Submission to the Queensland Floods Commission of Enquiry

This Submission is in response to the requirement in the Call for Submissions providing for submissions, not related to immediate issues, be forwarded separately. My submission of March 2011 contained my CV in some detail but here is a short summary----

Geoffrey Cossins, Age 95, B.E. (Qld—1944), Fellow of the Institution of Engineers, Australia. Extensive experience with the flood hydrology of the Brisbane River. In charge of the operation of Somerset Dam for 27 years, including the 1974 flood.

They Said That Brisbane Would Never Be Flooded Again

The cry now echoes around the ridges as it also did after the 1974 flood, but who is the mysterious **They ?** After decades of searching I am yet to find anyone. It was never said officially.

In a booklet published by the Bureau of Industry in 1938 it was estimated that Somerset Dam, after making an allowance for the river improvements for navigation made since 1893, would reduce the first 1893 record flood which reached a peak height of 24 feet above the official high tide (of seven feet) at the Port Office in Edward St to eleven feet, a reduction of 13 feet and for the 1898 flood at the same location, a reduction of eight feet from 13 feet to five feet. The actual 1898 flood was only two feet lower than the actual recorded 1974 flood and certainly was a major, damaging flood! Similar information was given in the booklet about Bulimba Ferry, Victoria Bridge and Indooroopilly. The Chief Engineer of the Stanley River Works Board, wrote popular articles about the dam and made radio broadcasts about it. The above figures were repeated in a brochure about Somerset Dam printed in about 1954 and again in 1958 in the brochure printed for the official opening of Somerset Dam by the Premier of Queensland, the Honourable Frank Nicklin. In current metric terms the above levels come to a resultant, mitigated height of 4.3 metres for the 1893 flood, which places it in the major flood range on the Bureau of Meteorology (2010) scale for Brisbane City gauge, and 2.4 metres for 1898 which is almost up into the moderate range. It was considered at the time that the 1931 flood at 3.25 m (AHD) represented the lower limit of damaging floods and, in current Bureau terms, this is the boundary between Moderate and Major floods.

A re-examination of the data following the 1974 flood, but made before Wivenhoe Dam was built, gave 5.60 m at the Brisbane City gauge for the 1893 flood with only Somerset Dam in operation (5.45 m was recorded in 1974) and 3.45 m for both Somerset and Wivenhoe Dams assumed to be using their flood mitigation storages. For a repetition of the 1974 storm, again with both dams in operation as above, it gave 3.50 m for the Brisbane City gauge so both mitigated floods in Brisbane would have been classified as Major. In actual practice the 2011 flood was recorded at 4.54 m putting it in the Major category. Sufficient data has been available only since 1887 to make reasonable calculations of the impact of the two dams working together upon flood levels in Brisbane so that in a period of 124 years since 1887 there have been only three floods in the Major damaging category. This, of course, ignores the 1841 flood which reached somewhat the same height as 1893—bearing in mind that its

height was not registered until 53 years after the event and then from someone's memory- and there is clear evidence of a large flood in about 1823 getting up towards the 1893 level. If mitigated by both of the dams working together these two floods would undoubtedly have fallen into the Major category. There is another large flood reputed by some authors to have been almost as high as the 1841 flood but the evidence is very shaky. It has variously been attributed to 1843, 1844 or 1845 and is best left out of consideration. An inspection of the available reported flood levels between 1845 and 1887 shows that all of these floods would have been reduced to harmless levels by the two dams. The net result leaves us with five Major, damaging floods in a period of almost 190 years. This brings me to the subject of larger floods in the future. In my ten years in the Stanley River Works Board / Co-ordinator General's Department I did not hear any discussion of floods larger than 1893. All calculations were based on the flow reduction that Somerset Dam could achieve in the Brisbane River at Lowood, the calculations having been carried out up to ten years before I appeared on the scene in 1944. As far as I can make out the only consideration given to a larger flood applied to the stability design of Somerset Dam in the 1934 Report by the Special Committee of the Bureau of Industry --- "Under the worst possible conditions the reservoir could deal with a flood exceeding those of 1893 by 20 per cent on peak flow and 50 per cent in volume"---. Other than this the whole emphasis was on the calculated 1893 flood and the unspoken feeling seemed to be that 1893 seemed to represent the maximum likely flood, the old Meyer rating being regarded with some awe in this respect. In its time this rating was derived from an empirical study of all the available flood data and, the formula considered applicable to dams, such as Somerset, gave the peak flood flow, measured in cubic feet per second, as 7000 times the square root of the area of the catchment in square miles. However it is now abundantly clear that, with the present configuration of the two flood mitigation dams, i.e, the 60 /40 ratio of flood pondage to water supply storage, there is always the rare possibility of a large damaging flood even though there was a fifty two year period between 1841 and 1893 and a period of thirty two years from 1899 to 1931, for people to become overconfident that they would never be flooded again. So, who told the citizens of Brisbane? Why—themselves and then they continued to believe their own bullshit. An interesting remark by Nobel Prize winner, Richard Feynman is appropriate here. "The first principle is you must not fool yourself and you are the easiest person to fool". However, on hearing of her son's Nobel Prize, his mother remarked " If that's the world's smartest man, God help us"!

At some time in the early 1950s I started to become concerned with the possibility of future larger floods than 1893. In this respect I was somewhat influenced by senior meteorologists in the Brisbane Office of the Bureau of Meteorology. This view was reinforced by the late 1960s concept of the Probable Maximum Precipitation (PMP) which would give rise to the Probable Maximum Flood (PMF) for a catchment. This is probably covered in more detail in other submissions to the Commission but, in essence, the PMP is the worst storm that the meteorologists can realistically consider possible for a local region or area based on all the factors they have studied. The PMF naturally follows from this. The PMP has a nominal probability of 1 in 10 000 but I only regard it as extremely rare without adopting a definite value. It therefore follows that there is a whole range of possible major, damaging floods yet to be experienced although they will be very rare.

Anticipation of Floods

Brisbane residents have been caught unprepared by floods on a number of occasions. The first significant occasion was in 1887 when Brisbane had its record 24 hour rainfall and the flood just reached major levels. This flood was preceded by a lengthy dry period which was of great concern for the water supply system but no one at that time was concerned about floods. In any case the dry period was in turn preceded by a lengthy run of small floods so that floods were not in the forefront of people's minds. It is notable that J.B.Henderson, in his 1896 report on the Brisbane floods, used the 1887 flood (2.60 m) as the desirable height to be achieved by any flood mitigation measures. Two years later the 1889 flood, at 2.72 metres, was only a little higher but the 1890 flood, at 4.75 m, was right up in the Major range and did take Brisbane by surprise. It was so much higher than 1887 and led to some evasive planning for future floods, the proposed Mt Crosby pumping station, for instance, being relocated ten feet above the 1890 level. News of the impending 1893 flood caused a frenzy of removing goods and belongings to higher levels---but not high enough. The long run of major floods between 1887 and 1898 was followed by the record Centennial Drought. So, except for the moderate 1908 flood which did not seem to arouse much comment, all discussion was concentrated on water supply with Henry Somerset's continual advocacy for a combined water supply and flood mitigation dam on the Stanley River being treated as a sideline. Flood complacency continued to be the order of the day during the almost continuous dry periods up to the mild 1927 and 1928 floods. Flood mitigation was only brought to the fore by the 1928 Royal Commission Report but it was the occurrence of the 1931 flood at just damaging levels that triggered the Somerset Dam project. That said, the emphasis was once again on water supply problems during a series of droughts up to 1942. At this stage the partially completed Somerset Dam provided some reliable headworks storage for the water supply and everyone (and in particular Brisbane City Council) heaved a big sigh of relief, but complacency quickly set in again with a series of floodless years and even a significant flood in 1955 raised little comment because the almost completed Somerset Dam had reduced it to harmless proportions in Brisbane.

