the ground water systems in the environment is very important, so the ridge top plantings may actually be very positive for controlling dryland salinity and, indeed, stream salinity. We have identified those particular ground water systems which are contributing to the salinity problem.

ACTING CHAIR—Can you provide us with some of the work that has been done on that, if there is any?

Dr Hairsine—Yes. There has been a great deal of work done in developing our understanding of ground water systems so that it is of use to the salinity debate. About 20 years ago, we were faced with a series of geological based maps across Australia which guided ground water use only from an extractive viewpoint. Basically, they guided us where to put bores for water supplies.

ACTING CHAIR—That worked really well.

Dr Hairsine—It did work very well, but now we have turned that knowledge to quite a different purpose. Our ground water understanding and our knowledge of where saline stores are such that we can interpret the changes to recharge and what impact that is going to have on both land salinisation and stream salinisation. The data have been very spatially sparse and often discontinuous. There has been a huge effort put into producing those maps across large areas of the country—and there is currently a map for the entire Murray-Darling Basin—which are very useful for our spatial prioritisation of revegetation.

ACTING CHAIR—In Clare—which is where I presume it is—where they have the grapes, I understand there is the building problem of the ground water becoming more saline.

Dr Hairsine—I am not able to comment on that specific instance; someone else may be able to. I would like to add one other comment, which is very important in our prioritisation for using these ground water systems. Ground water is very different in its nature from surface water in that there are long timelags associated with changing recharge and the response we see in stream systems. If we focused upon end-of-valley targets and the control of stream salinity as part of those targets then timelags typically range between 10 years and 200 years. So in some of our ground water systems we are still seeing a response to the initial European clearing. If we are to

use revegetation as a positive strategy we are best to target those with relatively short response times, which are typically in the upland environments. Already through that kind of accumulation of knowledge we have tools that are able to say where we get the best response in inputs to the ground water system and which enable us to make some economic analysis of the certainty and timing of the return on meeting stream targets.

Dr Williams—A good example—and I would like to provide it to you—of the technology that Peter as described is in the flagship program and was previously part of the heartlands program. We can give you the billabong catchment which has been analysed for the choices—

ACTING CHAIR—Is this down Holbrook way?

Dr Williams—Yes, essentially the Holbrook area.

ACTING CHAIR—I know it well.

Dr Williams—It is a mechanism that allows the catchment management authorities and the community as a whole to examine the trade-offs between the multiple objectives, and at the end of the day the community and decision makers will make the choices. I think we have moved beyond saying, 'This is good and this is bad.' It depends on the location and structure of ground water systems—all the issues that Peter and Rob have outlined. We have talked about the issue of yield loss in various circumstances and high rainfall where we put in plantations and trees. The other issue—Peter and Rob may like to comment on this—is that the river flow pattern is the important thing for river health. The important thing is the actual flow regime, not just the quantity. The interaction with the vegetation distribution on that is important. I know we have done work on it, and I imagine you can comment on that. We would not want to mislead you that it is just the amount of water; it is how that water flows in the stream.

ACTING CHAIR—If we were ever going to work out how much we can put into the environmental bank, as it were, we would have to work out how much is going to end up in the river. You may like to make some comment upon the water harvesting proposition of the Lower Balonne. You might not have brought your mind to it. I personally am horrified at the wink-and-nod arrangements that were made early on—years ago—which made all that Cubbie stuff become a reality.

Dr Williams—It is a large version of farm dams, and we have to look at the impacts on our streams and rivers in managing that issue. In Rob's recent paper that issue is dealt with, along with all the other land change issues.

Prof. Vertessy—It is one of many runaway processes that threaten future water resource security.

ACTING CHAIR—'Runaway' is a good description.

Prof. Vertessy—Climate change was mentioned earlier. Our estimate for the Murray-Darling Basin 20 years from now is possibly over 1,000 gigalitres less because of climate change. That is really a worry. Farm dams are still proliferating, even though we have some long overdue legislative control out there now. I understand that there are over one million small farm dams in

the Murray-Darling Basin and that is quite astonishing. You only need to fly out of Canberra in the afternoon to see the light reflecting off them; they are everywhere.

ACTING CHAIR—Come out to Hay!

Prof. Vertessy—When you add all these numbers up, for climate change, fires, modest plantation expansion because it probably will not be huge in the Murray-Darling Basin, and reductions in return flows, you are talking about 2,500 gigalitres and more, which dwarf the upper estimate of the e-flow that they are trying to get back for the river. The bank is going to run dry and Australia has to be prepared for that. If all these things continue to proliferate—some of which we have control over, some of which we do not have control over like climate change—that is what is going to happen.

Senator O'BRIEN—I want to return to an earlier question. Your paper contains four discussion points. I am trying to understand your second point in the context of one of your earlier answers. It refers to:

Planting in mosaics to spread out the impact. Catchments with less than 20 per cent area planted exhibit little water yield effect.

I wonder why it would have been wrong for anyone to interpret that in the way I think NAFI has interpreted it.

Prof. Vertessy—That is unfortunate wording on my behalf, but it should be borne in mind that it is applicable only to small-scale experiments.

Senator O'BRIEN—What about the other three points?

Prof. Vertessy—They are robust generalisations.

Senator O'BRIEN—Only applicable to small areas?

Prof. Vertessy—No, some are applicable to large catchments as well and the point I would like to make is that they can be extrapolated. What I should explain about catchment scale is that in terms of the generalisation of 20 per cent, if you are talking about a catchment that has a constant rainfall distribution, as you upscale in catchments above a certain size and when you are bigger than about 1,000 hectares, you start to get rainfall gradients in them. There would be a huge difference between planting in a large catchment in respect of 20 per cent of the driest part versus 20 per cent of the wettest part. There would be a radical difference in the response. That is why that generalisation cannot be held for large catchments.

Senator O'BRIEN—My understanding is that the bulk of plantations are in below 800 millimetre rainfall areas in this country. Is it not also the case that not a lot of CRC research has targeted the low-rainfall areas in terms of plantation forestry?

Prof. Vertessy—No, I would not say that that is accurate. We have done some work in lower rainfall catchments. I am a co-author of a book on trees, water and salt. A lot of the work in that book addresses lower rainfall catchments.

ACTING CHAIR—For the people who are not aware of what that means, what do you describe as low rainfall?

Prof. Vertessy—Below 700 millimetres of rainfall.

ACTING CHAIR—Some of us poor buggers out at Booligal actually think that is extremely high rainfall.

Dr Williams—We would call it mid to low.

Prof. Vertessy—Yes, I suppose we would call it mid to low.

Dr Hairsine—Maybe it is worth while just sharpening up that discussion in terms of what the current situation is with plantations. The recent assessment done by the Bureau of Rural Sciences on the percentage areas of the plantation estate inside the Murray-Darling Basin, as of 2000, found that four per cent of the plantation estate is below 800 millimetres. That is 96 per cent above 800 millimetres, so that gives you a sense of the degree of change.

Senator O'BRIEN—That is in the Murray-Darling Basin?

Dr Hairsine—Yes. There are certainly very significant areas of plantation outside the Murray-Darling Basin—in the green triangle, in Tasmania and in Western Australia, but inside the Murray-Darling Basin I guess those numbers reflect very clearly that the nature of the plantation industry for the new areas which are going to be in those lower rainfall zones is going to be quite different. We are going to see quite an unconventional form of plantation, with a diverse range of techniques, in the forestry industry. I believe that there is a very serious attempt, through the R&D process, to find out what those new forestry processes are—both the silvicultural practices and the processing of the products that come from them. But it is quite a departure from the current form of plantations within the basin.

Dr Cotterill—I would like to add to that. With these new commercial environmental forestry plantations and ideas and propositions, from what I have seen personally of them, we are going to be dealing very often with species that are not currently grown in the higher rainfall areas. They will be products that require research around how to get value from those products. I personally have heard a lot spoken about focusing on high-value wood products, and that is clearly important because if the tree is growing slowly then the quality becomes a large focus. But we need to also bear in mind that it is very rare that a forestry enterprise alone can survive economically on just high-value products. There are also the other products in the tree that need to be considered. My personal view is that these issues of forestry and trees as part of a landscape are extremely important ones. As I mentioned before, in my division we are diverting considerable resources towards that.

ACTING CHAIR—We can only encourage you to, because we lucerne fellows are a long way further ahead with our varieties than you are with the trees.

Dr Cotterill—Indeed you are.

Senator O'BRIEN—How would you suggest that the plantation forestry mosaic be managed to achieve the optimum outcome in terms of water utilisation and salinity management? Have you got any specific ideas that might assist the committee?

Mr Young—There are two sides. There is the biophysical side and there is the economic and social side of doing this. Perhaps first I should observe that around the world there are two different approaches to dealing with the impact of trees on water yield in rivers where it occurs. The first approach is to actually assign forestry, or people who plant trees, a prior right to do that and put in place an arrangement whereby it is understood by all people who have irrigation licences that their licences will be reduced as more and more trees are planted. It is just a mathematical calculation that is done regularly and everybody expects it to happen and there is no surprise. That is one robust arrangement.

