In the matter of the
Commissions of Inquiry Act 1950

Commission of Inquiry Order (No. 1) 2011

QUEENSLAND FLOODS COMMISSION OF INQUIRY

Witness Statement of Carl Christian Wulff

Chief Executive Officer

Ipswich City Council

QFCI

Date: 11/11/11 JM

Exhibit Number: 1017

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Table of Attachments

	Description
CCW-1	Memorandum from [redacted] Council's Deputy Works Manager, to the Secretary of the Ipswich Rivers Improvement Trust dated 18 September 2006
CCW-2	Memorandum from [redacted] Council's Deputy Works Manager, to the Secretary of the Ipswich Rivers Improvement Trust dated 16 November 2007
CCW-3	Memorandum from [redacted], Council's Deputy Works Manager, to Jamie Quinn, Council's then Chief Executive Officer, dated 2 October 2003
CCW-4	GHD comments on Ipswich Flood Study Rationalisation Project - Phase 3 - Monte Carlo Analysis
CCW-5	Email from [redacted] Sargent Consulting, to [redacted] and others dated 12 September 2003 regarding Brisbane River Flood Levels
CCW-6	Email from [redacted] Sinclair Knight Merz, to [redacted] dated 25 November 2003
CCW-7	Email from [redacted], SKM, to [redacted] and others dated 29 January 2004 attaching draft report by Sinclair Knight Mertz regarding the Ipswich River's Flood Studies - Further Investigation
CCW-8	Submission from [redacted], Acting Works Manager, to the Planning Manager dated 10 September 2003 regarding the draft 2004 Scheme
CCW-9	Notes of Meeting held on 20 November 2003 between Council officers and [redacted] of SKM
CCW-10	Notes summarising the position of the Council regarding the review of the Q100 lines prepared prior to the 20 November 2003 meeting
CCW-11	Email from [redacted], SKM, to [redacted] regarding the scope of the proposed review by SKM dated 25 November 2003
CCW-12	Email from [redacted] to John Adams dated 25 November 2005
CCW-13	Memorandum from the Planning and Development Manager to the Planning Manager dated 25 November 2003
CCW-14	Extract of Attachment B2 to the Council's Assessment of the Submission by [redacted] regarding the review of Overlay Map OV5 and the Q100 line
CCW-15	Handwritten note dated 19 December 2003 regarding a meeting between [redacted] and [redacted]
CCW-16	Document entitled "Action Plan to determine property based flood levels"
CCW-17	Letter from Ipswich City Council to the Department of Local Government and Planning dated 11 December 2003 regarding the updated draft 2004 Scheme

CCW-18	Memorandum from the Council's Planning Manager to the Planning and Development Manager dated 19 February 2003
CCW-19	Email from [redacted] dated 25 February 2004 attaching a discussion paper prepared by [redacted] and [redacted]
CCW-20	Email from [redacted] dated 22 March 2004 attaching revised draft of the SKM report
CCW-21	Report by Sargent Consulting regarding the current status of the Flood Study Rationalisation Project dated 21 November 2005
CCW-22	Memorandum from [redacted] Senior Engineer, to [redacted], Acting Deputy Works Manager, regarding the amendments to Overlay Map OV5
CCW-23	Memorandum from [redacted], Acting Planning Manager, to Deputy Works Manager dated 8 December 2006 regarding the Ipswich Flood Study Rationalisation Project Phase 3 Final Report by Sargent Consulting

Fourth Statement of Carl Christian Wulff

This statement is provided in response to a Requirement, dated 31 October 2011, to provide a written statement, under oath or affirmation, to the Queensland Floods Commission of Inquiry pursuant to section 5(1)(d) of the *Commission of Inquiry Act 1950* (Qld).

I, Carl Christian Wulff, Chief Executive Officer of the Ipswich City Council (variously described throughout this statement as **"ICC"** or **"Council"**), 45 Roderick Street, Ipswich in the State of Queensland, affirm as follows:

1. This statement is supplementary to my first statement dated 2 September 2011 (**first statement**), my second statement dated 13 October 2011 (**second statement**) and my third statement dated 14 October 2011.

Commission of Inquiry Requirement Notice dated 31 October 2011

2. The Queensland Floods Commission of Inquiry (**Commission**) has issued a Requirement dated 31 October 2011 to me to provide a written statement relating to flood studies which are described in paragraph 1 of the Requirement as follows:

> "(a) Sinclair Knight Merz in 2000
>
> (b) Haliburton KBR in 2002
>
> (c) Fisher Stewart in association with Sargent Consulting in 2002 and 2003
>
> (d) Sargent Consulting in 2005 and 2006."

3. As the information sought in the Requirement relates to each of these flood studies (which I will refer to in this statement collectively as the **flood studies**) it is important to be clear and identify the relevant flood studies. I refer to the Common Expert Reading List - prepared by the Commission in respect of the Ipswich and Bremer River Experts Hearing (**reading list**). I understand that the following flood studies identified in the reading list are the studies that fall within the description referred to above from the Commission's Requirement:

   (a) **Sinclair Knight Merz in 2000** - I understand this to refer to the "Ipswich Rivers Flood Studies Report Phases 1 and 2" Sinclair Knight Merz 2000 - which is referred to as item 2 of the reading list.

   (b) **Haliburton KBR in 2002** - I understand this to refer to items 4 and 5 of the reading list described respectively as "Ipswich Rivers Flood Studies: Lower Bremer River Flooding Report Haliburton KBR dated 8 May 2002" and "Ipswich

[redacted] [redacted]

Rivers Flood Studies: Phase 3 (Final Report) by Haliburton KBR dated 27 September 2002".

(c) **Fisher Stewart in association with Sargent Consulting in 2002 and 2003** - I understand this to refer to items 3 and 7 of the reading list described respectively as "Composite Mapping for 20 year ARI: Review and Recommendations by Fisher Stewart in association with Sargent Consulting 2002" and "Brief Review of Flood Frequency Analysis and Discharge Rate incurred for Brisbane River at Moggill Gauge by Fisher Stewart in association with Sargent Consulting 2003".

(d) **Sargent Consulting in 2005 and 2006** - I understand this to refer to items 9, 11, 13 and 14 of the reading list being the four Sargent Consulting Reports with various dates between 2005 and 2006.

4. I will respond to requests for information in paragraph 1 of the Requirement on the understanding that these are the flood studies referred to in paragraphs 1(a) to 1(d) of the Requirement.

5. In paragraph 1 of the Requirement the Commission seek information regarding the flood studies including:

(a) how the studies were conducted and who within Council made decisions or undertook activities relating to the studies;

(b) whether the CEO of Council or any Councillor or the Mayor was briefed regarding the results of the flood studies and who made decisions to give or not give briefings regarding the flood studies;

(c) what decisions were made as to whether the results of the flood studies have an affect on the Q100 or planning control lines;

(d) what decisions were made as to whether or not to obtain a review of the flood studies and whether a decision was made that further investigations were or were not required in relation to the flood studies.

6. In relation to this information, the Requirement also requires me to:

(a) in respect of the topics which seek to identify a person or persons who made a decision or undertook an activity, provide the name, position and qualifications of that person or persons;

[redacted]

[redacted]

(b) provide all information in my possession and identify the source or sources of that information; and

(c) make commentary and provide opinions I am qualified to give as to the appropriateness of particular actions or decisions and the basis of that commentary or opinion.

7. Paragraph 2 of the Requirement seeks information from the Council regarding the Council's current approach (as of 2011) to obtaining and assessing flood studies relevant to planning control line.

8. Paragraph 3 seeks information regarding whether the Council has considered using a Monte Carlo approach in a flood study.

9. Paragraph 4 enquiries whether the Council has considered using a joint probability approach in a flood study to take account of the interaction between the Bremer and Brisbane Rivers.

Information Gathering Process

10. Before responding to the substance of the Requirement it is important that I make some observations regarding my ability to respond to the Requirement based on my personal knowledge and the process that the Council has undertaken to provide a response having regard to information held by other officers of the Council and information contained in the Council's records. I have set out below the sources of my knowledge and the information gathering exercise undertaken by Council. I note that the Requirement was received by Council's solicitors by email at 4.22 pm on Monday 31 October 2011 and it requires Council's response by 3 pm Tuesday 8 November 2011. The information requested of Council in the Requirement covers an 11 year period. In the time allowed, which is effectively less than 6 business days, Council has applied extensive resources to seek to identify the information sought in the Requirement and, although I am satisfied reasonable steps have been taken to collate my response, I cannot be certain that all relevant information, documents and evidence has been discovered and produced to me.

11. I commenced employment with the Council in the role of Chief Executive Officer on 4 July 2006. I therefore have no personal knowledge of any of the information requested in paragraph 1 of the Requirement regarding the flood studies performed before that time, which includes all of the flood studies identified in paragraph 3 above, apart from the studies described as the "Ipswich Rivers Flood Study Rationalisation Project: Phase 3 - Re-estimation of Design Flows (Final Report) Sargent Consulting September 2006" (item 13 of the reading list) and the "Ipswich Rivers Flood Study Rationalisation Project: Phase 3 - Re-estimation of

[redacted] [redacted]

Design Flood Levels (Final Report) Sargent Consulting dated December 2006" (item 14 of the reading list).

12. I also note that the current Ipswich Planning Scheme was adopted by the Ipswich City Council on 14 December 2005 and commenced on 23 January 2006 (**2006 Scheme**) and the previous Planning Scheme was adopted by the Council on 10 March 2004 and commenced on 5 April 2004 (**2004 Scheme**). It follows that I have no personal knowledge in respect of the information sought by the Commission in relation to the relevance of the flood studies and any consideration and decisions made regarding those flood studies and their effect on the Q100 or planning control line in respect of the 2004 Scheme or the 2006 Scheme.

13. In relation to the flood studies identified in items 13 and 14 of the reading list (referred to in paragraph 11 above) I have no recollection of reviewing or considering those flood studies.

14. In order to prepare this statement in response to the Commission's Requirement and particularly those aspects of the Requirement where I have no personal knowledge, being paragraph 1 of the Requirement and, up until I commenced employment with the Council on 4 July 2006, the information requested in paragraphs 3 and 4 of the Requirement, the Council undertook the following process:

    (a) the Council sought to identify any officer still in the employment of the Council who was involved in the activities which are the subject of the Requirement;

    (b) Council officers conducted a search of the Council's records to identify any records that may be relevant to the Requirement and particularly the flood studies referred to in the Requirement.

15. I make the following observation in relation to the information that I have been able to determine by reference to the process referred to in paragraphs 10 to 13 above:

    (a) In respect of those aspects of the Requirement that relate to the planning function of the Council I have consulted with Mr John Adams, the Council's City Planner. In this regard I also refer to Mr Adams' witness statements dated 2 September 2011 and 25 October 2011 which are responsive to certain aspects of the Requirement which I will discuss below. I note that Mr Adams has been the City Planner since June 2008 and that he was Deputy Chief Town Planner and Strategic Planning Manager of the Council for approximately 20 years prior to that.

    (b) The information sought in paragraph 1 of the Requirement regarding the flood studies relates to activities that would have been primarily undertaken by officers of

the Council's Works Department in respect of the commissioning, review and analysis of the flood studies and the development of models and maps based on those flood studies and by officers of the Council's Planning and Development Department in respect of the incorporation of the results of that work into the Planning Schemes.

(c) In relation to the Planning and Development functions of the Council relevant to the Requirement I have relied primarily on the evidence of Mr Adams as set out in his statements and advice given to me by Mr Adams which I will refer to below.

(d) In respect of the activities of the Works Department, the Council has identified that the Council officer who had primary responsibility for commissioning, reviewing and analysing the flood studies was Mr Andrew Underwood who, during the relevant period, was the Acting Works Manager of the Council's Works Department. Mr Underwood was employed by the Council for the period from 14 June 1978 to 13 November 2009. Mr Underwood is now deceased and I understand that he passed away shortly after he ceased employment with the Council.

(e) It follows that my response to the information requested in paragraph 1, 3 and 4 of the Requirement is primarily based upon the Council's written records regarding those matters, except to the extent that I have any personal knowledge of those matters, which I will identify below.

(f) Council's records indicate that Mr Ravi Raveenthiran also had some more limited involvement in the activities of the Works Department in respect of the flood studies. Mr Raveenthiran is currently employed as Principal Development Engineer within the Planning and Development Department and he has held that position since January 2008. Prior to that time and since November 1998 he held the positions of Engineer and Senior Engineer with the Council's Works Department.

16. The flood studies referred to in paragraph 1 of the Requirement were reviewed and most likely considered in the context of the 2004 Scheme and the 2006 Scheme. In this regard, I refer to sections 14 and 18 of the Council's second submission dated 20 August 2011 regarding planning (which I will refer to as the **planning submission**) which provides a detailed description of the development of the 2004 and 2006 Schemes. I also refer to the following information:

(a) Paragraphs 72 to 77 of the statement of John Adams dated 2 September 2011, which deals with flood studies obtained or received by Council since March 2011

[redacted] [redacted]

and changes to Council's land planning processes and policies in response to the January 2011 floods.

(b) Paragraph 113 to 130 of my statement dated 2 September 2011 dealing with Council's review of stormwater design and urban run-off capacities and flood studies obtained by the Council since March 2011.

(c) Paragraphs 1.7 to 1.14 of the Council's planning submission which deal with the Council's response to the 2011 flood event and review of planning approach to flood regulation.

(d) Paragraphs 14.8 to 14.11 of the Council's planning submission which deal with the process for adoption of the Q20 and Q100 flood level for the 2004 planning scheme.

(e) The Council's submission on flood mapping dated 4 November 2011 which is in response to the Commission's request for submissions dated 18 October 2011.

(f) The joint expert statement dated 25 October 2011 in relation to the Bremer River flood frequency analysis, in particular those aspects of that statement that deal with the requirements for a comprehensive flood study for the Bremer River for the purpose of reviewing the Bremer River flood frequency and relevant flood lines, including the Q100 flood line.

(g) Mr Adams' second statement and particularly paragraphs 3 to 7 which deal with future management of flood risk in planning and the process for conducting regional flood studies and paragraphs 16 to 19 that deal with 2002 Fisher Stewart Report.

17. It is convenient to provide my response to paragraphs 2, 3 and 4 of the Requirement before dealing with paragraph 1 of the Requirement.

Council's current approach to obtaining and assessing flood studies relevant to planning control lines (paragraphs 2 of the Requirement).

18. The position regarding review of the Council's current planning scheme and the Council's response to the 2011 flood event, including review of the planning approach to the flood regulation is set out in:

(a) paragraphs 1.5 to 1.14 of the Council's planning submission;

(b) paragraphs 1.13 to 1.30 of my statement dated 2 September 2011;

[redacted] [redacted]

(c) paragraphs 72 to 76 of Mr Adams' first statement dated 2 September 2011;

(d) paragraphs 3 to 7 of Mr Adams' second statement dated 25 October 2011;

(e) the Council's flood mapping submission dated 4 November 2011.

I have read the above paragraphs of the Council's planning and flood mapping submissions and Mr Adams statements and I agree with those submissions and evidence.

19. As noted in paragraph 1.13(b) of the Council's planning submission, the next major statutory review of the Ipswich town planning scheme is due to commence after 2012. On 20 June 2011, the Council adopted Temporary Local Planning Instrument 01/2011 Flooding Regulation (**TLPI**). The TLPI is described in Mr Adams' first statement and it replaces relevant provisions of the 2006 Scheme for a period of 12 months.

20. I refer to the joint expert statement regarding the Bremer River flood frequency which sets out the requirements for a comprehensive study to review the Council's flood regulation lines. I understand that it will not be possible to complete that comprehensive study prior to the expiration of the TLPI on 19 June 2012. Council is reviewing two options to address the period between the expiration of the TLPI and the completion of the comprehensive flood study. One option is to seek legislative amendment that would allow the TLPI to be in place until the comprehensive flood study has been completed. A second option Council is considering is the opportunity to accelerate in accordance with the Temporary State Planning Policy, an interim amendment to the planning scheme that would remain in place until the comprehensive flood study has been completed. This option is currently being considered with the Queensland Reconstruction Authority.

Council's consideration of the Monte Carlo approach and the joint probability approach (paragraphs 3 and 4 of the Requirement)

21. In paragraphs 3 and 4 of the Requirement the Commission seeks information regarding whether Council has considered using a Monte Carlo or a joint probability approach in a flood study. I understand the Commission's enquiry to relate to whether the Council has considered such approaches for previous flood studies. I have no personal knowledge of whether Council has considered such approaches in the past. I note the following based on available Council records and advice from relevant Council officers:

(a) In paragraph 24 of the joint expert statement, the experts conclude that in order to characterise flood behaviour in Ipswich over the full probability domain, the flood models would need to be run in a Monte Carlo framework where certain factors

[redacted] [redacted]

were to be treated in a probabilistic manner. I understand the reference to a probabilistic manner to be, at least in part, a reference to the joint probability approach described in paragraph 4 of the Commission's Requirement;

(b) The Independent Review Panel (Mein et al 2003) recommended that Monte Carlo methodology be used to simulate the possible combinations of storm temporal and spatial patterns and could also include variation of loss rates and reservoir draw downs;

(c) The Sargent report to the Ipswich Rivers Improvement Trust dated January 2006 (item 14 of the reading list) is described as a "Monte Carlo" analysis of design flow. In the executive summary to Mr Sargent's report, he notes as follows:

"A full Monte Carlo analysis would comprise running a large number of trials (typically in the order of tens of thousands) in order to adequately describe the distribution of the dependent variable, in this case flood peak magnitude.

