SOLVING OUR WATER CRISIS

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We know there is a water crisis in Tasmania when representatives of farming organisations press for governments to redirect water from somewhere else or allow unrestricted dam construction, and when residents of rural or small communities plead for a reliable water supply; preferably one that is safe to drink.

What most Tasmanians do not appreciate is that this is the common position around the world. Demands on water supplies exceed capacity and mismanagement is endemic. (References in Budgets and Audits.pdf attached should be consulted). No part of Australia is free of problematic management and general ignorance of water issues. The problems are now so large and complex in some areas that the political and economical will required to resolve them is intimidating.

We are currently over-allocating surface waters, over-allocation and often not counting groundwater, with consequent run down of hydrological systems and a trend to desertification. The urge to build more dams, with effects due to diversion, and loss due to evaporation is not a help. How can we stop making mistakes of this order? What can we do to guide managers and individuals?

Knowledge and information is the secret key to solving our water crisis: that knowledge can provide for sensible management, changes in water use practices, and changes in land use or occupancy.
The solution also depends on our realisation that there is only one water system – and all its parts are interconnected and integrated. If we draw on one section, there will be a reaction somewhere else, and we may need to consider whether that reaction is critical or undesirable. Comprehensive management also requires that the water resource be publicly owned and not sectioned for private profit – something which can only lead to inequity, increased costs and inability to apply regional solutions.

We would need to consider how to manage our water resource in terms of internal pressures in any event, although this has rarely been done, but in times of climate change when the entire hydrological system is in flux this becomes vitally important.

Much data about the change in rainfall and stream flows now exists and it appears that the last fifty years have been exceptional and allowed us to imagine a larger resource than we have any right to expect. We have planned on the basis of this anomaly and assumed high rainfalls and flows will continue. This pattern is best known for the Warragamba Catchment (Sydney Water) where current yields are now returning to 1900-1950 levels, but this can be observed in some Tasmanian rivers as well.
Changes in rainfall patterns are also relevant and a study of twenty catchments in NE Tasmania reveals considerable variation in rainfall and yield. Loss of autumn rainfall is most common and this has implications for subsurface recharge and catchment yield in the following summer. While some localities have retained long term annual rainfall averages this has happened due to summer increases in rainfall which leads to greater loss to the catchment due to higher evapotranspiration and evaporation. Thus, while it may be observed that the inland sources for the catchments have lost of the order of 10% of long term average rainfall since 1975, the actual yield of the catchment may have been reduced by 10-40%. This multiplier effect has also been reported for catchments in SW Western Australia. Each catchment is unique and must be treated as an individual: no simple universal assumptions are advised.

How then, given these changes in rainfall and catchment behaviour can we manage or resolve the compounded problems of past practices?

The solution is maintenance of a water budget recognising that only if inputs exceed outputs are we likely to have a sustainable situation we can live with. The budget must omit nothing even if we must make estimates, however crude.

Further, there is little we can do about inputs: if it rains it rains, if it does not, too bad. Balancing the budget thus depends on dynamic adjustment of outputs (claims on the resource) and this needs to be done on a monthly basis in stressed conditions. Prior to European settlement expenditure took the form of natural growth demands (grassland, forests, animals, miniscule aboriginal use) and reactions after fires. All or any water left over was the environmental flow and sustained the landscape and its contents in proportion to that flow.

The total expenditure of a catchment is readily determined: total the rainfall across the catchment and then measure the yield at the end of the catchment. If there is no yield then the expenditure is at least 100% and further inspection of ground water levels will be required since the demands may be substantially greater. If there is yield then the ratio of the volume escaping to the volume input is a measure of total claim. Before 1788 we could count this yield as environmental flow but current yields are merely what is left over and it may not be enough to sustain the long term riparian environment or the landscape. It is not necessarily “free” water to be put to any use.

The matter of environmental flow is important to users since it ultimately determines what can be taken from a stream or catchment system. Note that natural expenditure not only includes grassland, forests and animals but also that volume necessary to sustain the catchment system. This volume may change monthly.