The other arrangement is being developed more and more in South Africa—and, as far as I am aware, it is the only place in the world where it is now being done. They have only just started to go into the next, brave, stage of starting up trading, where they require people—who actually re-establish trees; and, in fact, if it were lucerne it would be lucerne as well—who use more water and stop it flowing into the river to purchase a water licence. The scientific analysis and the economic analysis that we have been doing show that it really does not matter which one you have. The solid theory around it says that it does not matter which way you do it. What matters is that the accounting system ensures that if somebody takes more water somebody else takes less water. That is part of the accounting system.

ACTING CHAIR—But you would build into that the salinity credit, I take it.

Mr Young—That is where I was going to go next. You need to put in place a salinity credit. I am excited to announce here—and I do not think that even my chief is aware of this—that CSIRO has just been awarded a contract to work with people in the Bet Bet catchment to set up a dryland salinity credit trading system. That community has agreed to go through some of the pain of working out how to trial setting up salinity trading arrangements that involve both dryland as well as irrigation people. We are going to be very excited over the next year and a half to try to crack all of these problems and develop the technology necessary to do it. This is using support and funding from the market based instrument program that the Commonwealth and state governments are jointly supporting.

ACTING CHAIR—Would it be fair to say, though, that at 20 inches—or 500 millimetres—the difference in the changed use run-off between pasture and plantation is bugger-all?

Mr Young—I am the wrong person to ask that.

Prof. Vertessy—At 500 millimetres of rainfall?

CHAIR—Yes.

Prof. Vertessy—That would be right, yes.

ACTING CHAIR—So the bloke that grows the lucerne will not actually have much to worry about.

Mr Young—The same issues also apply for irrigation. Location of irrigation, particularly relocation of irrigation and expansion, is critically important. Dr Jeff Conner, from our team in Adelaide, has recently finished a report for the South Australian government that looks at what will happen in terms of salinity impacts on the river from expanded irrigation if you just allow improvements in water use efficiency and water trading to occur as you would expect it to occur under current policy scenarios, so there is just no change over the next 20 or 30 years. If that happens, somebody will have to pay about $160 million in salinity interception schemes to pump the salt which will flow in as a result of that expansion in irrigation.

ACTING CHAIR—More efficient irrigation.

Mr Young—If, however, you put all of the smart controls in place, including zoning and requiring upgraded water use efficiency, you can reduce the cost from $160 million to about $40 million, which is a significant saving. This, I think, highlights the opportunity to couple smart design of economic market based mechanisms and regulation with the underlying scientific information that is available that maps and identifies where water moves, where there is salt, where there are clean areas and how you package the whole thing together. We now have the science that enables us to start designing those sorts of systems. As Professor Vertessy has said, we have now started to prepare maps for the entire area that are improving in precision. Some of them need further work, but we are no longer at the stage where we do not know how to do this. We are now at the stage where we can design such arrangements, trial them, test them and improve them through time.

ACTING CHAIR—So that we do not alarm the 18 to 21 inch rainfall farmers about being sent a bill, we must put on the record that the run-off in a lot of those red loam country soils is not there. You have got to cart water every summer, because you do not get a run-off. We do not want to alarm anyone about some new great regime coming on board. Do have any reflection that you would like to make? As you rightly point out, if you have a look around when you are flying, you see a reflection on all of the farmlet dams, which obviously have an impact on what runs off in certain areas, especially if you get into the one to two per cent of the catchment in the Murray-Darling Basin that reflects 38 per cent of the run-off. Do have any reflection to make on the orchardists?

Mr Young—I am not sure if I understand you.

ACTING CHAIR—It is about equal treatment. Obviously, the forest industries are saying, 'Hang on, we only want equal treatment here in this argument about trees and intercepting the run-off.' Have we applied any work—

Dr Williams—to other trees, established trees?

ACTING CHAIR—Yes.

Prof. Vertessy—Much less. It is a fair comment, actually, by the forest industry. If we are going to have a water accounting framework that accounts for what a land use type uses, let us take a broader view and actually account for other land uses. I think that is quite fair. But the truth is that there is not a lot of prominent hydrologic literature on the effect of other enterprises like orchards, vineyards et cetera. My hunch is that they would be quite large water users. It

would depend a bit on the footprint—how much land they occupy. I think that work needs to be done in that area.

Mr Young—Perhaps there is an opportunity to think very constructively about this. If somebody changes land use from what might have been forest or an orchard to a dryland pasture, we could contemplate actually giving credit to people who increase run-off. If you are going to do it one way, you have a robust system. Then the reverse could also apply.

Dr Williams—Provided it did not end up adding to the salinity driver.

ACTING CHAIR—I am sure that, if you took a run up to Delegate or somewhere, there is plenty of drive-around evidence of the two effects—for example, when they clear the trees before the next lot go in and there is a cow paddock next door. There is plenty of anecdotal evidence of that.

Senator COLBECK—I want to go back to the question I asked the previous group. They handballed it on quite successfully and said I should ask you. That question related particularly to areas where there is high irrigation. How much work is yet to be done and needs to be done to effectively account for the hydrological characteristics of those systems?

Dr Williams—For the Wentworth Group to be able to provide that and to make sure we have comprehensive water accounting, fundamental to the earlier question is that all land users have to be treated in the same way. That would be fundamental. Documentation of those statements were worded very carefully to make sure that they were. Have we got enough technical and scientific knowledge of our landscapes to be able to do comprehensive water balance and water accounting everywhere? Probably the answer is: we have enough to start, but we will need to refine it as we go along.

In some situations, the scale of the question is: how much detail? For example, we have recently done work on the linkages between the ground water systems on the Murrumbidgee, for example, to understand how the trading between surface water and ground water would effect and where the linkages between the two are very strong and where they are very weak. The scale of that is fine—we can do that on a broad scale at the moment in the sense that the mapping would be equivalent to one to 250,000. But, if you wanted to come down to find more and more detail at the scale of, say, one to 25,000, the amount of knowledge and work required is huge.

So, in some instances, we have a good understanding, but there are many instances where a great deal more work and focus is needed to understand the linkages between the ground water and surface water systems, the implications of changing land use on those connections and the implications for the water we actually have in the river system, in the ground water system and in our extraction. Did I answer the question? I was trying to.

Senator COLBECK—I think I understand what you are saying. It was probably the answer that I expected. There is a body of work that exists at this point in time. Detail is perhaps an issue, but there still remains a lot to be done. I suppose that what I am trying to settle in my mind is how that starts to be bedded down, in the context of what will become quite detailed negotiations in relation to individual catchments and getting down to individual negotiations on a property basis, as to what the impacts are on those properties and how that will be related to

how much water they are allocated, maintain, have purchased back from them, or however the system works in the longer term.

ACTING CHAIR—Those comments would certainly, in my view, give cause to have an amber flashing light on the proposition that was put earlier in these debates on water trading. A lot of bankers and people were rushing around all over the place, seeing a river of gold from water trading in an open market. If you connect the trading of ground water to the trading of surface water, I think you have sounded a warning note for the government to be careful.

Dr Williams—Yes, be careful, because it is important to do it properly. I think we can start the process of understanding what a comprehensive water account will look like—and maybe Mike has a comment on this, and I would like comments from Peter and Rob—but we need to do it in a way that, as we learn more, we can make appropriate adjustments to the arrangements. That is why I think the market mechanisms need to reflect better and better knowledge in that structure.

Mr Young—I think it is probably worth trying to understand what we are trying to do here, and why we would invest in really complex accounting systems. What that enables you to do is to use more water with confidence. If you want to have a system without any accounting arrangements in it, it is quite easy: all you do is get rid of three-quarters of the irrigation in the basin, or in all of Australia; you run a very conservative system, and you will never get into trouble. As you start using more and more water, you need more and more sophisticated management systems. In the basin, we are currently using roughly 75 per cent of the water resources, which most scientists would say is way too much. The only way you can do that is by having very sophisticated systems, and there is a trade off.

There is also a trap: you can spend so much time in designing your system that you destroy it through its complexity. If you get down to arguments over how much water each farm is using or not using, you end up in strife. The systems the work best are those that are quite clunky and have four or five classes and a deeming arrangement, in which it is assumed that, for now, all lucerne, for example, has a recharge of such and such, or a run-off of such and such, or that a certain class of plantation has a factor of so much—you do it on a class-by-class basis. You build your accounting framework on that sort of fairly crude system, which will get it 80 or 90 per cent right.

Then you sit down and very carefully work out what is the likely return from making it more sophisticated. There are examples in the world where a community has started off with a sort of two-class system, and got that working, and once the community has become used to it they will then go to a three-, four- or five-class system and, ultimately, even go through to a continuous system where it pays. If you are looking at how to set up such systems quickly, and how to get the biggest gains and how to get the accounting system right, my advice would be to go for something that is fairly simple—something that is built around some deemed rules that set up some fairly crude exchange rates—and to run the system with a bit of a safety margin in it, rather than setting up schemes that are so expensive to run that nobody ever bothers to contemplate altering land use.

What you need is a framework that drives the restoration of Australia's landscapes and rivers and the communities that depend on them. If we go down that path, we need fairly simple systems—not so simple that they are hopeless but simple enough to enable us to trade out of

trouble, not further into trouble. If you can convey that message alone—that we need trading systems that trade us out of trouble, not further into trouble—then I think we are on a pathway to a very sustainable future.

