Stretton Group

Fire in Water Catchments

Wednesday, November 19, 2008

Luncheon Seminar: 12 noon – 2:00pm

Morgans at 401
401 Collins Street, Melbourne

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Melbourne's water storages are 65.7 % empty (59.9 % this time last year). Gunk at the bottom of the dams pollutes some of the water. As the drought continues, natural run-off into dams is insignificant because most of the rain is absorbed by a huge quantity of dead vegetation and transpired by thirsty trees and scrub.

Intense bushfires devastated about 2 million hectares of the Murray-Darling and Snowy River Catchments in 2003 and another 1 million hectares in North-East Victoria and Gippsland in 2006-07. Rain in those catchments caused, and continues to cause, flash floods, mudslides and millions of tonnes of topsoil to shift. The quality (and quantity) of Melbourne's water is at serious risk from a similar event

The Million dollar questions are:

- Will Melbourne's water storage cope with a major intense bushfire in their catchments?
- What can be done to minimise that risk, get more potable water running into the Dams and make direct attack on bushfires within the catchments easier and safer?

Professor Mark Adams on ABC Catalyst program Fire and Water 1/5/08, said:

"So if you can use fire to control fuels without creating mass regeneration, then we will suffer less, if you like. We won't lose as much water. Whereas if we let major fires run unchecked, where we have very high intensity fires over millions of hectares, then we create mass regeneration and that will really move things to the upper limit of our estimates, of the loss of water."

Guest Speaker:

Professor Mark Adams, Dean of the Faculty of Agriculture, Food and Natural Resources, University of New South Wales

About the Stretton Group

The Stretton Group is an apolitical, not-for-profit group established in December 2003 following the disastrous south east Australian bushfire crisis in 2002/3. The Stretton Group comprises a disparate association of volunteers who support the protection of the natural environment through greater transparency of the public sector processes involved. Named after the respected Royal Commissioner into 1939 Victorian Bushfires, Justice Leonard Stretton, the group proposes that government managed national parks and forests should be provided with a balance sheet value which encapsulates the environmental, cultural and economic value of these assets.

The Stretton Group is committed to ensuring that our intergenerational responsibility is met by Governments committing appropriate funding to the maintenance of this public property – commensurate with its asset value. The Group advocates the preparation and publication of performance indicators which enable the public to assess the quality of the management being provided to the natural environment. This would bring publicly owned wilderness into line with reporting required for hospitals, schools and other public institutions. The Stretton Group is committed to ensuring that the public debate about conservation is conducted on a balanced and informed basis – which may often disturb political myths or common preconceptions about the present quality of environmental preservation.

Members of the Stretton Group:

Simon Paton is a 5th generation farmer and cattle breeder from Callaghans Creek, Mitta Mitta and owns and operates the Bogong Ski-Hire centre at Mt Beauty. Simon has been a major spokesman for NE Victorian communities affected by the bushfires and is campaigner for community involvement conservation and forest management. (Tel: 03 5754 4555)

Peter Attiwill, PhD, BScFor, AssocDipFor, is Principal Fellow in Botany, and Senior Fellow, The Australian Centre, The University of Melbourne. He has researched in eucalypt ecology over 40 years, with a concentration on soils and nutrient cycles, and on bushfires and ecosystem recovery. He has published extensively in the international journals, and his latest book is Ecology: An Australian Perspective (co-editor BA Wilson, Oxford University Press 2003). (Tel: 03 9870 3034)

Athol Hodgson, BScFor, AssocDipFor, has more than 50 years experience in fire management and forest fire research in Australia, USA, Canada, France and Spain. He was formerly Commissioner for Forests, and then Chief Fire Officer, Department of Conservation. He was a Member of the Board of the Country Fire Authority and a Member of the State Disaster Committee and is a graduate from the National Advanced Fire Behaviour School, Marana, Arizona. (Tel: 03 9580 4964)

Bill Middleton, OAM, DipFor, has some 50 years experience in management of forests, of nurseries and of vegetation habitat in rural areas and he is an Honorary Life Member of Birds Australia. He was Supervisor of the innovative Potter Farmland Plan for ecologically-sustainable agriculture, and a Board Associate for the Trust for Nature. (Tel: 03 5254 2332)

David Packham, OAM, MAppSci, worked for 40 years in bushfire research with CSIRO, Monash University and the Australian Emergency Management Institute. He was responsible for fire-weather services in the Bureau of Meteorology. His extensive research concentrated on the physics of bushfires, and he applied this research to practical issues including the development of aerial prescribed burning, non-evacuation of properties, modelling of fire behaviour, and forensics.

Stewart McArthur, MA Cantab, was the Federal Member for Corangamite 1984 – 2007, a Camperdown farmer and company director. He was an active member of the all-party House of Representatives Select committee Inquiry into the 2003 Australian Bushfires whose report *A Nation Charred: Inquiry into the Recent Australian Bushfires* was tabled on Wednesday 5 November 2003.

Stretton Group Forums and Seminars:

Inaugural Oration Phil Cheney "The Green Inferno" (the Politics of Bushfires and Conservation) (November 25, 2004)

Forest Industries: "Their Contribution to Global Sustainability" Tricia Caswell (September 29, 2005)

"Lock 'em up and let 'em burn" – Public forum on Grampians and Anakie fires 2006 (February 23, 2006)

"Fire – Flood – Mud – Water" Luncheon Seminar: Rob Gilder (Licola farmer, Gippsland) and Professor David Dunkerley (Monash University, Landscape Water and Runoff) (May 28, 2008)

Acknowledgement and thanks

The Stretton Group is grateful for the very generous support by Gary Morgan and Michele Levine of Roy Morgan Research for their most generous assistance in helping with the production of this quality document. Without their help, and that of their staff, the important environmental messages provided by our speaker could not have been available to the public at large.

Speaker:

The Stretton Group thanks our guest speaker for his excellent presentation:

Professor Mark Adams, Dean of the Faculty of Agriculture, Food and Natural Resources, University of New South Wales

Fire In Water Catchments

Stewart McArthur: Ladies and gentlemen. Could I formally open our proceedings here this morning and welcome you on behalf of the Stretton Group. We're delighted with the turn-up and we appreciate the number of you who have travelled huge distances to be with us and I'll mention them in dispatches a little while later. Could I firstly thank Gary Morgan, and his wife Genevieve, for the wonderful hospitality we're receiving here today. They've gone to a lot of effort with Roy Morgan to ensure that the Stretton Group get the best of attention, and also to Michele Levine, the CEO of Roy Morgan Research.

Just by way of background, I'll tell you what the Stretton Group does, and how we came to be in existence. I'm Stewart McArthur and I'm the convenor of the Stretton Group. I am the first among equals. The Stretton Group emerged after the 2003 fires. I was a participant in the Federal Parliamentary Enquiry, and I saw the devastation in southern New South Wales and northeast Victoria. My view having participated in that enquiry, was that government agencies were derelict in their duty and the way in which they handled public land. The Stretton Group was formed in December 2003 and named after Judge Stretton. He provided a very comprehensive report of the 1939 bushfires, and it is an epic work on the kinds of problems they faced at that time. Conditions on 'Black Friday' have not been encountered before. I think, as I recall, 70 people died, and that was the start of the problem we face in southern Australia with bushfires.

The Stretton Group are a public advocacy group for good policy. We acknowledge the help of Allan Myers QC when we commissioned him on a pro-bono basis to challenge the Esplin Report. The Esplin Report was a report which, in our view, was flawed about the 2003/2004 fires. So the Stretton Group, I think, were instrumental – very much helped by Allan Myers' wonderful report – in making sure that the Esplin Report did not become conventional wisdom. We advocate that if people lock up public land in forests and parks, that they look after it. We are, of course, a strong advocate of fuel-reduction burning, so that those intense bushfires do not totally destroy the flora and fauna and the timber that has taken place on some of these very big fires. The Stretton Group have also, in recent times, put a submission to the State Government enquiry into bushfires, run by that standing committee, and that submission was well received.

