

In the matter of the *Commissions of Inquiry Act 1950*

Commissions of Inquiry Order (No.1) 2011

Queensland Floods Commission of Inquiry

Witness Statement of Peter Baddiley

I, Peter Baddiley, of Level 21, 69 Ann Street, Brisbane, in the State of Queensland, say as follows:

1. I am the Regional Hydrology Manager for Queensland in the Bureau of Meteorology (**the Bureau**). The Bureau is Australia's national weather, climate and water agency. I was performing the role of Regional Hydrology Manager during the recent Queensland flood events, including the major flood episode in southeast Queensland in December 2010 and January 2011. I am a Chartered Professional Engineer (CPEng), and a Registered Professional Engineer of Queensland (RPEQ), with 30 years experience in the water engineering field, particularly in operational hydrology. I have an Honours Degree in Engineering (Bachelor of Engineering (Civil), University of Queensland, 1977).
2. Prior to joining the Bureau in 1980, I worked as an Engineer for an engineering consultancy, WBM-Oceanics Australia, primarily in the area of hydraulic modelling of rivers and waterways as a part of studies to assess floodplain development and management options.
3. In the Bureau, I have held the following positions:
 - a. Engineer, Hydrometeorology Section, Brisbane (1980-1987);
 - b. Senior Engineer, Hydrometeorology Section, Brisbane (1987-1990);
 - c. Supervising Engineer, Hydrometeorology Section, Brisbane (1990-2008);
 - d. Regional Hydrology Manager, Water Division, Brisbane (current position);
 - e. In addition, during my career in the Bureau, and as a member of the Queensland Region Executive, I have acted as Regional Director for Queensland in a number of short periods since the mid-1990s.

Lodged on behalf of the Commonwealth of Australia

Contact: [REDACTED]

Attorney-General's Department
3-5 National Circuit
Barton ACT 2600

Telephone: [REDACTED]
Email: [REDACTED]

4. As a part of my work in the Bureau, I have been involved in the design, management and operation of flood warning systems in Queensland. The development of flood warning systems has been done in co-operation with many local governments and other water agencies, and during the past two decades, has seen significant expansion and automation using advanced monitoring and communication capabilities. I have led a team involved in the development and continuous improvement of computer-based flood forecasting models and flood warning information services, much of which has been made available on the Bureau's flood warning website. I have published papers on flood warning services and systems and have represented the Bureau in many water engineering and flood-related project management, consultative and technical advisory groups in association with state and local government, water agencies and disaster management agencies.

Request for information from the Queensland Floods Commission of Inquiry dated 22 March 2011

5. This statement is provided in response to a request for information from the Queensland Floods Commission of Inquiry (**the Commission**) dated 22 March 2011 which was received by the Bureau on the following day. Attached hereto and marked "PB-1" is a copy of this request for information (**the Request**).
6. I have been informed that the Bureau's Regional Director for Queensland, Mr James (Jim) Davidson, has provided a witness statement to the Commission (**Mr Davidson's statement**) in relation to those issues outlined in the Request which fall more within his area of knowledge and expertise. In particular, Mr Davidson has addressed in his witness statement those issues which were outlined under Item 1 ('BOM overview') and Item 3 ('Toowoomba/Lockyer Valley') of the Request, as well as providing responses to some additional issues stated in the Request.
7. I will be providing information in particular in response to:
 - the issues set out under Item 2 ('Interrelationship with government agencies and dam operations') of the Request, excluding dot point 2 of Item 2 which is responded to in Mr Davidson's statement, and
 - other issues concerning rainfall and river gauges outlined in the Request.

Except where otherwise stated, I make this statement from my own knowledge and on information and belief after making enquiries within the Bureau.