When I joined the Brisbane City Council's Department of Water Supply and Sewerage in 1955 I was somewhat amusingly known through the City Hall as the man who always talked about big floods but, apart from the Chief Engineer and other senior Departmental officers, the whole Council was satisfied that Brisbane would never be flooded again seeing that Somerset Dam was nearing completion. Not only was the Council complacent about the matter but the whole of Brisbane and, for that matter, most of Ipswich also. The Ipswich people had some doubts because they had previously experienced some damaging, independent Bremer River floods which Somerset Dam could not have been mitigated because the Brisbane River was not in flood at the time. My first job for the Department was at Mt Crosby pumping station which supplied virtually all the water for Brisbane, Ipswich and Redcliffe and I immediately realised how vulnerable the station was to flooding. The former massive positive displacement (plunger) steam driven pumps had been able to return to service within two days in both the 1893 and the 1898 floods but in 1955 the station had just been converted to electrical driven centrifugal pumps and water does not agree with 800 kilowatt electric motors. In the 1946 planning stages of the conversion programme the Council had ascertained from the Stanley River Works Board the estimated level to which the 1893 flood would reach at Mt Crosby with Somerset

Dam in operation (I saw the correspondence in the office). The Council then placed the most vulnerable piece of equipment, the final starters for the motors, just above that level with no consideration for possible higher floods. By the same token no suggestion had been made of such an event.

This long digression is simply to emphasise how completely unprepared the community was for the major flood event of 1974. The pumping station's most vulnerable features had been rectified and certainly saved the station from failure in the 1974 flood but all sorts of unimaginable factors brought the station nearly to the failure point except for the devoted endeavours of the station staff aided by the residents of Mt Crosby. The pre 1974 complacency was further exacerbated by the 1971Cabinet decision to proceed with Wivenhoe Dam so that it was impossible to convince anyone that Brisbane could again be flooded sometime in the future. The final irony was the dry run for a major flood event held by the State Counter Disaster Organisation shortly before the 1974 flood. This organisation was originally set up to deal with atomic fallout but, over the years with the fear of atomic war receding, its membership had faded away. The Bureau of Meteorology provided a flood scenario but was not otherwise involved, while the Council's Water Supply and Sewerage Department which operated Somerset Dam, was not even told of the event although people such as the Chief Gas Examiner were included. The organisers declared themselves to be completely satisfied with the outcome. In practice, as the older members of the community will remember, the actual organisation during the flood was chaotic. After the flood the Queensland Division of the Institution of Engineers, Australia held a lengthy symposium on the subject and various learned societies also discussed the matter and the 4th September 1974 issue of the Courier Mail carried an article by Douglas Rose headed **This COULD happen again** (copy enclosed) in which he quoted various engineers involved in the flood action who warned of the possibility but the message did not carry far. I appeared on television several times with the same message and also a radio talk back programme but with no lasting result in the face of the urgent factors that continually absorb the attention of both individuals and governments. Almost two generations later the complacency had returned well before the 2011 flood. If you scratched anyone before 2011 (and I scratched many) you got the same negative response that Brisbane was immune from flooding. I am prepared to speculate that, in two or three generations time, particularly if there is no significant flooding in the meantime, the same complacency will prevail. This over- confidence will be more marked if the flood mitigation storage capacity for the Brisbane River system is increased following all the current investigations and Commission of Inquiry.

Fear of Dams

People are completely ambivalent about dams. At the moment there is a popular call for more flood mitigation storage capacity for the Brisbane River system, particularly from the residents of Brisbane and Ipswich and also from the rural areas downstream of Wivenhoe Dam. Following the floods that originated in Queensland in January and February 2011 there were also calls from New South Wales, even at a Federal level, for more dams particularly in connection with the persistent Murray Darling irrigation problem. They probably were referring to irrigation dams but may be disappointed because of the lack of suitable dam sites on the gently sloping countryside on the

western side of the Great Dividing Range. In any case there are already 500 Large dams in Australia and very few remaining available sites. If, on the other hand they mean flood mitigation dams, they don't know what they are talking about. The only two controllable flood mitigation dams in Australia are located in the Brisbane Valley and are unknown outside Queensland. There was no mention in the 2000 edition of the prestigious volume *Dam Technology in Australia 1850—1999,* published by the Australian National Committee on Large Dams, of even the words "flood mitigation" although I now understand that there is now some mention.

The community fears dams. They KNOW that they cause floods. Their whole attention and fear is concentrated on the dam's spillway discharge which, to them, signifies the flood itself. My introduction to this pattern of thinking came in 1955. A potentially very damaging flood was mitigated down to almost harmless levels in Brisbane by the almost completed Somerset Dam but flood levels in the rural areas along the river, where the flood rise is high even for small flood flows, severely disrupted local communications. I was given a severe lecture by the Lowood Police Sergeant that the flood had been caused by opening the flood gates at the dam at the wrong time! A large thunderstorm on the Queen's birthday weekend in 1967 caused a major flood in Enoggera / Breakfast Creek, a suburban tributary of the Brisbane River. I sent an engineer to pick up flood levels and he was immediately assured that the flood was caused by opening the flood gates at Enoggera Dam. He offered to take people to the dam so that they could see for themselves that there were no gates on the dam. Only one man accepted so they went to the dam and solemnly inspected it. Finally the man said "Well this dam has no flood gates but how do I know that it is Enoggera Dam?" The inhabitants of the adjacent Kedron Brook, which has no connection with Enoggera Creek, also KNEW that their flood was due to the gates of Enoggera Dam. In some mysterious fashion a dam is supposed to swallow up a whole flood and then dispose of the stored water by invisible means. The sight of a spillway in action stirs the greatest fears. It isn't supposed to happen.

Both the press and television media only added to these fears in the 2011 flood by displaying, in any flood news item in the case of the Brisbane Valley and the city areas, the five gates of Wivenhoe Dam fully open and thundering out vast volumes of water whether this was relevant at the time or not. Radio stations continually drew attention to spillways in operation and letters to the editor in January 2011 drew attention to water coming over the spillways of dams as adding to the flood in the river below, whereas, in most cases, this showed that the dam had already mitigated the flood for them. There needs to be a special term for this kind of fear which inhibits the understanding of the real purpose and function of dams.