Since our formation, we have run a number of seminars like this one because our attitude is one that we want to advocate our position; we want to put it on the public record. Our first seminar was by Phil Cheney, 'The Green Inferno: the Politics of Bushfires and Conservation'. Phil Cheney is a world-

renowned expert on bushfires. He comes from Canberra with the CSIRO and he made a number of submissions on the Canberra bushfires, which some of you are very aware of. Tricia Caswell from the Forest Industries made another oration, 'Their Contribution to Global Sustainability by the Forest Industries'.

We also had a Report on the bushfires in the Grampians and in the Anakies. The Stretton Group advised the government that that would be the next big fire to take place, and sure enough it happened in the Grampians. We were unhappy about the way that fire was handled and we've got a very good report from participants who were in the fire and some of their observations on what actually took place.

Stewart McArthur: Ladies and gentlemen at this stage I would like to invite Athol Hodgson, one of our very active members of the Stretton Group to introduce our guest speaker. The guest speaker will address our luncheon and as I said, he will leave plenty of time for questions and debate and not too many speeches from the floor. Thank you Athol.

Athol Hodgson: Thank you Stewart. Our guest speaker today is Professor Mark Adams. He is the Dean of the Faculty of Agriculture, Food and Natural Resources, the University of NSW. He has chaired other professorships at other universities and at one time he was on the board of the World Agro Forestry Centre in Nairobi. So he sounds like a stranger being away a long time. But he is no stranger to Victoria. When he was completing his PhD in forest ecology, bushfires in Victoria in 1982 and 1983 destroyed his plots in the Yarra Ranges on the plateau and since then he has worked on the impact of fire in Victoria, Western Australia, Tasmania, NSW and the ACT. He's currently working with the Bushfire Co-operative Research Centre on Project Highfire which is a fuel based project on both sides of the NSW/Victoria border. And it's to get a bit of good science into the decision making process of people who manage both public and private land. And in 2001 he led the joint Victorian and University of Melbourne Forest and Fire Research effort for 3 years so he is one of us.

If you read Mark's recent writings you will find he has a passionate belief that good fire research should be done in the field and you should be getting your hands dirty doing it. He is not one of those, what I call, a so-called fire researcher who got his hands dirty when he was a student and since then has been sitting in academia asking other students to get their hands dirty while he got his name up the front of the research paper. The other attribute that Mark has, he's not afraid to speak out of his own mind when he feels justified to do so. And he is not afraid to upset Governments and he's not afraid to upset fellow colleagues if he feels that they should be upset. And there are people in this room who know something about that story.

I'd like to be able to say to you that I've known Mark for a long time but in fact I only met him an hour ago. But in reading his recent writings I found as a small child he was only kneehigh to the proverbial grasshopper his earliest memory of bushfires was one day in 1968, which is about 40 years ago, he was being driven in a vehicle along Mast Gully Road to rescue his grandfather. Now that rang a bell with me when I read that. Mast Gully Road runs along the top of Dandenongs in behind me the top road down to the road that goes from Ferntree Gully up through Upwey to Bell Road and it's a zigzag road and a fire on February 19, 1968 started in an incinerator in a house at the base which is down at the bottom of the Dandenongs and the fire raced up the hill and blew across the other side and all hell had broken loose. And Mark remembers that - rescuing his grandfather. Well I happened to be on Mast Gully Road at that moment. I was a young fire researcher, full of wind and vinegar and afraid of nothing, trying to do fire research when I ended up trying to rescue people out of Mast Gully Road also. I rescued a cat and a lady. I don't think there were any deaths there so we both scored a little bit that day Mark. So I can say that I've nearly known him for 40 years. We could have crashed together in the smoke on that day.

Mark, would you please come up and say what you have to say about this big subject of fire, and water, and whatever you'd like to say – the floor is yours.

Mark Adams: Thank you very much.

Well, thank you firstly to the Stretton Group for the invitation at this – they say you get a politician on a soapbox and look out. I'm no politician but I appreciate the soapbox.

It is true, and this is a sentiment that I shared with Peter Attiwill, it is true that academics and those that do research are too afraid often to speak out in public and in my view this has led to the detriment of public debate. We see increasingly and particularly in this area of forest management and fire that the space being occupied by people less well qualified – it's good if you are a basketball player or a football coach – you can speak out and be heard – but once the public domain becomes dominated by people less well labelled, less well informed, then the quality of the debate suffers. So I am very pleased to accept the invitation here and hope I can do it justice.

My topic today is as shown on the first slide here and I have posed it as a question, and the question is "Are we willing to manage our most crucial resource in the face of fire and changing climates?"

Against a backdrop of $10B of taxpayer funds for how water is used in the Murray Darling Basin, of billions more spent on desalination plants…..

- Some messages from the past.
- A look at the future.
- What we have learnt recently.
- Management - where to now?

And I've phrased this carefully. I've said changing climates because I think we need to recognise that climates have always changed and we're in the midst of further change right now. But as we go through, and I've always acknowledged at the start all the people and funding sources including things like the Australian Research Council and things as remote as the German Academic Foundation, a lot of people who've helped us along the way. It's worthwhile acknowledging that scientists such as myself need support in order to do the work that's required and certainly there is very good public debate at the moment about where we should invest our precious taxpayer dollars in terms of getting the best value for them. And so I have always been very grateful for the public funding that I have received and I know I share that with Peter. It is a privilege to have public funding to do research and I think the flipside of that coin is then it's our responsibility to talk about that research in public we are, after all, pot funded by the public purse.

So I've had the privilege of being able to work in forests for many years. And I'm doing so today, and talking to you today, I'm doing so against a backdrop of extraordinary expenditure of public funding. Taxpayer dollars - $10 billion - is being spent on how water is used in the Murray Darling Basin. Billions more are being spent on desalination plants across Southern Australia. And against that backdrop I'm going to talk a little about what we know from the past, a quick look into the future using those dreadful things, models, and then hopefully presenting some data to act as a counter weight to the models.

So some things we've learnt more recently and what do we do in future when we understand that we value water to the extent of spending $10 billion of taxpayer funding on how we *use* water in the Murray Darling Basin and the question I'll pose at the end – how many dollars are being spent on how much water goes *into* the Basin?

