GOING WITH THE FLOW?

We have all grown up with the idea that many things, such as climate, are a constant and things we have always done, or remember doing, such as grow a particular crop in a given place, or be able to water the lawns any time we wish, are things we will always be able to do. Those now familiar two words, “climate change”, imply that this might not be so – although no one can be quite sure how we might be affected.

What could happen to us, or to our children?

In this presentation I want to suggest that significant changes have already occurred and that the messages and implications of further change are writ large and clear on the nearest wall for us to read. We are going to have to roll with the punches, and lean with the flow – or suffer more than needed. Are we ready to face this new world order?

To understand the serious nature of the problems involving water we must first consider the fundamental relationships in the water system on planet Earth. Every school child is taught something about the water system: the water cycle. Two elements, one very important and the other relevant across geological time, are often omitted: these are the role of groundwater and its balancing effect, and the insertion of juvenile water from magmatic conversions within the planet. The concept of the water cycle has practical significance since it allows us to work out a budget with income on one side of the ledger, and usage on the other. Any change in income due, say, to climate change, demands commensurate adjustments across the ledger.
If we “mine” groundwater, or abuse the natural and current balances, we invite disaster: a crippled economy and society – and history is replete with examples.

Consider what has already happened.

There is nothing constant or predictable about annual rainfall. We may observe huge differences from month to month, season to season, same season each year, or from year to year. Such differences are “normal” variability. But, what if there is some systematic trend, either by month, season or year, and that trend has persisted for decades? What do we say then? Could it be a normal variation? What do we do about it? Do we attempt distinctions about the length of cycles, and temporary or long term trends, or do we continuously adjust to the balance: whatever it is?

Climate models may offer various suggestions about what may be experienced in future. Much depends on given inputs to models, or the changes we might foresee. Changes might include temperature rises, changed rainfall distribution or amounts, sea level changes or seasonal and drought effects. Statistics might suggest more warm nights, changes in heavy downpour frequency or windier periods. What do such statistics really mean? Further, many of these variations are difficult to define or quantify, or translate into everyday issues.
But, perhaps, we can gain some clues from what has already happened – and how we might react.

There have always been years of plenty and years of drought. We have also produced statistics such as long term averages, or expectations, or trends. Much data has been collected, so why not examine it?

Annual rainfall, for example, for St Helens in northeast Tasmania remains within 0.5% of the long term average – yet the distribution has shifted across the seasons, from autumn to late spring, since 1972.
This observation may be compared with some other areas.

In the northwest, midlands, or the northeastern highlands of Tasmania the total change for the same period may be of the order of 9, 14 and 12% respectively (all reductions). In several regions most of the loss has been in autumn and winter, with no spring or summer recovery. Such changes have been observed since 1972-6. In western Tasmania there may have been increases of similar amounts. Other places in southern Australia present similar patterns: Gipplsand (Vic), -10%; southeast South Australia, -5%; Perth (WA), -20%. The change may not have been steady nor constant across decades, a fact illustrated by Pipers River (NE Tas) catchment where there was a reduction in rainfall in the 1970s and 1980s but a gain during the 1990s. The river, throughout this period however, continued to lose flow: the capacity of the catchment to yield water decreased in each decade. How much of this effect was due to input change, and how much due to increased demands by the local environment – and its human passengers?

Regional, and quite local, variations can be identified in comparative mass balance analyses. Some examples are available for coastal and inland eastern Tasmania. Such studies depend on good, long term data sets for all sites compared. Continuity of record is highly desirable. Comparison of rainfall at Coles Bay and Bicheno, not so far apart on the coast, and Fingal some distance inland reveals some differences: the critical years being 1975, 1985 and 1987. The change in rainfall pattern for Bicheno and Coles Bay is slight (1987) but a much larger change occurred for the coupling of Coles Bay and Fingal (1975). The previous rainfall pattern was restored in 1985 but, during this ten year period, Coles Bay underwent a drying cycle. These are very local changes but we should consider them representative.
Large scale model studies indicate that south eastern Australia, taken as a full quarter of the continent, may gain rainfall in coming years. The eastern coastal belt, however, will lose rainfall. In either subset view the real issue is, how does the rainfall variation translate into environmental response and volumes of water available for diversion? And, at what time of year? It is also misleading to consider the statistics for the entire continent which suggest a slight overall total increase in rainfall. We must deal with data relevant to our application or our region and not apply irrelevant information.