Typically, applications of the Monte Carlo simulation process to rainfall – run off modelling, have used a simplified function so that the sample trials could be automated and a large number of trials undertaken. However, due to the complexity of the RAFTS model and its data input requirements, it is not possible to automate the process in this case and manual editing of the data files is required for each model run. As significant time is required to conduct each model run, there are time and budget constraints on a number of trials which could be conducted.

As the current Brisbane/Bremer River RAFTS model has been developed at considerable expense and has been widely used by both ICC and BCC as the basis of flood event modelling for some time, there is no incentive to change the modelling for that format this time.

Taking these constraints into account, the Monte Carlo modelling undertaken for this study was limited to exploring the variation in estimation of peak 100 year ARI flows resulting from variations in a limited number of model inputs in order to provide further insight into this variability and to reduce the uncertainty in the Q100 flow estimates."

(d) The executive summary of this report concludes as follows:

"Conclusions

[redacted] [redacted]

The analysis has shown that even with a relatively small number of trials, a Monte Carlo analysis was able to refine both the central estimates and likely range of key design values and to reduce uncertainty in these estimates. It is considered unlikely that further trials will significantly influence the results obtained.

It is acknowledged that there were limitations to the analysis which were necessary due to time and budget constraints. These limited considerations to the range of outcomes from 100 year ARI catchment rainfalls, rather than from the entire distribution of rainfall events.

Nonetheless, this provided a direct comparison with results of previous studies which were also limited in this way.

The results from the Monte Carlo analysis were generally consistent with the recommendations in the independent review panel report (Mein et al 2003) and have refined both the central flood estimates in the confidence limits or likely range of flood estimates.

In respect of the Bremer River and Lockyer Creek catchments, the Monte Carlo analysis results were 20% - 30% lower than those in the Ipswich Rivers flood study (SKM 2000) ... ".

(e) Attached to my statement and marked **CCW-1** is a copy of a memorandum from the Council's then Deputy Works Manager, Andrew Underwood, to the Secretary of the Ipswich Rivers Improvement Trust dated 18 September 2006 (**2006 Memo**). The 2006 Memo appears to summarise the progress of the Ipswich River's Flood Study Rationalisation Project, which includes the January 2006 Sargent report, and it sets out the anticipated key outcomes, study methodology and progress to date of the flood study project. The section of the 2006 Memo headed "**Hydrologic Analysis**" includes a section headed "**(a) Monte Carlo Analysis**" which then summarises the January 2006 Sargent report and its conclusions regarding the Monte Carlo analysis. At page 9 of the 2006 Memo under the heading "**Trust Engineer's Assessment**" the author states as follows:

"The outcome of the Hydrologic Analysis using the Monte Carlo method whilst supporting the independent review panel's findings was not embraced by the stakeholder group ... ".

(f) Then under the heading "**Conclusions**", the author of the 2006 Memo concludes as follows:

[redacted]

[redacted]

"1. The study has supported the findings of the Independent Review Panel but has not persuaded other stakeholders from other agencies that a less conservative approach can be taken in assessing design flood flow. The Trust will need to make further efforts to achieve the anticipated outcome of consistency of flood estimation and flood mapping across joint boundaries with neighbouring Councils. This can be further pursued by requesting the stakeholders to provide comments on the outcome of the study to date.

2. The study has proceeded on the basis that the post-dams Q100 design flow in the Brisbane River at Savage's Crossing should be 6000 Cumecs.

3. A range of design flows other than Q100 have been determined for the Brisbane, Bremer Rivers and tributaries.

4. The hydraulic model has been reviewed and the hydraulic modelling is underway.

It is proposed that a copy of this report be provided to Ipswich City Council, Bureau of Meteorology, Water Resources (Brisbane City Council), SunWater, Esk Shire Council, SEQWater and Department of Natural Resources and Mines for their information and that they be requested to provide comments on the study outcomes to date."

(g) Attached to my statement and marked "**CCW-2**" is a copy of a memorandum from the Council's then Deputy Works Manager, Andrew Underwood, to the Secretary of the Ipswich Rivers Improvement Trust dated 16 November 2007 (**2007 Memo**). The 2007 Memo records an update to the Trust in relation to the progress of the flood study project. It reports on further flood study reports received from Sargent Consulting and responses from the various agencies that were consulted subsequent to the 2006 Memo, including stakeholder comment on the Sargent Consulting Monte Carlo analysis. In the conclusion of the 2007 Memo, the author reports as follows:

"**Conclusion**

While not obtaining agreement with external stakeholders, the study has resulted in better understanding of hydrological and hydraulic issues associated with the Brisbane River and its tributaries.

[redacted] [redacted]

A single much improved hydraulic model has been produced for all major streams in Ipswich.

The decision by Ipswich City Council to adopt the equivalent of the 2% AEP from the SKM study as its 1% AEP flood regulation has been shown to be a sound decision.

It is proposed that the Trust receive and note this report and send copies of the report and supporting technical documents to the agencies involved in the consultation process for the study.

Future users of the model should be made aware of the considerable uncertainties in estimates and the need for uncertainty allowances to be added to design flood estimates when modelling outcomes are being reviewed."

22. I have not been able to find any record which further analyses or considers the Sergeant 2006 Monte Carlo analysis or the matters addressed in the 2006 and 2007 Memos.

Council's commissioning, review and consideration of the flood studies (paragraph 1(e) to 1(h), 1(j) and 1(k) of the Requirement)

23. In relation to each of the flood studies referred in paragraphs 1(a) to 1(d) I have referred to the summary of the studies and the comments on those previous studies set out in sections 3.2, 3.3 and 3.4 of the report by WMAwater to the Commission entitled "Supplementary Report – Ipswich Flood Frequency Analysis Final Report" dated October 2011 (**Bremer Frequency Report**). I have also consulted with Mr Neil Collins of BMT WBM Pty Ltd, consulting engineer engaged by the Council, and based on advice received from Mr Collins, I consider that sections 3.2 to 3.4 of Bremer Frequency Report accurately summaries the flood studies referred to in paragraph 1(a) to 1(d) of the Requirement. The flood study reports are very detailed technical hydraulic/hydrologic engineering reports. I have not read and reviewed the flood studies in depth in order to respond to the Requirement and I rely upon the summary of the flood studies in the Bremer Frequency Report for the purpose of responding to the Requirement.

24. In relation to the information sought in paragraph 1(e) of the Requirement dealing with:

(a) the choice of the external consultants;

(b) the material provided to the consultants; and

[redacted]

[redacted]

(c) determination of the scope of work, instructions on timeframe and data and any assumptions in respect of the studies;

I have not been able to identify any relevant information that would assist the Commission in respect of those matter apart from what is recorded in the reports of the flood studies themselves. This is primarily because these activities would likely have been undertaken by Mr [redacted] who is now deceased and the Council has not identified any relevant records regarding these matters.

25. In relation to paragraph 1(f) of the Requirement, I refer to paragraph 24 and repeat my response.

26. In relation to paragraphs 1(g), 1(h), 1(j) and 1(k) of the Requirement the only record that I have been able to find regarding whether the Chief Executive Officer of the Council, any Councillor or Mayor was briefed regarding the results of the flood study is what appears to be a draft committee report to the Council's Planning & Development Committee scheduled for 4 November 2003. This is in the form of a draft memorandum from the Council's then Acting Works Manager, [redacted] to the then Chief Executive Officer of the Council, Mr [redacted] dated 2 October 2003 (**2003 Draft Report**). Attached to my statement and marked **CCW-3** is a copy of the 2003 Draft Report. The Council has searched its records and has been unable to locate a final copy of this document. A search of the Council records reveals that the 2003 Draft Report was not put before the Planning and Development Committee meeting on 4 November 2003 and I cannot verify whether the 2003 Draft Report was actually received and considered by [redacted] the then Chief Executive Officer.

27. I have not been able to find any records on who made decisions regarding the provision of briefings with respect to the results of the flood studies, what decisions were made in that respect and what decisions were made regarding the need for further investigations, other than what is recorded in the 2003 Draft Report, the 2006 Memo and the 2007 Memo.

28. In relation to paragraph 1(j) regarding decisions about whether or not to obtain a review of the flood studies, by whom, when and on what basis that decision was made, I again refer to what is recorded in the 2003 Draft Report, the 2006 Memo and the 2007 Memo and I also attach to my statement and mark **CCW-4** a document headed "Comments on Ipswich Flood Study Rationalisation Project, Phase 3 – Monte Carlo Analysis" which is undated but is issued on the letterhead of GHD, which I understand to be a reference to the consulting engineering firm, Gutteridge, Haskins and Davey Pty Ltd.

29. In addition, I refer to and attach the following documents:

(a) attached to my statement and marked **CCW-5** is a copy of an email from David Sargent of Sargent Consulting to Andrew Underwood and others dated 12 September 2003 (12.23 pm) regarding Brisbane River flood levels;

(b) email from Mark Salisbury of Sinclair Knight Merz (**SKM**) to Andrew Underwood dated 25 November 2003 (at 8.34 am marked **CCW-6**); and

(c) email from Mark Salisbury of SKM to Andrew Underwood and others of the Council dated 29 January 2004 (11.26 am) attaching a draft report by Sinclair Knight Mertz in respect of the Ipswich River's flood studies – further investigation dated 9 December 2003 (**CCW-7**).

The flood studies and the Q100 and planning control lines (paragraph 1(i) of the Requirement)

30. In relation to paragraph 1(i) of the Requirement, the Commission seeks information regarding what decision was made as to whether the results of the flood studies would have an effect on the Q100 or planning control lines, including when, by whom and on what basis was that decision made. The flood studies referred to in the Requirement could only have had an influence on the Q100 or planning control lines adopted for the 2004 Scheme and the 2006 Scheme.

31. As explained in paragraph 12 above, I have no personal knowledge of these matters and I therefore rely upon the process described in paragraphs 10 to 13 to respond to this aspect of the Requirement.

32. I am advised by John Adams that, as Town Planner, he relied upon advice provided to him by officers from the Council's Works Department regarding the technical determination, modelling and mapping of the Q100 and other flood, drainage and stormwater related development control lines. Mr Adams informs me that once the Works Department had completed the engineering assessment of the flood, drainage and stormwater planning control lines based on the flood studies the Works Department then provided to the Planning Department Geographic Information System (**GIS**) layers which contained data sets that were used by the Planning Department to produce the mapping for the development control lines adopted for the Planning Schemes.

33. I am advised by Mr Ravi Raveenthiran that he had some involvement in the review and analysis of the flood studies for the purposes of determining the flood, drainage and stormwater related development control lines for the 2004 and 2006 Schemes. Mr Raveenthiran has reviewed the following paragraphs of my statement and he has confirmed

that, to the best of his recollection, to the extent those paragraphs attach and refer to documents the contents of those documents are a true and accurate record of the matters they address and, to the extent the following paragraphs refer to the Council's activities in respect of the flood studies, they are true and correct to the best of his recollection.

34. I have read paragraphs 14.8 to 14.11 of the Council's planning submission and paragraphs 42 to 47 of John Adams' first statement and I understand those submissions and statements to be an accurate record of the process of taking into account the flood studies for the Q100 and other flood, drainage and stormwater related planning control lines.

35. By way of further elaboration on the process for the adoption of the Q100 and other flood, drainage and stormwater related planning control lines for the 2004 Scheme, I set out in the following paragraphs my observations having regard to the Council's records. For context I also refer to the documents that were produced to the Commission under cover of a letter from the Council's solicitors, Clayton Utz, dated 22 August 2011, which responded to paragraphs 1 and 2 of the Commission's Requirement dated 5 August 2011 requiring the Council to produce all applications, and all correspondence relating to applications, to the Minister for Local Government and Planning pursuant to which the 2004 Ipswich Planning Scheme and the 2006 Ipswich Planning Scheme were found to meet the Requirements of the *State Planning Policy 1/03 - Mitigating the Adverse Impacts of Flood, Bushfire and Landslide*. As those documents have already been produced to the Commission I will only refer to them to the extent necessary for the purposes of this statement.

Chronology for the Q100 flood line adopted for the 2004 Scheme

36. The 2003 Draft Report appears to contain an accurate record (at least up to the time that memo was produced) of the process that was undertaken by the Council to determine the Q100 and other flood, drainage and stormwater development control lines having regard to the flood studies then available to the Council. I will set out in the following paragraphs my understanding of the chronology for the development of the Q100 line for the 2004 Scheme.

37. The draft 2004 Scheme commenced the public notification stage on 12 June 2003 and was on public display until 5 September 2003. The draft Planning Scheme relied upon the SKM 2000 flood study (for urban areas) and the Haliburton KBR flood study (for rural areas) to develop the Q100 flood line.

38. I understand that Development Overlay Map OV5 (**Overlay Map OV5**) formed part of the draft Scheme and that map depicts 1 in 100 flood line (which I will refer to as the Q100 flood line), the 1 in 20 development line (which I will refer to as the Q20 flood line), the urban storm water flow path areas and certain areas that are described as "indicative and subject to further

[redacted] [redacted]

detailed assessment". I understand that areas within this last category could not be accurately modelled for a range of reasons so the development control lines are based on the best available information and historical knowledge.

39. On 10 September 2003, the Acting Works Manager, [redacted] made a submission to the Planning Manager in relation to the draft 2004 Scheme. Attached and marked **CCW-8** is a copy of that submission.

40. The submission refers to an updated flood study conducted by the Brisbane City Council and notes that the flooding data in the draft Scheme was based on a previous iteration of the Brisbane River flood data prepared by SKM for Ipswich and Brisbane which is graphically depicted in Overlay Map OV5. [redacted] recommended a review of Overlay Map OV5 to incorporate the latest data contained in the Brisbane study.

41. I understand that the updated study conducted by Brisbane City Council refers to the report entitled "Review of Brisbane River Flood Study – Report to Brisbane City Council by Independent Review Panel dated 3 September 2003" (**Independent Panel Review report**).

42. On 10 September 2003 [redacted] commissioned Sargent Consulting to review that report and the AR&R and CRCFORGE technical rainfall and run off estimates provided by the chief executive officer of SEQWater.

43. On 18 September 2003 Sargent Consulting produced a draft report to the Council reporting on the results of that review. A summary of that report is contained in the 2003 Draft Report.

44. Sargent Consulting recommended that the Q100 flood line in Overlay Map OV5 be reviewed and suggested that there were two options:

(a) ICC could undertake the MIKE 11 modelling and subsequent mapping based on the updated estimate of the Brisbane River Q100 flood frequency flow of 6000 cumecs as determined by the Independent Review Panel. This would be best achieved by modifying existing 50 year ARI files to scale hydrographs to give the required flows, which requires a maximum of 10% adjustment; or

(b) utilise the current 50 year ARI flood mapping from SKM 2000 study, with the understanding that these maps are marginally (less than 10%) non-conservative in terms of flows, but are believed to be more conservative in terms of levels.

Sargent Consulting advised that the former of these two options was preferred. I understand that the "current 50 year ARI flood mapping" referred to paragraph 44(b) above is a reference to the Q50 flood line mapping in the SKM 2000 flood study.

[redacted]

[redacted]

45. It appears that there was subsequent consultation with BCC and SKM and I understand that the effect of the advice contained in the 2003 Draft Report was that the first option was not feasible in the time limited to complete the 2004 Scheme. On page 5 of the 2003 Draft Report, [redacted] concludes as follows:

> "(2) Sargent Consulting have indicated that a revision of the Council's flooding overlay flood map could be undertaken fairly quickly using levels based on modified Q50 levels from the SKM 2000 study. This will produce levels which would probably be marginally conservative but still provide a good indication of flood levels on broad scale maps. This may meet Council's needs as far as a revision of the proposed planning scheme was concerned."

46. Attached to this statement and marked **CCW-9** are notes of the meeting held on 20 November 2003 between Council officers, including [redacted] with [redacted] of SKM. Also attached and marked **CCW-10** are what appears to be notes prepared prior to this meeting which summarise the position of the Council regarding the review of the Q100 flood line.

47. This note of the meeting records the following, among other things:

> "It was discussed whether the Q50 Brisbane River flow of around 6,800 Cumecs from the Ipswich River's Flood Study Phase 1 and Phase 2 report, SKM (2000) could be the good representative and conservative matching Q100 flow as far as Ipswich was concerned. If this is acceptable, already mapped Q50 flooding and inundation could be replaced as the Q100 map. Since this Q50 map has already been mapped (need smoothening), this option would be a cost effective exercise.
>
> [redacted] agreed to look at the earlier SKM's Q100 flows for the Bremer River catchment with consideration of Aerial Reduction Factor for the rainfall and to compare with the Q50 flows and to see whether the variation is acceptable or not. This would justify the option to adopt the current Q50 map as the new Q100 map. If it is not within the acceptable limit, SKM will advise ICC on any further work undertaken.
>
> SKM is also to advise what other actions are needed in the long term to finalise the flood study and ensure that the outcomes are coordinated between ICC and BCC."

48. On 25 November 2003, [redacted] of SKM sent an email to [redacted] setting out the scope of the proposed review by SKM. A copy of this email is attached to my statement and marked **CCW-11**.

[redacted]

[redacted]

49. Attached to my statement and marked **CCW-12** is an email from [redacted] to John Adams dated 25 November 2003. I note that this email states as follows:

"Please see attached submission that resulted from last week's meeting with SKM.

Also we've just finished the first cut of the "SKM 2000 – 50 year floodline" produced in a smooth line at the detailed property levels. So if SKM's analysis was to indicate that this "flood line" was a fair representation of the "2003 – 100 year floodline" then we are well positioned to have a mapping product ready on fairly short notice."