ACTING CHAIR—I can think of an added complexity we could do without. It is to do with my poor old lucerne. Do not forget that in the lower rainfall areas, where I do not think anyone is going to be in any trouble, over a five-year cycle, especially in a farming cycle, the plant numbers in a lucerne paddock decline remarkably. Your run-off would vary, so you cannot have 'lucerne: one tick, one calculation'.

Mr Young—But you may decide that, rather than putting in the sophistication. Remember also that, if you have a five-year system, rather than just one value for lucerne, you then have to measure the rain on each farm every year and have arguments about how that will be done.

ACTING CHAIR—Let's not go there!

Mr Young—I do not think you want to go there!

ACTING CHAIR—We will go back to Senator Colbeck, thanks!

Mr Young—Keep it simple and have one value for lucerne—even your lucerne—and you will have a solution.

Dr Williams—I was wondering whether we answered Senator Colbeck's question sufficiently. I answered in a general sense. Do you want to investigate a little further with comments from Peter and Rob, who have a more detailed knowledge than I have?

Senator COLBECK—I would be interested.

Dr Hairsine—We are not starting from a blank sheet in terms of a water accounting system. The states have water accounting systems used in the planning environment, primarily for their regulated systems. In Queensland and New South Wales, for instance, they use a tool called IQQN, which enables them to look at the various demands in the system and how they manage their storages. There is also representation of the catchments and how they provide run-off of different security to the downstream users. We are about really taking those to a new level, putting some of the sophistication in the things we have discussed today and in some of the market mechanisms that would enable us to consider solutions to get beyond the impasse Mr Young has just described, where rivers are so allocated that the very fine detail of the conditions on licences—the way we operate our reservoirs—are all of considerable consequence to both the consumptive and non-consumptive uses. There is clearly a need for us to free up the system so that there is some ability for us to share water in a better way.

ACTING CHAIR—I thank Mr Mike Young for his attendance today. We do not want to see you miss your connections, and we hope you have a barbecue in Eritrea, on your way to Ethiopia, with Australian mutton!

Mr Young—Thank you very much.

ACTING CHAIR—Senator Colbeck, do you want to expand on your questions?

Senator COLBECK—Going back to plantation issues, I am interested in exploring a little bit more about the water use through the cycle and the level of information currently available, going through from a semi-mature or mature plantation that is harvested. The document here talks about the conversion of grassland to plantation. How well is that understood through the plantation cycle within, basically, a maintained use?

Prof. Vertessy—There is reasonably good knowledge on that matter. If you start with a pasture and you plant a plantation, you would expect to see very little change for the first three to five years. Most effects would begin to be felt after around seven or eight years—here I am talking about typical south-eastern Australia; in other countries it is very different.

Senator COLBECK—Are we essentially talking about north island information?

Prof. Vertessy—North Island in New Zealand?

Senator COLBECK—No, north island in Australia.

ACTING CHAIR—That is flash for: we are not talking about Tassie!

Prof. Vertessy—I have never heard that one before! Yes, it is. Some good plantation work has been done in Tasmania. I am not on top of the numbers that have been gathered from that, but through the Forestry CRC quite a bit of work has been done on the hydrology of plantations down there—not so much at catchment scale but more at a site scale.

Senator COLBECK—So that is more on a plot or an individual site?

Prof. Vertessy—Yes, that is right. But in general there would not be much regional difference in south-eastern Australia in how things operate there. It would be much the same. Just to come back to my line of thinking, the effects would be minor until years 3 to 5. They would gradually increase and probably start becoming significant around year 7 or so and probably attain the maximum effect around age 10 and would remain pretty much at a constant level until age 20 to 30, probably, which is usually the end of the plantation rotation. If for some reason you did leave them in there for the long term there might be a 10 per cent or 15 per cent tailing off of the water use beyond that over a few decades. But in the case of plantations—

ACTING CHAIR—Just to put that into some sort of vision, with a typical 40 inches or 50 inches of rainfall in a plantation forest area for the 10 years of the cycle, we are talking about comparing the water use back to the pasture use of two megalitres to 2½ megalitres a hectare?

Prof. Vertessy—If you were around the 1,000 millimetre rainfall isohyet, yes, it is two megalitres per hectare. I will check my numbers here. In fact, for pine forests at 800 millimetres it is two megalitres per hectare if you are planting clear land.

ACTING CHAIR—That is at what year?

Prof. Vertessy—That is an average and that is probably—

ACTING CHAIR—That is just a guide.

Prof. Vertessy—That would reflect the period probably from about year 8 to the end of the rotation. An important point is that you should realise that in a plantation system you are always cutting trees down at the same time as you are planting them. Those areas of the plantation that are cut down will yield more water for a period of time. It would probably be a short time because the planting usually takes place within a year or so but you could use that effect to your benefit, maybe by delaying the planting, for instance. This is where the phasing and rotation arguments can come into practice.

Senator O'BRIEN—So with the 10 to 12 year rotation of plantation timber crop—pulpwood, typically—are you saying that for the first three to five years there will be little impact and that out to 10 years the impact will grow?

Prof. Vertessy—In a fast rotation system that is designed to grow very quickly I would think you would need to bring those numbers back. I am working on the assumption of a pine plantation here in south-eastern Australia with a rotation maybe of the order of 30 years.

Senator O'BRIEN—But your pine numbers are higher than your eucalypt numbers?

Prof. Vertessy—Yes. It should be added that those eucalypt numbers pertain to native eucalypt forest. They do not pertain to intensively managed plantations. There is not a lot of data on them, unfortunately, but my strong gut feeling is that they would behave quite close to the pine line.

Senator COLBECK—What do you mean by native eucalypt plantations?

Prof. Vertessy—Sorry, not plantations: native eucalypt forest. A natural—

Senator COLBECK—So it is like a regrowth type situation?

Prof. Vertessy—In most cases it is usually a mid to mature age forest. The data that goes into the line in this graph in that paper is from catchments with just native original vegetation that may or may not have been harvested some time in the past. That would not be indicative at all of regrowth native eucalypt forest.

Senator COLBECK—So is there any information available in respect of those sorts of forests?

Prof. Vertessy—There is very little data at the catchment scale on hardwood plantations. Once again, there have been plot based experiments of the kind that I have described here that Forestry have undertaken in Tasmania. But it is a real gap. There is of course in South Africa a large body of work on the comparison of pines and hardwood eucalypt plantations. But there the dynamics are different. It is a slightly different climate and that exerts some important impacts on the water use behaviour of the plantation. The lack of predation of the eucalypts by bugs and so on also makes a difference. It changes the relativities of pines and eucalypts.

ACTING CHAIR—How far out does your graph go on that? Do you go up to 60 inches?

Prof. Vertessy—This graph here goes up to 1,600 millimetres per year.

ACTING CHAIR—Forty-eight inches. So what does it say there for an interception?

Prof. Vertessy—At 1,600 millimetres a pine plantation would use 450 millimetres per year more than a pasture and a native eucalypt forest would use 320 or so millimetres per year more.

ACTING CHAIR—That is a bit of a guide.

Prof. Vertessy—There is an interesting point about that. Peter Hairsine mentioned earlier that a large part of that plantation resource is above the 800 millimetre rainfall isohyet. If you were to convert some of that pine plantation back to native eucalypt forest and let it age gracefully over time, in the long term you would actually capture a water yield benefit.

Dr Cotterill—In the work that we have been doing on this type of thing together with the CRC in Tasmania we have a physiologically driven model for tree growth, which is a very interesting tool for this type of work. It takes into account the nutrition and the water that is used by the tree and it attempts to understand the interactions between them. It takes into account, to some extent anyway, the species of the tree. Again, it is work that we have tried to prioritise over the last year or more. The experimental data driving it is partly Tasmanian and partly from trials in south-west Western Australia. I am trying not to forget any. It is partly, I believe, the Murray-Darling Basin and the green triangle of South Australia and western Victoria. I think they are rather powerful tools which, together with the other tools and the other science we have been hearing about, can add quite a lot to the discussion.

There is another very quick point that I would like to make. Senator O'Brien asked about the mosaic. It is very interesting to look at the positioning of trees on farms, particularly in these medium to lower rainfall environments. That is part of the mosaic. The water use equations and the water use modelling of those plantations will be quite different because they are slower growing and in different environments. But when it comes to the mosaic positioning, there is certainly the environmental aspect of the positioning: how can we put those trees in a position where the water that they use has a positive environmental outcome?

The other thing that we have been working on is the economic aspect of that for a farmer. A lot of farmers who might plant trees could simply plant them in the wrong part of the farm—for example, on the other side of a creek or on country that is too steep—which would increase the cost of taking those trees off the farm. When it comes to the economics of growing trees in drier and medium areas, there is a lot of attention paid to growth rates and so on but a large part of the cost of getting that wood to a processing plant will be harvesting and transport. In the mosaic positioning the environment and the economic outcome are important. It is not attractive to farmers to have all the income in one or two years. For income diversity on the land, you would want to get the income flowing across a number of years, which lends itself very well to environmentally friendly harvesting technologies.