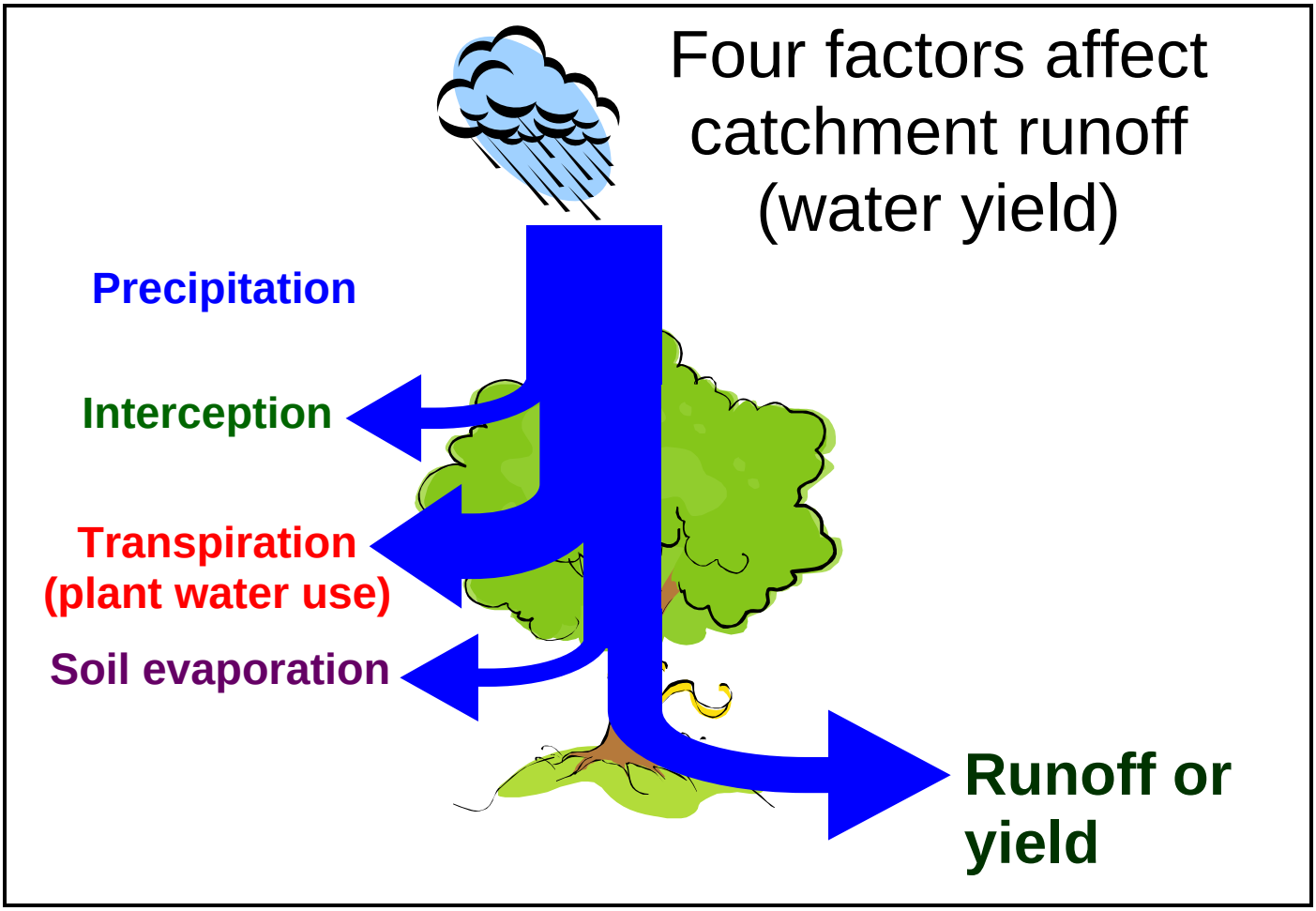
And if someone here can put up their hand and tell me how many dollars are being spent on how much water is going into the Basin catchments I'd be pleased to know – but I suspect it's rather small. So my subject is to try and inform you, hopefully entertain you a little, about water and forests and fire.

Governments of the past built dams, climatic conditions were favourable, and dams filled.

Governments of today, and arguably climates of today, are not favourably disposed towards "filling dams".

And I've started here with a simple statement about how Governments in the past have built dams and we were lucky when the dams were built in the 50s, 60s and 70s - we were actually in periods of above average rainfall. Rainfall in those periods was greater than the long term records such as we know it. And so the dams filled. Unfortunately for that the Government's more recently spending on infrastructure is only belatedly being recognised as a priority. Moreover, even if we did build more dams – is the climate sufficient now to fill those dams? So we've seen a very great shift in public thinking. And today I'm going to talk, I'm going to use a few technical terms and I just want to try and get over the obvious hassle of using technical terms, you'll have to forgive me for being a scientist. And so I will try and explain from the start and ask you to remember.

The key things I'm going to talk about are related to what people think of as water yield from catchments. Sometimes it's called run-off, probably incorrectly, because a lot of it isn't actually run-off, it's actually percolation followed by infiltration, followed by some water ending up in the dam.
But let's just think of run-off as roughly being equivalent to water yield.



I'm going to talk a little about rainfall or precipitation and a little about interception, interception is simply how much of the rainfall is intercepted by the vegetation. I'm going to talk about transpiration and you might think of transpiration is being how much water is being used by the vegetation. I'll talk a little about evaporation from soils and as I said, run-off or yield – I will use interchangeably. But really, that is my take home message – it's right there is that slide. If you look at the size of those arrows you can see my take home message immediately – that of all the water we get in our forests in south eastern and south western Australia – the great majority of it is used by the vegetation it is transpired – it doesn't run-off, it doesn't become water yield, most of it goes straight back to the atmosphere.

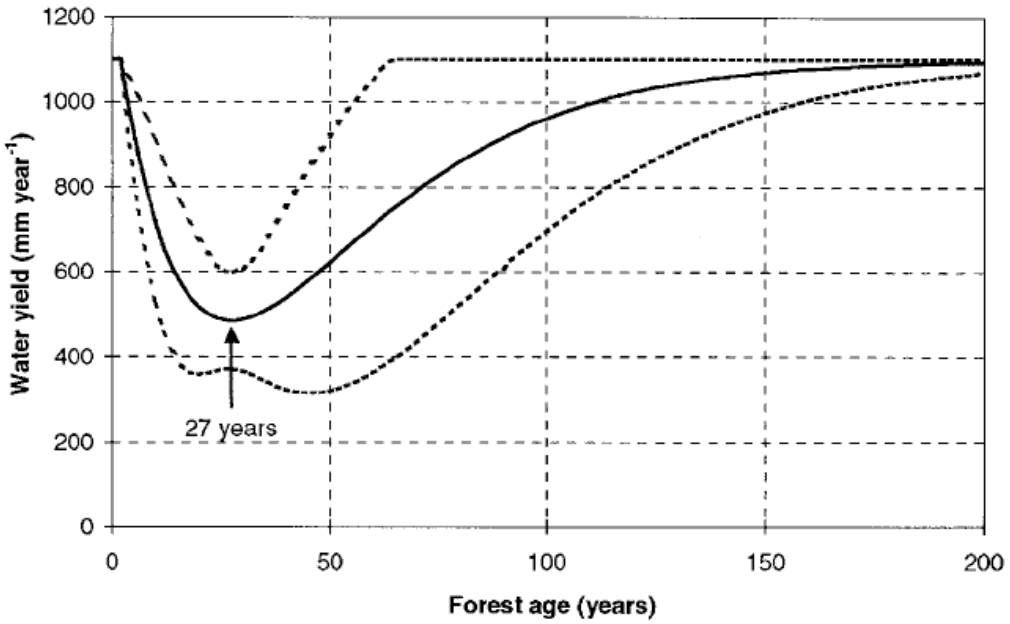
And that arrow that says transpiration is one of my take home messages – that we need to know a hell of a lot more about transpiration if we are going to really work out how much water we are going to have for cities like Melbourne or Canberra or Adelaide in future. So transpiration (or plant water use) is one of my main take home messages we need desperately to know more about – transpiration by eucalypts.

The take-home message from today's lecture is:

We (desperately) need to know more about *transpiration* by eucalypts

And I was immediately, before we gathered here today in chatting with people – we just talked very quickly about how there was a step forward in our knowledge of how much water we get in the catchments in the 1960s and 1970s – there was one more step forward made in the 1980s and 1990s but in between we have learnt, or we have ignored, much of what we need to know about water yield from our eucalypt forests. We tend as a country to invest in research as we need it rather than as we think we might need it in future. And in the past this is the classic example for the City of Melbourne. This is the work done by Kuczera and others many years ago based on the water catchments and based around measuring water yield after the 39 fires and this these data that were collected a long time ago now are still the basis on which we estimate water for the City of Melbourne and it shows a water yield – which is the solid black line, declines after fire for about 27 maybe 30 years and then slowly returns, or slowly increases.