50. Attached and marked **CCW-13** is a committee report (without attachments) from the Planning and Development Manager to the Planning Manager dated 25 November 2003 which was considered by the Planning & Development Committee meeting held on 2 December 2003. This report provides advice on the public consultation stage of the draft 2004 Planning Scheme, the Council's review and assessment of all submissions received in respect of the draft 2004 Scheme and makes recommendations in respect of the Council's response to the submissions, modifications to the draft 2004 Scheme and forwarding the modified draft 2004 Scheme to the Minister for the final State interests review.

51. Attached to my statement and marked **CCW-14** is an extract of Attachment B2 to the memo which contains the Council's assessment of the submission by [redacted] dated 10 September 2003 regarding the review of Overlay Map OV5 and the Q100 flood line. The recommendation of the Planning Branch in response to the submission (noted as submission 19 in Attachment B2) is as follows:

"The approach suggested by the Acting Works Manager is concurred with.

Overlay Map OV5 was compiled using the 'best available data', however the more recent data would appear to indicate that the previous data used was somewhat conservative.

It is also considered desirable to adopt, as far as possible, a consistent approach to flooding along the reaches of the Brisbane River which adjoin both the Ipswich and Brisbane local government boundaries."

52. At the Council's meeting held on 10 December 2003 the Council resolved to adopt the draft 2004 Scheme as amended in accordance with the recommendations set out in the memo dated 25 November 2003, including the amendments to Overlay Map OV5. Although it is not entirely clear from Council's records I understand that the Overlay Map that formed part of the draft 2004 Scheme approved at this meeting would have been based on the map prepared by

[redacted] [redacted]

[redacted] and referred to in his email dated 25 November 2003 (**CCW-11**). I note that the intention was to adopt that map subject to the SKM review which was to be completed by 1 December 2003 (refer to [redacted] email dated 25 November 2003 at **CCW-11**) but it appears that SKM did not complete the work in time for it to be considered in respect of the draft 2004 Scheme. In this regard attached to my statement and marked **CCW-15** is a handwritten note dated 19 December 2003. I am advised by [redacted] that this note was written by Mr Underwood and that it records a meeting between [redacted] I refer to the following extract of the note:

"Brisbane Study Revision

[redacted] advised 18/12/03 that SKM would not deliver report by end of 2003 because there is some conflict with flood frequency analysis.

[redacted] asked him to advise [redacted] of this.

Melbourne office will be looking at it again in early Jan 2004 and should only take a week or so to get back to ICC.

He also advised that the 2000 Q50 appeared to be a good fit for the new Q100 if not a little conservative."

53. Attached to my statement and marked **CCW-16** is a document headed "Action Plan to determine property based flood levels" and another document headed "Action Plan to determine property based flood levels". I cannot determine the identity of the author of this document. There is also no date on the document. I expect it is likely to be an officer from the Council's Works Department. I note from this document that it summarises the actions required to set the property based Q100 and 1 in 20 development flood levels. I note that in respect of the Q100 the following is stated:

"SKM's Q50 level is going to be the future Q100 level for the urban area (phase 1 and phase 2 study area)".

54. On 11 December 2003 the Council wrote to the Department of Local Government and Planning submitting the updated draft 2004 Scheme and requesting the Department's confirmation that the Council could proceed to the final adoption of the plan following the final State Interest Review. Attached to my statement and marked **CCW-17** is a copy of that letter. I note that at the top of page two, as part of a summary of the main changes to the draft Scheme previously submitted to the Department, the Council advises (see the last dot point at the top of page 2):

[redacted] [redacted]

"revising the flooding data used to formulate the flooding overlay maps based on more recent data obtained as a result of a joint project with the Brisbane City Council involving the Brisbane River."

55. I refer to the email from [redacted] of SKM to [redacted] dated 29 January 2004 which attaches a draft report from SKM to the Council dated 9 December 2003 (both of which are attached and marked **CCW-7**). Although the draft SKM report is dated 9 December 2003, it appears that it was not received until it was sent to the Council under cover of the email dated 29 January 2004. I note that SKM seeks the Council's comments in the draft report.

56. I note at page 8 of the SKM report there are recommendations including the recommendation that the 1 in 100 AEP flood levels reported in the SKM 2000 report remain unchanged. The report also recommended further investigation be undertaken to reconcile the differences between the rainfall-based and flood frequency estimates, particularly with respect to the joint occurrence of flood-producing factors. It is suggested that this work could be done in conjunction with the Brisbane City Council as many of the issues requiring consideration are common to both parties.

57. On 18 February 2004 the Council received a letter from the Minister of the Department of Local Government and Planning advising that, in accordance with section 18(4)(a) of Schedule 1 of the IPA Council could adopt the 2004 Scheme as submitted by the Council. I note that in paragraph numbered 4 at the foot of the first page of the letter from the Minister the Minister advised that she is satisfied that State Planning Policy 1/03 Mitigating the Adverse Impacts of Flood, Bushfire and Landslide is appropriately reflected in the Scheme.

58. Attached to my statement and marked **CCW-18** is a committee report from the Council's Planning Manager to the Planning and Development Manager dated 19 February 2004 (without attachments). I understand that this report was considered by the Council's Planning and Development Committee on 2 March 2004 and a full Council Meeting on 10 March 2004 at which the Council resolved to adopt the 2004 Scheme in accordance with the recommendation set out in the report with the Scheme to commence on Monday 5 April 2004.

59. I reviewed the Council records to determine the extent to which the draft SKM report dated 9 December 2003 was considered by the Council in the context of the Q100 line. Attached to my statement and marked as below are the following documents:

(a) email from [redacted] dated 25 February 2004 attaching a discussion paper prepared by [redacted] regarding the draft SKM report (**CCW-19**); and

(b) email from [redacted] dated 22 March 2004 attaching a revised draft of the SKM report - **CCW-20**.

60. I have not been able to find any record of a final version of the SKM report having been provided to the Council and it appears to me from the Council's records that the issues that were raised by the draft SKM report were addressed as part of the scope of the Ipswich Rivers Flood Study Rationalisation Project conducted by Sargent Consulting jointly on behalf of the Council and the Ipswich Rivers Improvement Trust. This study produced the reports that are described in paragraph 1(d) of the Requirement.

61. Attached to my statement and marked **CCW-21** is a report by Sargent Consulting dated 16 November 2005 that summarises the then current status of the Flood Study Rationalisation Project. I note that at page 2 it is stated that the Study was being funded under the federal government's Natural Disaster Risk Management Programme and that the funding application gave the following expected outcomes for the Study:

(a) Refined hydrologic model and design flood discharge hydrographs compatible with the latest rainfall and hydrologic modelling undertaken for Wivenhoe Dam operations and for Brisbane City Council;

(b) Refined hydraulic modelling based on the refined hydrology, and recalibration using the latest version of MIKE 11 (or a 2-dimensional model such as MIKE 21) to take account of recent improvements in hydraulic roughness representation;

(c) Consistency of flood estimation and flood mapping across joint boundaries with neighbouring Councils;

(d) Updated flood mapping for a range of flood frequencies and for PMF;

(e) Update of flood overlay in the Ipswich Planning Scheme; and

(f) Preparation of a Flood Study Report.

62. I also refer to pages 4 and 5 of the report and note the following extract:

"1. As noted in Sargent Consulting (2003) and confirmed by the recent Brisbane City Council hydrologic modelling, the design flow hydrographs produced from the RAFTS model used in the recent Ipswich Flood Studies (SKM 2000 and Halliburton KBR 2002) are conservative, resulting in the estimated flood levels derived from them also being conservative. This affects not only the Ipswich reach of the Brisbane River but the whole of the Bremer River catchment;

2. Sargent Consulting (2003) identified that the calibration of the current MIKE 11 model is skewed towards replicating larger floods, and is conservative in respect of smaller floods (eg <=20 year ARI);

[redacted] [redacted]

3. ICC's flood planning levels are based on an estimated 100 year ARI flood of 6,900m³/s for the lower Brisbane River (the 50 year ARI from SKM 2000) whereas BCC's are now based on 6,000m³/s on the basis of advice given by the Independent Review Panel (2004);

4. Due to the above there is an inconsistency in design flood levels on the Brisbane River across the BCC/ICC boundary at Gailes. **For example, at Moggill Gauge, the Q100 flood level was estimated to be 18.34 m AHD and 14.36m AHD in the 2000 and 2004 modelling respectively, a difference of 4.0m**.

In addition, the following new information needs to be taken into account:

- availability of new rainfall design data (CRC-FORGE) and a new estimate of probable maximum flood (PMF); and
- the construction of the fuse plug spillways Wivenhoe Dam.

Resolution of these matters is urgently required by ICC so that:

- the flood overlay in the Ipswich Planning Scheme can be confirmed and updated; and
- the current development of emergency response flood mapping is not compromised."

63. I understand from this chronology that the Q100 flood line depicted on Overlay Map OV5 adopted for the purposes of the 2004 Scheme was derived as follows:

(a) for urban areas, the modelling and mapping for the line adopted a flow in the Brisbane River of 6,800 cumecs (or 6,900 cumecs -see paragraph 3 of the quoted extract in paragraph 62 above). This was based on the findings of the Independent Review Panel that the Q100 flow for the Brisbane River flow was 6000 cumecs and the advice of Sargent Consulting that a conservative representation of this line would be the Q50 line adapted from the SKM 2000 Ipswich flood study for urban areas (which was based on a flow of 6,800 cumecs in the Brisbane River) (see item 2 of the reading list); and

(b) for rural areas, the line was based on the Ipswich Rivers Flood Studies: Phase 3 (Final Report) by Haliburton KBR dated 27 September 2002 (item 5 of the reading list).

Chronology for the Q100 flood line adopted for the 2006 Scheme

64. The 2006 Scheme was adopted by the Council on 14 December 2005 and commenced on 23 January 2006. It appears that, at the time of the review and updating of the 2006 Scheme none of the key outputs of the Flood Study Rationalisation Project had been completed. I understand that the first study report was produced by Sargent Consulting in January 2006 entitled Phase 3 "Monte Carlo" Analysis of Design Flows dated January 2006, which I have discussed at paragraphs 21 and 22 above.

[redacted] [redacted]

65. I am advised by [redacted] and Mr Adams that the Q100 flood line as depicted in Overlay Map OV5 in the 2006 Scheme remained relatively unchanged from the 2004 Scheme Overlay Map OV5 apart from minor amendments in certain areas which reflected more accurate and up to date data obtained from localised flood studies. Attached to my statement and marked **CCW-22** is a copy of a memorandum from [redacted], Senior Engineer, to [redacted], who was the then Acting Deputy Works Manager, which summarises the amendments to Overlay Map OV5 that were incorporated in the 2006 Scheme.

66. I am advised by [redacted] that the summary of the review and consideration by Council officers of the reports produced as part of the Ipswich Rivers Flood Study Rationalisation Project is accurately reflected in the 2006 Memo and the 2007 Memo.

67. Attached to my statement and marked **CCW-23** is a memorandum from the Acting Planning Manager, Mr [redacted] to the Deputy Works Manager, dated 8 December 2006. [redacted] is no longer employed by the Council, but I expect that this memo refers to the Ipswich Rivers Flood Study Rationalisation Project Phase 3 Final Report by Sargent Consulting on the Re-estimation of Design Flood Levels dated December 2006 (item 14 of the reading list). I have extracted below the content of the memo:

"I refer to the above project and accompanying report and offer the following comments. There does not appear to be final resolution of flood modelling outputs between the Rationalisation Project and the Stakeholder group. This situation exists because:

1. the reduction of flood flows in the Rationalisation Project is dependant on the existence of significant flood storage being available in the dams before a flood event has commenced; and

2. the Stakeholder Group has concerns that the flows identified in this study are significantly less then those identified in both previous studies and flows experiences historically in the catchment.

From a risk management and risk minimisation perspective it is therefore considered that the current GIS mapping that is utilised to identify Q20 and Q100 flood events in the Ipswich Planning Scheme should not be varied or amended."

68. I refer to paragraph 21(g) of my statement and repeat the extract from the conclusion of the 2007 Memo as follows:

"The decision by Ipswich City Council to adopt the equivalent of the 2% AEP from the SKM study as its 1% AEP flood regulation has been shown to be a sound decision."

I understand the reference to the "2% AEP from the SKM study" to be a reference to the Q50 line identified in the SKM 2000 study and the reference to the the "1% AEP flood regulation" is a reference to the Q100 flood regulation development line. This was based on design flows of 6,800 cumecs in the Brisbane River.

Ongoing review of the flood studies

69. I understand that no regional flood study has been completed subsequent to the Ipswich Rivers Flood Study Rationalisation Project and the reports that were produced by Sargent Consulting as part of that project. As noted in Council's planning submission and paragraph 19 above the next major statutory review of the Ipswich town planning scheme is due to commence after 2012.

70. In terms of review of the Council's planning scheme and the Council's response to the 2011 flood event, including review of the planning approach to the flood regulation I repeat and rely upon paragraphs 18 to 20 above.

AFFIRMED this 8 day of November 2011 at Ipswich in the State of Queensland in the presence of:

[redacted]

Carl Christian Wulff (Deponent)

[redacted]

Witness Solicitor.

[redacted]

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18 September 2006

MEMORANDUM

TO: SECRETARY IPSWICH RIVERS IMPROVEMENT TRUST

FROM: DEPUTY WORKS MANAGER - ANDREW UNDERWOOD

RE: IPSWICH RIVERS FLOOD STUDY RATIONALISATION PROJECT

INTRODUCTION:

This report addresses the Ipswich Rivers Flood Study Rationalisation Project being undertaken by the Trust under the National Disaster Management Program. It discusses the context, key outcomes, study methodology, progress to date, hydrologic analysis, hydraulic analysis; flood mapping, other issues and provides an assessment on the findings to date and some recommendations to the Trust. Much of the content of this report bas been drawn from documentation prepared by consultants undertaking the project.

CONTEXT:

Since detailed flood studies for the urban areas of Ipswich were completed in 2000 (Sinclair Knight Merz) and for the rural areas in 2002 (Halliburton KBR), there have been a number of developments relating to flood studies in the Brisbane River which have resulted in the current flood studies and the corresponding flood extent maps no longer being compatible with those of Brisbane City.

These include:

- Updating of flood hydrology for Wivenhoe Dam operations;
- Availability of new rainfall design data (CRC-FORGE) and new estimate of probable maximum flood (PMF);
- Revised flood modelling for Brisbane City Council;
- Review of the latter by an Independent Review Panel which has led to the 100 year design flood flow being reduced from approximately 8 000m^3/s to 6 000m^3/s.

In addition, in response to apparent anomalies with predicted 20 year ARI flood levels in particular, Ipswich City Council commissioned Sargent Consulting in 2002 to review the current flood models. This review concluded that the current hydraulic model calibration is skewed towards the replication of major floods with the result that water levels for smaller floods are overestimated.

Also, in the period since the flood study results became available, a number of inconsistencies have been noted which require rectification.

As a consequence of the recent changes to the lower Brisbane Flood Studies, the current studies for the two local government areas are no longer compatible, and the current Brisbane River model is known to have some inconsistencies.

It was believed that urgent review, updating and rationalisation of the 2000 Ipswich Rivers Flood Study were required to overcome these inconsistencies and funds were sought to do so.

Natural Disaster Management Program

The Trust was successful in obtaining a grant under the Natural Disaster Management Program with funding being sourced from the State Government (Department of Emergency Services), Federal (Department of Transport and Regional Services) and the Ipswich City Council.

ANTICIPATED KEY OUTCOMES:

The expected key outcomes for the study included:

- Refined hydrologic model and design flood discharge hydrographs compatible with the latest rainfall and hydrologic modelling undertaken for Wivenhoe Dam operations and for Brisbane City Council;
- Refined hydraulic modelling based on the refined hydrology, and recalibration using the latest version of MIKE 11 (or a 2–dimensional model such as MIKE 21) to take account of recent improvements in hydraulic roughness representation;
- Consistency of flood estimation and flood mapping across joint boundaries with neighbouring Councils;
- Updated flood mapping for a range of flood frequencies and for the PMF;
- Update of flood overlay in the Ipswich Planning Scheme;
- Flood Study Report.

STUDY METHODOLOGY:

The study methodology was to comprise of the following major components:

- Liaison with Brisbane City Council, Bureau of Meteorology, Dept of Natural Resources Mines and Energy;
- Review of existing RAFTS hydrological model of the Bremer and Brisbane River catchments and its calibration with a view to reducing the variance of previous RAFTS results with those from direct flood frequency analysis, including frequency analysis of flood of flood volumes;
- Use of stochastic simulation (Monte Carlo Method) to account for probability distributions and combinations in spatial and temporal rainfall distributions, in model loss rates and in reservoir drawdown;
- Updating MIKE 11 model to latest version and rectification of geometric anomalies or the establishment of a new 2–dimensional model (eg MIKE 21 or MIKE FLOOD);
- Recalibration of MIKE 11 model using "triple zone" roughness definition and giving equal weighting to medium and large floods or equivalent 2–d modelling;
- Inclusion of tidal variations using Monte Carlo simulation to examine the joint probabilities of flow–rates and tide height;
- Use refined hydraulic model to re–estimate design flood levels;
- Prepare revised flood extent mapping for a range of flood Annual Return Intervals (ARIs) and for the PMF;

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- Report on the above; and
- Revise of Flood Overlay Map in Planning Scheme.