ACTING CHAIR—Planned around a hub, I have to say. There would have to be some hub planning.

Dr Cotterill—Indeed. Proximity to a mill, particularly if it were a regional mill, is important. Mills want a lot of wood not too far away.

ACTING CHAIR—Some people have learnt the hard way that when you get outside the hub, no-one wants to do the job.

Dr Cotterill—I would like to add to the last aspect of that. It is near the outskirts of my knowledge, but if a farmer is selling the land with plantations on it then I suppose they want a number of things, and one would be some recognition of the taxation credit or the environmental credit for the trees that are planted. I guess that will be a very important part of the things we have to deal with to encourage farmers to plant.

ACTING CHAIR—We are already getting queries about whether you can slice the 30-year investment in two and—as I call it—find the bunny investor for the back end of the thing.

Senator O'BRIEN—So there is an ongoing project—the work is now under way on those effects of plantations in the various areas and on looking at species?

Dr Cotterill—Yes, from a wide range of directions. In the CSIRO Division of Forestry and Forest Products there is the physiological growth modelling. There are the attempts to look at the existing value of the new species and how we can add to that, the silvicultural and other aspects of growing trees and, coming back to your original question, the genetics to try and get species that are adapted and also grow as well as they possibly can. We are also working with other divisions in CSIRO on the water and landscape issues.

ACTING CHAIR—Could I come out of left field a bit. Do you people have a view of the vexed question, as I would describe it, of describing burning forests as a renewable resource for power—or is that too far out for you?

Dr Williams—In the document we tabled on the forestry and agroforestry for mid- to low-rainfall areas, we recognised that one of the three legs of the stool for what was termed the short rotation, oil mallee sort of activity is power generation, through a rotation and coppicing process, to produce power at the same time as oil and maybe high-quality charcoals. As you all know, I am sure, that has been worked on actively in Western Australia and Paul's division is working on that issue. Using trimmings and that type of short rotation for power generation is certainly part of the equation.

ACTING CHAIR—How do you see it as being a proposition, though? I am well aware that the freight costs of a solid log versus a truckload of trimmings or waste product would be very much time and load sensitive. How would that ever pay?

Dr Cotterill—We were saying in the beginning that certainly growing the trees for timber alone in medium to low rainfall is not going to be an economic proposition. But the other aspect to the economics of that is that you do need a range of products. It may be, for argument's sake, that the high-value product that you produce is paying all or a large proportion of the costs that were incurred in growing the trees, so the profit, in fact, could be on what you were able to recover from the remainder of that tree.

Senator O'BRIEN—But does it really matter? Going to the nub of the original question, if whatever arrangement exists—tree crop or shelter belt system, plantation or farm forestry—is economically viable with renewable energy credits to convert that to energy, what is wrong with that?

Dr Williams—That is part of the ball game. The work I have seen, and I am sure you are aware of it, is a forage/harvest type approach to the mallee that includes the pack-up, the density, the mass gain and therefore the cost of transportation and also recognises that there are some recent, quite important developments in generation—the distributed generation into a grid system allows you to transport the electricity rather than the wood. That is the sort of analysis that is in that document. We have costed all that and you can have a look at it.

Dr Cotterill—The oil mallee plantings in Western Australia are an example supporting what you are saying. There it is the energy carbon oil equation. The point I was trying to reinforce there is that probably one product alone is not going to solve it.

Senator O'BRIEN—Let us make an assumption that larger species are able to be grown in parts of the 500 millimetre rainfall country where they require a 50-year rotation but thinning. The thinnings are low value but able to be used for that purpose. If there are legislative barriers to using them that way and if renewable energy credits are made available, I do not understand why there should be a problem with the parliament looking at that positively.

ACTING CHAIR—As a stand-alone proposition—and in Tasmania there may be a stand-alone proposition—do you have a view on the burning of timber as a renewable resource as compared with wind and sun et cetera?

Dr Williams—I do not think I can add greatly to that; I might just mislead on that one. I do not have the facts.

Senator O'BRIEN—Professor Vertessy, is the paper you have given us based on plantation developments that take into account current plantation development requirements and codes in terms of planting around streams and drainage lines?

Prof. Vertessy—No, they are not addressed in this paper.

Senator O'BRIEN—Is it likely that those restrictions on plantation development would have a significant impact on run-off?

Prof. Vertessy—It is a complex question to answer. My feeling is that it would probably have a mild moderating influence. I think what you are referring to is the fact that not 100 per cent of a plot of land is always planted to trees. There is a net area planted to trees.

Senator O'BRIEN—And there are areas where water runs that are not planted.

Prof. Vertessy—Yes, there are stream-side reserves but in many cases, presumably, they would be under tree cover already. I am aware of plantation development up around Tumut, for instance, where pastures were converted right down to the stream line. There are both cases in operation.

Senator O'BRIEN—Sure. I understand that, yes.

Prof. Vertessy—So in a situation where a significant part of the landscape is not treated or planted to trees, because of roads or reserves et cetera, the effects will be moderated back linearly according to what percentage of the catchment remains untreated. So these effects that are talked about in the paper assume maximal impact—maximal planting, as it were—and you would need to moderate those. We had a meeting last week with some experts at BRS and forestry and we talked this particular issue through. What was the gut feeling on the net area planted in a common plantation context, Peter?

Dr Hairsine—Typically in the order of 95 per cent. It depends upon the provision for firebreaks, which is a large exclusion, and also the area of roads, and occasionally there are some significant areas associated with the actual forest operations themselves.

Prof. Vertessy—So it is a mild moderating effect, if that.

Dr Cotterill—My understanding of the other legislation for these environment zones along streams or rivers and so on is to do with the quality of the water to reduce the impacts of forestry on the soil load that the water is carrying. I think that is an important issue to bear in mind. The discussion we are having in the high rainfall zones of course is about the volume of water coming out of those zones. There is also the issue of the quality of water and erosion.

Dr Hairsine—I would like to add some comments about the robustness of the conclusions that we can make concerning the water yield issue. In the discussion that has happened in recent years about this issue there have been a variety of exceptions raised to try to disclaim these general principles of the establishment of new forests on grazing lands changing water yield. As a person who looks across the range of natural resource science, these are some of the most robust relationships that I have seen. I make those comments on the basis of the nature of the data.

One of the original review papers on which the water review relationship is based, which was published in an international journal back in 1999, took into account 360 studies that have been done world wide, many of them Australian. The Australian data mapped exactly onto the world studies, basically saying that Australian forests were no different from international forests in terms of statistical behaviour. Those studies which were done world wide showed this very universal and robust relationship in the change in water yield, changing primarily as a result of the mean annual rainfall which happened in that location. My experience across sediment transport, nutrient transport and other environmental measures indicates that this is the most robust relationship which describes that data. It is robust because statistically it appears to be relatively universal. It is robust because it is based upon data rather than a sophisticated analysis derived from a model. So you should take it with that degree of certainty.

Senator O'BRIEN—So if we look at South African studies we can rely on them just as much as we can on Australian studies?

Dr Hairsine—I think we have been very cautious in our interpretation of the world literature. We have compared the Australian data to the South African data—there are some very useful comparisons there—but most of the differences we see are in second and third order issues,

things like the timing of the water yield response. But in terms of the overall issue of trading the vegetation type to the quantity of water that is available in the stream, that baseline first order relationship is very robust across all of the world literature.

Senator O'BRIEN—There is one other area. I think Senator Lees mentioned it. It is to do with the issue of forest regeneration after fire. I am sorry but I was out of the room when the question was asked. What is the likely impact on the Murray-Darling Basin of the forest regeneration in areas where fires have hit the basin?

Prof. Vertessy—I undertook a short analysis. I would not want to be betting my wife and children on these numbers, but within the constraints of the analysis that I conducted—

ACTING CHAIR—We will not even tell them you thought about that.

Prof. Vertessy—Okay. In the upper Murray system in Victoria, a conservative estimate of the effect 20 years out from now would be a reduction in mean annual yield of 430 gigalitres per year. That is using pretty conservative and safe assumptions. If you were to be a little more pessimistic about some of the assumptions, the effect could be as great as 1,300 gigalitres per year, 20 years out from now.

ACTING CHAIR—So perhaps 1,000 gigs in—

Prof. Vertessy—It could be.

Senator O'BRIEN—Not the Cubbie Station area?

Prof. Vertessy—In both instances, 20 years out is probably the worst time. You would probably begin to benefit after 30 years—it would start dropping back towards normal. In fact, the time trend depends a little on your starting assumptions—what the age of the forest there is. I should note that we are about to undertake a major study with the Department of Sustainability and Environment in Victoria, who are commissioning a study on those catchments in Victoria to do a more rigorous analysis. I think that in the next 12 months we will be in a much better position to give you a good, robust answer to that. There probably will not be any noticeable effect for the next five years. In fact, there will be more water coming out of those catchments, which is good news.

ACTING CHAIR—It is still any long-term water plan—

Prof. Vertessy—Absolutely. It should definitely factor into it.

ACTING CHAIR—Between that and water harvesting and so on—

Prof. Vertessy—Exactly.