Many catchments in the drier half of Tasmania (eastern Tasmania) mimic the now well known yield curve for the Warragamba catchment which supplies the bulk of Sydney water. Since 1960 there has been a systematic decrease in catchment yields but each anomalous period, either of short term increase or decrease, can be matched in east Tasmanian catchments. A longer term drying trend has over-printed short term fluctuations. These observations suggest a continental or global influence across eastern Australia.

At this time (2007) the trend at Warragamba is toward the lower yield levels which prevailed prior to 1950. There is no evidence to suggest that lower yields prevailed in Tasmanian catchments prior to 1950-60 but few records are available (e.g., North Esk). We should not, however, presume to receive higher yields in any of these catchments in future. The trend of decades is quite clear and there is no indication of a recovery and, even if there were, we should not expect it to be more rapid than the decline has been.

Then, there are the consequences of seasonal changes. Loss of rainfall in autumn or winter is very serious since it reduces soil moisture and groundwater recharge, and limits spring growth. Lower evaporation and transpiration levels in winter normally permit water system recovery but this is not possible if winter topping has not occurred and human and environmental demands then increase with spring or spring rains.

Data from river systems such as the North Esk, in NE Tasmania, reveal that loss of autumn rains leads to a storage recovery delay of at least two months and this is not completed until just before the onset of the growing season. If winter rains also fail, or are much reduced, then the system simply does not recover. All growth and, of course, productivity is retarded. Droughts may have extended effects depending on the rainfall pattern which follows them. Does the drought-breaking rain occur in summer or winter? Also, it may take many years before a catchment responds directly to rainfall after a long dry period; three years has been demonstrated for the Swan River in eastern Tasmania after 1967-8. If the growing season begins before groundwater and soil moisture levels have been restored then there is a risk that the system will retard productivity and catchment yield for that season – especially if follow up rains are poor. The best insurance against a poor season is a full ground storage and this is one reason we should never regard all of flood flow as excess: some recharge and cleansing is essential.

It follows, therefore, that if we have organised our allocation and water take system on the assumption that there is spare water in winter and all contracts are so specified then any changes in climate or inputs render this approach costly to both the water system and productivity. Water should be taken when it is there: not when it has always been taken, which may not have been wise in any event. Certainly, we should not take water from a system which is depleted in winter since we are then actively preventing its top up and reducing benefits we might have obtained in summer. It is not a valid argument to suggest that farm dams, topped up in winter from a run down system, are insurance. We need to review the possible damage to the entire catchment system. These comments imply that we may need to be much more flexible about when takes are advisable and this may well mean a complete change in cropping and farm procedure. The current rule in Tasmania, of takes between April and October, should be terminated in most catchments given present climate conditions and switched to perhaps August to November or even December – provided it can be shown that the water system has recovered for that year.

If the annual rain balance is made up in summer then much of the benefit of that rainfall is lost due to increased evaporation, increased transpiration, reduced recharge and greater demands generally. Catchments may not be replenished by such rains unless these are heavy and multiple, and the yield loss may be amplified when viewed on a monthly to annual basis. The Ransom River in NE Tasmania provides an example in which rainfall in the catchment has varied but increased in recent years: the river, however, has lost 33% of its yield since 1984! The deviation between rainfall input, and yield, is striking. This behaviour can only be ascribed to seasonal and not human demand factors which have been relatively constant. No assumptions should be made about the yield of such catchments using long term averages. The trend should be used as a basis for all allocation and yield assumptions, and catchment comparisons suggest we should treat catchments as individuals.

Reductions in ground storage also have implications in terms of flood response which may be immediate, or there may be none. The length of dry periods or periods of very low flow, springs, or salinity of surface water may also vary. If storage is full, and water tables shallow, then rivers respond quickly and may surge within hours of rainfall. Dry periods have the opposite effect and, if extended, lead to desertification as the system runs down. Managers and users must be aware of this and not add to the stress on the system with ill-considered demands.

There are corollaries.

If the weather and climate patterns change in an extended manner then any long term reduction in ground storage limits plant accessibility – and both farm and forest production, and, urban availability.
The result is both die back, now common in many parts of Tasmania (for various reasons), and a change in species populations. Damper forests become more open dry forests, for example. These things have already happened in those environments which were marginal but the effects have been amplified by the increasing drought conditions of the past five years. Many patches of forest have either died or are dying. Understorey plants have disappeared. These changes directly reflect increased average depth of water tables to levels which many plants and rock types have not experienced, or not for, or over, long periods. Changed fire risk is an additional factor. These changes are already evident in the eastern highlands of Tasmania.