Report and background briefing provided by the Bureau to the Commission of Inquiry

8. I have been involved in the preparation of a detailed report to the Commission titled "Report to Queensland Floods Commission of Inquiry: provided in response to a request for information from the Queensland Floods Commission of Inquiry received by the Bureau of Meteorology on 4 March 2011", which was prepared in response to an earlier request for information from the Commission received by the Bureau on 4 March 2011 (**the Report**). A copy of the Report is attached to Mr Davidson's statement as "JD1".
9. I also contributed to the 'Provision of Preliminary Meteorological and Hydrological Information: Background Briefing for the Queensland Floods Commission of Inquiry' (**the Background Briefing**) which was provided to the Commission on 17 March 2011. A copy of the Background Briefing is attached hereto and marked as "PB-2".
10. To avoid repetition, in responding to the issues outlined in the Request, I will refer to relevant sections of the Report and the Background Briefing to the extent it is appropriate. I will now address the issues in the order they are set out in Item 2 of the Request.

Response to issues in Item 2 of the Request

Description of the relationship between the Bureau, Flood Operations Centre and Seqwater in relation to information provision, forecasts, data collection, advice, consultation, etc.

11. Section 7, Paragraph 241 of the Report provides a description of the roles of the Bureau, Seqwater (working as the Flood Operations Centre (FOC)) and other agencies with regards to flood episodes in the Brisbane River.
12. In relation to data collection, the Bureau and Seqwater work cooperatively to share data available for Brisbane River flood monitoring and forecasting. Seqwater is the owner and operator of a network of automatic rainfall and water level stations in the Brisbane River basin. These stations are compatible with the Bureau's "ALERT-type" (real-time event reporting via VHF radio) flood warning systems and the Bureau has supplied Seqwater with the Bureau ENVIROMON software package which receives, displays and stores the data collected from the monitoring network. As described in Section 7.2 of the Report, Seqwater makes data from their Brisbane River basin monitoring network available to the Bureau on a direct and continuous basis and the Bureau provides Seqwater with data from other monitoring stations in and adjacent to the Brisbane River catchments and elsewhere in southeast Queensland.

13. In relation to information provision, forecasts and other communication, Sections 7.1 and 7.2 of the Report are relevant as those sections cover the range of forecasts and warning products which the Bureau provides to Seqwater. Section 7.2 in particular provides information on the forms of communication between the Bureau, Seqwater and Seqwater Flood Operations Centre.

Actual forecasts and warnings given to the Flood Operations Centre during the January 2011 Flood Event.

14. Sections 7.1 (in particular Table 7.1.1) and 7.2 of the Report provide a listing of the Bureau forecasting and warning products received by Seqwater. A list of the specific products provided to Seqwater for the period of 6-19 January 2011 is attached hereto and marked as "PB-3".

Other communication, including exhaustive accounts of communication between BOM and the Flood Operations Centre during the January 2011 Flood Event.

15. Section 7.2 of the Report provides a description of the forms of communications which take place between the Bureau and FOC during flood episodes.
16. A list of phone calls between the Bureau and FOC is attached hereto and marked as "PB-4".
17. Copies of emails between the Bureau and FOC for the period of 6 January to 19 January 2011 are attached hereto and marked as "PB-5". In my experience, the Bureau will often respond to an email from FOC by telephoning the person from FOC who sent the email.
18. In relation to communications with Seqwater other than the FOC, I was involved in a telephone conference on Monday 10 January from approximately 12:30pm to 1:20pm arranged by the SEQ Water Grid Manager which, as far as I am aware, involved the SEQ Water Grid Manager, Queensland Department of Premier and Cabinet, Seqwater, the Brisbane City Council, and the Ipswich City Council. Other agencies may have been involved in the telephone conference but I am unable to confirm this as no other persons introduced themselves on the call.
19. To my understanding, the telephone conference was conducted to provide an update for those involved in the call regarding the Technical Situation Report issued by the Grid Manager; the developing flood situation in the Brisbane River; latest Wivenhoe Dam release strategies; downstream river height predictions; and the information needs of the Brisbane City Council to relate predicted flood levels to tide datum.