The five hundred Large dams in Australia have three main spillway configurations. The first group, by far the largest, has a simple open spillway with no gates. Contrary to popular belief these dams actually provide some flood mitigation as explained in the attached sheet and the water seen coming over the spillway is not the feared flood itself but the residual flood after the dam has done its work. The rate of discharge is obviously proportional to the spillway length and if the spillway is made shorter the water level in the dam will have to be deeper to give the extra pondage in the reservoir thus reducing the flow over the spillway and giving more flood mitigation but this would require a higher dam. While this idea is attractive it must be remembered that the cost of a dam is more or less proportional to the square of its

height so that such an arrangement is rarely economical. A special case occurred during the construction of North Pine Dam during the 1974 flood. The dam has a central concrete spillway of 50 feet wide monoliths with earth banks on either side. In order to protect the earth banks during a flood one of the spillway monoliths was left very low giving the effect of an exaggerated deep spillway. It turned out to be a perfect flood mitigation dam, greatly reducing the downstream flood. but some people living downstream of the dam were badly mislead. As a result of this unusual effect their house was not flooded in 1974 and they reasoned that if the incomplete dam could do this much during a near record flood the completed dam would give more protection, but the completed North Pine Dam comes into the second category and provides no flood mitigation at all as the people later found to their cost.

The second category, as exemplified by North Pine Dam, has spillway gates but these are only used to keep the water level in the reservoir within narrow limits by progressively opening the gates in a flood and closing them as the flood subsides. This arrangement limits the height of the dam and thus its cost. In effect these dams allow a flood to pass through them as if they did not exist but viewers are treated to the horrible, threatening sight of water tumbling out of the dam and down a spillway. There are many such dams in Australia. The gates of North Pine were originally operated to a rigid schedule by the shift electrician at the pumping station in the adjacent water treatment plant but I believe that they are now controlled to the same rigid schedule from the flood operational centre with the shift electrician keeping an onside check.

The third category covers the only two true flood mitigation dams in Australia as I have pointed out above. The upper sixty percent of the storage capacity (not the height of the dam) is kept permanently empty to be ready for flood mitigation as required while the lower forty percent of the storage (again not the height of the dam) is reserved for urban water supply storage. Flood mitigation is ideally achieved by letting a flood flow through the dam without storing any flood water in the upper flood compartment until the right time comes to close the flood gates and use the flood compartment to store the whole flood flow from the catchment of the dam and thus prevent it from adding to the peak of the flood in the unregulated catchment downstream of the dam. This provides the maximum flood mitigation possible for the areas downstream of the dam. When the resultant flood peak has moved sufficiently downstream, the stored flood water has to be discharged in a controlled fashion to empty the flood storage of the dam in readiness for a subsequent flood. In 1893 there were two record floods a fortnight apart with a half sized flood in between. In 1974 the emptying process was halted by the Lord Mayor of Brisbane on the mistaken advice that this action would clear flood water away from peoples houses more rapidly, a matter of some concern to the leaders of local authorities as seen in widespread cases throughout the eastern states of Australia in the December/ January period In 1974 the closing of the Somerset gates could not possibly have worked as Clem Jones hoped because it took two days for water from Somerset Dam to reach Brisbane in 1974 before Wivenhoe Dam was built. Apart from engineers the whole of Brisbane was on the Lord Mayor's side, not because of freeing houses of flood water, but it seemed to them to be the height of madness to be letting water out of the dam while the flood peak was still passing through central Brisbane. The fear of the dam was at its maximum!

Living Space Height Restrictions

The minimum height for domestic living space has been related to flood probabilities for some years with subsequent modifications and is, in fact, presently under review but I have heard ominous suggestions that people who build above the decided level limits are starting to believe that they will never be flooded again. The Courier Mail of March 29th 2011 covers the decision of Brisbane City Council to raise the height of the highest point of new houses, units and townhouses from the former 6.7 m to 9.5 m in flood affected areas. The accompanying illustration for a particular house carries the noting of "HIGH AND DRY". It relates only to the house in question but the message is there, loud and clear, to be misinterpreted.

The Tidal Factor

Increasing flood flows in the Brisbane River damp out the tidal effect as seen on the attached diagrams, the larger the flood the further downstream the damping occurs. In 1893 the tide was damped out in the central city, in 1974 at Dutton Park and, in 1968, somewhere between Darra Wharf and Goodna. In particular the flood peak in small floods, such as1968, seems to go backwards in time as shown on the diagram due to the tidal dominance. This can result in many problems in deciding the time of the peak flood flow in Brisbane. In 2011 there was confusion on the travel time of the flood between Savages Crossing and Brisbane, figures varying from 24 to 36 hours being quoted due to this effect and leads to the problem of deciding which tide actually coincided with the peak flood flow.

Hydrologists

The term has been bandied about continuously in the last few months but what is a hydrologist? I describe myself as a hydrologist, a term that needs a wider explanation. Roughly speaking hydrology is concerned with what happens to the rain drops once they hit the earth. That's a very crude definition but a very important one. Meteorologists are concerned with forecasting the timing and the amount of rain that will fall on a particular area but the hydrologist then takes over to decide the fate of the raindrops often in a manner that depends on the individual's specialised area of concern. A water supply and flood hydrologist like myself wants to be able to calculate how much of the rain will appear in rivers but an agronomist is much more concerned with the proportion that will replenish the soil moisture store on which shallow rooted plants, such as wheat and most vegetables, depend while the underground water specialist (outside my province) is concerned with the recharging of aquifers so that wells and boreholes will continue to be productive. In my early professional life there were few hydrologists, virtually all civil engineers, but since the Second World War the numbers have greatly expanded and many courses have been established to cater for hydrologists without an engineering background. In the widespread January 2011 floods in the Brisbane Valley the term "hydrologist" became almost a household word but too many of them were speaking outside of their specialised areas and simply adding to the confusion with their novel interpretations of the available data.

I have before me an article headed "A Perspective on Public Water Policy" dated March 20th, 2011 from the Brisbane Line---Current issue, Here and Now by Jim Galletly who is described as an Agricultural Ecologist specialising in hydrology. He states his position openly that only is Wivenhoe Dam not a water supply dam but it actually reduces Brisbane's water supply because of its large area and high net evaporation rate and should be regarded only as a flood control dam and managed as such, the prime reason for building it being to protect the real estate investment on the flood plain of the Brisbane River. To support his contention he quotes from tables of the average characteristics of both Somerset and Wivenhoe Dams and by multiplying averages together while subtracting average evaporation rates he claims to have made his point. If only water supply hydrology were so simple! I would not have had to sweat for years over the detailed calculations that my fellow hydrologists seemed to consider necessary to reach the opposite conclusions and so con the community into building an unnecessary dam which I mistakenly believed was required for the continued water supply of the Brisbane conurbation! It may be strange, that in the face of the overwhelming mathematics evidence he presents, I am still convinced that Wivenhoe Dam actually saved the water supply system during the Millennium drought and I also believe that many of the citizens of Brisbane are misguided enough to share the same delusion. He may be an expert on soil moisture behaviour but water supply hydrologist he is not. At least he has done some arithmetic using averages, a process not relevant to the problem which can only be resolved as a dynamic system.