Various ideas have been trialled concerning environmental flow, including arbitrary percentages of annual flow or certain flow volumes as cut-offs. Neither of these methods are effective since both fail to provide the stream with its seasonal or annual pattern and with which its biology was once concordant. Nor do they guarantee adequate flow levels at critical times in life cycles. Simple numbers such as these do allow easy bureaucratic management and also mislead users in what they might expect since the cut-offs are always much higher than the low flow values of, say, summer seasons past.

A better, if more complex, solution is to examine several species from different phyla living in the riparian zone and assess their needs on a monthly basis. The required demands will vary across the year but all we need to note is the maximum demand in a given month since that flow level will sustain the other species. We may then consider the yield as measured and subtract the species demand (maximum per month) and any water in excess is water in excess, and can be allocated.

Allocations may be in the form of rights or grants and used directly on stored. Many such guarantees are extant even though, increasingly, the water is not available to fill them.

Allocations may be for agriculture, industry or urban situations and all are expenditure items in the catchment budget. Where a town or factory returns water to the catchment then that becomes a secondary input and only the resultant loss, if any, is scored as output. Where the catchment yield shows a persistent trend then all allocations should reflect that trend (up or down) and the trend should be annually appraised by means of a ten year moving average.
It should be noted that other uses may not be permitted or registered. These include diversion of springs from streams to dams, or as groundwater extractions. Some estimates must be made for these items. Contrary to popular views, groundwater is not an alternative resource: it is directly and totally linked to the surface water system – draw on one and you affect the other. In the case of wells and water bores an estimate can be derived from the well acceptance test by the driller and assuming that this volume is sustained all year. This is an extreme, but conservative, value protective for the catchment. Similarly, it must be assumed that all rights are fully taken, whether they are or are not.

Water flowing through the catchment can be intercepted or diverted. Redirection into dams, or to other catchments, is the most common. Translocation to other catchments is an expenditure in the supply catchment and input in the receipt catchment.
Interception, however, is normally taken to mean what is happening in the vegetation and soils of the catchment and this is included in the basic balance of total expenditure. We do not need to know exactly how the water is used, or intercepted, in a forest, merely that it is and that that use is part of the natural budget.

It is only when we change the land usage in a catchment that we transform the interception and diversion equation for every land use change (clearing, planting, burning, urban development) exacts a hydrological change. Several of these changes lead to changes in water quality (salinity, siltation, erosion) but, in terms of the water budget, it is the change in catchment expenditure which is relevant. If we have a forest in the catchment, average rainfall of 1000 mm, then the run off is about 200 mm. If it were a grassed catchment then the run off would be some 350 mm. Thus if we clear the forest we release 150 mm from the expenditure ledger for running the catchment. The land becomes wetter, reeds appear, and farming is easier. A new equilibrium may be reached in 3 to 5 years.

If, however, we take a grassed catchment (or burn or clear a forest, then replant) we reverse the trend but there is now a long growth demand and for part of the growth cycle the water demand will exceed that of a native mature forest by up to 50%. Thus our newly treed land at 15 years may be drawing 900 mm of the 1000 mm of rainfall and only 100 mm can run off. It may take many more decades before the run off levels match those of a mature forest. These time functions mean that the forest industry demands in a catchment are far from simple but potentially very large. In SE South Australia an average coupe lifetime usage value is now used (approx 1.8 ML/ha/year) in order to include a reasonable value in the regional water budget. Tasmanian catchments are much more varied, and either wetter or drier as well, and this average value could range from 0.3 to 2.5 ML/ha/year but with peak values nearly double this.
Note that where pasture has been converted to plantation the change in water availability at peak times is equivalent to 250 mm (350 as pasture less 100 as peak growth trees). A more dynamic function is advised in variable Tasmanian catchments which provides for the demand variation.

Once water has been committed or allocated and included amongst catchment outputs it matters little to the budget how it is used or wasted. That has to be an issue for the user. But, if the budget requires that all users take proportional cuts in allocation then minimisation of wastage or loss and maximisation of economic benefit will crystallize all such factors. This is how it should be.
Such considerations might mean closed storages, rather than shallow open dams which may lose most of their water by evaporation.

It will be clear that now items in the budget will be zero or always zero, as happens today for forest or groundwater usage, for example. Town usage should also be included. Any first budget will inevitably contain estimates or approximations and, provided these are conservative with declared assumptions, then the catchment will be protected.