It is my opinion that the currently quoted lack of wood production in many plantations reflects this factor. Too many assumptions have been made about what is possible, often on the basis of no detailed crop research, or on long term averages of past history. None of these factors is relevant in a time of change and much more conservative production estimates should form the basis for investment and profit calculations. I suspect that Gunns pulp mill, if built, may well fail commercially for this reason: there is nothing in the relevant documentation which suggests this risk has been considered.

Any continuation of current trends can only exacerbate the effects generated over the last thirty years. This has implications for how we judge or estimate “environmental flow” levels.

What kind of environment do we seek to protect: the one which belonged to a water balance of decades ago, or one which is reactive and able to survive in current conditions? If we accept that climatic conditions may change then we must also accept that the biological mix compatible with those conditions must also change. Just what amount of water is involved, necessary or to be permitted?

At the present time Tasmania calculates a century long average yield for a catchment, using a catchment model proportionate to rainfall or proxy rainfall data, quite ignoring the reality that nothing like this is now being achieved, and then sets aside a fixed amount of water for environmental flow conditions. Any remainder is divided amongst drinking water, stock water, industrial or agricultural usage. We may see how silly this is by reviewing the recent problem of the Clyde River, galaxias in source lakes and the townsfolk of Bothwell in central Tasmania. Since the yield for 2006-7 was way below expectation, an unrealistically elevated average in the first instance, and the volume legislated was set aside for environmental purposes based on those assumptions, there was little left for anything or anyone else. This type of management is narrow and unbalanced toward ecological conditions which cannot persist. The answer to this problem lies in greater flexibility: a proportional system for users, which works regardless of flow levels. All users receive reductions in poor times. The other part of this equation is prioritisation of usage where some uses are not allowed when levels drop below a certain point.
The “conservation” movement must also come to terms with this reality. In a world where climate changes, the biosphere also changes. There are winners and losers: the mix varies.
Some other jurisdictions are more advanced in working toward an adjusted and more flexible system of balances (e.g., Wungong catchment, Perth, WA) and have put considerable effort into education programs outlining options and choices.

It is clear that human demands, especially those created in good times, may produce considerable difficulties for a catchment in marginal times and possibly bankrupt those who depend on artificial or unrealistic water volumes or allocations. Changes in attitudes to water use, crop selection, area selection and profitability per hectare are needed. It is my observation that at the present time we are showing little sign of responding to changing flows and storages. The cry is for drought relief in anticipation of recovery. The call is understandable but it is not the long term answer - on a drying trend: that may involve closing the farm, merging properties, going somewhere else or changing product.
We have to alter in many ways or we will dessicate our environment and our economic future with it.

Allocations must be dynamic. This is but one management need.

We must match usage to income. Israel provides an example of such change. Once a citrus producer and exporter, the country realised that it was actually exporting water, a commodity it was short in. The question was asked, what can we do with less water that will produce more income? Much of Australia has to face this question. It is uncomfortable but essential that we do so. There will be regional catchment factors and there will be some essential commodity factors. Some regions should produce certain products depending on the current water balance trends and availability. No general assumptions should be made.

Crops and take, or usage, times may also need to change. If we assume that catchments are topped up and responsive by spring, much later than past history, then take periods should start at that point. Not before. Take periods might also need to be abbreviated by full summer in streams with strong seasonal character. We may also need to consider total reductions in takes in proportion with trends in yields.

It is clearly essential, for management purposes, that we keep a close track of catchment inputs, yields and trends and that we fund this data bank nationally. It is not something which can be privatised. Data must be objective.

A study of Earth history, and life on Earth, has told me one critical thing: when Erda reacts, whatever that reaction is, be sensitive to it – and go with it. Resistance or inflexibility is likely to be costly, messy and possibly a basis for extinction.

I can see reactions. I am aware of some of the trends. I understand some of the science and assumptions by which we may extend projections into the future. I am not convinced by all of these but we must take the trends at face value and act cautiously. I am not of the view that we will react at the scale necessary to reverse the inferred trends; some authors have suggested CO_2 reductions of up to 90% in order to achieve this, or control of anthropomorphic change. But, we should try; any reduction in pollution is no bad thing in any event.

More important, however, is that we go with the flow of the trends we can be certain of and manage the changes in progress to our advantage. This is the only way in which we can adjust to changing circumstances, feed ourselves, stay healthy, share changing water resources, and buy time to really alter our ways – if indeed we are amplifiers of climate change. If we are serious players then our planning will keep us in the game of life on this planet: our only chance is to limit pollution and to go with whatever flow there is, plus or minus, while the planet adjusts.

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All illustrations are provided in the associated presentation PDF file.