Seqwaters's January 2011 Flood Event Report on the operation of the Somerset Dam and Wivenhoe Dam

20. The Bureau has continued to work closely with Seqwater during recent flood events. Due to ongoing operational requirements and the need to respond to the Commission on a range of questions and associated provision of data, the Bureau has not had the opportunity to examine the extensive Seqwater Report in detail. However, if required, the Bureau could provide an analysis as a separate submission if the Commission has particular issues it wishes the Bureau to address. Regarding the Quantitative Precipitation Forecast (QPF) calculations for specific catchments and apparent reliance on some QPF estimates referred to in the Seqwater Report, the Bureau has continually and openly advised of the uncertainty of these catchment estimates.
21. The Bureau has over a long period of time advised Seqwater of uncertainty in rainfall forecasts over small space and time scales, such as for catchments. It was recently reaffirmed by email by the Bureau to Seqwater on 1 December 2010 that "whilst weather prediction models are steadily improving, the forecast of rainfall amounts over catchment time/space scales is recognised as one of the most challenging/difficult tasks". In this email communication, attached hereto as "PB-6", the Bureau also provided a copy of a report titled "Rainfall Forecasting for the Wivenhoe Dam Catchment (2006)" (**the 2006 Report**), attached hereto as "PB-7".
22. The 2006 Report states at page 3 that "the capability of the science to provide sufficiently reliable 24 to 48 hour advance predictions of high catchment average rainfalls is limited". As a brief explanation of this, the 2006 Report (at page 1) states "that the improved skill of numerical weather prediction (NWP) models in recent years has particularly been in forecasting the development and movement of broad-scale synoptic features that would be likely to produce the threshold rainfall amounts in question. These large-scale features include decaying tropical cyclones, east coast low pressure systems and significant upper level troughs. However while these systems may be well forecast on a time scale of 2 to 3 days the very heavy rainfall concentrations are dependent on finer scale (mesoscale) and convective features. Whilst there is often the ability to forecast the potential for a significant rain event to occur in the southeast Qld-northern NSW region, it is difficult (if not impossible) to predict the actual location of the heaviest rain, even with only a few hours notice." For larger catchments, it is more likely that the area-averaged NWP rainfall forecasts will be more reliable, although, in Queensland, runoff generation may still be dominated by embedded heavy rain over parts of the catchment.

23. The Bureau also considers that rainfall intensity and spatial variation is very important in determining inflows to storages and even a successful forecast of rainfall on a daily timescale may not be useful for decisions regarding dam operations.

24. The Bureau's view, and the advice which has been consistently provided to Seqwater by the Bureau, is reflected in Seqwater's "January 2011 Flood Event Report on the Operation of Somerset Dam and Wivenhoe Dam" (Section 6.2, page 55) which states:

A number of rainfall forecasting tools were provided by the Bureau of Meteorology (BoM) and were used to inform decision-making during the January 2011 Flood Event. Seqwater understands from experience and ongoing discussions with BoM that there are always uncertainties associated with rainfall forecasts. Previous flood event reports have discussed these uncertainties. While rainfall forecasts provide an awareness of potential flood event conditions, as shown below and in previous flood event reports, the forecasts themselves do not provide a definitive basis on which to make operational decisions on releasing flood water from the Dams. Generally, the longer the forecast lead times, the higher the degree of uncertainty in the forecast.

25. As described in the Bureau's Report, the Bureau's longer-range forecasts for the wet season, and during the critical heavy rainfall periods in southeast Queensland during Dec 2010 and Jan 2011, provided good quality information for disaster managers and dam owners regarding the expected very heavy rainfalls. It is further noted, however, that the provision of accurate and reliable forecasts of rainfall amounts and intensities for a 1, 3 and 5 day forecast period on the spatial scale of Somerset and Wivenhoe Dam catchments is currently limited by the state of the meteorological science and modelling, although improvements are being made through active research by the Bureau and the international meteorological community.

Duplication of equipment

26. Duplicated equipment is generally an outcome of decisions taken by relevant agencies to install new and upgraded flood warning systems consisting of a network of rainfall and water level monitoring stations in a catchment or region. It is important to note that duplication of monitoring station equipment forms one part of a package of measures taken to develop more resilient end-to-end flood warning systems. Duplication may typically also involve duplicated communication paths (e.g. additional repeaters to allow for multiple paths of radio communications and/or backup computer-to-computer data transfers) and multiple locations at

which the rainfall and water level data is received and analysed (e.g. at computers in one or more local agency offices in addition to the Bureau's computer systems).