The Call for More Flood Mitigation Storage

The present clamour for more flood mitigation storage has brought forward a number of definite suggestions, the most common one being to reduce the water supply storage levels in both dams before the wet season to give more flood mitigation storage against a possible flood. This idea was briefly scouted by the Special Committee of the Bureau of Industry in its 1934 Report on the Water Supply of Brisbane. As I pointed out in my earlier submission, there are risks involved in this procedure. Other proposals involve providing alternative sources of water supply so that a much larger proportion of the water supply reserve of the two dams could permanently be utilised for flood mitigation. The first suggestion is to utilise the existing desalination and waste water treatment plants to full capacity to make up the deficiency but the high cost of running the plants will make this proposal unattractive. The second suggestion is to build other dams to make up for the deficiency but there are limited opportunities in South East Queensland. Two of the few possible dam sites are unavailable because of political decisions not to proceed with them and this leaves one possible site on the Upper Brisbane River near Linville. I know that this site was thoroughly investigated by the Irrigation and Water Supply Commission before 1970 because the Irrigation Commissioner was required to give an assurance to the Morton Regional Advisory Committee that the Commission would not seek to build it for an irrigation scheme as this would cut into the potential water supply yield of the then proposed Wivenhoe Dam, (I was at the meeting). I do not know to what extent a water supply dam at that location would replace the proposed loss from the two major dams but this could easily be worked out. As one alternative it has been suggested that the Wolffdene Dam project be revived. This, of course could be costed but it would involve the possible abandonment of at least part of the present Mt Crosby water treatment plants unless a dedicated raw water main was built from

Wolffdene to Mt Crosby. It would take a very brave government to adopt this proposal.

When it comes to purely flood mitigation dams the same problem of possible sites arises. The Linville site could be possible. At first glance it seems to be so far up the Upper Brisbane River that it would be of doubtful utility but a detailed investigation could determine this factor. In spite of frantic letters to the Editor, there are no sites on Lockyer Creek but there is a possible site on the Brisbane River downstream of Fernvale where the river goes through some narrow valleys. A flood mitigation dam here world be most effective for the cities but would flood the whole of the productive agricultural areas of the Lockyer Valley and, in view of the pounding the valley suffered in the 2011 flood, I do not think this proposal will receive much enthusiastic support. The next possible site is right in the middle of Ipswich where the railway crosses the Bremer River. It would provide some flood mitigation for Brisbane but would flood a large part of Ipswich and the Amberley Air Force Base as well as a huge agricultural and pastoral area. Again I do not expect any enthusiasm for the idea. Other than this the only other suitable dam site on the Bremer River system is Moogerah Dam on Warrill Creek. Located in a deep gorge between two mountains it could be raised more economically than the major dams but the catchment area is so small that the effort would not be worthwhile. The options for further flood mitigation provision are apparently limited to raising either, or both, of Wivenhoe and Somerset Dams. The long embankments of Wivenhoe would present few problems but raising the spillway with its gates while maintaining both the water supply and flood mitigation functions of the dam would present major engineering problems. Somerset Dam may not be so difficult but the justification of the cost of such works would need a comprehensive economical study and this would require much more time than is set down for the Commission.

Intense Rainfall

There has been much controversy about very intense rainfalls and Seqwater has been accused of inventing them to suit its case. There is increasing evidence of the importance of such events when analysing floods. The estimation of runoff was previously always based on 24 hour rainfalls as this was the only data available and it was assumed that the readings from a rain gauge represented the average from the surrounding area of the catchment. It was also assumed that the rate of infiltration of rainwater into the ground during a storm was constant but it is now realised that this is not necessarily the case. In the last decade or so it has been recognised that the previous assumptions were not adequate and that intense spot rainfalls, mixed up in a storm, could give a very different result. Reconsideration of the few rain gauge readings available in the early floods, such as 1893, has led, in some cases, to the almost doubling of the previously accepted peak flood flows.

This brings me to the intense Lockyer Valley storm of January 2011. The most intense areas of this storm avoided the radio reporting rain gauges in the area but a static rain gauge was later found to have recoded an immense rainfall which would have been expected in such a gigantic flood. This type of intense, localised rainfall within a general storm also occurred during the 1974 flood. The Eagle Farm airport radar showed an intense fall of 120 mm per hour at New Beith on the Oxley Creek

catchment (figure attached). Fortunately there was a rain gauge in the very area which recorded some 800 mm for the storm which, otherwise, could have been overlooked. A question now arises about the need to revise the flood maps which were compiled after the 1974 flood. These were based on detailed soundings of both the Brisbane and Bremer Rivers right up to their tidal limits made by the Department of Harbours and Marine after the flood. As much navigational dredging of the river has been discontinued since 1974 a further investigation could be warranted and the hydrology revised. Figure 4 on the reverse side of each flood map was based on flood flow measurements made from Centenary Bridge in both the 1968 and 1974 floods. The measurements made in the small 1968 flood were considered to be acceptable as a full coverage of the river depth was achieved, but the current was so strong in 1974 that the measuring equipment could not be lowered to the full river depth. The flood measurements of 1974 are not as confident as those made in 1968 so the discharge rating of the Centenary station is somewhat questionable. It is understood that further flow measurements were made at this station in the January 2011 flood with improved equipment so that the results of these later measurement may have some impact on the earlier calculations.

Finally

Modern electronic methods of communication are now the accepted form of rapid communication available to all. This has a downside as it facilitates the spread of erroneous information as seen in the enclosed copy of an email that a friend drew to my attention. Overlooking the obligatory abuse of politicians and bureaucrats (whatever they are except imaginary whipping boys) the ascertainable facts are completely wrong, I should know because I was right in the middle of it all and am regarded as the leading historian of the water supply and the flood mitigation in the Brisbane Valley.

G Cossins
30 03 2011

FLOOD MITIGATION BY A DAM

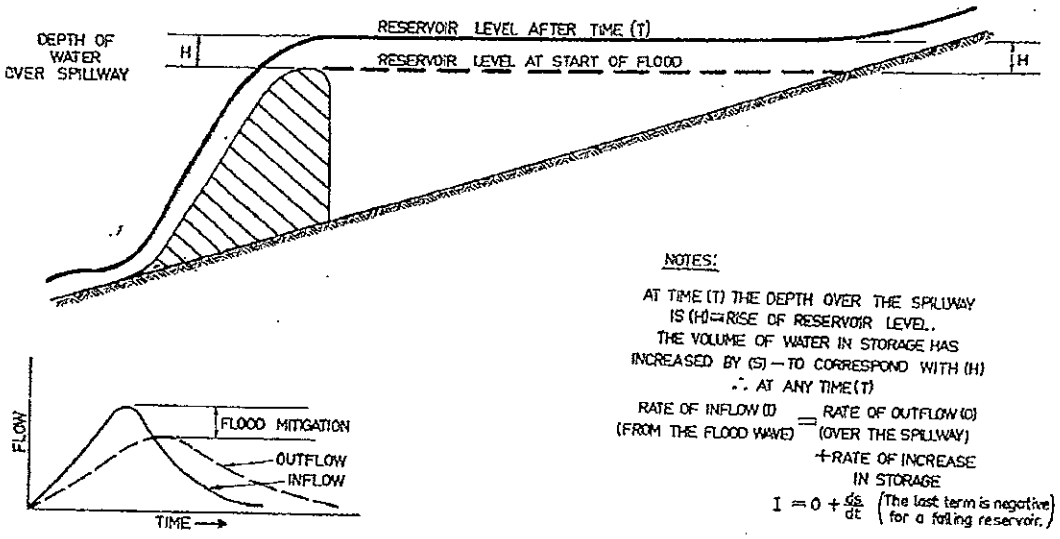


Fig. 5

Only one more point needs to be made clear to the layman to complete his understanding of basic hydrology. This concerns the mitigation of flooding by dams. Let us start with the case of the dam with an open spillway and no gates of any sort. Fig. 5 shows a dam and its reservoir diagrammatically. Let us imagine that the reservoir is filled to the spillway of the dam as a flood wave, shown by the hydrograph on the diagram, comes down the river.