The past……..

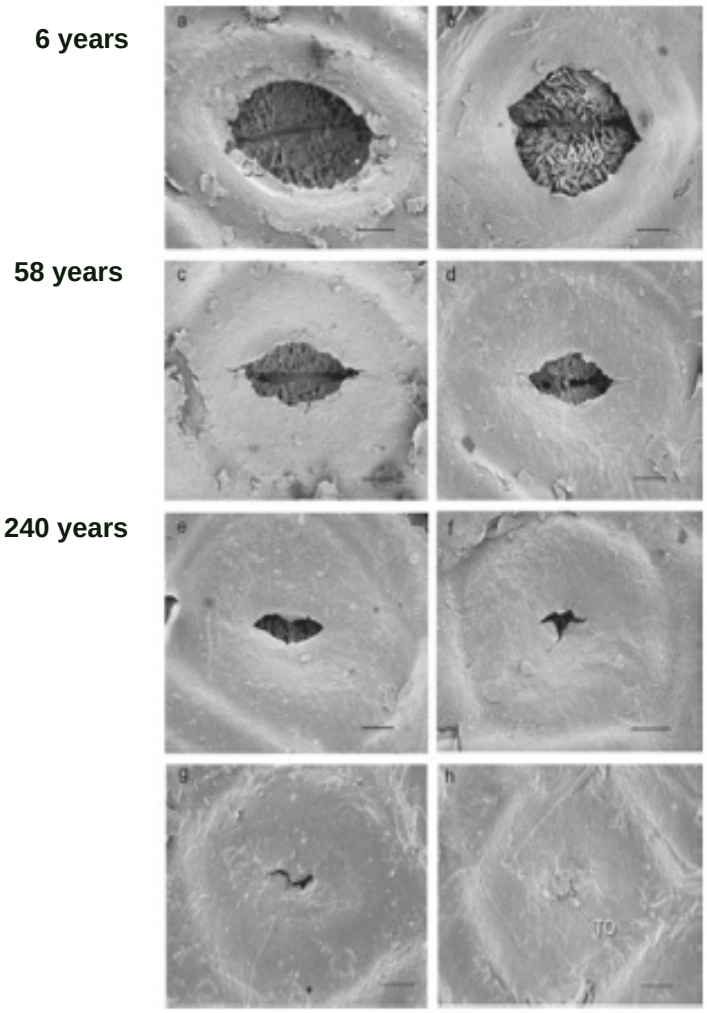


The 'Kuczera curve'for Mountain Ash forests regrowing after fire. Minimum water yield is predicted at about 27 years after fire.

And one of the key issues for us to think about is that this graph shows the water yield declining from a point, and the point used in this example is from a very old mountain ash forest, not an ash forest of 60 years of age or 80 years of age but an old ash forest. I'm going to deliberately avoid using the term old growth. Old growth foresters are fine, old growth forests worry me. But old forests they were never the less. And much of the debate around the water yield issue of the mountain ash forests around Melbourne has, is centred on, the notion that that point, right up there on the y axis, should be our reference. That is of an unusually old mountain ash forest. If instead we had used a somewhat different point, perhaps a mountain ash forest of 80 years of age or even 100 years of age instead an ash forest of 150 or 200 years of age we might think about water yield somewhat differently. But the reason for putting this slide up here is this is what we learnt by work done by the Melbourne and Metropolitan Board of Works and scientists who worked in their catchments for many years.

And again the comment was made before my presentation that Melbourne's water quality is exemplary because all of those catchments are behind fences. Sure, we have great water in Melbourne, but pretty soon you will be drinking desalinated sea water. In Brisbane they will be drinking sewage, treated sewage. Now, what's the difference between accepting a slight modification of water quality or having to treat water that comes out of a forest and having to treat seawater? This is a question that I pose.

We get very strange about our water we are happy enough to put a fence around a catchment and declare it sacrosanct and then say haven't we got wonderful water and then on the other hand we are quite happy to build desalination plants, send a zillion tonnes of carbon into the atmosphere and drink desalinated sea or drink purified sewage. There is obvious, hypocrisy is too strong a word, but obvious fault in our logic from time to time. We are not willing to treat water which comes out of forests but we are perfectly willing to treat seawater. Work done in between those sorts of milestones in the work by Kuczera and others including work done by my colleague Peter Attiwill has helped us understand a little about transpiration and the water used by eucalypts. And these photos simply show the pores in leaf surfaces and how they change with age.



Plants might also adapt structurally …..

Increase in cuticular ledge and waxy occlusion in leaves of *Eucalyptus regnans* in trees of increasing age

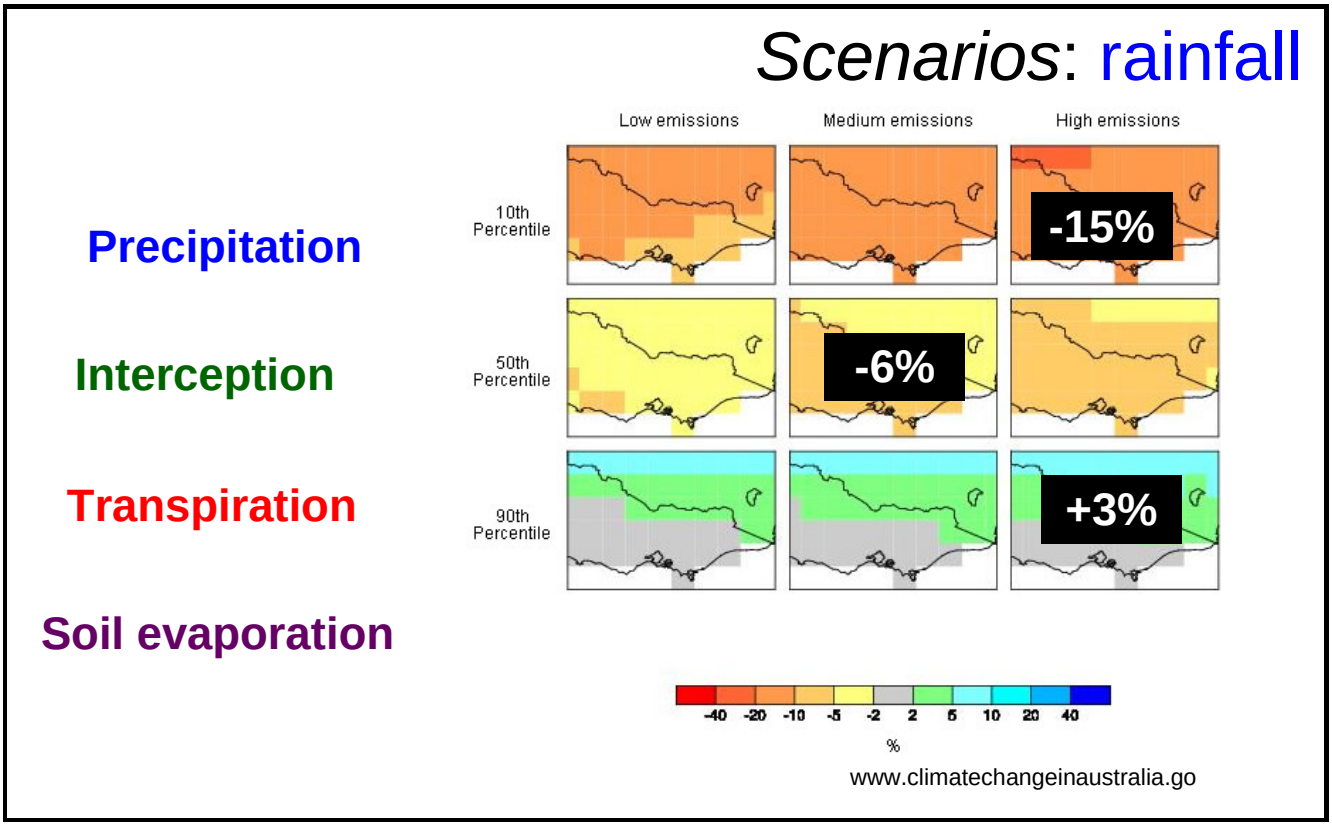
England and Attiwill, 2006, *Trees* 20, 79-90

You can see the open pores at the top of the figure, the pores at the bottom of the figures are closed, build up of a waxy surface on the leaves has helped to close the stemlatel pore and thus help to reduce water use by old forests. And so go backing to this figure, in fact going back three figures, we need to keep in mind that the amount of water that becomes yield is very much the amount of water that is not used by the vegetation. So keep this is mind. The amount of water that becomes yield is that not used by the vegetation. So if the vegetation uses less water because the pores in the leaves are smaller, then there is more water to become yield.