ACTING CHAIR—I am a wool classer; well, a broken-down farmer. Are we going to learn anything from all the mistakes that were made in the Colorado River sharing agreement in 1922? Are we going to have enough caution signs up to—

Prof. Vertessy—I remain hopeful that we will.

Dr Williams—There is enough information. I suspect it is up to us to make sure it is understood and in the right places and the appropriate conversations—

ACTING CHAIR—We hope we can assist you with the passage of those flashing lights.

Dr Williams—Yes, because I think we do know enough to avoid many of those issues.

Prof. Vertessy—Hydrologic knowledge should not be seen as an impediment to better management of our water resources any longer.

ACTING CHAIR—My congratulations. I can only urge you to keep up the good work and keep us informed.

Proceedings suspended from 6.48 p.m. to 7.03 p.m.

GOSS, Mr Kevin Frederick, General Manager, Natural Resources Management Branch, Murray-Darling Basin Commission

KEYWORTH, Mr Scott William, Director, Rivers and Industries Unit, Murray-Darling Basin Commission

ACTING CHAIR—Welcome. Do you have any comments to make on the capacity in which you appear?

Mr Goss—I am Deputy Chief Executive with the Murray-Darling Basin Commission.

ACTING CHAIR—I invite you to make an opening statement and then we'll belt the hell out of you with questions!

Mr Goss—Thank you. I would like to make a brief statement and then ask Scott to make some more detailed points after that, but they will not take long. We are very keen to be here today. As you would know, water resources, land use and river health are very much on our plate at the moment. I think there is a sense in which 2003-04 is a year of very important decisions for the future in that area. We had the first round of Council of Australian Governments decisions on 29 August. That has done a lot already in settling down a lot of the uncertainty, particularly in the southern Murray-Darling Basin.

We will have a Murray-Darling Basin Ministerial Council meeting on 14 November. It has said that it is prepared to consider a first-step decision on the Living Murray on that day, and we are within 24 hours of submitting the proposal for that decision. Into next year we can reasonably expect that the Council of Australian Governments will come together again and pick up the work that they have announced. The working relationship between the two becomes very important, as I will point out as I proceed.

In our submission we gave a summary of what the policy agenda is and what the strategies are with the commission from the immediate past into the future. I do not intend to go over it—it is a matter of record now and we accompanied it with publications—so I would like to concentrate on the near future, which I think you will welcome our talking about, and no doubt you will have some questions. At the moment, for the reasons I have given, there is a terrific opportunity for national leadership, particularly Murray-Darling Basin leadership, around water and river health. On particular matters that have been raised through the Council of Australian Governments, all the signals to us—we have an analysis that backs them—are that, handled appropriately, enhanced water trade becomes very important to getting better outcomes for the southern basin in particular and the Living Murray. No doubt I will get some questions in response to this

There is the opportunity for the governments that have declared their hands on the $500 million investment to address water overallocation in the basin to think through how they could handle that investment in a way that is unprecedented and that would achieve the dual objectives under the Living Murray of a healthier river in the long term and sustainability of industry. It is a one-off opportunity to boost what would happen to industry in that respect. It is also an opportunity to look at the institutional arrangements as to how to handle these matters of

recovering water and managing environmental water in such a way that you give an environmental benefit dividend to the community and so that the community can be confident that it is well managed and that the dividend will increase in future for the scarce resources that have been made available for it.

Regarding the needs of the southern basin—I am focusing on the southern Murray-Darling Basin because that is where demonstrably the opportunity is to address water overallocation and where the focus is—we are in the final stages of preparing a proposal for the Living Murray. There are some characteristics about that proposal which have already been made public. Given that to tackle the river system as a whole in one fell swoop is a very tall order when it comes to the volumes that would be considered—that is, 1,500 gigalitres and upwards—it has already been announced that the approach is quite different from that. It is to look at the river, decide at the outset what are the most important ecological assets on the river, focus attention on those areas as a potential first step, and then build credentials and move on from there. That point has been well made.

Whatever volume of water is decided by the ministerial council, the real incentive and expectation will be that that water is managed to get the best outcomes with the investment in structures, the changing structures and the changing operating rules on the river so that there is a leverage on the volume of water to take it much further than would otherwise be the case.

I will finish with a couple of remarks about the threats to the water resources of the future. I know that you have had extensive discussions about this issue today, so I do not propose to go back into the same information, because our information comes from exactly the same source. The gigalitres that have been talked about with you today, whether they be regarding climate change, plantation forestry or farm dam development, have come from reports that we commissioned, and the information in those reports is from the experts that you had here earlier today. I just wanted to register that we also are looking very closely at those predictions and clearly we intend to work them through and build them into the policy advice that the commission will give to the ministerial council over the coming months and perhaps years. But they are certainly very important to us as well.

As a final point, Senator Heffernan in particular, you know some of the work that we have done on some of these issues, particularly the forestry issue, and I think you appreciate the extent to which we are prepared to go to build a knowledge base behind these issues in advance of taking policy decisions. We believe it is incredibly important to do that, and that is the hallmark of how we operate. We are at the right point on the Living Murray. Despite some of the public debate recently, we believe we have built very strong information behind that decision, and we would expect to repeat the same for these other issues against water resources for the future.

Mr Keyworth—To reiterate Kevin's comments, we are delighted to be here. As Kevin has indicated, we are aware that you have received information, a number of documents, from us and that you are hearing from a large number of other very well recognised experts in the field, many of whom we draw information from as well.

There only two points that I want to make up front. They are essentially at a little higher level than Kevin's and bring us back to the charter of the Murray-Darling Basin Commission. Without my going into the detail of it, the charter of the Murray-Darling Basin Ministerial Council is

basically the promotion and coordination of actions to achieve a sustainable resource management within the basin. In the context of promoting and coordinating, I see two very significant opportunities in relation to water resource management within the Murray-Darling Basin at the moment. One that Kevin alluded to is the decision in August by COAG to have a number of Australian governments coming together and seeking to coordinate their activities.

From the commission's perspective—and certainly all of our experience says this—there are very significant opportunities to improve the overall efficiency and effectiveness with which the water resource is managed where governments cooperate with one another rather than act independently of one another. We see significant opportunities there for those governments to continue to act cooperatively not only as they have with the Murray-Darling Basin Agreement over literally the last hundred years but also in this new environment which we are working within—particularly in relation to the Living Murray—where there are opportunities for governments to agree on specific environmental outcomes that they are seeking. The capacity for them then to work together to achieve those is likely to generate significant benefits in a very cost-effective way in comparison to where they acted independently of one another.

The second relates to the capacity to coordinate action at a particular resource level. That acknowledges again, as COAG has done, that what we are actually dealing with in water resource management is a total water cycle and the interdependence between surface and ground water systems. Certainly work that we have undertaken has been able to quantify the impacts of ground water and ground water resource management in terms of its potential impact upon future management of surface water systems. Again, I would be very pleased to see governments, as they have done, acknowledge the interdependency between surface and ground water systems and recognise that any policy decisions that are then to be brought forward in the management of surface water systems need to acknowledge that interdependency. Ground water systems will also need to be managed, but managed conjointly. Policy decisions that may be taken simply to manage surface water resource may be undermined over time unless that interdependency is recognised. That is all I have to say.

ACTING CHAIR—Thank you very much. I want to put on the record how grateful I am to the Murray-Darling Basin Commission for the education I have been given. One day when I was down there I promised to get out and spread the word, and I have been busy!

Mr Goss—I think you have. We have heard that you have been spreading the word.

ACTING CHAIR—One of the things I have been trying to stress to the people who have influence in divvying up the water of the Murray-Darling Basin between the various users, including the environment, is that we need to make sure we work out how much there is to divvy up. We heard today that the fires will cause a decline in runoff—a median figure of 1,000 gigalitres from part of the catchment. We have learnt today about the water harvest—which I admit does not find its way to the mouth of the Murray—at the lower Balonne where they have built 1,000 gigalitres of storage. Are you confident that we will not make mistakes, given the information we have, or do we need to get more information? Given that the fire event is out of left field, are you confident that we have enough information to be able to effectively audit what we are talking about?

Mr Goss—No, I would not say that we have enough information to audit what we are talking about. We have taken the audit approach in the past and we would think about taking that approach again. I think we are on the path to auditing very strongly the future threats to water resources. If you are asking whether we have enough information to be able to recommend with confidence a position on the Living Murray—which at this stage is to take a first step decision and manage that against some particular high value sites on the river—I would say we are confident and it will be a modest volume. But beyond that we clearly have a lot more work to do in continuing to audit the threats and then to deal with them. Scott has already given an indication of one area that we are already looking at—that is, ground water in the context of surface water.

ACTING CHAIR—Have you already built the firestorm effect into your information?