The characteristics of the spillway are known so we can calculate the rate of spillway discharge for any level of the water surface in the reservoir. After the first interval of time, say 1 hour, a certain volume of water has entered the reservoir from the flood wave. The water level of the reservoir has risen so that the volume discharged over the spillway can be calculated.

But wait! We said that the water level of the reservoir had risen. The volume of water in storage in the reservoir must have increased. Where did it come from? The only source of inflow is the flood wave so that the spillway discharge for the first time interval must be less than the flood inflow. When this process is continued we find, as shown in the inset diagram on Fig. 5, that the outflow from the reservoir has a lower peak than the inflow and the peak of the outflow is delayed. A dam with a simple, uncontrolled spillway automatically mitigates flooding. Enoggera Dam on Enoggera Creek has such a spillway yet the residents of the valley are convinced that it is the cause of all their troubles. Such is the fate of the hydrologist. Are you still keen to be one? If so lets move to the next section.

Courier Mail 11.9.74

This COULD happen again

The Institution of Engineers yesterday issued the first comprehensive report on the Australia Day Floods in Queensland. It answers many of the questions which have been asked since the disaster, and urges not only better forecasting networks, but a public education programme to persuade people not to trust in dams. In this look at the report, DOUGLAS ROSE says the engineers are convinced the floods could happen again — Wivenhoe Dam or not.

DON'T be gulled into false security: New dam or not at Wivenhoe, Brisbane and Ipswich certainly will be deluged with floods equally as severe as the Australia Day, 1974, disasters.

This is the grim warning yesterday in a report published by the Queensland division of the Institution of Engineers (Australia).

The report, which examines in detail the January floods, says in the first authoritative review of the flood:

● The January floods dispelled the myth that Somerset Dam would prevent major floods in Brisbane.

Serious

● Following construction of the Wivenhoe Dam, the flood risk in Brisbane will be further reduced, but it should be well recognised that occasional flooding will occur in Brisbane in the future which could have equally serious consequences.

● In the period 1840 to 1900, there were a number of major floods, some very close to each other, only a week or two apart. A similar wet period could occur again.

The warning could hardly come from a more sober-minded or qualified source. The Institution of Engineers is the professional body supervising engineering, and its members include the top engineering brains in the State.

There is a strong call for engineers to take a more active role in keeping the problems of flood dangers before the public — and doing something to alleviate the problems.

Yesterday's impressive volume, 275 pages long, crammed with expert opinion, graphs and diagrams, had its origins in the symposium on the floods held in Brisbane in April.

The book answers lots of questions which could be posed about the disaster.

Here are some of the questions that people have been asking since January, and some of the expert answers:

Can it happen again?

THE CO-ORDINATOR-GENERAL (SIR CHARLES BARTON):

The lesson is that there must be strenuous efforts to get information about flood-prone areas across to people.

In Brisbane many people suffered from what I call the Somerset Dam Syndrome. They knew about the 1893 flood and the heights reached but now that we have Somerset Dam it won't happen again. I believe many engineers would have told people of flood possibilities, to find them unbelieving.

When Wivenhoe Dam is built, don't let us have a Wivenhoe Syndrome develop in the community, for Wivenhoe Dam, while it will greatly reduce the flooded areas, will still leave areas subject to severe flooding.

OVER TO MR. J. K. G. WARD, SENIOR ENGINEER, IRRIGATION DEPARTMENT:

The construction of dams such as Wivenhoe Dam will no doubt modify the magnitude of future floods, but it would be false to assume that they will eliminate floods from that time onwards.

A city, such as Brisbane, situated at the mouth of a river which has a catchment of some 13,600 square kilometres (5300 square miles), should devise a warning system that allows everyone to assess what is likely to happen in their area, based on the official information relayed over news media.

WEATHER BUREAU DIRECTOR (MR. A. SHIELDS):

The rainfall in the 1893 flood in the Brisbane - Ipswich area was relatively minor compared with the January 1974 flood rainfall. In the Ipswich area (Bremer River) the January 1974 totals show rainfall which was approximately three times greater than any previously recorded flood rainfall.

Higher

A judicious temporal and a rain combination of the 1974 and 1893 rainfall distribution patterns, which is certainly a meteorological possibility, could produce a significantly higher flood in the Brisbane area than any yet recorded and there is some geological evidence that such floods have occurred.

What are the chances of better flood forecasts?

THIS IS THE ASSESSMENT OF MR. G. HEATHERWICK, SENIOR HYDRO ENGINEER, BRISBANE WEATHER BUREAU:

A highly satisfactory flood forecasting performance was achieved for the Brisbane River Port Office during the January 1974 flood. The warning times were the best that could be given in a situation where a major contribution to the flood came from local creeks between Brisbane and Ipswich, and the Bremer River itself.

However little advance warning time beyond the present eight to 12 hours can be expected for Ipswich for a Bremer River flood unless precipitation can be forecast accurately in advance.

The problem has no easy solution. It is a statewide problem, but in Ipswich and Brisbane it is most complex.

For Brisbane metropolitan creeks, significant improvements in flood forecasting and warning services are unlikely until improved data acquisition techniques for the receipt of rainfall and discharge data are introduced.

In this regard, the further development of radar as an operational tool for rainfall assessment will in future have a significant influence on the overall operation of flash flood warning systems.

Instead, improved qualitative warnings seem to be a more feasible proposition.

Errors

Can the public rely on flood height forecasts?

MR. G. COSSINS, INVESTIGATING ENGINEER, BRISBANE CITY COUNCIL:

Experience in the January 1974 flood showed that flood levels can be forecast for the metropolitan reaches of the Brisbane River with a high degree of accuracy but that there is a serious deficiency in the mechanism for conveying the forecasts from the forecasters and interpreting it in a meaningful fashion to the public in the areas likely to be flooded.

The main factors causing the errors of forecasting the metropolitan river flood levels, i.e. the contributions of the Bremer River and of the metropolitan creeks to peak flow and the storm surge in Moreton Bay, will be evaluated in the near future leading to improved forecasts.

There is no guarantee that the transmission of meaningful forecasts to the public will be considerably improved although some improvement is surely inevitable.

Just what effect will the Wivenhoe Dam have?

In terms of Mr. Cossins' calculations, had the Wivenhoe Dam been built before the January flood, then the flood levels would have been reduced by 2.2 metres at the Port Office, 3.3 metres at Indooroopilly and 4.3 metres at Moggill.

Will my house be flooded?

MR. J. FAIRWEATHER, B.C.C. WORKS DEPARTMENT CHIEF ENGINEER:

I do not think that the issuing of flood information in terms of levels on the river means very much to the public. But I think if you can say to the public that by, say, midnight tomorrow night the area of, say, South Brisbane bounded by Glenelg, Hope and Peel streets, would be inundated with water at the intersection of Grey and Melbourne streets, 5ft deep, this would be meaningful and would be of great assistance.

It is planned to prepare such information and keep it updated so that the next time the river floods, we will be in a better position to keep the people informed.

Was there a cover-up or a refusal to recognise danger before the floods?