PROGRESS TO DATE:

The following tasks have been undertaken:

1) A hydrologic analysis of Q100 flows using a stochastic simulation (Monte Carlo Method) to account for probability distribution etc has been completed by Sargent Consulting and a report produced.

   This report has been circulated to key stakeholders for comment and subsequently a workshop was held on 20 February 2006 to review the outcome. A number of stakeholders provided written responses and these will be discussed later in this report.

2) The latest version of the hydraulic model for the Brisbane and Bremer Rivers was obtained from SEQ Water and it has subsequently been updated and subject to certain improvements by modelling consultants DHI Water and Environment. The outcomes of this work will also be discussed later in this report.

3) A hydrologic analysis is almost completed to establish the Average Return Intervals flows for a range of flows other than Q100. A draft report has been prepared and the issues raised to date will be discussed below.

4) It is expected that all necessary hydrological modelling will be completed in the near future allowing the hydraulic modelling to be finalised for a range of return intervals. Once the hydraulic modelling is complete and calibrated satisfactorily it will be possible to run the model for design flood levels and to undertake the preparation of flood maps.

HYDROLOGIC ANALYSIS

a) MONTE CARLO ANALYSIS

The report prepared by Sargent Consulting entitled "Ipswich Rivers Flood Study Rationalisation Project, Phase 3 'Monte Carlo' Analysis of Design Flows Final Report – Executive Summary January 2006" concluded that:

The analysis has shown that even with a relatively small number trials, a Monte Carlo analysis was able to refine both the central estimates and likely range of key design values and to reduce the uncertainty in these estimates. It is considered unlikely that further trials will significantly influence the results obtained.

It is acknowledged that there were limitations to the analysis which were necessary due to time and budget constraints. These limited consideration to the range of outcomes from 100 year ARI catchment rainfalls, rather than from the entire distribution of rainfall events.

Nonetheless, this provided a direct comparison with results of previous studies which were also limited in this way.

The results from the Monte Carlo analysis were generally consistent with the recommendations in the Independent Review Panel Report (Mein et al 2003) (IRP), and have

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refined both the central flood estimates and the confidence limits, or likely range of the flood estimates.

In respect of the Bremer River and Lockyer Creek catchments, the Monte Carlo analysis results were 20% – 30% lower than those in the Ipswich Rivers Flood Study (SKM 2000).

The review of the RAFTS model with deterministic inputs resolved the anomaly between the RAFTS modelling and flood frequency analysis from SKM (2003) noted in the IRP report, and hence it was considered unwarranted to undertake the frequency analysis of flood volumes.

Specific conclusions were as follows:

- *In respect of the pre-dams scenario, the "best" estimate of Q_{100} peak flow at Savages Crossing was 14 000m^3/s within a range of 12 500m^3/s to 15 000m^3/s (compared to the IRP value of 12 000m^3/s, within a range of 10 000m^3/s to 14 000m^3/s);*
- *In respect of the pre-dams scenario, the "best" estimate of Q_{100} peak flow at Moggill and the Port Office was 13 000m^3/s within a range of 11 000m^3/s to 14 000m^3/s (compared to the IRP value of 12 000m^3/s, within a range of 10 000m^3/s to 14 000m^3/s);*
- *In respect to the post-dams scenario, the "best" estimate of Q_{100} peak flow at Savages Crossing was 4 500m^3/s compared to 5 500m^3/s within a range of 2 500m^3/s to 7 000m^3/s compared to the IRP value of 5 000m^3/s, within a range of 4 000m^3/s to 6 500m^3/s;*
- *The corresponding post-dam values at Moggill and Port Office are 4 500m^3/s, within a range of 3 000m^3/s to 6 000m^3/s compared to the IRP value of 5 000m^3/s, within a range of 4 000m^3/s to 6 000m^3/s;*
- *For the Bremer River at Walloon, the "best estimate" was 1 200m^3/s, within a range of 900m^3/s to 1 500m^3/s;*
- *For Warrill Creek at Amberley, the "best estimate" was 1 800m^3/s, within a range of 1 300m^3/s to 2 200m^3/s compared to the previous estimate (SKM 2000) of 2 600m^3/s; and*
- *For the Bremer River at Ipswich, the "best estimate" was 2 600m^3/s, within a range of 2 000m^3/s to 3 100m^3/s compared to the previous estimate (SKM 2000) of 3 200m^3/s.*

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Table ES2 Comparison of Results Pre-Dam Construction

Source	Method	Location	Estimated Q_{100} Peak Flow m^3/s			Comment
			Best Estimate	Lower Bound	Upper Bound	
Current Study	Rafts Modelling – Deterministic	Savages Crossing	13 000	N/A	N/A	Upper and lower bounds not applicable
		Moggill, Port Office	12 500	N/A	N/A	
	Monte Carlo Modelling with RAFTS	**Savages Crossing**	**14 000**	**12 500**	**15 000**	**Lower and upper bound taken as 5% and 95% confidence limits**
		Moggill, Port Office	**13 000**	**11 000**	**14 000**	
SKM (2003) and Independent Review Panel Report to BCC (2003)	Flood Frequency Analysis	Savages Crossing	12 000	10 000	14 000	
	RAFTS Modelling	Savages Crossing, Moggill, Port Office	10 000	8 000	11 000	Estimates considered to be low by Independent Review Panel
SKM (2000) Ipswich Rivers Flood Study	Rafts Modelling – Deterministic	Moggill	13 700	N/A	N/A	

Table ES3 Comparison of Results Post-Dam Construction

Source	Method	Location	Estimated Q_{100} Peak Flow m^3/s			Comment
			Best Estimate	Lower Bound	Upper Bound	
Current Study	Rafts Modelling – Deterministic	Savages Crossing	6 500	4 000	9 500	"Best" estimate based on 75% initial storage, and upper and lower bounds on 100% and 50% respectively
		Moggill, Port Office	5 000	4 000	7 500	
	Monte Carlo Modelling with RAFTS	**Savages Crossing**	**4 500**	**2 500**	**7 000**	Lower and upper bound taken as 5% and 95% confidence limits
		Moggill, Port Office	**4 500**	**3 000**	**6 000**	
SKM (2003) and Independent Review Panel Report to BCC (2003)	RAFTS Modelling	Savages Crossing	5 500	4 000	6 500	
		Moggill, Port Office	5 000	4 000	6 000	
SKM (2000) Ipswich Rivers Flood Study	Rafts Modelling – Deterministic	Moggill	8 100	N/A	N/A	

Table ES4 Comparison of Results Bremer River Catchment

Source	*Method*	*Location*	*Estimated Q_{100} Peak Flow m^3/s*			*Comment*
			Best Estimate	*Lower Bound*	*Upper Bound*	
Current Study	*RAFTS Modelling-Deterministic*	*Bremer River at Walloon*	*1 200*	*N/A*	*N/A*	*Upper and lower bounds not applicable*
		Warrill Creek at Amberley	*1 700*	*N/A*	*N/A*	
		Bremer River at Ipswich	*2 500*	*N/A*	*N/A*	
	Monte Carlo Modelling with RAFTS	***Bremer River at Walloon***	*1 200*	*900*	*1 500*	*Lower and upper bound taken as 5% and 95% confidence Limits*
		Warrill Creek at Amberley	*1 800*	*1 300*	*2 200*	
		Bremer River at Ipswich	*2 600*	*2 000*	*3 100*	
SKM (2000) Ipswich Rivers Flood Study	*RAFTS Modelling-Deterministic*	*Warrill Creek at Amberley*	*2 600*	*N/A*	*N/A*	*Upper and lower bounds not applicable*
		Bremer River at Ipswich	*3 200*	*N/A*	*N/A*	

It further recommended that the estimates of the Q_{100} design flows produced from the Monte Carlo analysis described in this report in respect of current catchment conditions be adopted as the basis for inputs to the hydraulic modelling component of this and the parallel BCC study to determine design flood levels and flood inundation mapping.

The following, which were beyond the scope of the current study, are recommend for consideration for further work:

- *Extension of the Monte Carlo Analysis to the Q_{20} event which is still an important land use planning criteria for ICC;*
- *Refinement of the distribution of starting storage in Wivenhoe and Somerset Dams by an analysis of the historic distribution, and if this is significantly different from that assumed herein, consider repeating the Monte Carlo analysis; and*
- *Investigation of the sensitivity of RAFTS model results to the lumped conceptual storages in the model, particularly those at the Lockyer Creek/Brisbane River and Bremer River/Brisbane River confluences, and if found to be warranted recalibration of the RAFTS model.*

b) HYDROLOGIC ANALYSIS FOR AVERAGE RETURN INTERVALS OTHER THAN 100 YEARS

A draft report dated July 2006 entitled Ipswich Rivers Flood Study Rationalisation Project Phase 3, Re-estimation of Design Flows Bremer Catchment has been provided by Sargent Consulting and reviewed by GHD. This report is currently being finalised.

HYDRAULIC ANALYSIS

a) REVIEW AND UPGRADE OF HYDRAULIC MODEL

In May 2005, Modelling Consultants DHI Water And Environment completed a review of the two separate upper (rural areas) and lower (urban areas) MIKE11 hydraulic models which encompass the Ipswich Rivers area and made a number of recommendations for updating and improving the model stability and accuracy. They were commissioned in late 2005 to update the model as per their recommendations. The major tasks involved in this update were;

- Merging of the upper and lower models into a single model in the latest version
- Positional accuracy
- Model schematisation etc.

The upgrading of the model is complete and the consultants have prepared a report entitled 'Ipswich River MIKE11 Model Upgrade' dated May 2006. In the introduction to this report the following was advised:

The aim of the model update is to implement necessary improvements and modifications required to improve stability and improve the model performance. A major task of the update process was the merging of the upper and lower models into a single model. The lower model consists of the Brisbane River flood model from Wivenhoe Dam to the Port of Brisbane combined with the Ipswich Rivers model of the lower Bremer River. Brisbane City Council

have previously carried out some minor updating of the Brisbane River components of this model and it was necessary to incorporate these into the combined model to ensure that the most up to date information available, was included in the model.

A range of modifications were proposed in order to update the model to a standard sufficient for future flood and forecasting studies. The specific recommendations from the model review undertaken include the following:

1. *Positional Accuracy*
   - *Include accurate aerial photographic background image to ensure positional accuracy of the model branches and cross sections.*
2. *Model Schematisation*
   - *Remove closely spaced grid points.*
   - *Include Link Channels in place of artificial slots in connecting cross sections.*
   - *Check model chainages against registered photographic images.*
   - *Update branch layouts where possible and cross section extents in areas of cross section overlap in order to eliminate storage duplication.*
   - *Divide channel and flood pain flows into separate branches for excessively wide floodplain sections.*
3. *Cross Section*
   - *Remove all artificial slots in cross sections.*
   - *Increase the number of processed data points in some cross sections to between 20 and 40.*
4. *Numerical Parameters*
   - *Centre the numerical scheme using a delta value of 0.55.*
   - *Define a stable static initial condition to allow the model to cold start correctly.*
5. *Simulation Time Step*
   - *Update model time step to between 30* seconds and 1 minute depending on model sensitivity testing.

b) CALIBRATION OF UPGRADED MIKE11 MODEL AND DESIGN RUN

In June 2006 Sargent Consulting was engaged to calibrate the upgraded combined MIKE 11 model and to run the design flood scenarios for various return periods. Some modelling runs have been undertaken and preliminary calibrations results calculated. Once the calibration is complete, the consultant will run the model with design flows determined by the hydrological analyses to determine design flood levels for various return periods. These will then be used to complete the flood mapping for the project.

OTHER ISSUES:

1. It is noted that the Trust completed a study entitled "Bremer River Catchment Flood Risk Management Study" in 2004. This highlighted high risk areas for flooding in the Ipswich Area. The medium to high risk areas highlighted in the study should receive extra attention when the new mapping is being undertaken.

2. The availability of more precise contours in new areas such as Ripley Valley have highlighted anomalies in flood mapping in areas with wide flood plains and multiple channels. Extra attention will be required when addressing mapping in these areas.

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3. As part of the Brisbane Valley Flood Damage Mitigation Project BCC Design Services are focusing on the impact of floods higher than Q100 up to the probable maximum flood. Ipswich City Council and Esk Shire Council are also involved in this project.

4. Ipswich City Council has undertaken a Natural Disaster Risk Management Project to develop GIS mapping to assist in managing future flood events Among other things this product provides the following information for various flood scenarios:
   - Areas likely to be inundated.
   - Individual properties that will be affected.
   - Access roads that might be cut.
   - Key infrastructure that will be affected.
   - Evacuation centres.

   This will assist in preparedness planning and in managing response when significant floods occur.

TRUST ENGINEER'S ASSESSMENT:

The outcome of the hydrologic analysis using the Monte Carlo method while supporting the Independent Review Panel findings was not embraced by the stakeholder group. It is understood that there were a number of reasons for this including:

1. Reduced flood flows are dependent on significant flood storage being available in the dams before the event started. and;

2. Some stakeholders have concerns that the flows identified in this study are significantly less than both flows identified in previous studies and flows experienced historically in the catchment.

It is suggested that the Trust will need to make further efforts to achieve the anticipated outcome of consistency of flood estimation and flood mapping across joint boundaries with neighbouring Councils. This can be further pursued by requesting the stakeholders to provide comments on the outcome of the study to date.

Further having taken the consultants recommendation and the stakeholder feedback into account, it was determined that the study should continue on the basis of the Independent Review Panel findings and that the post dams Q100 flow in the Brisbane River at Savages Crossing should be 6 000 cumecs.

The attenuation of the natural storages at Savages Crossing and at the junction of the Bremer and Brisbane Rivers will affect the flows predicted by the hydrological analyses and these will vary marginally from that assumed in the hydraulic modelling at the time of the Independent Review Panel.

CONCLUSIONS:

1. The study has supported the findings of the Independent Review Panel but has not persuaded other stakeholders from other agencies that a less conservative approach can be taken in assessing design flood flow. The Trust will need to make further efforts to achieve the

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anticipated outcome of consistency of flood estimation and flood mapping across joint boundaries with neighbouring Councils. This can be further pursued by requesting the stakeholders to provide comments on the outcome of the study to date.

2. The study has proceeded on the bases that the post dams Q100 design flow in the Brisbane River at Savages Crossing should be 6 000 cumecs.

3. A range of design flows other than Q100 have been determined for the Brisbane and Bremer Rivers and tributaries.

4. The hydraulic model has been reviewed and the hydraulic modelling is underway.

It is proposed that a copy of this report be provided to Ipswich City Council, Bureau of Meteorology, Water Resources (Brisbane City Council), Sunwater, Esk Shire Council, SEQ Water and Department of Natural Resources and Mines for their information and that they be requested to provide comments on the study outcomes to date.

RECOMMENDATION:

A. That the report be received and noted.

B. A copy of this report be provided to the organisations listed below for their information and that they be requested to provide comments on the study outcomes to date.
   Ipswich City Council
   Bureau of Meteorology
   Water Resources, Brisbane City Council
   Sunwater
   Esk Shire Council
   SEQ Water
   Department of Natural Resources and Mines

Andrew Underwood
DEPUTY WORKS MANAGER

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16 November 2007

MEMORANDUM

TO: SECRETARY IPSWICH RIVERS IMPROVEMENT TRUST

FROM: DEPUTY WORKS MANAGER

RE: IPSWICH RIVERS FLOOD STUDY RATIONALISATION PROJECT

This report is an update on previous advice to the Trust dated 7 March 2007 regarding the above project. (Copies of the previous advice can be provided on request).

As per the Trust's resolution of a copy of the September 2006 report was provided to the organisations listed below for their information and they were requested to provide comments on the study outcomes to date.

Ipswich City Council
Bureau of Meteorology
Water Resources, Brisbane City Council
Sunwater
Esk Shire Council
SEQ Water
Department of Natural Resources and Mines

It is further advised that the Sargent Consulting has submitted a further report entitled "Ipswich Rivers Flood Study Rationalisation Project Phase 3 Re-estimation of Design Flood Levels Final Report" dated December 2006.

RESPONSES FROM OTHER AGENCIES:

Responses have been received from Esk Shire Council, SEQ Water, Water Resources, Brisbane City Council (BCC) and Department of Natural Resources and Water. Discussions have been held with staff of Council's Planning and Development Department. The other agencies have been followed up and Sunwater has agreed to pursue the matter.

In recent discussions [redacted] formerly of the Bureau of Meteorology and now employed by SEQ Water, suggested that the advice that he provided on behalf of the Bureau of Meteorology to the Trust in February 2006 would still be valid.

Esk Shire Council indicated that it was unable to comment on the report.

SEQ Water advised that "It is agreed that the findings of the rationalisation project are not conclusive enough at this stage to ensure consistency of flood estimation and flood mapping

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across joint boundaries of neighbouring local authorities, in particular Q100 at Savages Crossing. The letter further advised that SEQ Water is willing to meet Ipswich City Council and Brisbane City Council representatives to continue efforts to achieve the anticipated outcome of consistency.

Brisbane City Council provided a detailed letter that raised issues regarding the Monte Carlo methodology, sensitivity to spatial and temporal variations, storm duration data, Wivenhoe Dam water storage assumptions, initial loss and peak flooding, Q100 flows (Pre and Post Wivenhoe Dam), and concluded that the final report prepared by Sargent Consulting does not shed additional light onto the Independent Review Panel estimate of the Q100 flood nor does it follow the desired Monte Carlo investigation suggested by the Independent Review Panel as a possible review of their estimate. Further the letter advised that the methodologies and assumptions employed in the final report tend to skew the Q100 results down.

Comments were subsequently sought from Sargent Consulting and the peer reviewer [redacted] of GHD on the BCC response.