Mr Goss—In terms of the Living Murray, we have not taken it off a figure, but a decision has not been made about the Living Murray so I have to be cautious about pre-empting any decision that might be taken. The volume is a few hundred gigalitres and, in the context of all that we are talking about, we are confident that that is manageable. That program could not be delivered within a year; it will happen over several years. The proposition to the ministerial council is very much about learning as you go—or in our jargon 'adaptive management'. One of the hallmarks of that is that you set your plan at one point in time, draw in your evidence—you run your auditing over the top—and then you make very conscious decisions to change as you go along. It is not changing your mind as you go along; it is a very structured decision that circumstances now justify a change. That is clearly the proposition we are putting. So in the case of bushfires, we are conscious that there is a 20-year prediction and there is a 50-year prediction. The 50-year prediction is for a lot less water than the 20-year prediction. When we look at how a river responds to these sorts of decisions we would be looking beyond 20 years. That is an important consideration for us.

ACTING CHAIR—In relation to the ground water-surface water connection, would you be able to provide the committee with the big map of the Murray-Darling Basin? I have a copy of the map and I wonder whether it would be useful—we cannot do it here now—to provide the map to the committee and to go through that and explain the ground water connect: the broken aquifer east of Hillston and Narrandera-Albury versus the aquifer on the other side and at Loddon. I think it would be useful for the committee to be briefed in the right format.

Mr Goss—With pleasure—we could definitely do that. We have not got that map with us today. I would suggest we could go a bit further than that. Scott made his remarks about ground water and surface water interaction on the basis that we just received another report in draft form, and that takes us further in the quantification of that. Going back to your question about auditing, we do creep up on these things slowly at times. We are probably into our third or fourth report on ground water. We started with some fairly crude modelling about 'What is the connection?' and are now starting to put some fairly specific volumes on that. I think it would be a good thing to explain the pattern of the system across the southern basin and then start to bring some of this to bear as well.

Senator O'BRIEN—I think you told us that you have nearly got ready your evaluation of the social and environmental impacts of the three reference points for the ministerial council on 14 November.

Mr Goss—If you could bear with me, I might just explain some of the challenges in that area and then wrap up with an answer to the question. One of the issues in the whole Living Murray process is that we set out with an objective and we have had to clearly change as we went along. That is really in the face of some pretty strong community reaction and also the uncertainty that the whole thing created. We set out to do what we called the triple bottom line—the economic, environmental and social assessments—against the three reference points. We have delivered the first report on the ecological side—that is, the scientific reference panel report.

We have not made public the economic or social reports for some pretty straightforward reasons. It is almost impossible to do a quantitative social impact assessment against the three reference points if there has not been a decision or a specification on how the water is recovered. It is not only the money that changes hands between governments and from where the water will be taken—and I would like to say 'irrigators' here; I am talking about irrigation authorities and other areas—but also how it is done and where it is done. We found that we would have to make assumptions that either would be wrong or would be pre-empting a ministerial council decision in order to even conduct that analysis, so we have put that on hold for the moment. In the case of the economic analysis there are similar difficulties but not to the same degree. We can have some numbers in the absence of governments putting money on the table and then in the presence of that. In the last few weeks we moved beyond the three reference points, as unfinished business, and then focused on looking at what we call ecological assets, which are significant sites on the river, and managing the water in those areas—then what would it look like? That is the work that we have done. We have had to do that since the COAG decision on 29 August, which gave us the bounds in which governments are prepared to invest.

The advice that goes forward to ministerial council—this is the answer to your question—will be specifically on what are the benefits and costs to industries around the five ecological assets, assuming a volume of water that will deliver into those assets. That is a much more meaningful figure at this stage. That leaves the larger debate against the three reference points for later. We are not shying away from that; we are just saying that is an ongoing consideration beyond November.

Senator O'BRIEN—What is the state of the Murray at the moment? I understand the water quality and salinity at the southern end of the river have improved of late. Do we put that down to salt interception works?

Mr Goss—Among other things. Your question is quite relevant to the public debate that is going on, particularly around reports that have been issued by the Institute of Public Affairs. We are very conscious of that and we have responded to those things, but I would like to respond to them again. The median salinity concentration in the river measured in the lower Murray at the town of Morgan, which is the key site where we do our monitoring, is about 200 ECs better today than it was in the mid to late 1980s. We are saying that, the Institute of Public Affairs is saying that and that has been common knowledge with the river managers, the state authorities and even the irrigation authorities for some time—it is not new information.

It has happened because of salt interception schemes and it has happened because there was an earlier decision in the late 1980s to run additional dilution flow into South Australia. That was a decision taken under the Murray-Darling Basin agreement. All states are bound to it and we consider that we still deliver this additional flow over and above South Australia's entitlement to

manage salinity. It also is attributable to the irrigation areas themselves that went into land water management plans—clearly they are managing their affairs differently today than they were then, and they can take enormous credit for part of this improvement.

The thing that absolutely astounds me about the way the debate is running—and I find it amazing and difficult to deal with—is that the argument is that salinity today, in 2003, is better, therefore we do not have to consider decisions against future threats or what might happen to the river in the future. To portray a picture here, in the mid to late 1980s there were citrus crops damaged by salinity. There was serious damage and death because there were some salt spikes in the river for various reasons then. So something clearly had to be done. One of the important pieces of work that was done then was to take the best knowledge of the time and make a prediction. The prediction was on future threats, not just the damage of the current salt spikes.

One of the predictions was that, with the rising ground water in the irrigation districts getting within two metres of the surface—which is where capillary action starts to pick up and cause salt to surface—by 2020 more than 50 per cent of the irrigation areas would be subject to the salinity threat by higher ground water if nothing new or different was done. So a prediction was made in the 1980s to take action against a 30-year projected outcome. The actions were taken, the trend went the other way and we now have salinity better off today over 20 years. So is the argument that we should not act on predictions? I think the salinity story is very much a story where you make the predictions and you act on them.

The other thing about it is that whatever we do with salinity there is a cost or there is a benefit from today. We know, for instance, from the work that we have just done, that under an assumption for the Living Murray outcome there could be an additional $7 million to $8 million a year benefit in further improvement in salinity, or $115 million estimated as net present value into the future. So any shift in salinity is a cost or a benefit from today, and we have good information behind that. That is important to understand on salinity. The other thing about salinity is that it is not the one measure of river health. It is part of the suite of water quality measures that we use, but river health is also about habitat and managed environmental flow. The evidence for acting on the Living Murray is a much broader base than simply salinity sitting within the water quality dimension.

Senator O'BRIEN—And apart from salinity of course there are other indicators of river health, such as biodiversity of the red gums and fish stocks. What are those things currently telling us?

Mr Goss—Perhaps the most important basis for coming to a conclusion that the health of the River Murray is declining and will continue to decline if we take no further action comes out of the work that was done for the National Land and Water Resources Audit several years ago. That has sort of got lost in the debate a bit. That was a national investment of $37 million to $40 million and produced some incredible reports, including one on rivers and estuaries and their environmental conditions. That gives a very comprehensive assessment of the declining condition of biota, measured in various ways: in fish; in macroinvertebrates, or water bugs, which are considered to be a conventional measure of a river's ecological health; in birds; in the morphological condition of the river in relation to sediments, what is happening to banks and the physical structure of the river; and in water quality, including nutrients and algal blooms.

That made a very clear prediction about declining health in the Murray. It was not universal for the whole river; it clearly is more severe as you go down the river. Then we backed that up by asking the people who advise us out of the Cooperative Research Centre for Freshwater Ecology to go back through the National Land and Water Resources Audit information and pull it together specifically for what was then called the environmental flows project, now called The Living Murray, and they did that in a much more visible and graphic form. That was presented to the ministerial council and events took over from there.

Since then there have been other developments. The first is that there has been a very high and unusual rate of death of river red gums below Wentworth on the Murray. We had a survey team look at and report on that. It is very severe—quite out of the ordinary. There has been a combination of circumstances: the reduced connectivity between the river and the flood plain due to low flows and diversions over many years, the accumulation of salt in the root zone, aggravated by severe drought. Clearly it will be an event of catastrophic proportions if it continues.

We have gone back over the fish information, which is quite incomplete. There is no long-term information on fish, so we get into arguments in the absence of that information. One of the interesting things about the debate is that there was a survey conducted of 76 fishers on the Edward-Wakool river system, which is one of the anabranches of the River Murray, where 91 per cent reported that the catch of Murray cod is better today than it has been in the past. That has been a very important piece of information behind the advocacy that the river is not in declining health.

We have gone back and looked at this pretty carefully. New South Wales and Victorian fisheries agencies are stocking the river with 1½ to 2 million fingerlings a year of Murray cod and other preferred species for fishing. We try to take that into account: here is fish being stocked and fish being caught; what is the relationship between the two when it comes to the underlying trend of native fish? The numbers of fish, or of any fauna population, vary enormously according to climatic and other circumstances, and they respond to flows and other things. These signals mask the underlying trend, and we have challenged people to advise us more carefully on these matters. We have to say that probably the only species we got reasonable information on is silver perch, and we are fairly confident that in the case of silver perch the population and distribution has reduced by somewhere between 90 per cent and 95 per cent over the last 50 years. It is that underlying trend that we are responding to.

ACTING CHAIR—One of the traps in this fish argument—and you will hear it on radio stations; we will not nominate them but there are radio stations that say the Murray cod are biting in Old Man Creek or somewhere else—is that, if you talk to the fishermen, it is really an ad to encourage people to buy their fishing gear to go fishing, because in actual fact the fish are not biting there. On the Murrumbidgee I know that the Murray cod hatchery in Wagga lost some of their breeding Murray cod and have had hell's own trouble trying to legally trap some Murray cod for breeders, but they cannot find them.