AGAIN, MR. COSSINS: The mental lack of preparation among both public and authorities alike can be attributed to four factors. In the first place, the developers and the associated real estate fraternity have unblushingly claimed for the last 40 years that the construction of Somerset Dam had removed all possibility of flooding in Brisbane.

Also there was the unwillingness of official bodies, both State and local authority, to undertake any campaign of educating the public to these risks. The official attitude, as in so many matters, is that all queries will be answered truthfully (but maybe not fully) but that the public must of itself seek out the right authority and pose the question.

In the process, it was known that some misleading advice was given in all good faith by public servants of all types who themselves, did not understand the problem.

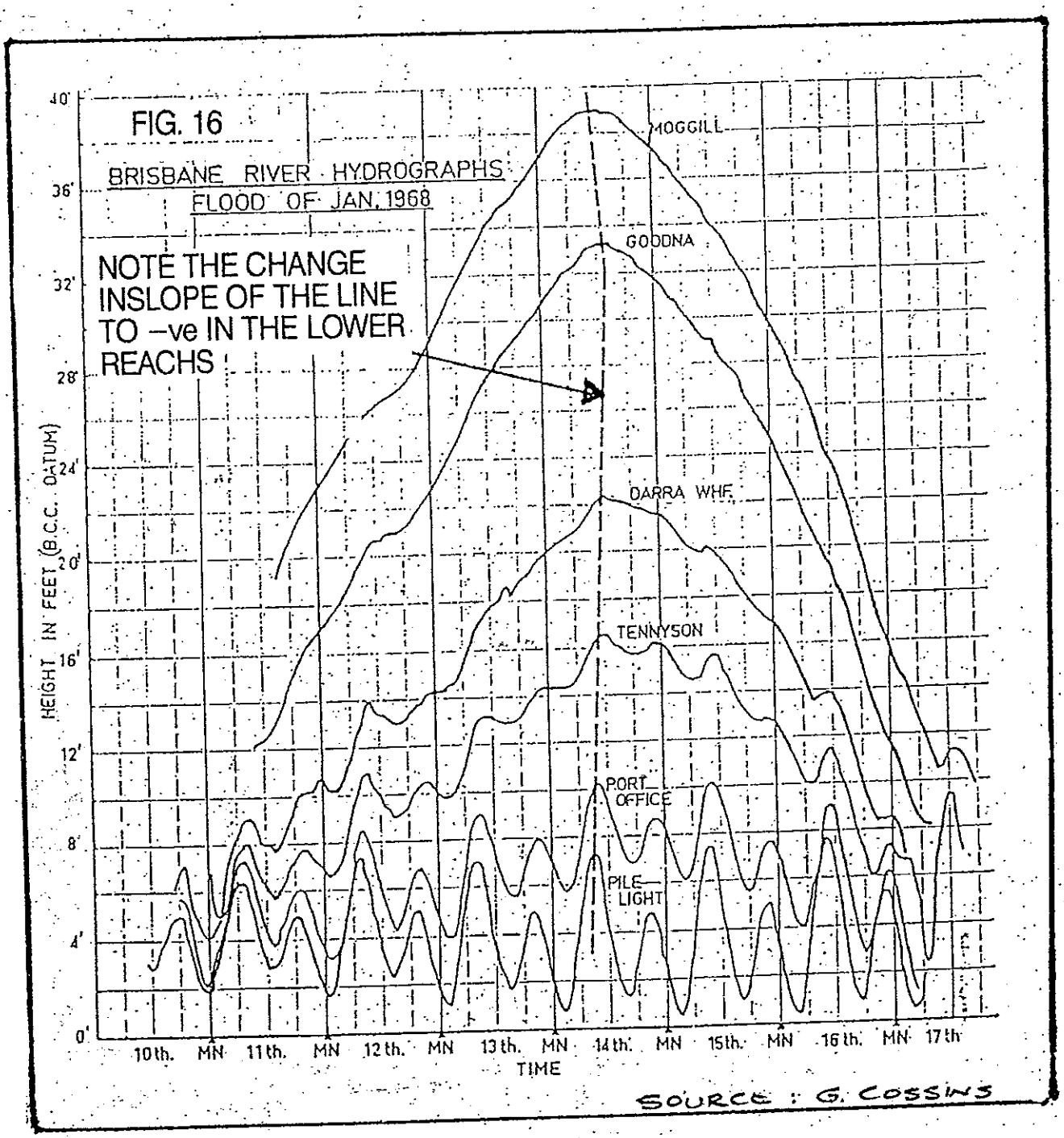


FIG. 16
BRISBANE RIVER HYDROGRAPHS
FLOOD OF JAN. 1968
NOTE THE CHANGE INSLOPE OF THE LINE TO –ve IN THE LOWER REACHS
MOGGILL
GOODNA
DARRA WHF.
TENNYSON
PORT OFFICE
PILE LIGHT
HEIGHT IN FEET (B.C.C. DATUM)
40'
36'
32'
28'
24'
20'
16'
12'
8'
4'
0'
10th. MN 11th. MN 12th. MN 13th. MN 14th. MN 15th. MN 16th. MN 17th
TIME
SOURCE : G. COSSINS