The General Manager (WIR) of the Department of Natural Resources and Water (See attachment C) offered a number of comments including:

- The use of the Monte Carlo analysis to assess reservoir drawdown prior to flood events up to the 1% AEP floods is accepted in principle provided all the significant variables are adequately accounted for. It is not yet accepted for rarer extreme flood events used for the design of extreme hazard dams.

- It is also noted that the Monte Carlo analysis demonstrates that there is some potential to reduce the magnitude of the 1% AEP discharges although the number of simplifying assumptions made in the analysis such as the number of storms of different durations being centrally applied in the catchment and the uniform distribution of antecedent reservoir levels means that the result must be considered with some caution. It is recommended that, if the Monte Carlo results are to be relied on then they should adequately be taken into account.

- Because of its significance it is particularly important that the predicted behaviour of the Wivenhoe/Somerset reservoir system reflect the true probability of a range of storage levels.

- The Trust Engineer's finding that the post–dams Q100 flow in the Brisbane River at Savages Crossing should be 6 000 cumecs is noted.

ASSESSMENT OF RESPONSES

The issues raised are technical and are associated with assessing the risks involved in determining design flood flows.

Staff of the above agencies including BCC participated in earlier stakeholder consultation and did not raise objections to the methodology at the time but did raise concerns about the initial results when they became available. The new BCC position that the proposed methodology was not acceptable is inconsistent with previous advice.

Attention is drawn to [redacted] response dated 26 February 2007 (Attachment A) which provides an independent summary and comment on the issues and suggests that the median peak flow at Savages Crossing is around 6 100 cumecs and this slightly higher result is consistent with the Independent Review Panel estimate and may be a better estimate of the peak flow at this location than the 4 500 cumecs estimate.

It is noted that the hydraulic analysis for the Study has proceeded on the assumption that the peak flow at Savages Crossing would be 6 000 cumecs

HYDRAULIC ANALYSIS

The executive summary from the "Ipswich Rivers Flood Study Rationalisation Project Phase 3 Re–estimation of Design Flood Levels Final Report" dated December 2006 is attached to this report (Attachment B). Pages xviii) and xix) have a summary of conclusions and recommendations that need to be considered. These are reproduced below:–

Conclusion

All hydrologic and hydraulic analysis and modelling contain uncertainties: these can be related to natural variability in hydrologic processes; modelling uncertainties which recognise that no model can fully represent the real world response to rainfall on the catchment; potential climate change impacts; and knowledge uncertainty which reflects errors in the data used and in assumptions mad in the model.

This study has attempted to identify these uncertainties, which should be taken account of in using the results of this study for town planning and infrastructure design purposes.

Sensitivity testing undertaken in the design phase has confirmed that model results are sensitive to: changes in waterway geometry which impact on the apparent hydraulic roughness required for replication of historic flood levels; possible errors in flood flow estimates; limitations in the schematisation of the model; and to the potential impact of climate change of the model; and to the potential impact of climate change on design rainfalls.

The sensitivity testing has also shown that flood levels in Ipswich are insensitive to storm surge levels, within current estimates, including allowance for climate change impacts; and have low sensitivity to the adopted stage – discharge rating curve at Jindalee.

Whilst the sensitivity test results presented herein go some way to quantifying the major uncertainties, it would require a Monte Carlo simulation approach, which is outside the scope of the current study, to provide further quantification of the uncertainties.

In Summary, the study concluded that:

- The new design flood levels represent improved estimates as they reflect recent upgrades in design rainfalls, recent remodelling of design flows and significant upgrades to the hydraulic model;

- Notwithstanding the above statement, the study has shown that there is considerable residual uncertainty in the design flood levels estimates which should be taken into account when establishing flood levels for town planning and infrastructure design;

- A number of conclusions were drawn from the initial investigation of physical change to the width and depth of the Brisbane River in the vicinity of its confluence with the Bremer River. These were:

  - Confirmation that both deepening and widening have occurred in that reach particularly between 1970 and 1978 which period encompasses both the peak of dredging activities and the 1974 flood;

  - The conclusion that both of these effects have increased the flow carrying capacity of the Brisbane River in this reach;

  - Indications that the scale of these changes is commensurate with that required to rectify the anomaly in calibrating the hydraulic model to the 1974 flood and to later events.

  - That it is reasonable to infer that the impacts of dredging affect all of the tidal reaches of the Bremer and Brisbane Rivers in a similar fashion, although it is not possible to quantify this impact without further work;

  - That it was not possible to differentiate between the relative effects of the 1974 flood and dredging on the widening and deepening observed in the reach investigated; and

  - That, if the findings of this initial investigation were confirmed to be applicable to the whole of the modelled are, the roughness parameters obtained by calibrating the 1974 flood levels with the more recent cross–section data would not be representative of current conditions.

Recommendations
Uncertainty Allowance

Having considered the results from the various sensitivity tests undertaken, it is clear that there is considerable uncertainty regarding the estimated design flood levels.

It is important that this uncertainty be recognised in the flood levels that Ipswich City Council adopts for town planning and infrastructure design purposes. This should be recognised by adding an uncertainty allowance to the estimated flood levels.

Leaving aside possible impacts of climate change over the next few decades, it is recommended that, to make a reasonable allowance for this uncertainty, the 100 year and 20 year ARI design flood estimates have an uncertainty allowance of 1m to 2m added to them.

If possible climate change impacts are taken into account; it would be prudent to add a further 1m to the uncertainty allowance.

Recommendations for Further Work

The following additional work is recommended in order to reduce the uncertainties remaining in the model results:

- Re–schematisation of parts of the MIKE 11 model to better represent floodplain storage in areas in which floodplain flowpath length is significantly reduced;

- Re–schematisation of Western Creek, the current schematisation of which is unrealistic and causes numerical stability problems in the model;
- Review of the schematisation of sections of the model where calibration errors were excessive;
- Re–estimation of the design flows using the Bureau of Meteorology's URBS model and CRC–FORGE design rainfalls;
- Extension of the investigation into physical changes in the river channel for the whole model area, with a view to estimating cross–sections, when it should be expected that there will be improved agreement between 1974 and 1996 calibrations allowing the uncertainty in hydraulic roughness parameters to be considerably reduced;
- Re–estimation of design flood levels on the basis of the revised flows and hydraulic parameters;
- Uncertainty analysis using a Monte Carlo approach to estimate the distribution of uncertainties and hence to better quantify the uncertainties.

BRISBANE VALLEY FLOOD DAMAGE MINIMISATION STUDY

The final report for this project dated 19 September 2007 was recently received by Ipswich City Council. A copy is included in Attachment D.

The aim of the project was to gain a greater understanding of potential damage caused by a range of flood events in the Brisbane River Catchment and to consider, if applicable, reviewing the dam operating rules to improve flood mitigation.

To meet the project objectives, the following tasks were to be undertaken:

- Develop a series of updated and regionally consistent flood damage models for Brisbane City Council, Ipswich City Council and Esk Shire Council
- Produce a consolidated regional flood damage model for the Brisbane River catchment area
- Refine the Bureau of Meteorology forecasting model for the Brisbane River catchment area and to obtain a better understanding of modelling process by all flood operation centres
- Develop a refined warning system leading to a better informed (and hence resilient) community
- Determine if the 'Operational Procedures' for the Brisbane Valley Dams can be modified to achieve a more effective flood mitigation outcome

Project Success Factors

This project was to be deemed successful if

- There was an increased understanding of the flood damage
- Lower flood damage by changing the operating rules of the dam

- Findings were adopted by Councils
- Increased collaboration and understanding across agencies

Phase 2 of the project was to estimate only the *potential direct flood damage* (internal, external and structural damage) to residential, commercial, industrial and public properties. It did not estimate flood damage to public infrastructure (e.g. roads and bridges), sports and recreational areas, parks and gardens, and conservation areas. Indirect damages (e.g. financial, clean up and opportunity costs) and intangible damage (e.g. social costs associated with flooding) have not been included in the damage estimates.

The key input data used for potential flood damage estimation were classified into five (5) groups

- Property data
- Topographic data
- Floor level data
- Flood level data
- Flood stage damage curves

The data collected from the five groups were then combined to form a property flood damage database. This data was combined with the recently completed flood models using GIS techniques to develop flood damage curves (flow versus damage) for Brisbane City, Ipswich City and Esk Shire Councils.

The project was halted at Phase 3. It was agreed by the Steering Committee that the damage curves derived did not indicate an opportunity to target changes in dam operation in order to avoid a damage threshold. However all stake holders considered that the communities of all Councils gained significantly from the work to this point through:

- A better understanding of flooding and its effects
- A better understanding of how Wivenhoe impacts on flooding downstream
- The sharing of this knowledge across all the agencies involved as this will form the basis for flood emergency planning, including per–emptive flood preparations and post flood recovery.

A copy of page 11 of the report is reproduced below for the Trust's information.

Table 4.1 Residential and Non-Residential Flood Damage Summary Results, Ipswich City

Flood Discharge (m^3/s)	Residential			Non-Residential			Total Damage ($million)
	Total Damage ($million)	No. of Flood Damaged Properties	Average Damage Per Property ($1000)	Total Damage ($million)	No. of Flood Damaged Buildings	Average Damage Per Building ($1000)	
1000	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0
3000	0.23	6	38.09	0.03	2	15.06	0.26
4000	3.97	98	40.50	1.14	102	11.22	5.11
5000	19.09	393	48.58	3.99	152	26.23	23.08
6000	54.20	899	60.29	10.59	212	49.96	64.79
7000	110.59	1556	70.98	24.50	315	77.77	135.09
8000	181.95	2425	75.03	47.50	449	105.76	229.45
10000	327.42	4161	78.69	102.33	845	121.11	429.75

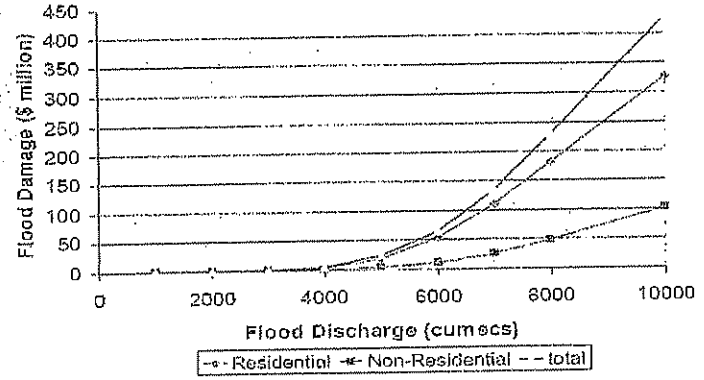

Figure 4.1 Residential, Non-Residential and Total Flood Damage Estimates, Ipswich City

The difference in damage costs between a 6000 and 7000 cumec flood in Ipswich City was approximately $70M with double the number of residential and non-residential properties affected. In addition, the difference in damage costs between a 7000 and 8000 cumec flood event was approximately $90M.

It is noted that the Flood Damage cost increases from $64.79m to $135.09m when the discharge increases from 6000 cumecs to 7000 cumecs, an increase of about 100%.

It should be noted that that these Flood Damage estimates do not include damage to publicly owned infrastructure

ENGINEERS ASSESSMENT

This study has resulted in the refinement of the hydrologic and hydraulic models for the Brisbane River. It has clarified uncertainties in the major inputs to these models but not produced a consensus among the stakeholders.

The modelling has shown that the ICC decision to adopt the 2% AEP levels of the SKM study (approx 6 800 cumecs) was sound and provides a reasonably estimate of the levels that should be used in determining the 1% AEP regulation level for ICC.

Further adjustments to the design flood levels should take into account the risks the community and infrastructure.

The table below shows a comparison for the Brisbane River of the recorded 1974 flood levels at key locations, the Q100 estimated levels from the Trust's 2000 Study, the Independent Panel's high range levels and this Study's high range flood levels.

Assessment of Risk
Various Flood Heights (AHD) Brisbane River

Location	Recorded 1974 Flood	Q100 SKM 2000	Independent Review Panel high range 8 000 cumecs	This Study High Range
Source of Information	ICC Records	SKM 2000 Study	SKM 2000	This Study
Woogaroo Creek	18.6	16.7	16.2	14.7
Moggill	19.93	18.3	17.6	16.1
Colleges Crossing	24.5	25.3	24.5	23.0

The table below shows a comparison for the Bremer River of the recorded 1974 flood levels at key locations, the Q100 estimated levels from the Trust's 2000 Study, the Independent Panel's high range levels and this Study's high range flood levels.

Assessment of Risk
Various Flood Heights (AH) Bremer River

Location	Recorded 1974 Flood	Q100 SKM 2000	Independent Review Panel high range 8 000 cumecs	This Study High Range
Source of Information	ICC Records	SKM 2000 Study		
David Trumpy Bridge	20.7	18.5	19.0	17.8
One Mile	25.1	24.5	24.8	22.9

The table below shows a comparison for the Brisbane River of the Current ICC Planning Scheme, indicative figures provided by Brisbane City Council for its regulation line, Q100 for this study and Q100 plus 1 metre.

Assessment of Risk
Comparison of Q100 Regulation Line Levels (AHD)

Location	Current ICC Planning Scheme	Regulation Line Indicative from BCC based on Q--6800	Q100 This Study	Q100 This Study plus 1 metre
Woogaroo Creek	14.7	15.1	13.6	14.6
Moggill	16.2	16.1	15.0	16.0
Colleges Crossing	23.0	21.5	20.4	21.4

The table below shows a comparison for the Bremer River of the Current ICC Planning Scheme, Q100 for this study and Q100 plus 1 metre.

Assessment of Risk
Comparison of Q100 Regulation Line Levels (AHD)

Location	Current ICC Planning Scheme		Q100 This Study	Q100 This Study plus 1 metre
David Trumpy Bridge	16.8		15.3	16.3

One Mile	22.9		20.7	21.7

During the study a number of drafting issues associated with the 1in 100 Flood Line published in the Ipswich City Council Planning Scheme Overlay 5 Flooding were identified. These related to the methodology originally used to produce this line. It looks smooth and consistent with the surrounding topography on a large scale plan but is jagged and sometimes inconsistent with the surrounding topography when individual parcels are viewed. This means that the extent of flooding on particular parcels is confusing in some cases and overstated in others. As new mapping techniques are available to improve this situation the Council might consider reviewing this line at some time in the future.

SUMMARY OF STUDY OUTCOMES

- Did not obtain agreement of other stakeholders on hydrology studies due to the uncertainties in key parameters.
- Independent review panel said best estimate was 6 000 cumecs with a plausible range of 4 000 to 8 000 cumecs.
- This study produced a mean post dams flow of 4 500 cumecs in a 5% confidence limit range of 2 400 cumecs to 6 900 cumecs.
- Engineers decided to proceed with hydraulic study with a post–dams Q100 flow in the Brisbane River at Savages Crossing of 6 000 cumecs.
- Reviewer Toby Loxton of GHD suggested 6 100 cumecs may be a better estimate of the peak flow rate at Savages Crossing than the 4 500 cumecs.
- It is noted that BCC has retained its flood regulation line based previously hydraulic analysis using a design flow of 6 800 cumecs.
- The study has resulted in an improved hydraulic model that better represents the existing situation and is a single composite model for the city for a range of events.
- Model results are sensitive to changes in waterway geometry, errors in flood flow estimates, limitations in the schematisations of the model and the potential impact of climate change or design rainfalls..
- There are insensitive to storm surge levels and have long sensitivity to the adopted stage–discharge curve at Jindalee.
- The study identifies that there is still considerable uncertainties in the estimates, and suggests allowance of one to two metres be added to design flood estimates.

CONCLUSION

While not obtaining agreement with external stakeholders the study has resulted in better understanding of hydrological and hydraulic issues associated with the Brisbane River and it tributaries.

A single much improved hydraulic model has been produced for all major streams in Ipswich.

The decision by Ipswich City Council to adopt the equivalent of the 2%AEP from the SKM 2000 Study as its flood regulation has been shown to be a sound decision.

It is proposed that the Trust receive and note this report and send copies of the report and supporting technical documents to the agencies involved in the consultation process for the study.

Future users of the model should be made aware of the considerable uncertainties in estimates and the need for uncertainty allowances to be added to design flood estimates when modelling outcomes are being reviewed.

Attachment A – 26 February 2007 response by [redacted] GHD consultants.
Attachment B – "Ipswich Rivers Flood Study Rationalisation Project Phase 3 Re-estimation of Design Flood Levels Final Report" – executive summary
Attachment C – Correspondence from DNRW – NRW comment on Ipswich Rivers Flood Study Rationalisation Project Report
Attachment D – Brisbane Valley Flood Damage Minimisation Study ~~Ipswich City Flood Damage Assessment – Summary of Results~~

RECOMMENDATION

1. The report be received and noted

2. That copies of the report and supporting technical documents be sent to the agencies involved in the consultation process for the study.

3. Future users of the hydraulic model should be made aware of the considerable uncertainties in estimates and the need for uncertainty allowances to be added to design flood estimates when modelling outcomes are being reviewed.

[redacted]
DEPUTY WORKS MANAGER

F. APU: KT
h:/WM/Reports/2003/Review of Ipswich Rivers Flood Studies

2 October 2003

Planning & Development Committee	
Mtg Date: 04.11.03	OAR: YES
Authorisation: Andrew Underwood	
Committee to prepare letter: [Yes/No] No	
Program No: 21	

MEMORANDUM

TO: CHIEF EXECUTIVE OFFICER

FROM: ACTING WORKS MANAGER

RE: REVIEW OF IPSWICH RIVERS FLOOD STUDIES

INTRODUCTION:

This is a report by the Acting Works Manager dated 2 October 2003 concerning

BACKGROUND:

Council considered a report in February 2002, concerning an update on flood studies being under taken in the city area.