Mr Goss—The reason I quoted the Edward-Wakool survey is that it is the one that is used. In the public meetings where I have debated this I was not as uncharitable as you in dismissing it in that way, because I just do not have the hard information or perhaps the experience that you have on the Murrumbidgee. People want to fish for preferred species in preferred locations where they

know they can get the fish with better gear than they have had for years and better knowledge. People fishing in preferred locations for preferred species—is that a valid indication of what is happening to native fish across the 39 species in the basin? I do not think it is, and that is the point that we are trying to make.

ACTING CHAIR—The poor old redfin has gone.

Mr Goss—We have also had evidence on wading birds and colonial birds. At the Coorong, the numbers are just so far down compared to previous years. It is just one more indication of a river that has declining health.

Mr Keyworth—Given the very great significance that is placed on whether resource condition is improving, stationary or declining, we are taking a proposal to the next meeting of our ministerial council for what we refer to as a sustainable rivers audit. It has been designed over the last two years in order to give a comprehensive assessment over a long period of time of overall river health and condition with a number of indicators that have been assessed by technical specialists. Trials have been run within each of the basin states for implementing the sustainable rivers audit, and we are confident that if we can get agreement to implement the audit and give it an enduring role—and that is the way it is being structured—we will be in a far better position over the next decades to give very sound advice back to governments and communities about the underlying trend of riverine health within the basin as a whole. To date, significant information is available, which is recovered from local groups—as you would be well aware—at catchment level, at state level. With the exception of certain areas and species, we have not had the capacity before to bring information together in a consistent and dedicated way where it can be investigated in a consistent manner and where you have sufficient confidence in the quality of the information in order to detect any underlying trends. We are confident that the sustainable rivers audit will provide us with that foundational information. At this stage we are confident that our ministerial council will agree to provide direction back to the states to source it and support it.

ACTING CHAIR—In your fishing calculations, how much has all of that been masked by the damage of the dirty old carp?

Mr Goss—Carp gets a lot of bad press, doesn't it? One of the arguments I find really interesting is: is carp the cause or the symptom of the problem? I chaired the National Carp Control Coordinating Group about three years ago, and it was fascinating to see this argument played out. In the end, it was a hung jury, and it is both a cause and a symptom. With something like the Living Murray, one of the important objectives is to improve the circumstances for native fish so they get a better competitive advantage against carp. Therefore, habitat restoration along with flow becomes pretty important.

When we set out to prepare a native fish strategy, which has now been agreed to by the ministerial council, we set an exercise for the fish experts. We asked them if they had their way and all these things were done, what would contribute most to the improvement in native fish: flow, habitat restoration, fish ladders on the weirs, control of carp and so on. They advised that restoring flow was probably 25 to 30 per cent of the answer, restoring habitat was probably 25 to 30 per cent. If you put those two together, you get about 50 per cent. The others are cream on the top of that. We have been influenced by that ever since. In the case of carp, there are a couple of

things to mention in terms of our thinking. The first is to explore whether we can do a king hit on carp. Is there something that we could do with carp, as has been done with rabbits with calicivirus and myxomatosis before that?

Senator O'BRIEN—There were no king hits with rabbits, I can tell you.

Mr Goss—I think with rabbits, the numbers—

ACTING CHAIR—You did a good job on rabbits, I can assure you.

Senator O'BRIEN—Not on my place, you didn't.

ACTING CHAIR—I congratulate you on the rabbits.

Mr Goss—I am talking about integrated pest management here—that is, you get a king hit and then you manage your way from there. We have taken a strategic investment in what is called daughterless carp technology. We have the Pest Animal Control Cooperative Research Centre based at Gungahlin supervising the labs at CSIRO Marine Research in Hobart that are pursuing gene modification within the species. They now understand the mechanism by which you can switch off part of the biochemical pathway so that, at a key stage in the embryo, those embryos that were destined to become daughters do not become daughters; they become pseudomales, so you have infertility within the species.

ACTING CHAIR—There is no danger that this would transmit to humans, I hope!

Mr Goss—No. I said 'within the species'. We are pursuing that. It is a risky venture on several counts: is the technology transferable from the laboratory to the field and from the species being experimented on to carp, with its longer generational life? Also, we do have to manage public perception—we are aware of that—but we are prepared to go to those lengths to look for the answer.

The other thing we are doing, as you may know, is putting fish passage on all of our structures from the Murray mouth up to below Hume Dam. We have designed the fish ladders to suit Australian conditions rather than adopting them from North American conditions. We have worked pretty hard on that. Now we are looking quite seriously at whether there is a device you could have in the fish ladder system that would divert carp from native fish on the basis of an understanding of their behaviour once they hit a barrier or a fish-drafting gate.

ACTING CHAIR—Like grading apples.

Mr Goss—Yes. So we are pursuing that idea as well. That is what I mean about taking a very direct action against carp, as well as managing the river for the long term to improve the competitive advantage of fish. That is the integration in the pest management.

ACTING CHAIR—Thank you very much for that.

Senator O'BRIEN—In the executive summary of the interim scientific reference panel, at point 48, it says:

Further, consideration should be given to the development of a year to year roster for the allocation of water to particular locations along the Murray to achieve longer term ecological outcomes.

I assume this means that from year to year different parts of the river will be targeted for increased flows?

Mr Goss—That is clearly the conclusion they have drawn. We have actually put it to the test in a dry run. If we had the last eight years from 1995 to 2002 over again and we had additional water there every year on environmental water account—that is, permanent water as an entitlement for the environment—and we played it out, according to our understanding, against the four ecological sites on the river and took extra care of certain things in the river channel itself, could we have changed the outcome in those eight years? We are fairly confident that we could have, with that additional water.

The interesting thing about it, which clearly speaks to that conclusion, is that you do have to make judgments. You have a flood coming down the river of modest proportions, of a particular nature or hydrograph pattern—and you are not sure of that because it is coming down in actual time, but you are monitoring it very closely—and you take decisions about whether that flood is big enough or long enough to put it through Barmah Forest and still have enough over for other points down the river. Or perhaps Barmah Forest is in good enough condition this time around, so you put it into Chowilla further down or you reserve it for the Murray mouth. It is those sorts of decisions in real time that we have practised, and we are fairly confident, over an eight-year period, that we could have improved the outcome with the additional water.

I will just give you a couple of specifics about that. In the case of Barmah Millewa Forest and the Chowilla Floodplain area—which are two of the ecological assets that we have named—they require very significant floods to be delivered that you then top up with the water on the account. You either peak the hydrograph higher with a flood or you extend it further, but you are very driven by the nature of the flood that is coming your way. In fact, the water you put on top of it from the account is in the order of 10 per cent of the total volume. Thinking about providing further into those areas with water acquired for that purpose is a very big ask indeed.

Somewhere like the Gunbower Forest on the Victorian side and the Koondrook Perracoota Forest on the New South Wales side—where there is a much closer connectivity to the Torrumbarry Weir Pool—have a much greater capacity to deal with stored volume to deliver water in those areas. You are not so dependent on a large flood that you top up. You make those judgments as you go along; do you pass up the opportunity with Gunbower to deliver the other two, because you know you can come back and do Gunbower with some mechanical works to get water in there in one of the off years? In the case of the Murray mouth, it is a different story again—that is, it pretty much needs to see an annual additional amount to lower the probability that the Murray mouth closes. That conclusion is an important one. We have practised it. We will advise the ministerial council that we are confident that we can actively manage according to what nature presents to us in the form of flow.

ACTING CHAIR—Have you changed your management practice in, say, the Barmah Forest? The last time I was there it was divided into three 32,000 acre leases and people used to run stock in there. Does that still happen?

Mr Goss—Yes, stock are still run in there today. Scott may want to add a little bit more detail because he has been quite heavily involved in the Barmah Millewa Forum, but there are forest interests in there as well.

Mr Keyworth—I suppose it comes back to the specific question. Stock are not run across Barmah or Millewa forests anymore. There are still annual grazing arrangements for the cattle. Essentially, the management of the forest is now seeking dual outcomes from a timber perspective. There is a small amount of return associated with grazing, but it is also a very significant tourist area and is actively managed in terms of environmental tourism.

ACTING CHAIR—I have to say it frightened me off because I knew if I put them in there I would never get them back.

Mr Keyworth—It is big social event rounding them all up, at the end of the day. You then have to argue over whether you can actually read your ear tag and whether somebody else has got your steer. I think it is more of a social event.

Mr Goss—One of the things that may have been overlooked is that if there is a decision on the Living Murray by the council and our member—and clearly we are focusing on these sites—the question is: how much water and how is it going to be managed and so on? Given the sheer nature of that decision, it is challenging to everybody involved—particularly water users. It will be a reasonable expectation for all those people involved to think that those areas will now be managed at a much higher level. It is not just the water management and water delivery, which I have talked about, but all aspects of those areas—from managing the land, as well as managing the water, to how it is established for recreation and tourism; to information interpretation and all those things. I think the Living Murray could trigger some pretty exciting things in terms of new ecological assets being treated in a way that would realise the full expectations we have for these areas.