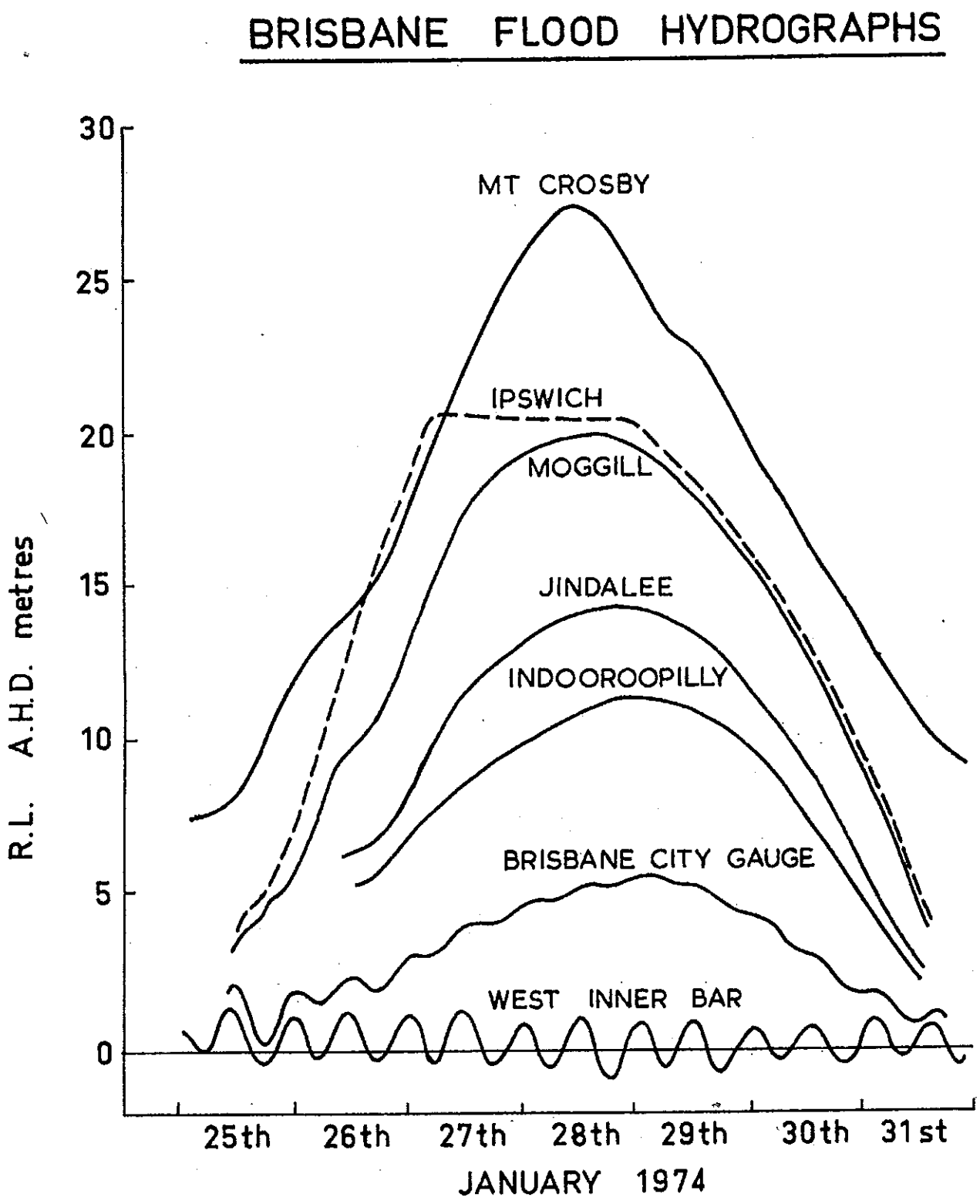
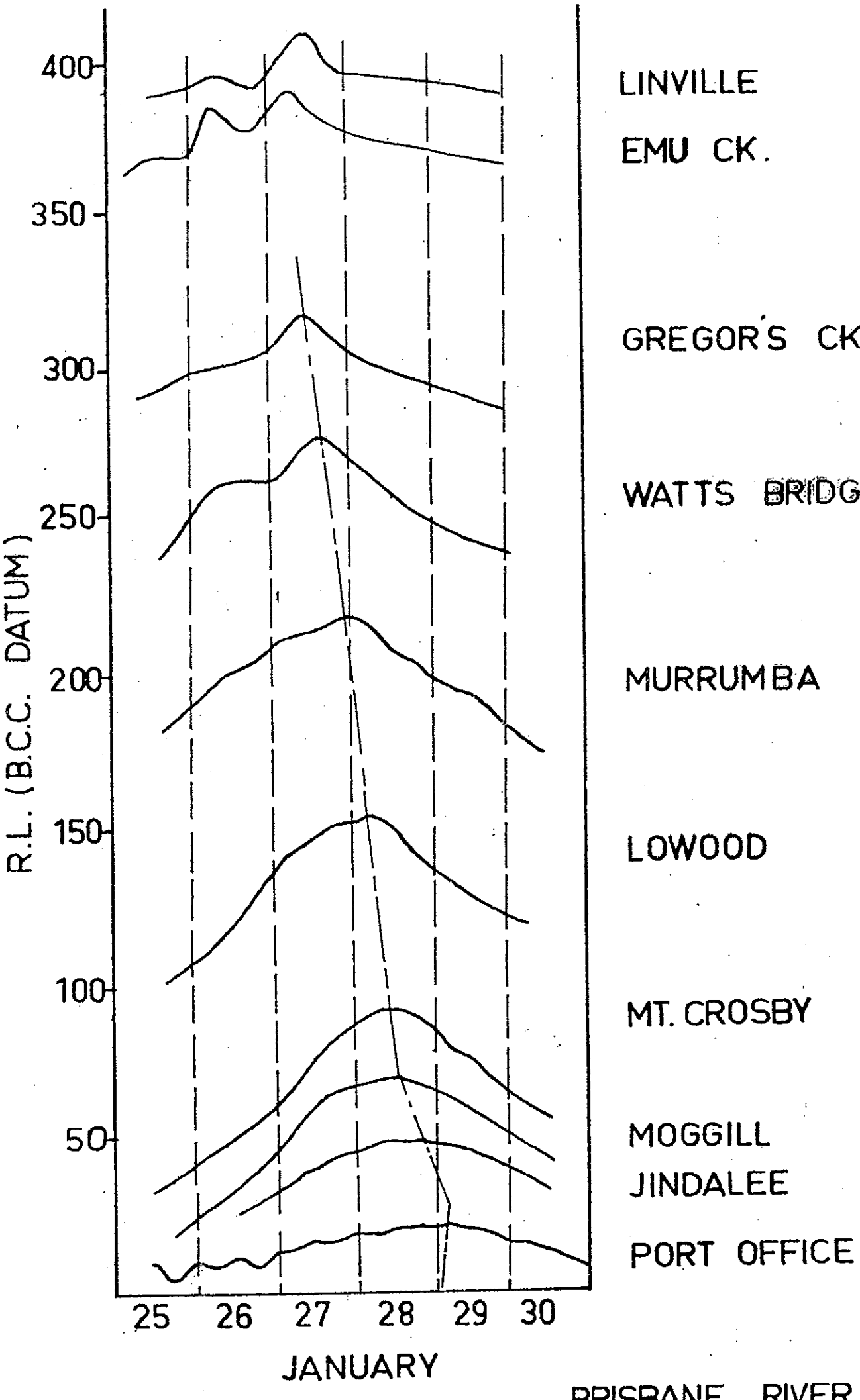


Fig. 4: Damping of tides by flood waters in the Brisbane R., January 1974.

Probable Maximum Flood

The frequency study of the Brisbane River showed that there is every chance of a future flood reaching much greater levels than the 1974 flood. The only thing that can be said about this is the higher the possible future flood then the less the frequency will be. There is, however, a cut-off point known as the Probable Maximum Flood. The height of this flood can also be arrived at by considering the maximum amount of rain that possibly could fall in a major storm. The Probable Maximum Flood for the Brisbane City Gauge has been placed at ten metres. By comparison, the 1974 flood reached 5.5 metres on that gauge.


400
350
300
250
200
150
100
50
R.L. (B.C.C. DATUM)
LINVILLE
EMU CK.
GREGOR'S CK.
WATTS BRIDGE
MURRUMBA
LOWOOD
MT. CROSBY
MOGGILL
JINDALEE
PORT OFFICE
25
26
27
28
29
30
JANUARY
BRISBANE RIVER