27. The Bureau provides advice to local agencies which is generally limited to the design, specification and commissioning of a monitoring network. It is the responsibility of the local agencies to apply for funding for additional equipment, not the Bureau.
28. In recent years, the installation of a new or upgraded flood warning system has generally been initiated by an agency (usually a local government), at times in consultation with the Bureau, seeking funding via the Commonwealth Natural Disaster Resilience Program (or previously the Regional Flood Mitigation Program and Natural Disasters Mitigation Program). The priorities for this funding are as established by the NDRP assessment process. Frequently, the driver for establishing an improved flood warning system is the experience of past flooding or as a mitigation option arising from a risk management study.
29. These upgraded systems generally include a number of flood warning monitoring stations (rainfall and water level) which frequently augment an existing monitoring network, either based on volunteers taking rainfall and water levels and/or automatic stations with telephone-based communications. Generally, in respect of field monitoring stations, duplicated equipment is established at selected water level stations, rather than rainfall stations. For rainfall stations, it is generally more effective to have additional independent rainfall stations at other locations to provide improved monitoring coverage of areas in the catchment.
30. A typical example is the installation of new ALERT radio telemetry equipment at an existing Department of Environment and Resource Management gauging station. This provides for both cost effectiveness and increased robustness for a water level station which is used in monitoring and modelling floods. A second typical example is where automatic equipment is installed at a volunteer river height station where the volunteer reader is retained to provide check readings.

Rainfall and river gauges in Toowoomba, Cooby Creek Dam, Upper Sandy, Helidon, Sandy Creek, Flagstone Creek or Ma Ma Creek

31. For the locations listed above, the following table summarises the use of duplication in measuring equipment and communications.

Location	Station Names	Duplicated	Duplicated

	(& Ownership)	Measurement	Communications
Toowoomba	Toowoomba AL (Seqwater) Toowoomba AWS (Bureau)	Yes. (Independent stations)	Yes (Independent stations)
Cooby Creek Dam	Cooby Creek Dam (Bureau) Cooby Creek Dam AL (Toowoomba Regional Council)	Partial (daily manual rainfall and automatic event- reporting rainfall)	Yes (telephone, VHF)
Upper Sandy Creek	Upper Sandy Creek AL (Lockyer Valley Regional Council)	No	No
Helidon	Helidon TM (DERM) Helidon AL (Seqwater)	Partial (shared gas line, independent sensing equipment)	Yes (telephone, VHF)
Sandy Creek Road	Sandy Creek Road AL (Lockyer Valley Regional Council)	No	No
Flagstone Creek	Flagstone Creek TM (DERM)	No	Partial – duplicate polling of the logger by DERM and the Bureau but both rely on telephone.
Ma Ma Creek	Ma Ma Creek TM (DERM)	No	Partial – duplicate polling of the logger by DERM and the Bureau but both

			rely on telephone.
--	--	--	--------------------

Recommendations for duplicate equipment in this region following the weather events on 10 and 11 January 2011

32. As a consequence of the recent severe flooding, it is anticipated that there will be increased interest from agencies, including local governments, in new and upgraded flood warning systems for many areas/locations in Queensland, including the Toowoomba-Lockyer valley region. Such systems are likely to involve additional stations as well as some duplication of existing rainfall and/or water level stations, but also importantly involve end-to-end warning-response arrangements.
33. As mentioned above at paragraph 27, these agencies can make direct applications to the NDRP for the new or upgraded flood warning system they require. The priorities for this funding are as established by the NDRP assessment process.
34. Two existing consultative committees involved in flood warning and flood risk management in Queensland, namely the Queensland Flood Consultative Committee (QFCC) and the Flood Warning Consultative Committee (FWCC), may also play a role in recommending, or advising on, future improvements to flood warning systems and other flood mitigation measures. The QFCC is a state government inter-departmental committee chaired by Emergency Management Queensland. The Bureau is a member of the QFCC. The Bureau established the FWCC in the late 1980s as an advisory committee to the Bureau and participating state and local agencies. It is chaired by the Regional Director, Mr Davidson. The FWCC acts as one of the advisory bodies to the QFCC.

Date: 5 April 2011



Peter Baddiley