Item 21:03 Works Committee Report No 2002(02) of 11 February 2002 (as amended Council 20 February 2002.

This report discussed issues concerning the estimate of flood releases from Wivenhoe Dam and recommended negotiations continue with BCC, SEQ Water & DNRM.

On 8 September 2003 the Courier Mail headlined articles on Brisbane City Council's review of the impact on the 1 in 100 year flood on the Brisbane City area. The articles indicated that an independent panel of experts had concluded the most likely scenario was that the Q100 flow figure was close to or at the level of the BCC 1984 Q100 figure.

On 10 September 2003 the author advised the Planning Manager.

"Please treat this report as a submission to the draft new planning scheme.

It has been brought to my attention that the Brisbane City Council has updated its flood study for the Brisbane River.

The flooding data in the draft new Ipswich planning scheme was based on the 'best available data' as contained in a previous 'iteration' of Brisbane River flood data prepared by SKM Consultants for use in both Ipswich and Brisbane. The data is depicted graphically in Overlay Map OV5 in the draft new Ipswich planning scheme.

In the interests of adopting consistent approach to development along the reaches of the Brisbane River which adjoin both Ipswich and Brisbane local government areas it is consider that Overlay Map OV5 should be reviewed to incorporate the latest data contained in the Brisbane study."

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Further Information Provided in 2003

During 2003 Council has been given two technical documents that are relevant to the review of the BCC 1999 report and the IRIT 2000 Report. These were as follows.

1) In July the Chief Executive Officer of South East Queensland Water forwarded technical schedules prepared by the Department of Natural Resources and Mines reviewing rainfall and run–off estimates in the catchment.

   This was in the form of a series of notes and was not a technical report as such.

2) In September BCC supplied a copy of a report entitled Review of Brisbane River Flood Study – Report to Brisbane City Council by Independent Review Panel dated 3 September 2003.

   It is noted that this report can be found on BCC website and is available to the general public.

   A copy of the Lord Mayor's media statement date 8 September on this subject is enclosed in this report.

"Media Statement - Lord Mayor Tim Quin

Works Department staff have organised consulting engineer Sargent Consulting to review both these documents and the implications any outcomes might have on predicting flood levels in the Ipswich City area.

An extract of the subsequent report from Sargent Consulting and the BCC report including the summary and the recommendation is set out below.

1. Summary

   This review is based on the report of the Independent Review Panel (Mein et al 203) commissioned by Brisbane City Council to review work undertaken by SKM in 2003 to update estimates of design flood discharges for the Brisbane River.

   The purpose of this review is to advise ICC on whether these new estimates of design flow are better than the previous estimates, and if so the process required to produce revised flood maps which will be consistent with these new estimates of design flows in the Brisbane River.

   The Panel concluded that the "best estimate" of the **100 year ARI** flow in the Brisbane River at Moggill and Brisbane is **6,000 m^3/s**, within a "plausible range" of 5,000 m^3/s to 7,000 m^3/s.

   This is substantially lower than the 100 year ARI design flow at Moggill of **8,300 m^3/s**, estimated by SKM (2000) and which has been used as the basis for the 100 year flood mapping in Council's IPA Planning Scheme.

   My review of SKM's flood modelling in the Ipswich Rivers Flood Study in November 2002 indicated my belief that, for a number of reasons, the design flows were overestimated.

.../3

As a result of the new work by SKM reported in Mein et al (2003), and in view of my previous reservations, I am satisfied that, subject to more detailed review of the SKM report and modelling, the revised estimates of flow are of the right order, and I believe they form an adequate basis for modification of the 100 year ARI flood maps.

However, in the work reported in Mein et al, insufficient work had been done to estimate the effect of these revised flows on design flood levels. Only 1 MIKE 11 run is reported, but that was using a peak flow of 5,000 m^3/s, and not the recommended value of 6,000 m^3/s. Hence, a further run based on the latter flow is required before the flood levels can be re-estimated.

As an interim guide, comparison of the revised flows with the previous estimates showed that these are similar to the previous 50 year ARI estimates. As an interim estimate, this appears to be consistent across the Bremer River catchment and Brisbane/Bremer River tributaries.

On this basis, indicative values of the resulting reduction in flood levels ranges from about 2m in the Moggill – Woogaroo Creek reach of the Brisbane River, and in the lower reaches of the Bremer River, to about 1.5m in Ipswich CBD and 0.9m in Warrill Creek at Cunningham Highway. These reductions reduce in the upper reaches and the tributaries. Nonetheless, although smaller, these reductions extend upstream of the influence of Brisbane River backwater, as a result of the reduction in 100 year ARI flood flows.

Time is of the essence in regard to any revised flood mapping in Ipswich as the Draft Ipswich IPA Planning Scheme has now completed its public display period and is in its final stages of approval. As a result, only a relatively small time interval is available in which to include amendments to the flood overlay.

1.1 Recommendations

As a consequence of the above, the recommendations from this review are separated into immediate and medium term measures, such that medium term measures will lead to further refinement of the flood maps.

These recommendations are outlined below.

1.1.1 Immediate

In this situation the most appropriate course of action is to produce new 100 year ARI flood mapping based on a run of the existing MIKE 11 model (as modified by Halliburton KBR in 2002) with a design Brisbane River discharge of 6,000 m^3/s.

If BCC has not requested such a run, then ICC should request BCC to commission SKM to undertake this additional run. Full supporting documentation, in the form of reports, RAFTS and MIKE 11 input and results files should also be obtained, in order that a more detailed review may be undertaken.

If it is not possible to obtain this information in the time available, there are two options:

- ICC can undertake the MIKE 11 modelling and subsequent mapping. This will be best achieved by modifying the existing 50 year ARI files to scale the hydrographs to give the required flows, which requires a maximum of 10% adjustment; or

- Utilise the current 50 year ARI flood mapping, with the understanding that these maps are marginally (<10%) non-conservative in terms of flows, but are believed to be more conservative in terms of levels.

The former of these two options is preferred.

.../4

1.1.2 Medium Term

In the medium term, I believe that my previous recommendations in regard to refining the calibration of the MIKE 11 model should be undertaken. In summary these were:

- Convert the model to the current version of MIKE 11;
- Check the bridge, culvert and weir definitions and refine as necessary;
- Recalibrate the MIKE11 model using one of the functional forms for roughness which incorporate variations due to velocity and/or depth;
- Refine the floodplain roughness elements using the "triple zone" function available in M11 v2001b;
- Re-run the design runs with modified design discharges;
- Undertake sensitivity testing to identify likely error bands in predicted water levels; and
- Revise the flood mapping.

As the design flood levels in the lower Bremer River and the Brisbane River are dependant upon the flood operation of Wivenhoe and Somerset Dams, I also recommend that the wording of documents relating to their flood operation be checked to make sure that adequate guarantees are in place against future changes in operating procedures, which would result in an increase in design flood levels.

Meeting with BCC Staff

A meeting was held on 24 September 2003 with BCC Water Resources Staff, the CEO and Technical Services manager of SEQ Water and the Acting Works Manager and Specialist Design Engineer of ICC, to discuss this issue and matters to do with the Wivenhoe Dam Alliance.

The outcomes of the discussions included the following:-

1) BCC believe that the review has shown that the Q100 flood line is below its adopted development control line by typically a depth of 900 mm, and hence they expect that their Council will decide to retain the current development centrol line.

2) The most likely Q100 flow of 6 000 cumecs has not been modelled so the Q100 design flood line has not been precisely determined for either the Brisbane City or Ipswich City areas.

3) BCC would be prepared to work with ICC on a joint modelling project on a cost sharing basis to ensure that a consistent result is obtained for the Q100 design flood line across both areas.

4) There is some concern that BCC's development control line in the upper reaches of the River around Karana may not be consistent with the latest Q100 estimate and may have to be reviewed. It is noted that Works Department staff have been questioned by prospective developers about the disparity between levels between Karalee on the Ipswich side of the River and Karana on the Brisbane side.

5) The issue was raised that the two Council's planning scheme requirements for slab levels on dwellings will still be different, even if a common Q100 line is established for the two City areas. ICC require residential slab levels to be ~~300~~ 250 mm above the Q100 flood level. It is understood that the BCC development control line will set residential slab levels at 900 mm above the Q100 flood level. This produces a mismatch of ~~600~~ 650 mm between the level of residential slabs on either of the River where the River is a common boundary.

Assessment

1) The proposed joint modelling between the two Councils on a cost sharing basis should be undertaken but will take some months, if it is to be completed properly with robust results. This will not suit the proposed planning scheme review process.

2) Sargent Consulting have indicated that a revision of the Councils flooding overlay flood map could be undertaken fairly quickly using levels based on modified Q50 levels from the SKM 2000 study. This will produce levels which will probably be marginally conservative but still provide a good indication of flood levels on a broad scale maps. This may meet Council's needs as far as a revision of the proposed planning scheme is concerned.

3) Consideration needs to be given to the issue arising where the different planning scheme requirements produce a mismatch of ~~600~~ 650 mm between the level of residential slabs on either of the River where the River is a common boundary.

4) While the revision of the broad scale plan discussed above could meet the planning scheme review requirements more precise modelling will be needed to provide suitably accurate advice to property owners on a property by property basis. This reinforces the importance of undertaking the proposed joint modelling with BCC.

CONCLUSIONS:

[redacted] **it is proposed that a strategy be developed with P&D staff that will produce the best result for Council**

RECOMMENDATION:

It is proposed that the recommendations will reflect this strategy

[redacted]
ACTING WORKS MANAGER

I [concur/disagree]concur with the recommendations contained in this report.

[redacted]
CHIEF EXECUTIVE OFFICER

Comments on Ipswich Flood Study Rationalisation Project, Phase 3 – Monte Carlo Analysis

In the introduction, the scope of the investigation should be summarised to highlight the limited number of runs being undertaken due largely to the nature of the hydrologic model. Namely, the RAFTS programme does not lend itself to automation of multiple runs necessary for a detailed Monte Carlo analysis, and therefore, it is an expensive exercise to undertake a more thorough analysis. Also, there has been some subjectivity about the RAFTS model results from earlier studies by others, and at this stage, this study serves a purpose by exploring the likely range in peak flow rate estimates for the 100 year ARI event, and other local government authorities are currently using the model. Given this background, it would not be prudent to switch to a more efficient modelling platform at this stage.

The study only uses CRC-FORGE data for storm durations of 24, 30, 36, 48, and 72 hours. The report should still acknowledge that durations for sub-daily durations can be estimated according to the procedure described in Australian Rainfall and Runoff (1999) based on Intensity Frequency Duration (IFD) datasets contained in that document. However, for the purposes of this study, sub-daily events were not considered.

Also, the report should possibly acknowledge that the Department of Natural Resources and Mines (DNRM) have released a computer programme to estimate IFDs using the CRC-Forge dataset. This programme estimates IFDs from 1 in 5 to 1 in 2,000 Annual Exceedance Probability (AEP) events for durations ranging from 1 hour to 120 hours. However, this programme was not available at the time of commissioning. The results from DNRM's programme will be nearly identical to the rainfall totals in this study.

In section 5.2.2 (Post Dam Conditions), the second dot point refers to "convert the sampled starting storage volumes ...", an explanation of what is meant by sampling in this instance would be helpful.

In Section 6.1 (Storm Duration), a 3 parameter generalised Pareto Distribution was adopted, and the report acknowledged this may not hold true for south-east Queensland. Rahman and Carroll have prepared a paper where a gamma distribution is employed and may be more suitable. Some commentary on Rahman and Carroll's work may be appropriate for completeness (a copy of this paper is attached).

Section 6.3 (Storm Temporal Distribution), the assumption of 50% probability of occurrence for the AVM patterns is appropriate. Perhaps the basis for this assumption could be expanded slightly, as the objective of deriving the AVM patterns during the revision of the Generalised Tropical Storm Method (GTSM) was to achieve AEP neutrality (Green et al, 2004), a copy of this paper is attached. Assuming 50% probability of occurrence with the ARR temporal patterns may not be sound.

Section 6.5 (Dam Starting Levels) indicates that the earlier SKM study used starting dam volumes of 50%, 75%, and 100% and these have been explored as part of this study. A nominal rectangular distribution has been employed. For completeness, the water level AEP distribution based on long-term daily dam behaviour simulations for the dams should be reviewed and compared. DNRM are likely to have such estimates, perhaps the distribution based on water levels at 1st December may be appropriate. The report also suggests the actual distribution of storage levels could be analysed to allow the assumed distribution to be refined (p44).

From: [redacted]
To: [redacted]
Date: Fri, Sep 12, 2003 12:23 pm
Subject: Brisbane River Flood levels

[redacted]

I'm in the process of reviewing the Independent Panel's Review Report as discussed at our meeting on 10th. On reading the report in more detail, there is one thing I wish to make you aware of in case you are speaking to BCC before you receive my full review.

This is that, whereas the Panel recommended a Q100 of 6,000 cumecs, the MIKE 11 model run they refer to was based on 5,000 cumecs, giving 2.68 mAHD at the Port Office. The Panel then estimated by interpolation that this would be about 3.3m AHD for 6,000 cumecs.

Hence, our agreement on 10th that you should seek the SKM input and result files for this run was premature.

It is possible that SKM have since undertaken a 6000 cumec run, and if so these are the files you should seek (rafts, and Mike 11 input and output files).

If SKM have not yet done a 6,000 run the alternatives are:

1) Request BCC to get this done and provide access to the results (I would think they would be asking for this anyway): or

2) Use existing 50 year (6,800 cumecs 16.2 m AHD at Moggill) compared to current SKM 100 year of 8,300 cumecs and 18.2 m): or

3) Extract flood levels corresponding to 6,000 cumecs at Moggill from existing 50 or 100 year model results. I've looked briefly at this - it gives a lower figure of about 14.3m AHD at Moggill from the 100 year .

On a pragmatic basis, I recommend 1) if the data can be made available in time.
Failing that, 2) is a reasonable contingency plan as it is available, and should still be slightly conservative. I don't recommend 3) as those runs contain higher Bremer R river (ie SKM originals) which are now confirmed to be conservative, so the 6,000 cumec point in this run has a higher proportion of Bremer flow than it should - it's hard to tell but this could have some bearing on the development of backwater from downstream .

I'll get my review to you in the next few days

Kind Regards

[redacted]
Sargent Consulting

[redacted]
THE GAP
Queensland 4061
Mobile
Fax: [redacted]
email: [redacted]

From: [redacted]
To:
Date: Tue, Nov 25, 2003 8:34 am
Subject: BRISBANE AND BREMER RIVER FLOODING WITHIN ICC BOUNDARY

[redacted]

We have checked thought about what we discussed at last Thursday's meeting and we think the best way to proceed is as follows:

* Determine the Areal Reduction Factors (ARF) for the Brisbane and Bremer Catchments.
* Determine the Average Rainfall Depths between 100 and 50 year ARI flood events for both the Bremer and Brisbane Catchments. We will then determine the ration of rainfall depth between 100 and 50 year ARI events and compare to the ARF.
* As a final check we will determine average flows (IRFS 200) for the Q100 and Q50 within the reach of interest for the Brisbane and Bremer Rivers and find the ration between the Q100 and Q50. This ratio will be compared to the ARF and the rainfall depth ratio.
* We will then determine whether it is appropriate to adopt the old Q50 flood event (IRFS 2000) for the Bremer and the Brisbane River within the confines of ICC boundary.
* Prepare a letter report stating the methodolgy and the accuracy of the adopted flows and flood levels.

Some preliminary numbers that we have undertaken suggest that this will provide a reasonabley good estimate in the short term.

The fixed fee to complete these works is $2390.00 (GST Exclusive). If you would like to proceed with this investigation please reply to this e-mail and advise us to proceed. If you advise us to proceed prior to COB on Wednesday 26/11/03, we can have the report completed by COB 1/12/03.

All work will be condusted in accordance with our Standard Terms and Conditions for Professional Services. I have attached a copy for your information.

I trust this proposal meets your requirements however should you have any further queries, pleas contact me at this office.

Regards

[redacted]

P [redacted]
F
M

*

CC: [redacted]

SKM

Terms of Agreement for Professional Services

1. Sinclair Knight Merz Pty Limited ("the Consultant") shall provide to the Client the professional services ("the Services") for the Project being undertaken by the Client ("the Project") described in the accompanying letter and as prescribed by these Terms of Agreement ("the Agreement").

2. In providing the Services, the Consultant shall exercise the degree of skill, care and diligence normally exercised by professionals in similar circumstances.

3. The Client shall provide to the Consultant briefing and all information concerning the Client's requirements for the commission.

4. The Client shall pay to the Consultant the Fee and the Reimbursable Expenses as set out in the accompanying letter.

5. All monies payable by the Client to the Consultant shall be paid within 14 days of invoice. Monies not paid within that period shall attract interest from the date of invoice until payment at the rate of the current CBA Corporate Overdraft Reference Rate plus 2%, calculated on daily overdue balances.

6. Notwithstanding any other provisions of this Agreement, the Consultant's liability to the Client:
(a) under or arising from the Agreement;
(b) in tort (including negligence) or under any statute arising from the Consultant's acts or omissions,
shall not exceed the sum of
(c) $300,000; or
(d) the cost of reperforming the Services the subject of this Agreement,
whichever is the lesser.
The Consultant's liability to the Client for any loss or damage, including a claim for damages for a breach of the Agreement by the Consultant shall be reduced to the extent that an act or omission of the Client or its employees, agents or consultants contributed to the loss or damage.