When we look to the future we know that increasing concentrations of carbon dioxide has increased water runoff on a global basis. But Australia is not the world. Australia is instead home to fires. We have a peculiar climatic regime in Australia that predisposes us to bushfires of one kind or another. The fires that raised Canberra, the fires in Ash forest, I apologise the likings a little fierce here on the

screen and you can't really see this but this is a photo taken from Winters Pinch outside Licola after the aftermath of the 03 fires.

These fires will in terms of water swamp all of the likely benefits that we might gain from an increase in C02 and we have been doing some modelling as have many people, particularly the economists, but our modelling is focussed on what's going to happen in future and I admit immediately that our modelling is as rubbery as that of the economist's.



Even so, rainfall predictions for southern Australia and you can see here very simply rainfall low, what we call the low emissions scenario, the medium emissions scenario and the high emissions scenario and the 10th percentile in the top, the 90th percentile in the bottom and the 50th percentile in the middle. Even taking the mean of a great many other projections for rainfall for southern Australian suggests, or that the 50th percentile more correctly, suggests a reduction of what we have currently. Rainfall is likely to reduce. And in our modelling we simply looked at three scenarios, one, a high emissions scenario where Co2 rises, or quickly a medium emissions scenario and a low emissions scenario and the likely changes in rainfall that are predicted by various agencies including CSIRO and the Bureau of Meteorology.

So we have three scenarios. A 15%, a 6% and a plus 3% increase in rainfall. They are our three scenarios.

Now let's think about what happens to interception which is one of the other components of the water balance. We know that under high Co2 under an increase in Co2 leaf area generally increases, an increase in leaf area will mean an increase in the amount of rainfall that is intercepted. And shown here is a figure of 21% under the middle scenario, 23% under the worst case scenario, 7% under the best case. I won't bore you with the details other than we can go through all of the possible influences on the amount of water that is going to be used by the vegetation under a world where we have a high Co2 environment, less rainfall, greater temperatures and when you start to put all these things together, we come to our projections for the whole of the eastern highlands, from Sydney all the way through to Adelaide. Water that drains from the great divide, both north and south, and we show here four scenarios: the current estimate of rainfall and these are of course medium figures rather than science specific figures.

The current situation for rainfall, the worst case scenario, the middle case and the best case scenario. Now if all the forests were to remain the age they are presently you can see small changes amongst the different scenarios, in, for example, soil evaporation or transpiration or run-off and you'll note the transpiration in terms of the total amount of water from an old forest is a little bit less than interception roughly a bit more than run-off a little bit more than soil evaporation. However if we have fires and convert our old forests to young forests, then you will see the transpiration number, so if you look at the middle of that figure you'll see the transpiration figure. Go back to this figure you'll see the transpiration figure.

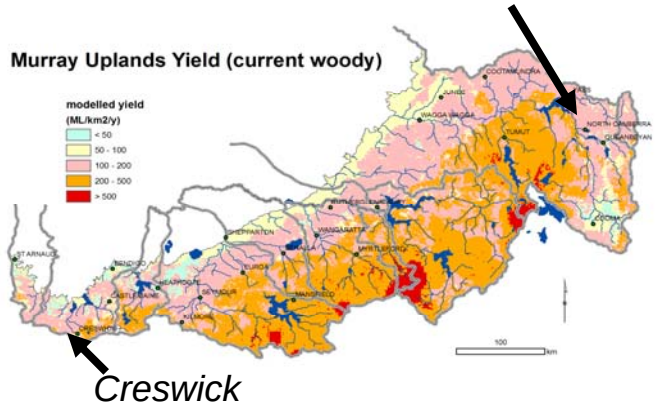
Native forests are critical to urban water supplies

90% of Melbourne's, Canberra's and Adelaide's water comes from wet eucalypt forests

The Eastern Highlands:

- 3.5 million hectares of forests
- 32,000 GL annual water use
- 8,000 GL annual stream flow

Canberra



Creswick

Marcar et al, 2005

5% change in water use (transpiration) = 20% change in stream flow

(= 1.3 million ha new plantations)

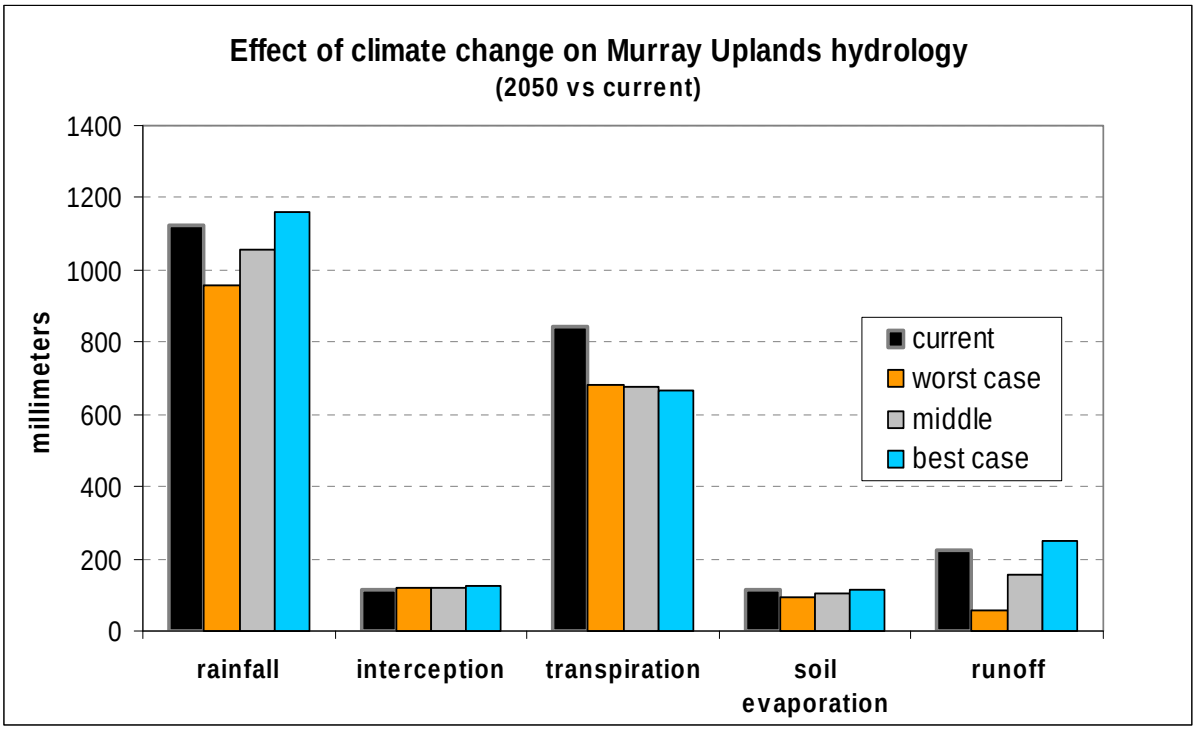
Changes in climate may change plant water use by >> 5%

But now you can see the effects of bushfires on converting old forests to young forests. And this is what I meant when I said that the effects of fires have the potential to completely swamp the effects of changing climates. Fires more than climate, fires more than logging are changing the water balance of our native forests.