Senator O'BRIEN—Judging from your conclusions on ecological habitat conditions, waterbird populations, flood plain vegetation, blue-green algae abatement, downstream salinity and red gum health, it appears that, compared to the reference points of 350 gigalitres and 750 gigalitres, the 1,500 gigalitres option is the best. Is that a fair summary?

Mr Goss—That is based on my understanding of the conclusions of the scientific reference panel, which is clearly the really important evidence here and which we are not straying from. We accept it as very good evidence, and we are moving forward on it. The panel have said that, for a moderate probability of improved health for the river as a whole—that is, the length of the river and its flood plain—you have to think about 1,500 gigalitres. With 750 gigalitres, you may or may not get it—the probability is lower. They have been very clear about that, so we accept that.

We are also advising that that discussion should continue around the three reference points. We put the question back to the scientific reference panel. In fact, they were pursuing it themselves, but we focused the question a bit more. We asked: if you were to put water into certain places and manage it in particular ways, can you achieve it at lower volumes?—because there is something 'all or nothing' about 1,500 gigalitres. The chair of the panel said that, yes, he was confident you can do that. In fact, they ran a case study—it was on the Gunbower Forest—

which is in the report. It found that, if you ran flow alone into that forest, you would get certain outcomes at 1,500 gigalitres. If you put in new structures to manage the water off Gunbower Creek, and put it in there, by using those new structures in a smart way you would get exactly the same result at 750 gigalitres as you otherwise would at 1,500 gigalitres. That has made us more confident that the tools of management, whether they be regulators or whatever, will allow us to get significant benefits at lower volumes, in the early stages, while we continue to run the discussion against the 1,500 gigalitre number.

Senator O'BRIEN—Let me understand what you are saying. You can direct outcomes to particular parts of the river at 750 gigalitres—

Mr Goss—Or even less.

Senator O'BRIEN—or 350 gigalitres?

Mr Goss—Yes, you could.

Senator O'BRIEN—You could address those areas but not the general health of the river?

Mr Goss—Yes, that is generally the case. Obviously as you get down to 350 gigalitres your options diminish in how many places you can deliver the water to. One of the real arts in finalising a proposition with the ministerial council is to settle on a volume of water, with pretty tight management over it, that gives you significant environmental benefits at a sufficient number of places that you can build confidence and support, but not so high that you have issues on the other side, in terms of the impact on industry, that you cannot manage. That is in the region of 350 gigalitres to 750 gigalitres.

ACTING CHAIR—Wouldn't there be a time specification around this?

Mr Goss—The time over which you gather water?

ACTING CHAIR—The time of the year.

Mr Goss—In which you manage the water into these areas?

ACTING CHAIR—Yes.

Mr Goss—Yes. For most of these areas, it is spring flow. For those areas that respond to a flood it is spring flow, but for the Murray mouth the key period is the five months over summer to autumn. We are quite confident that we can see those local results at these sorts of volumes. But there is a trade-off between volume and the number of sites. I want to make an additional point—and I know that Scott wants to answer too. In our assessment, the debate around the reference points really focused too much on volume. We set out, from the beginning of the discussion, to say that volume is the currency in which we work but the real objectives are the environmental benefits and the sustainability of industries and communities—and volume is a means to that end. What happened in the debate on the reference points was that volume became everything, and that clearly concerned us. We think that one of the breakthroughs in the

proposition, going forward, was to get the focus back on the environmental outcomes and the opportunities that investment in this can deliver to industry—and volume is a means to that end.

Senator O'BRIEN—So the scientific reference panel was established to provide independent expert scientific advice on the potential ecological benefits associated with the three reference points.

Mr Goss—Yes.

Senator O'BRIEN—How is the panel made up?

Mr Goss—The commission appointed it. So, in terms of independence, it is appointed by the commission. We selected people who had the mix of skills necessary. The panel is chaired by Gary Jones, who is now the chief executive officer of the CRC for Freshwater Ecology, and he is joined by people who have expertise in fish, flood plains, wetlands, billabongs and so on. They were chosen for their skills. None of them are employees of the commission or the agencies that are partners to the commission. I think they are demonstrably experts in their own right and they would be considered that way. I do not know of any criticism as to their credentials as individual scientists or experts.

ACTING CHAIR—Are they beneficiaries of any of the decisions?

Mr Goss—We have supported and built the scientific reference panel on the basis of the CRC for Freshwater Ecology. You can make your own conclusions. The commission invests between $1 million and $2 million a year in the CRC for Freshwater Ecology. Clearly they are a beneficiary of the commission's investment. Can I say, though, that, if you were witness to telephone calls and emails between me and Gary Jones, I think you would observe that he is a pretty independent person.

Mr Keyworth—One thing further on that, in terms of the sense of independence and integrity, is that the scientific reference panel's interim report has been independently peer reviewed by two leading scientists—one international and one from Tasmania—who have come back with strong endorsement of the findings of the panel. So we have spared no effort in finding the best people we can and then backing it up with independent judgment.

ACTING CHAIR—I have some questions to ask on behalf of Senator Meg Lees, if I can interpret them right.

Senator O'BRIEN—We will check afterwards to see if they really were!

ACTING CHAIR—South Australia Water is currently selling surplus water to the Clare Valley in South Australia. Is there a surplus 7.3 gigs of water for them to pipe into the Clare Valley?

Mr Goss—With such a specific question, I think we will have to take it on notice.

ACTING CHAIR—You can take it on notice. The second question—and perhaps all of these will be on notice—is: where was this water? South Australia was getting its allocation but the

lakes fell to below sea water. Do you have a problem with spare water being sold while existing users—for example, Renmark—are facing cuts? The next question is: we need floods to get water into Chowilla or the high parts of Banrock; what is stopping the Murray-Darling Basin Commission initiating or ordering floods and topping up high flows? Is it threats of litigation, fixed irrigation pumps and/or shacks?

Mr Goss—I would like to answer that. Firstly, what is stopping the commission flooding these areas? I explained earlier that Chowilla is such that the only reasonable way that you would consider improving the situation at Chowilla with floods would be to look at what nature delivers and then add to that. What we do know about Chowilla is pretty specific stuff from the planning that is done there. If we are able to top up a flood to 70,000 megalitres a day for 30 days, we think it is a reasonable objective that we could protect for the long term about 20 per cent of the black box in that area, and much more significant areas of river red gums. If it is 78,000 for 30 days, it would be from 20 to 30 per cent of the black box. The advice is that to go further, including Banrock, would be 85,000 megalitres a day or in that order. That is the nature of the decision. It is not an either/or decision. The moment we start thinking about 85,000 megalitres a day, that really is a pretty big ask in terms of the total volume we are talking about. That is the judgment that the ministerial council has got to make and, having made that, that is the judgment that the river environmental manager has got to make in real time.

ACTING CHAIR—I will just add the footnotes to the questions here: keeping levels at normal by varying locks did not divert moderate flow into Chowilla in 1998; it lowered locks and let it go. I do not know what that all means. Anyhow, I will hand those to you as questions on notice.

Mr Keyworth—As Kevin has indicated, if you understand the topography of the area and the volumes that are required in order to actually flood the flood plain, you will know dealing with the locks will not provide you with that volume, or the time. For those areas to be flooded, you need a significant flood on the Darling system and a capacity to attenuate or manage that. There is very little regulation on the Darling system. What you are basically dependent on is a rainfall event across a large part of the northern part of the basin and its capacity to find its way across that flood plain into the channel.

ACTING CHAIR—And you have got to deal with all those water harvesters as well.

Mr Keyworth—That is somebody's task. Nonetheless, you have got to be able to get the water down to the bottom end of the Darling and then be able to manage it. The commission has some experience in doing that. Two years ago we tried to actively manage a flood on the Darling and enhanced flooding at the bottom end of the river. But the volumes are very significant and the capacity to provide those volumes artificially out of, say, releases from Hume would not be possible without major flooding of upstream areas and significant impacts upon those communities.

ACTING CHAIR—That is a good answer.

Mr Goss—I did not answer the remark about shacks and other assets and I guess the important point to make there is that we would look at that pretty carefully before we would recommend a decision. It is not something that we are unfamiliar with. In the case of the Hume

to Yarrawonga reach, when it comes to managing floods into Barmah we know that we have got to go outside channel capacity and consider daily volumes in the region of 25,000 and perhaps as much as 45,000 megalitres a day. We know that that floods farmland. We have got quite specific information on that. We have been consulting with those farmers, since the large release of water from the Hume Dam in 1996, about the prospect that there would be an acquisition of rights to flood that land, with a certain probability of floods of certain sizes over an extended period. That is consultation in process, but that is the sort of thing we will have to think about in other areas as well once we have worked out what is at risk.

ACTING CHAIR—Was that 1996 water the time that the wall was—

Mr Goss—That was when there was a structural failure on the dam and there was a special release, yes.

ACTING CHAIR—Thank you very much, everybody. I declare this little section of our inquiry over for the night.

Committee adjourned at 8.04 p.m.