7. After the expiration of one (1) year from the date of invoice in respect of the final amount claimed by the Consultant pursuant to clause 4, the Consultant shall be discharged from all liability in respect of the Services whether under the law of contract, tort or otherwise.

8. Copyright in all drawings, reports, specifications, bills of quantity, calculations and other documents provided by the Consultant in connection with the Project shall remain the property of the Consultant.

9. Subject to clause 10, the Client alone shall have a licence to use the documents referred to in clause 8 for the purpose of completing the Project, but the Client shall not use, or make copies of, such documents in connection with any work not included in the Project.

10. If the Client is in breach of any obligations to make a payment to the Consultant, the Consultant may revoke the licence referred to in clause 9, and the Client shall then cause to be returned to the Consultant all documents referred to in clause 8, and all copies thereof.

11. The Client shall ensure, to the extent reasonably possible, that the Consultant's input into the Project is duly recognised in any publicity material generated by the Client in respect of the Project.

12. Any dispute between the Client and the Consultant shall first be the subject of mediation provided that this provision shall not prevent the Consultant from instituting legal action at any time to recover moneys owing by the Client to the Consultant.

13. The Client may terminate its obligations under this agreement:
(a) in the event of substantial breach by the Consultant of its obligations hereunder, which breach has not been remedied within 30 days of written notice from the Client to the Consultant requiring the breach to be remedied, or
(b) upon giving the Consultant 60 days written notice of its intention to do so.

14. The Consultant may suspend or terminate its obligations under this Agreement:
(a) in the event of:
  (i) monies payable to the Consultant hereunder being out-standing for more than 28 days;
  (ii) other substantial breach by the Client of its obligations hereunder, which breach has not been remedied within 30 days of written notice from the Consultant to the Client requiring the breach to be remedied, or
(b) upon giving the Client 60 days written notice of its intention to do so.

15. Termination shall be without prejudice to any claim which either party may have against the other in respect of any breach of the terms of the Agreement which occurred prior to the date of termination.

16. If the Consultant considers it appropriate to do so, it may with the Client's prior approval, which shall not be unreasonably withheld, engage another consultant to assist the Consultant in specialist areas. The Client accepts responsibility for all monies payable to such other consultant.

17. Neither party may assign, transfer or sublet any obligation under this Agreement without the written consent of the other. Unless stated in writing to the contrary, no assignment, transfer or subletting shall release the assignor from any obligation under this Agreement.

18. The Client acknowledges that, unless agreed otherwise, the provision of Services by the Consultant for the Project is not given on an exclusive basis.

19. Fees and disbursements are exclusive of any Goods and Services Tax, whether levied on inputs to the Services, or on the Services. Any such Goods and Services Tax costs shall be to the Client's Account.

From: [redacted]
To: [redacted]
Date: 29/01/2004 4:40:25 pm
Subject: [Fwd: REPORT]

-------- Original Message --------
Subject: REPORT
Date: Thu, 29 Jan 2004 11:46:42 +1000
From: [redacted]
Re[redacted]
To[redacted]

[redacted]

Attached is a draft of the report for the revision of the Ipswich Rivers Flood Studies. Please review and make comments.

Essentially, I have discussed the issue of flood level reduction with Rory Nathan at length and they feel there is enough uncertainty to warrant not revising the estimates in the 2000 study.

I am happy to discuss the outcomes. I am sorry about how long this has taken but there have been circumstances outside my control.

Regards
[redacted]

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[redacted]
Ipswich City Council
Deputy Works Manager
[redacted]
Ipswich QLD 4305

9/12/2003

1_Ipswich_rjn3
QE0??????

Dear [redacted]

IPSWICH RIVERS FLOOD STUDIES - FURTHER INVESTIGATIONS

Sinclair Knight Merz were commissioned to undertake further investigations of the 1 in 100 AEP flood for the Brisbane and Bremer Rivers within the local government boundary of Ipswich City.

The need for further investigations were triggered by the following:

- *Derivation of CRC Rainfall estimates and Areal Reduction Factors (ARFs)* – rainfall depth estimates and ARFs have recently been revised by the DNRM. While the rainfall depth estimates are similar to those used in the Ipswich Rivers Flood Studies (IRFS), the introduction of ARFs reduce rainfall depths by approximately 20%. The current ARFs were not available when the original Ipswich Rivers Flood Studies were undertaken (SKM 2000)
- *Supply of Wivenhoe and Somerset Dam Operations Model* – the Wivenhoe and Somerset Dams Operations Model was not available for the original Ipswich Rivers Flood Studies (SKM 2000). Therefore, a simplified inflow/release procedure was adopted. This was based on emergency release procedures and basically assumed that all floodgates were opened and free overflow from the dams could occur. The Wivenhoe and Somerset Dam Operations Model looks at inflows upstream and downstream of the dams, and adjusts dam releases accordingly thus providing a less conservative estimate of actual dam releases.
- *Review of the Brisbane River Flood Study* – a recent review of the Brisbane River Flood Study investigated the impacts of the CRC Forge Rainfalls, ARFs and the Dam operations and found that flows in the Brisbane River could be reduced by approximately 25%.

Given that flooding of the Brisbane River has significant affect on flooding in Ipswich, Ipswich City Council Officers contacted Sinclair Knight Merz and requested that a 'cost effective' solution be derived to revise flood flows and levels. The methodology outlined in

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the subsequent section was proposed to determine if a simple adjustment was possible for assigning the 1 in 100 AEP flood level in a 'cost effective' manner. This method was proposed to determine whether an interim 1 in 100 AEP flood level could be provided pending a more detailed investigation.

Methodology

The following methodology was adopted in order to determine whether interim estimates could be provided:

- Determine the average rainfall depths for 1 in 100 and 1 in 50 AEP events for both the Bremer and Brisbane Catchments, and compare to earlier estimates;
- Use the ratio of the catchment rainfalls to flood peaks derived from the original study to derive *approximate* flood peaks corresponding to the new rainfall depths;
- Derive an independent estimate of the 1:50 AEP and 1:100 AEP *flood peaks* using regional information derived for the recent study of Brisbane River;
- Derive an independent estimate of the 1:50 AEP and 1:100 AEP *flood levels* from a statistical analysis of historic maxima;
- Assess differences between the three sets of estimates and provide comment on the likely direction of change in flood estimates.

CRC Forge Rainfall Estimates and Areal Reduction Factors

Rainfall depths derived for the Ipswich Rivers Flood Studies (SKM 2000) were derived using Australian Rainfall and Runoff (1987) technique. Since this time the Department of Natural Resources and Mines have derived new point rainfalls based on the CRC Forge technique, and also new Areal Reduction Factors (ARF). Estimates of *catchment rainfalls* – that is the product of point rainfall depths and the ARF – based on the new information are now *lower* than were used in the original study.

A comparison of the 1 in 50 AEP and 1 in 100 AEP catchment rainfalls for the Brisbane River and Bremer catchments is provided in Table 1 for storms of various durations. It is seen that the new catchment rainfalls for the Bremer catchment are around 20% lower than used in the original study.

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- **Table 1 Comparison of Average Rainfall Depths**

Duration	1 in 50 AEP Catchment Rainfalls			1 in 100 AEP Catchment Rainfalls		
	Original Depth (mm)	New Depth (mm)	Ratio of New:Old	Original Depth (mm)	New Depth (mm)	Ratio of New:Old
Brisbane						
24	225	171	0.76	256	188	0.73
30*	**239**	**186**	**0.78**	**271**	**209**	**0.77**
36	258	206	0.80	293	228	0.80
Bremer						
12	162	125	0.77	182	140	0.77
18*	**186**	**151**	**0.81**	**210**	**170**	**0.81**
24	213	179	0.84	241	202	0.84

Notes: *bold values indicate the critical duration event.

Rainfall to Peak Flow Factors

An approximate indication of the impact of the reduced rainfalls on flood peaks can be obtained from inspection of the factors relating rainfall depth to flood peak. Values of rainfall depth and flood peak obtained from the original study are provided in Table 2, along with their corresponding factors. These factors reflect the product of catchment area and runoff coefficient, in a similar fashion to that computed for the probabilistic rational method.

Table 2 Evaluation of Rainfall to Peak Flow Conversion Factors for the critical duration event

Event	Rainfall depth (mm)	Flood peak (m^3/s)	Factor
1 in 50 AEP	186	2822 2693	15.17 14.48
1 in 100 AEP	210	3431 3543	16.34 16.87

It is seen that there is some variation in the derived factors, which result from the non-linearities of the flood-producing factors. While it would be expected that the factors would be dependent on rainfall depths, there is too little information with which to reliably estimate (or extrapolate) the results. Thus, for this exercise a conservative approach is adopted in which the factors are linked to the AEP of the event being considered.

Thus, approximate estimates of revised 1:50 AEP and 1:100 AEP flood peaks at the David Trumpy Bridge are as follows:

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- 1 in 50 AEP peak = 151*14.48 = 2186 ≈ 2190 m^3/s 2291 < 2822.
- 1 in 100 AEP peak = 170*16.87 = 2868 ≈ 2870 m^3/s 2780.

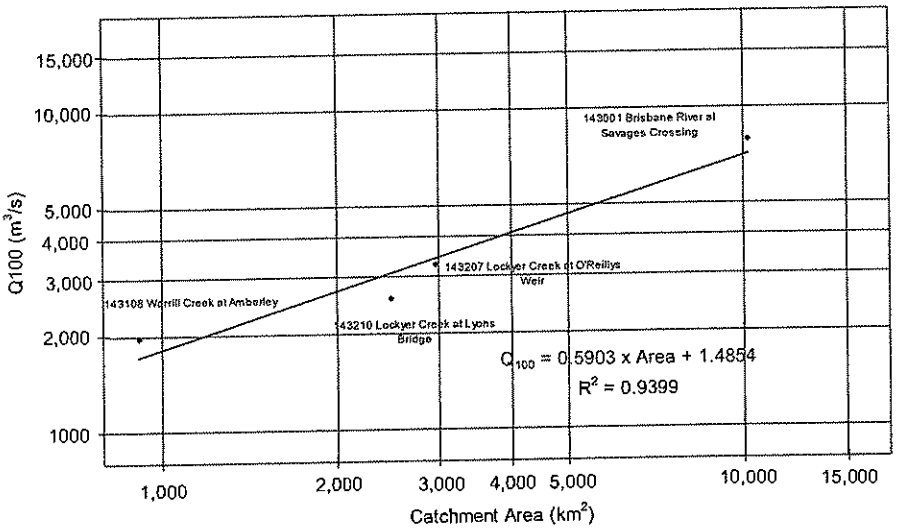
Given the approximate nature of the foregoing analysis is worthwhile comparing these values with independent estimates derived from other analyses. Two sets of independent estimates can be derived. First, a direct estimate of flood peaks can be obtained from a regional analysis of catchment area and flood peaks, and secondly an estimate can be inferred from a frequency analysis of flood levels of historic maxima. These two approaches are discussed in the following sections.

Regional Analysis of Flood Peak Based on Catchment Area

From the regional estimation work undertaken on the Brisbane River done for the Expert Panel review of the Brisbane River flood studies (SKM, 2003) SKM estimates:

- the 1 in 50 AEP peak flow at Ipswich to be 2080 m^3/s and / Ipswich 1 in 50 2822.
- the 1 in 100 AEP peak flow to be 2700 m^3/s.

Refer to Figure 1 below for the plot of the regional analysis results for the 1 in 100 AEP event.



- **Figure 1 Derived relationship between catchment area and 1:100 year peak flows for the Brisbane River catchment (SKM 2003 assessments for Expert Panel review of the Brisbane R flood study).**

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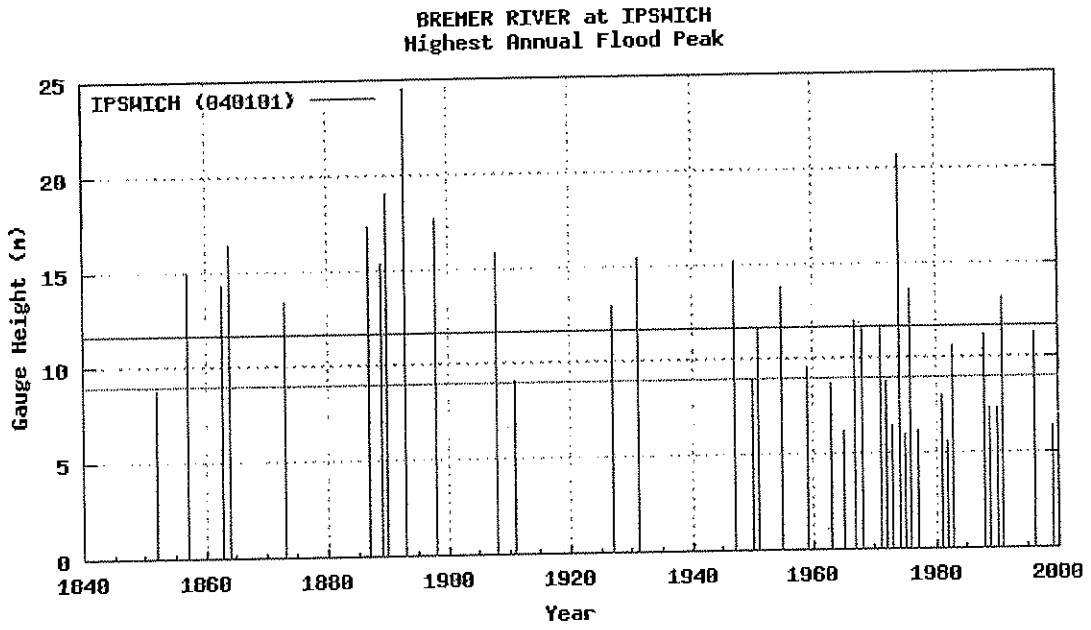
Peak level investigations

To assist in determining whether the conversion from flow to level can be considered to be probability-neutral, a partial series analysis of the peaks at Ipswich Alert (040101) was undertaken. The Bureau's plot of the major events is shown in Figure 2. It indicates the typical nature of the data (the actual data has more peaks below 10 m and there is one event in 1850s on the plot that is not in the peak data obtained from the Bureau of Meteorology).



- **Figure 2: Peak flood heights at Ipswich (040101) (Source: Bureau of Meteorology, 2003).**

The data was treated as a partial series and was analysed using a peaks over a threshold (POT) method. The Generalised Pareto distribution was fitted and used to estimate a distribution of peak flood heights for peaks over a threshold of 10 metres or 12 metres for various periods as outlined below:

- If all data greater than 10m from 1840 is included the 1 in 100 AEP flood level is 20.86 m;
- If peaks greater than 12m from 1840-2000 are included the 1 in 100 AEP flood level is 20.67 m; and,
- If peaks greater than 10m from 1945 –2000 are included the 1 in 100 AEP flood level is 18.91 m.

These compare with the SKM (2000) value for the 1 in 100 estimate of 18.47 m.

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The results post 1945 are the most relevant, and they do not provide clear support for adoption of a lower flood level for the 1 in 100 AEP event. There are a number of reasons why this information may differ from the regional flood frequency analysis and the assessment of the rainfall and flow ratios reported above. In summary they include:

- there is reasonable evidence to suggest that the frequency of recording may be less prior to 1940;
- there are reports of a change from 1945 to a wetter sequence than the previous half century or so; and,
- there is also the effect of Wivenhoe and Somerset dams which would reduce the likelihood of high Brisbane R flows and the associated backwater effects at Ipswich.

Discussion of analysis of Ipswich flood level data

The partial series analysis indicated the 1 in 100 AEP quantile from the local level data is 0.5 m above the previous estimate (SKM 2000) of the 1 in 100 AEP level. This may well be an overestimate of what would occur now given the construction of Wivenhoe and how it is operated, though the effect of the gate operation rules should be assessed to quantify the joint probability of flood flows at Ipswich and levels in the Brisbane River.

The flood level frequency analyses indicate a 1 in 100 AEP level higher than that indicated from the rainfall based assessments undertaken above. However the large flood events are all prior to Wivenhoe Dam being constructed (1985) and so would be expected to overestimate the flood level at Ipswich post construction of Wivenhoe Dam.

The effect of Brisbane River flow levels can be significant at Ipswich. The coincident flows for the two scenarios of: (i) the Bremer River given a flood on the Brisbane River, and (ii) the flows in the Brisbane River given a flood on the Bremer River is significant and cannot be readily determined from the information available. The reasons for this are firstly, the period of record since Wivenhoe Dam was constructed is short, and secondly, the dam operation rules are dynamic and involve the flows at various upstream and downstream locations. The coincident flow challenge can be solved using a joint probability approach and using rainfall-runoff modelling to integrate the flow sequencing.

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Conclusions

A review of the Ipswich Rivers Flood Studies was undertaken to revise the estimate of the peak 1 in 100 AEP flow and flood level estimates in the Brisbane and Bremer Rivers within the boundaries of Ipswich City. This revision was prompted by new information being made available. The new information consists of:

- CRC Forge rainfall estimates and Areal Reduction factors;
- Access to the Wivenhoe and Somerset Dam Operations Model; and,
- Revision of the Brisbane River Flood Study.

Following recent additional studies on the Brisbane River, there are two pieces of information that indicate there may be a reduction in the peak water level at Ipswich. The first indicator is the change in the design rainfall depths. The application of CRC FORGE areal reduction factors (ARF) has resulted in the design rainfall depths being reduced by about 20%, and analysis of rainfall to peak flows (Table 2) suggests that the new 1 in 100 AEP estimate ~~may lie slightly above~~ is slightly below the original 1 in 50 AEP flood estimate.