Now these figures as shown here are truly alarming. If this were correct and this is shown here as the 20/50 scenario. If we, for example, have a succession of bushfires – and remember we have already burnt 3 million hectares of Victorian forests in two fire seasons alone, but if that sort of pattern would continue we are talking about not 5% reduction of water into the Murray Darling or into the Gippsland Lakes or indeed any of the Gippsland rivers, we are talking of 30% reduction in water yield.

Younger forests

Projections



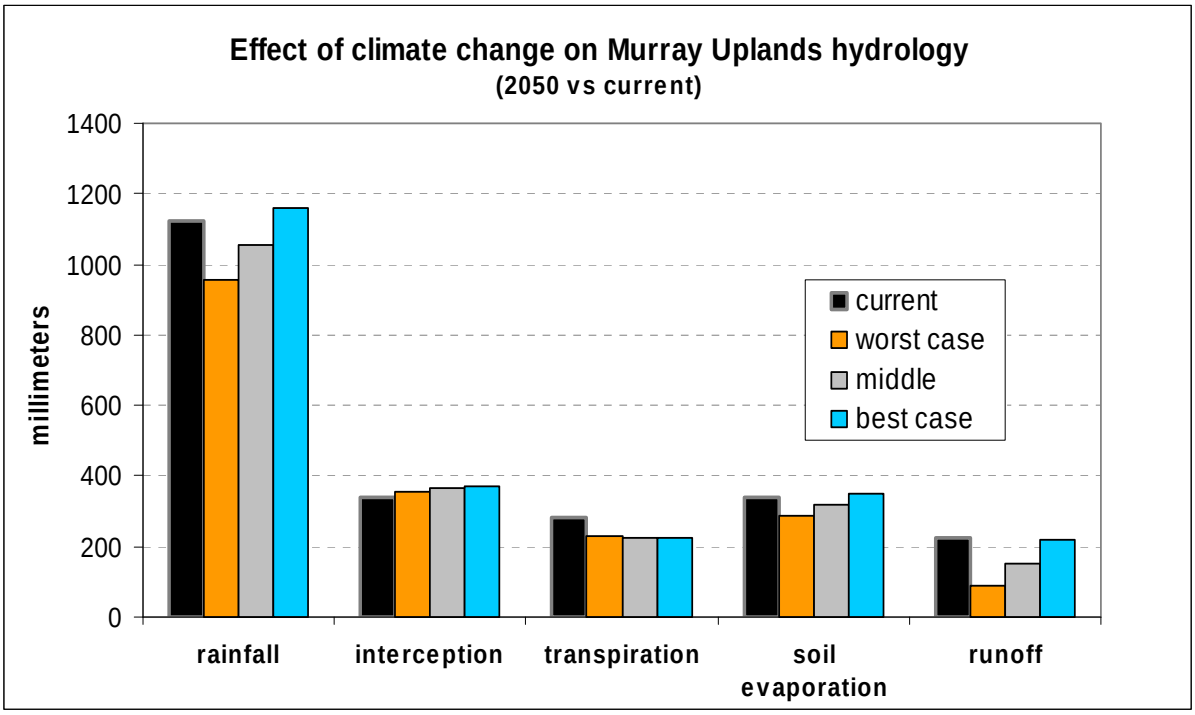
Now I'm a modelling sceptic along with a lot of other people. I much prefer to think of hard numbers. But those numbers certainly gave me cause and when we developed these model projections they were built with the best available models at the time with the best available data we could access. But they emphasise just how important again is the transpiration figure.

Transpiration largely determines the amount of water that is yielded into our dams and rivers. So native forests are critical to urban water. 90% of Melbourne, Canberra and Adelaide water comes from our eucalypt forests. The 3.5 millions hectares in the eastern highlands yield roughly about 8,000 gigalitres of water each year. On the other hand they use 32,000 gigalitres of water each year. Again this is the sort of number that the general public need to understand. Of the water that comes in as rainfall, four times as much goes back to the atmosphere through transpiration as ends up in dams or rivers.

A 5% change in water use gives you a 20% change in stream flow, broadly speaking. That would be the equivalent of establishing 1.3 million hectares of new plantations if we so choose. Everything and all plants need water to grow. We need to keep these sorts of figures in mind when we are thinking of public policy and how we manage our forests.

Projections

Older forests

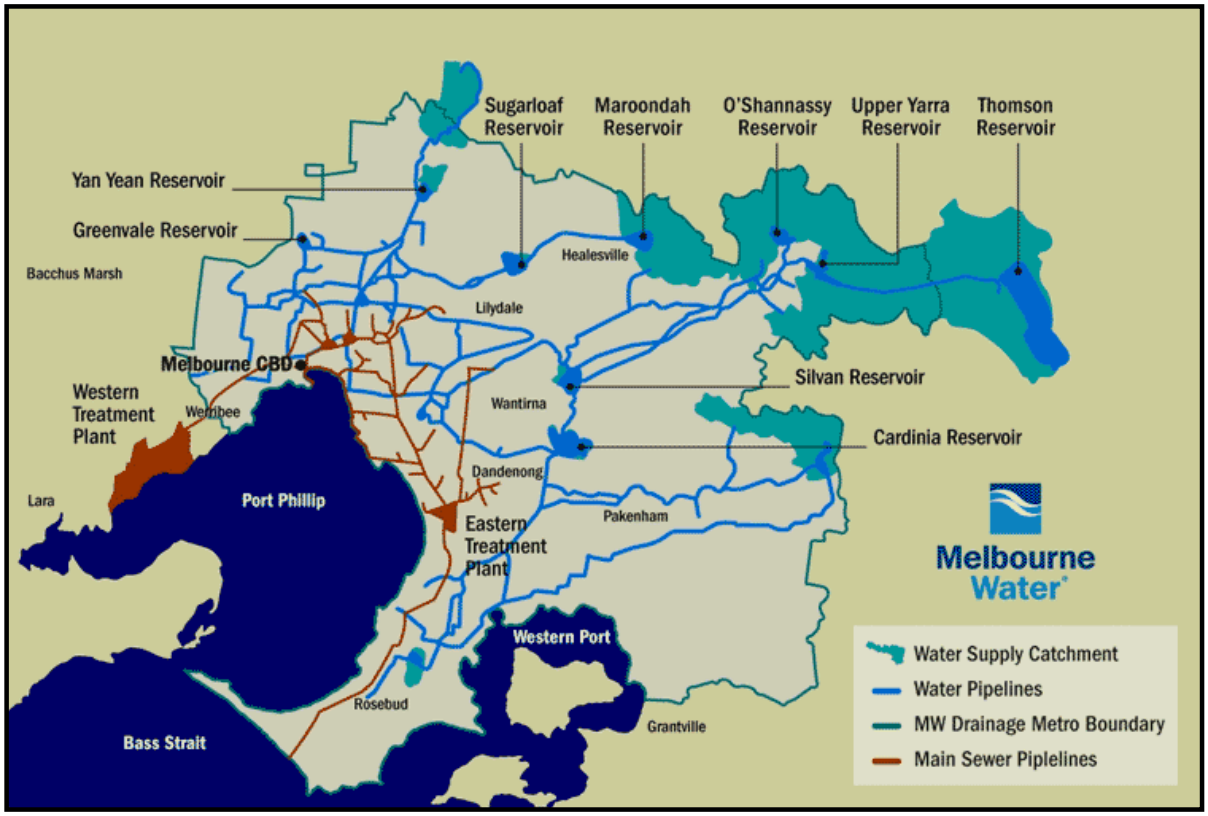


Changes in climate may change plant water use by very much more than 5%. Changes in fire regime multiply that by four. Now I'm making some sweeping generalisations here but I'm doing so from a knowledge of the literature. All of the literature that we have available to us at present suggests that regenerating forests use much more water than the older forests they replaced. A 5% change in transpiration can translate into a 20% change in stream flow.