Accountability in this form is the first step to sustainability and a secure economy in the catchment. It is also the means by which conflicts can be identified and addressed.

Thus if there are legal rights to store water in a dam, run a dairy, and grow plantations in the same area then the background exists by which the inter-related hydrology can be appreciated. If the trees are too many or too close, and draw down the water table so drying the spring to the dam, and hence terminating supply to the dairy then all is obvious. At the present time all three activities are legal but only two have licensed water permits. This is a recipe for inequity and folly.

Calculation of initial budgets also exposes deficiencies in data available.
There are rarely enough rain gauges for a truly comprehensive view and many more stream gauges are required. These are a small price to pay for sensible long term management.

But how to make that initial audit? It need not take a long time to collect the necessary data.
The input side of the ledger can be quickly assembled from extant rainfall data.
The output side of the ledger depends on the existence of a stream gauge and clearly more of these will be needed.
The two pieces of information provided by rain and flow data allow estimation of total expenditure in the catchment.

The detailed information on fixed expenditure, allocated expenditure and other usage may be acquired by desk audit – where records exist and approvals have been given – and by user questionnaire. This may take the form of those used by Australian Bureau of Statistics in their rural water and land use enquiries.
In this case the questions may include such things as: what is your right or permitted allocation, how much of it has been available in the last three years, how many wells or water bores do you have, what is your estimate of water drawn from wells and bores per year, how many dams do you have and what is their capacity, what is their present state of filling, how do you use the water (irrigation – including sub classes such as vegetables, vineyards, pasture etc, stock etc), are your dams earthen, are you part of an irrigation scheme, what do you pay for your water, are your storages filled from allocations or springs on the property, what proportion of your property is forested, what proportion is plantation (how many hectares), how old is the plantation, and so on.

Such a questionnaire can be advised by public notices and then sent to all land owners in the catchment requesting return within three months. It should be known that failure to respond might mean that requests for allocations or other approvals would not be considered for at least five years. This needs to be the only threat since the more information the better. Nor does it matter if there is some falsification or obfuscation undertaken since it will emerge eventually and, by treating key items conservatively, there should be few serious deficiencies in the total budget. Again, nothing will be zero.
Allocations, rights, plantation use based on a nominal region value, well use estimates can all be summed internally.

Where the basic catchment budget is found to be negative, overcommitted, then a scaled and tapered adjustment program must be undertaken until the budget allows some form of environmental flow excess. Most Australian catchments, and many in Tasmania, fall in this category and require urgent management. Such management is required under the National Water Initiative agreement but there has been little sign of the necessary auditing to either appraise the situation, or determine the scale of corrections required, and in which aspect of the catchment resource usage. Australian governments tend to focus on the Murray-Darling system and fail to appreciate that there are many other "Murray-Darlings" elsewhere; they are just smaller, and some of them with all the same problems and causes of problems, are in Tasmania.

Where the basic budget is marginal then the catchment may be given a gentle allocation taper and be listed for immediate on-ground review.

Where the basic budget is positive, and comfortably so, then new development or allocations could be considered.

Note that by budgeting on a continuous moving average basis for all elements that this system can work in both static or variable climate situations.
Simple hydrological functions and assumptions must be avoided. There has been a trend toward calculations which, whether based on observed rainfall and yields or inferred, take a century long average of yield and apply it to the future. This is simply silly given what we know to be happening.

Similarly there has been use of approaches which assume that rivers rise with rainfall and that off takes can be related to certain flow levels. Most rivers do not behave in this way and antecedent season and rain history are crucial to response. Such methods mislead users. There has been a history of allowing allocation takes from streams during winter in Tasmania since that is when most water is available. Examination of climate effects shows, however, that loss of autumn or winter rains, is destabilising the historic context and take periods should be altered to protect the catchment.

The clear message from any budget will be what is possible. This translates into "if you live in a desert, then you must live like a desert dweller." Every means must be taken to make the most of every drop and to resuse and recycle as necessary. It also exposes the risks related to the demands for translocation from other catchments or for unfettered dam construction without due regard for equitable supply up and down the catchment. These are not long term solutions unless audited budgets confirm their validity and they should not be entertained on the basis of lobbying alone.

For managers: do, or approve, nothing which cannot be undone.
This ancient principle has been completely forgotten.