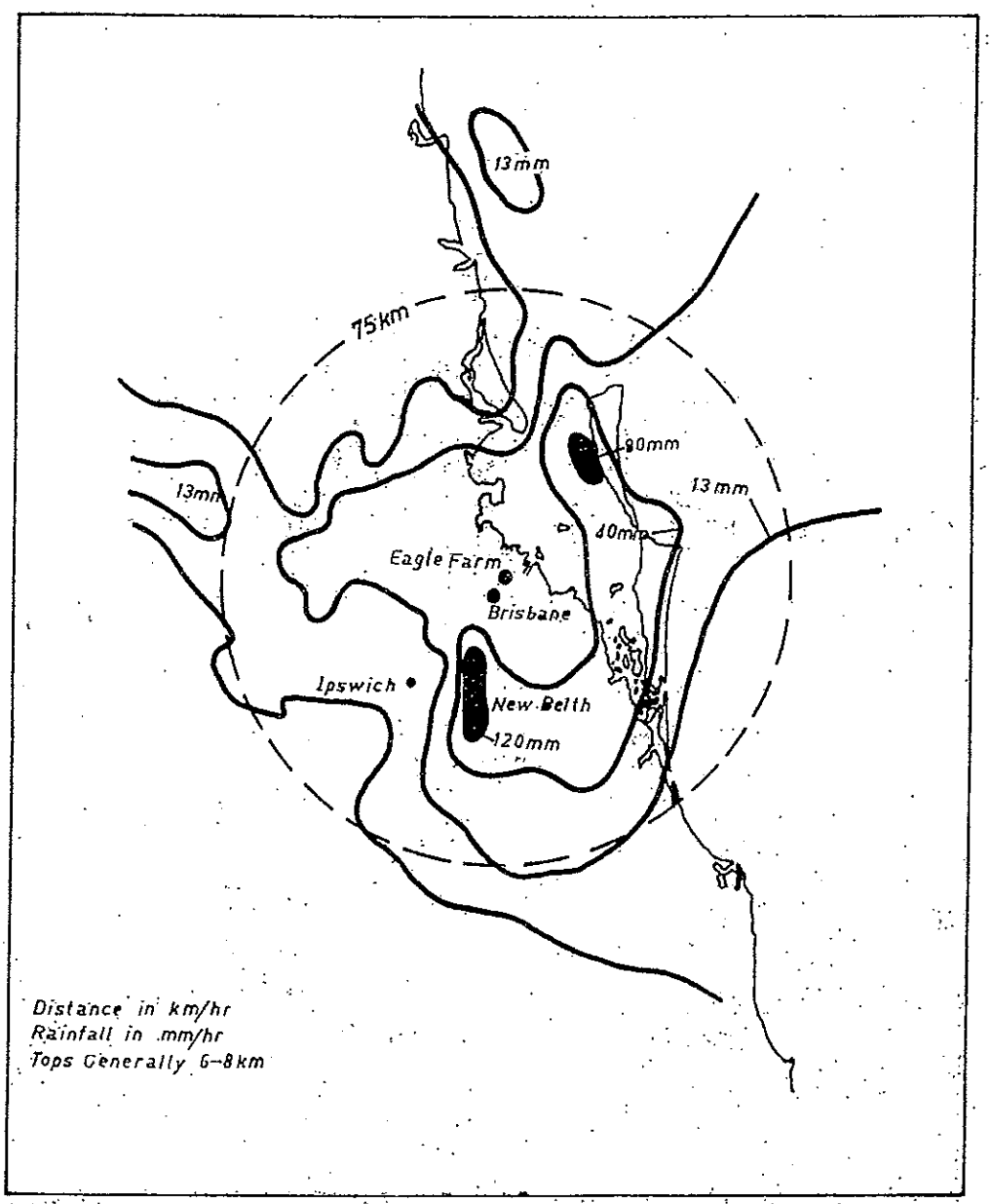


Fig 6 Brisbane Raintall Intensity Schematic Presentation of Radar Rainfall Data 3am 25th January. Rainfall Rates in mm/hr

Geoff

This is an extract of an email doing the rounds - thought you might like to read it given your expertise in this area.

Richard

---- *The story behind the Brisbane Floods*

Don't you feel like going out and take all these government bureaucrats away, in whatever way, and replace them with persons who are professionals and have experience in their area of expertise?
We fell like that strongly.
Here are the reasons behind this unavoidable catastrophe.

Subject: BRISBANE FLOODS - WHY???

Do we really deserve such stupid politicians?
Anna Bligh has had a feast over recent weeks because she has been dealing with one of the very few subjects in which she has expertise - media manipulation. She has a proven track record of gross incompetence in managing Queensland and our economy, but right now, she is the darling of the media. Why? Because she makes herself available for all media interviews, calls the interviewers/ journalists by their first names, and because she is genuinly upset (as we all are) with the nature and extent of the devastation caused by the floods..... and, our suspicion is, because she knows in large part, that her incompetence (and her predecessor's) has been one of the root causes of the unbelievable damage and loss that many Queenslanders have needlessly sufferred.

The great shame is that the current flooding of large areas of Brisbane should not have happened. They are a direct result of (past) Government stupidity; and it's typical of today's Governments.

In 1974 Brisbane was flooded slightly worse than this time, although the damage this time is much worse because of the advancement since then of Brisbane as a city . Following the 1974 flood the Qld State Water Commission, which was made up of people who knew what they were talking about (hydrologists, geologists, geophysicists, meteorologists etc) recommended the building of a flood mitigation dam on the Brisbane River well west of the city. This was done in the form of Wivenhoe Dam about 50 Km west of Brisbane. At about this time Brisbane 's water supply came from 3 small dams around the Brisbane area (Somerset , North Pine and Ennogera).

In about 1980 because of the rapid growth of the population of Brisbane the State Water Commission started agitating for the State Govt to build a substantial water supply dam for

Brisbane . The State Govt responded that they didn't need to as they had Wivenhoe Dam. The Water Commission pointed out that Wivenhoe was a flood mitigation dam and NOT a water catchment/supply dam and that the Govt needed to stop dallying and build Brisbane a water catchment/supply dam or they would have water supply problems by about 2000; they also recommended a few possible sites. In good political response the State Govt disbanded the State's Water Commission.

A few years ago Wivenhoe was down to < 20% capacity, and we had severe water restrictions. The State Govt decided to re-establish a Water Commission. Unfortunately this time it was made up of totally useless bureaucrats, with no professional expertise and headed up by a less than useless bureaucrat. Their great plan was to build a water catchment dam (the Traverston Dam) on the Mary River up the coast; this was some of Queensland 's most productive agricultural land and was not one of the recommended sites from 20 years earlier. The Traverston Dam when full would have had a average depth of 10 metres and an enormous surface area - unbelievable evaporation as a number of experts pointed out and in a drought would become an enormous mud bowel. The State Govt spent millions of dollars surveying the area, buying back properties, alienating the locals and designing the dam construction before they had asked the Commonwealth Govt whether they could build the dam. In the end the Commonwealth Govt said no due to environmental reasons and all those tens of millions of dollars had been wasted. It would be a bit like you or I finding a nice block of land, spending thousands on having it surveyed, an architect design a house before finding out if the owner would sell it to us.

The end result was that when the drought broke towards the end of last year, the dam filled and the water was stored; after all Brisbane was dependent on this water for it's supply. However, when the rains really came a few weeks ago (we have been having almost non-stop rain for several weeks) Wivenhoe (a flood mitigation dam) was starting at 110% full. Thank God the dam had been built to hold 210% of it's planned capacity before water started running over the dam wall and threatening dam wall integrity. It didn't take more than a few weeks and the dam was up to 198% capacity and the flood gates were opened. That meant the end of a water mitigation dam because then everything that went into the dam had to be released to protect the dam's integrity. The end result is that Brisbane has had a major flood through a good part of the CBD and suburbs which wouldn't have happened if the dam had been at 20% when the rains started several weeks ago.

The problem was that the original Water Commission was right, Wivenhoe was meant to be a flood mitigation dam, in other words you want it kept empty so it can act like a buffer in the event of torrential rain. It was not meant to be a water supply dam, which you want to keep as full as possible for when there is a drought.

Don't you just love politicians?