We know that the effects of fires and changing climates will vary massively across species and sub-catchments, and that water yield is heavily leveraged to these effects…….

A 5% change in transpiration can translate into a 20% change in streamflow….

Let's bring it a little closer to home and talk about the Melbourne water catchments. A catchment area is roughly 160,000 hectares and eucalyptus regnanes mountain ash provides something like 80% of that water yield.



Facts: - catchment area >157.000 ha
- *Eucalyptus regnans* forests provide 80% water yield

Melbourne Water 2007

When we started to analyse this and we started to think about or could we get more water out of the forest. It doesn't take very long to realise that if we thinned just one quarter of Melbourne's water catchments – just one quarter of them were thinned in a commercial operation, a commercial or even a non commercial operation, just thinned the forests for the value of their water we could achieve an increase in yield roughly the same as that that is going to supposedly be delivered by a pipeline from the north of the divide. So active management of one quarter of Melbourne's water catchments could provide as much water as is going to be delivered by a pipeline.

I am very reluctant though to focus solely on Melbourne Water catchments. And I am reluctant because every person in Australia, no, well not every person, a huge proportion of Australia's population relies on water that drains from a forested catchment somewhere. I hazard a guess that it's something of the order of 95% of the Australian population rely on water from forested catchments. And so while Melbourne has a peculiarly, a peculiar approach with its "fenced" water catchments, what about the people of Gippsland, what about the people of north eastern Victoria or of people who are west of the divide in NSW and Queensland. All those people too rely on water from the forested catchments but they don't have lock up and leave it water catchments. We must be very careful about how we frame our public policy. If we are just going to protect the water supplies from Melbourne what about everyone else?

Since 2003 we've been working extensively in the mountain ash forests in the Upper Yarra and in the alpine ash and snowgum forests in the high country as well as some of the mixed species forest. We've been using new technology to try and measure transpiration. Transpiration as I've said is absolutely the core of determining water yield.

We've developed our own technologies and in some cases commercialised them, but we've, in all of our research, we've paid as much attention as we could financially to issues such as replication, such as dealing with different parts of the landscape. And I won't go into the details via slides like this other than to point out that we haven't just been concerned by the overstorey, in this case the mountain ash. We've actually been measuring the amounts of water required by other plants within the forests, and so understories, heavy understories of acacia species or a pomadaris and many other species also require water and as I said I won't go into this other than to point out to you that all of the plants obey some sort of basic biological phenomena - they all use water, the amounts of water they require are dictated by climatic conditions and so here you can see in this graph simply the amount of water used per square centimetre of wood plotted against the mean daily temperature for mountain ash in the top panel and two understorey species in the next two panels. This is the sort of data that we collect and if you noted the number of replications is 180 odd – that's 180 days of continuous measurement. So we've been out in the forests and as I was kindly introduced as a person who likes to do my own dirty work I was out in the forests and trip over the tree roots and knocked myself cold a few times – but that's part of it. These measuring transpiration or understanding vegetation water use is not simple. We can't just go out there and whack a gauge against a tree trunk and measure it. It's actually rather complicated.

And we've developed some rather robust relationships. We understand things like the amount of water used by an individual mountain ash and plotted against the sapwood area of the tree forms a

logistic relationship. And we can use those sorts of understandings to start to make predictions that are empirically based rather than purely processed based modelling. And some of our empirical models tell us that water use by ash forests that have a heavy understorey might be 20% or 30% greater than water use by ash forest that have little or no understorey species.

So in this slide you can see that the total in the top panel versus the total in the bottom line so 350,000 litres of water per hectare in May in a mountain ash forest without an understorey versus 430,000 litres per hectare in May for a forest with a heavy understorey.

What about June and the other months or is it the other way round?

In the next month we have 407,000 versus 378,000, still the understorey adds another 127,000 litres so the total in June is 500,000 the total without an understory is 400,000.

So I'm just using these as example data. Now this is not something particularly startling. All biologists would have told us that all vegetation requires water. All vegetation is going to be using water.

The point is that we have started to quantify exactly how much water is required by the different parts of the forest. We have also started to quantity what happens in forests of different structure. Whether it is a young stand, for example here of 1,000 stems, all for example, of around 30cm or an old stand where we have perhaps only 60 stems per hectare but each has got a diameter of 150cm, for those old foresters in the room, they would be very happy to say yes those are big trees that have got a diameter of 150cm. The young stands though use much more water than the old stands. This is not a difference now due to different understorey, it's simply a difference due to the nature of trees, the trees themselves. So we know now that the understorey is an important component of the water balance, we know that the structure of the stand can dramatically change how much water is required and therefore how much water is going to be released.

Now I'll make a point at the end that much of Melbourne's water in a non drought year actually originates in the Indian Ocean and much of the water in non drought years comes right down through central Australia. So somewhere like Cement Creek on the south side of Mount Donna Buang we can measure exactly what is the contribution of water from the Indian Ocean and what is the contribution of water from the south west of the fronts. And what we have found is in non drought years there is a significant contribution of Indian Ocean rainwater whereas in drought years it is almost totally reliant on the south westerly fronts.

- Water yield from south-facing, radiation-limited *E. regnans* forests was little affected by plant water use (e.g. “base flow” for Yarra and catchments)
  - Rainfall the determinant of water yield
  - There is a significant “continental” component of rainfall in non-drought years - Indian Ocean temperatures are important to Melbourne!
  - In drought years, south-westerly fronts become even more important as sources of rainfall

In summary a lot of our work in mountain ash forest has shown us that in south facing radiation limited forests there’s not much difference in plant water use – well let me put it differently, plant water use is very much independent yielded in catchment, in other words some of our most sheltered catchments have a base flow or provide much of the base flow for the Yarra and for catchments for Melbourne and rainfalls are determined by water yield. In drought years, south west of the front become very important. The point here is not all parts of the Melbourne water catchments behave the same. Some parts of them we can model using what we call our biophysical models where we use climatic conditions such as temperature and humidity, in other parts we can use much more simple models based solely on rainfall.

The other point that I make here is that we still have an alarmingly small amount of knowledge – even for well studied species like mountain ash. Skip this, then just to make the last point on the last slide is that even for the Melbourne catchments we have possible, and I’ve called them win, win, win, scenarios, we can have larger trees, more water and less fire risk, but only if Governments are willing to invest funding to improve how we could thin even a small portion of those water catchments. Even putting that out as an idea is something of an anathema to many people in the public domain. People are very protective of Melbourne’s water catchments and the idea of any management other than let’s guard the perimeter, let’s build a big fire break around them, is something that many people are not willing to consider.

Summary so far….

- We know that "not all *E. regnans* forests are the same" - differences driven by topography and history, especially fire history.
- 'Water' behaves differently, depending on topography and fire history, across the landscape.
- Understorey uses significant amounts of water.
- Stand structure (e.g. diameter distribution) is crucial to water use and thus yield.
- There are possible win-win-win scenarios - larger trees, more water yield, less fire risk - but only if governments are willing to invest the modest amounts of $ required to improve thinning techniques

But when we think about drinking recycled sewage or when we think of spending billions of dollars to desalinate water - why are we not willing to be even considering the idea that we might thin, and then if necessary, if necessary, treat the water that comes out of the thinned forests, if – and I say if - it is in need of treatment and I contend that in fact with modern logging techniques it would be not necessary to treat very much of the water at all. Our work has gone well beyond the Melbourne Water catchments, we are now working in the high country, we're working in the alpine ash and snowgum forests in north eastern Victoria, we are working around Canberra, we are working in the regrowth stands, we are working in the mature forests and I need to hurry up. We've put in place an infrastructure now across Victoria into NSW and the ACT that includes large numbers of forest stands, all of which have been implemented.

We've included snowgum alpine ash we measure things continuously, we measure things over long periods of times, we use all sorts of census and we can measure tree water use really very accurately, a lot more accurately than we could measure 10, 20 or 30 years ago. And we find, and this is no surprise that the regrowth forests shown here in the dark bars are using water much more liberally than the mature forests they replaced shown in the purple or blue. I apologise for the clarity of the slide. This sort of information confirms previous studies for mountain ash so the alpine ash is behaving somewhat similarly to the mountain ash. But even more surprising is we are finding phenomena that

we didn't know existed. For example, night time transpiration. Alpine ash in the bottom panel here freely at night time some days as it does during the day.

Night time transpiration, the line above it is daytime transpiration. Now this is the sort that are adding to our sum total on the other hand the snowgum appears to not as freely as the alpine ash.

So these are new findings confirming what we knew that regenerating forests than the forests they replaced but we are also finding very large differences depending on

We can't simply say that the cause occur for mountain ash applies the landscape and so I return to this figure and if I haven't .. is the thing we need to understand then I feel I will have failed. Transpiration is the most important in terms of the science and what we can learn and how we can prove our management. We now have in place a most comprehensive climate and change we have strong rigorous designs and we know from the work we have done in the high country that using fire we can control fuel loads and fire risks with minimal risk to water quality or water yield. This is the area of research we are now engaged in, we are engaged vigorously in ACT and Victoria we have experiments on the ground and how they can be used to control fuel loads.

I'm afraid my message in part is one of deep concern – and that is our future in south eastern Australia is one of certainly less water. I'm not here to argue the case that prescribed fire or thinning forests will replace all of the water that we are likely to lose as a result of bushfires or a result of changing climates.

- Eucalypt transpiration remains the single most important component of catchment water balance.
- We now have one of the most comprehensive networks of *calibration* stands for studies of transpiration.
  - Incorporates the effects of fire and climate change
  - Strong, statistically rigorous design
- Planned fire (or prescribed fire) can be used to control fuel loads and fire risk in many upland forests (SG, AA, MS)

Indeed I don't think we could ever stop what we are facing at the present time. We will still have less rainfall, we will have more interception. We will have more fire. Our options are to use more prescribed fire where we can, understory management where we can. We should consider thinning wherever possible and I use that term advisedly, wherever possible. In some cases it is not possible. Our other option is to pay billions more for our water. As Melbourne's waters catchments have been managed by a strategy of hope by the politicians. I'm faced with the job of telling the public telling them they have 40% less water. My concern is that strategy is increasingly adopted for our native forests… and surely now the dollar value of water is changing public and political perceptions of such a strategy. And I think I better leave it there. Thank you.

Take-home messages

For Eastern Highlands as a whole (including Gippsland), runoff will decline

How much? **~ 30% (-75% to +5%) over coming decades**

Why? **less rainfall**
more interception
more fire

Options?

Fire management - more planned burns where we can
Understorey management (fire, mechanical)
Thinning
Pay billions more for water *(desalination)*

Melbourne's water catchments have long been managed via a "strategy of hope":

"I hope that they don't burn on my watch"

Unfortunately, that strategy is being increasingly adopted for nearly all of our native forest estate.

Surely, the $ value of water is changing public and thus political perceptions of such a strategy?

Questions

And I will take questions.

Simon Paton: Can you successfully burn the understory without killing the forest?

Mark Adams: I'll just take the last bit first. I'll answer the last thing first. It's long been part of the strategy developed many years ago to build reservoirs – it wasn't to collect the average rainfalls, it was to collect the abnormal events of anything but going to the first part of the question I have to rely here on more experienced people than myself in the practical application of prescribed burning under alpine ash.

What I have seen myself is that it can be done very successfully and was done very successfully in the north eastern parts of Victoria for many years. The difficulty arises when it hasn't been done for long periods of time. Then it becomes a much more challenging task. Once there is a fire regime in place of greater frequency and again, and no one that I know of from the scientific fraternity is proposing annual burning or anything like it.

We are talking here about return fire periods of 5-10 years – even with the best will in the world we know that we are going to struggle to get back financially in the current environment to be able to do it but the problem at the moment of course is that much of what hasn't been done does propose significant challenges and certainly would take a greater effort than otherwise would be the case to use prescribed fire in the alpine ash.

John Cribbes: My name is John Cribbes and I stay in Gippsland and I have a recreational interest in the bush and I am also a great advocate for a duty of care to the native flora and fauna as some governments don't seem to worry about them at all – my question is the same as the question to the speaker in May – is your work been brought to the attention to the Government's Environment and Natural Resources Committee as they are currently researching Melbourne's future water supply.

Mark Adams: Not by me and I'm not aware of others who have brought it to their attention.

Jami Nettles: My name is Jami Nettles and I am a Forest Hydrologist in Weyerhauser USA and I am here looking at Australian traditions. In USA we have traditionally been concentrating on water yields. In the USA we tend not to burn because of all the social concerns. Would you use herbicide to reduce the understories?

Mark Adams: I should have added that we could control using mechanical means as well as fire – I have no great aversion especially around high value assets – I think increasingly we will be faced with how do we manage risk around using chemical herbicides.

Regrowth forester: What is your view on monoculture plantations? Are they economic and do they distort farmland?

Mark Adams: I completely concur. We recently raised this question in a paper… I raised this personally with ministers of both colors. It is one of the only times in my life I have agreed – why are we giving huge tax breaks and run and leave someone else to manage the land.

Stewart McArthur: Thank you - Graham Stoney.

Graham Stoney: What do you think of logging in water catchments? .

Mark Adams: As a matter of good public debate – it would be a sensible public policy. I'm hesitant to use my soapbox other than to say we have an increasing knowledge of how to harvest forests in a

sustainable manner. The Greenies say clear fell logging will do this, a clear fell logging will do that. The debate has become polarised – maybe dead in the water.

It's for all of us to remember it is to get the science correct.

Loris Duclos: It seems to me that cattle in the bush can be a very useful tool to thin instead of using fire or chemicals – cows are a natural tool.

Mark Adams: We are trying to put the numbers behind fuel load.

Alistair Urquhart: How do you rate the Stretton Group with getting the information out?

Mark Adams: This is something close to my heart, I think the Stretton Group has received recognition for public debate. I think it has achieved significant reviews – I don't think they would be there without the Stretton Group.

Question: Fuel reduction burning in NSW.

Mark Adams: Now that I live in NSW there is a group of people fiercely opposed to the use of fire as a fuel reduction tool.

Professor Peter Attiwill: What is your assessment of fuel reduction burning in the public arena?

Mark Adams: Yes. In that book Peter, the one that you're helping me write, but in that book I think it's a book that sets out a case for prescribed fire. But in the start of the book, and you don't know this yet, but it's about science. What the future generations will think about us. Bring science together or whether we have just made decisions about huge impacts if our forebears hadn't built dams – where would be now. The things that mattered were based on what was available at the time.

Vote of thanks - Stewart McArthur: At this point I think we might thank Professor Mark Adams. It proves he is prepared to argue the case, even if he has not got an exact answer. I think we can end on where would we be today. We want to get this issues and this forum out for open public debate. We will welcome Professor Mark Adams back in a couple of years when we have had rain.