The second indication that flow levels should decrease is from the regional flood frequency analysis undertaken for the whole of the Brisbane River catchment, though this is based on the assumption that the flood response in the Bremer catchment is similar to the catchments used in the regional analysis. The regional analysis undertaken for the Brisbane River catchment indicates that the 1 in 100 AEP flow rate for a catchment the size of that upstream of Ipswich is about 2700 m³/s. This is very similar to the 1 in 50 AEP magnitude of ~~2693~~ 2822 m³/s from the Ipswich River Flood Study (SKM 2000).

The above evidence leads to the expectation that the peak flow rate and associated level should decrease. However, it does not take into account the effect of: (a) the tailwater level in the Brisbane River associated with a local 1in 100 AEP event on the Bremer River catchment, or (b) the local flow contribution to a flood level caused primarily by a 1 in 100 AEP event on the larger Brisbane River catchment which causes high backwater up the Bremer River. The results of the third estimate based on a frequency analysis of flood levels suggests that the 1 in 100 AEP flood level may be higher than the original estimate; thus while local design rainfalls may have reduced, other factors may be impacting on the final flood levels at the site.

Table 3 summarises the results for each of the methods used in this report.

SKM

Table 3 Summary of Estimates

Method	1 in 50 AEP event		1 in 100 AEP Event	
	Peak (m^3/s)	Ratio to original estimate	Peak (m^3/s)	Ratio to original estimate
Original	~~2693~~ 2822	1.00	~~3543~~ 3431	1.00
Factored rainfalls	~~2190~~ 2291	0.81	~~2870~~ 2780	0.81
Regional estimate based on catchment area	2080	0.77	2700	0.76
Inferred from flood frequency analysis of peak levels (RL 18.91 m) – 1945 onwards			~~5540~~ no validity because of backwater effects	1.56 ? BOM ? 1974 flows

Given the uncertainties in the foregoing analyses and the spread of the results, it is considered that there is insufficient information with which to confidently revise the original flood estimates. While the design rainfalls have decreased by around 20%, it is possible that other factors are influencing flood levels and these should be investigated prior to deriving new design flood estimates.

Recommendations

Based on the foregoing we recommend that:

- the 1 in 100 AEP flood levels reported in the Ipswich Rivers Flood Studies (SKM 2000) remain unchanged; and,
- further investigation be undertaken to reconcile the differences between the rainfall-based and flood frequency estimates, particularly with respect to the joint occurrence of flood-producing factors. Such work could be done in conjunction with Brisbane City Council as many of the issues requiring consideration are common to both parties.

SKM

I trust you find this report satisfactory however should you have further queries, please contact the undersigned at this office.

Yours sincerely

[redacted]

10 September 2003

MEMORANDUM

TO: PLANNING MANAGER

FROM: ACTING WORKS MANAGER

RE: DRAFT IPA PLANNING SCHEME - SUBMISSION ON FLOOD LEVELS

Please treat this report as a submission to the draft new planning scheme.

It has been brought to my attention that the Brisbane City Council has finalised its flood study for the Brisbane River.

The flooding data in the draft new Ipswich planning scheme was based on the 'best available data' as contained in a previous 'iteration' of Brisbane River flood data prepared by SKM Consultants for use in both Ipswich and Brisbane. This data is depicted graphically in Overlay Map OV5 in the draft new Ipswich planning scheme.

In the interests of adopting a consistent approach to development along the reaches of the Brisbane River which adjoin both the Ipswich and Brisbane local government areas it is considered that Overlay Map OV5 should be reviewed to incorporate the latest data contained in the Brisbane study.

[redacted]
ACTING WORKS MANAGER

Notes of the Meeting with SKM on Review of Flood Study

Venue: SKM's Office, Brisbane
Date and Time: 20 Nov. 03, 10am
Attendees: [redacted] - ICC
- SKM
- SKM
- ICC

- [redacted] explained the purpose of this meeting which was to discuss the BCC's flood study review outcome and how to proceed with the ICC's flood study review incorporating the BCC's Review Panel's outcome

- [redacted] described the work carried out by the SKM for BCC so far. ICC's RAFTS model was incorporated with the simulation of the Wivenhoe and Somerset Dams operations. This model was run for various rainfall patterns over the catchment and corresponding flows were derived. The Review Panel recommended the Q100 flow of 6000cumecs from Savages Crossing to Port Office Gauge through Moggill Gauge for the Brisbane River.

- It was discussed whether the Q50 Brisbane River flow of around 6800cumecs from the Ipswich Rivers Flood Study Phase 1 and Phase 2 report, SKM (2000), could be the good representation and conservative matching Q100 flow as far as Ipswich concerned. If this is acceptable, already mapped Q50 flood inundation could be replaced as the Q100 map. Since this Q50 flood map has been already mapped (need smoothening), this option would be cost effective exercise.

- [redacted] agreed to look at the earlier SKM's Q100 flows for the Bremer River Catchment with the consideration of Areal Reduction Factor for the rainfall and to compare with the Q50 flows and to see whether the variation is acceptable or not. This would justify the option to adopt the current Q50 map as the new Q100 map. If it is not within the acceptable limit SKM will advise ICC on any further work to be undertaken.

- SKM is also to advise what other actions are needed in the long term to finalise the flood study and ensure that the outcomes are coordinated between ICC and BCC.

Proposed Meeting with SKM to discuss Flood Study

1. **ICC's work to date on Phase 1 and Phase 2 Study**

   - ***MIKE 11 model modification since SKM (2000)***

Done by:	Halliburton (2002)
Reason:	SKM's flood level seems to be high u/s of David Trumpy Bridge up to the Phase 1 & 2 boundary on Bremer River
Work involved:	modification of MIKE 11 parameters- roughness and extension of cross section sufficiently to represent the total storage and re-run the model for the existing case scenario.
Results:	Reduction of flood levels around 0 at David Trumpy Bridge and varies to 0.88m at Hancocks Bridge, 0.95m at One Mile Bridge and 1.5m at the model upper boundary for Q100 design flood.

2. **BCC's Design Flood Discharge Estimation and Independent Review Panel's Report (Sept 2003)**

   - Review panel's recommendation for Q100 flow is 6000m^3/ s from Savages Crossing to Port Office Gauge. How are Q100 discharges along Bremer River and it's tributaries going to be changed compared to earlier results from SKM's (2000)?

     It is presumed that RAFTS nodal Q100 discharges within Bremer Catchment should have been already derived as part of this review. Is it correct?

     What about the discharges for the other ARIs (2, 5, 10, 20, 50, 200, 500 and PMF)?

     Are we going to do anything at this stage? As far as risk management concerned we may need them in future. In this case, it may be possible to get quotation for this task even if it won't go ahead now.

   - Review Panel's report stated that MIKE11 calibration was carried out only at Moggill and Port Office gauges. Whether calibration has been undertaken along the Brisbane River at different locations?

     Do we need to do the calibration run within Bremer for our purpose? If this is the case is it possible to use the modified MIKE11 model?

     What is the consequence on earlier calibrated flood levels against four historic floods (1974, 1983, 1989 & 1991)?

     What version of the MIKE 11 model is currently being used for this review?

3. **What are the tasks involved to produce the new Q100 flood map according to the BCC's Review Panel Outcome?**

   - Tasks involved, time frame and cost
   - How to proceed with the flood mapping exercise? Council staff will undertake the same using 12D and consultant is to pass the model results compatible to do this exercise.

From: [redacted]
To: [redacted]
Date: Tue, Nov 25, 2003 8:34 am
Subject: BRISBANE AND BREMER RIVER FLOODING WITHIN ICC BOUNDARY

[redacted]

We have checked thought about what we discussed at last Thursday's meeting and we think the best way to proceed is as follows:

* Determine the Areal Reduction Factors (ARF) for the Brisbane and Bremer Catchments.
* Determine the Average Rainfall Depths between 100 and 50 year ARI flood events for both the Bremer and Brisbane Catchments. We will then determine the ration of rainfall depth between 100 and 50 year ARI events and compare to the ARF.
* As a final check we will determine average flows (IRFS 200) for the Q100 and Q50 within the reach of interest for the Brisbane and Bremer Rivers and find the ration between the Q100 and Q50. This ratio will be compared to the ARF and the rainfall depth ratio.
* We will then determine whether it is appropriate to adopt the old Q50 flood event (IRFS 2000) for the Bremer and the Brisbane River within the confines of ICC boundary.
* Prepare a letter report stating the methodolgy and the accuracy of the adopted flows and flood levels.

Some preliminary numbers that we have undertaken suggest that this will provide a reasonabley good estimate in the short term.

The fixed fee to complete these works is $2390.00 (GST Exclusive). If you would like to proceed with this investigation please reply to this e-mail and advise us to proceed. If you advise us to proceed prior to COB on Wednesday 26/11/03, we can have the report completed by COB 1/12/03.

All work will be condusted in accordance with our Standard Terms and Conditions for Professional Services. I have attached a copy for your information.

I trust this proposal meets your requirements however should you have any further queries, pleas contact me at this office.

Regards

[redacted]

*

CC: [redacted]

SKM

Terms of Agreement for Professional Services

1. Sinclair Knight Merz Pty Limited ("the Consultant") shall provide to the Client the professional services ("the Services") for the Project being undertaken by the Client ("the Project") described in the accompanying letter and as prescribed by these Terms of Agreement ("the Agreement").

2. In providing the Services, the Consultant shall exercise the degree of skill, care and diligence normally exercised by professionals in similar circumstances.

3. The Client shall provide to the Consultant briefing and all information concerning the Client's requirements for the commission.

4. The Client shall pay to the Consultant the Fee and the Reimbursable Expenses as set out in the accompanying letter.

5. All monies payable by the Client to the Consultant shall be paid within 14 days of invoice. Monies not paid within that period shall attract interest from the date of invoice until payment at the rate of the current CBA Corporate Overdraft Reference Rate plus 2%, calculated on daily overdue balances.

6. Notwithstanding any other provisions of this Agreement, the Consultant's liability to the Client:

(a) under or arising from the Agreement;

(b) in tort (including negligence) or under any statute arising from the Consultant's acts or omissions,

shall not exceed the sum of

(c) $300,000; or

(d) the cost of reperforming the Services the subject of this Agreement,

whichever is the lesser.

The Consultant's liability to the Client for any loss or damage, including a claim for damages for a breach of the Agreement by the Consultant shall be reduced to the extent that an act or omission of the Client or its employees, agents or consultants contributed to the loss or damage.

7. After the expiration of one (1) year from the date of invoice in respect of the final amount claimed by the Consultant pursuant to clause 4, the Consultant shall be discharged from all liability in respect of the Services whether under the law of contract, tort or otherwise.

8. Copyright in all drawings, reports, specifications, bills of quantity, calculations and other documents provided by the Consultant in connection with the Project shall remain the property of the Consultant.

9. Subject to clause 10, the Client alone shall have a licence to use the documents referred to in clause 8 for the purpose of completing the Project, but the Client shall not use, or make copies of, such documents in connection with any work not included in the Project.

10. If the Client is in breach of any obligations to make a payment to the Consultant, the Consultant may revoke the licence referred to in clause 9, and the Client shall then cause to be returned to the Consultant all documents referred to in clause 8, and all copies thereof.

11. The Client shall ensure, to the extent reasonably possible, that the Consultant's input into the Project is duly recognised in any publicity material generated by the Client in respect of the Project.

12. Any dispute between the Client and the Consultant shall first be the subject of mediation provided that this provision shall not prevent the Consultant from instituting legal action at any time to recover moneys owing by the Client to the Consultant.

13. The Client may terminate its obligations under this agreement:

(a) in the event of substantial breach by the Consultant of its obligations hereunder, which breach has not been remedied within 30 days of written notice from the Client to the Consultant requiring the breach to be remedied, or

(b) upon giving the Consultant 60 days written notice of its intention to do so.

14. The Consultant may suspend or terminate its obligations under this Agreement:

(a) in the event of:

(i) monies payable to the Consultant hereunder being out-standing for more than 28 days;

(ii) other substantial breach by the Client of its obligations hereunder, which breach has not been remedied within 30 days of written notice from the Consultant to the Client requiring the breach to be remedied, or

(b) upon giving the Client 60 days written notice of its intention to do so.

15. Termination shall be without prejudice to any claim which either party may have against the other in respect of any breach of the terms of the Agreement which occurred prior to the date of termination.

16. If the Consultant considers it appropriate to do so, it may with the Client's prior approval, which shall not be unreasonably withheld, engage another consultant to assist the Consultant in specialist areas. The Client accepts responsibility for all monies payable to such other consultant.

17. Neither party may assign, transfer or sublet any obligation under this Agreement without the written consent of the other. Unless stated in writing to the contrary, no assignment, transfer or subletting shall release the assignor from any obligation under this Agreement.

18. The Client acknowledges that, unless agreed otherwise, the provision of Services by the Consultant for the Project is not given on an exclusive basis.

19. Fees and disbursements are exclusive of any Goods and Services Tax, whether levied on inputs to the Services, or on the Services. Any such Goods and Services Tax costs shall be to the Client's Account.

From: [redacted]
To: Adams, John; [redacted]
Date: Tue, Nov 25, 2003 11:19 am
Subject: Fwd: BRISBANE AND BREMER RIVER FLOODING WITHIN ICC BOUNDARY

Please see attached submission that resulted from last week's meeting with SKM.

Also we have just finished the first cut of the "SKM 2000 - 50 year flood line" produced in a smooth line at the detailed property level. So if SKM's analysis was to indicate that the this "flood line" was a fair representation of the "2003 - 100 year flood line" then we are well positioned to have a mapping product ready on fairly short notice.

Comments please.

Thanks [redacted]
Deputy Works Manager
[redacted]
phone [redacted]

CC: [redacted]

DEO:GMH
H:\IPA Planning Scheme\Stage 5 – Public Notification
[Post Display_P&D Report_Covering Report.doc]

Planning & Development Committee	
Mtg Date: 02.12.03	OAR
Authorisation: Gary White	
Committee to prepare letter: No	
Program No: 02	

ITEM 02.03

25 November 2003

MEMORANDUM

TO: PLANNING AND DEVELOPMENT MANAGER

FROM: PLANNING MANAGER

RE: DRAFT IPSWICH PLANNING SCHEME – FINALISATION AND REVIEW OF SUBMISSIONS RECEIVED

INTRODUCTION:

This is a report by the Planning Manager dated 25 November 2003, in relation to the Draft Ipswich Planning Scheme.

The report is intended to facilitate Council's response to submissions received from the public and government agencies during the public display of the Draft Ipswich Planning Scheme and to enable the Draft Ipswich Planning Scheme to be referred to the Minister for the final 'consideration of state interests' in accordance with the provisions of the Integrated Planning Act (IPA).

BACKGROUND:

The report as set out below:

- provides an overview of the Draft Ipswich Planning Scheme display process;
- outlines the submissions received in relation to the Draft Ipswich Planning Scheme;
- provides an assessment of the various issues raised in relation to the Draft Ipswich Planning Scheme; and
- recommends actions relating to the submissions received, to be undertaken prior to finalising the Draft Ipswich Planning Scheme.

.../2

OVERVIEW OF DISPLAY PROCESS:

The Draft Ipswich Planning Scheme display process included the following elements:

- a static display at the Council Administration Building at Roderick Street, where a professional planning officer was available throughout the 60 business display period (i.e. 12 June 2003 to 5 September 2003);
- a telephone hotline for phone enquiries;
- a static display at each Divisional Electorate Office;
- making the Draft Ipswich Planning Scheme documentation available for perusal via Council's web site, through the Council's mobile library network and via a static display (to facilitate after office hours access) at the main library in the Global Information Centre;
- a statutory public notice in The Queensland Times; and
- the production and distribution of letters to land owners whose proposed land-use designations faced significant changes.

Further information in relation to the submissions received during the public display of the Draft Ipswich Planning Scheme are included as attachments to this report:

Attachment A1: Provides a brief summary and divisional reference for the submissions received from the public.
Attachment A2: Provides a precis and assessment of the submissions received from the public.
Attachment B1: Provides a brief summary and divisional reference for the submissions received from government agencies.
Attachment B2: Provides a precis and assessment of the submissions received from government agencies.

OVERVIEW OF THE SUBMISSIONS RECEIVED FROM THE PUBLIC:

At the close of the formal, statutory display period on 5 September 2003, Council had received 181 submissions from the public in relation to the Draft Planning Scheme. Nine (9) submissions were received after the close of the formal, statutory display period. The total number of submissions received (including those received after the close of the formal, statutory display period) was 190.

A breakdown of the issues raised in the submissions is provided below:

(1) Conservation

(A)	Objections	52
(B)	Further Information Requested	5
(C)	Inclusion / Support	3
	Total	**60**

(2) Marburg Stables Residential Zone

(A)	Objections	27
(B)	Support	4
	Total	**31**

(3) **Cultural Heritage 'Listings'**

(A)	Objections / Removal	9
(B)	Inclusion	4
	Total	**13**

(4) **Bushfire Risk Areas**

(A)	Objections	2
	Total	**2**

(5) **Industrial Zonings**

(A)	Ebenezer	4
(B)	Swanbank / New Chum	4
(C)	Others	2
	Total	**10**

(6) **Other Issues**

(A1)	Proposed Zoning Changes	45
(A2)	Proposed Zoning Support	10
(B1)	Extractive Industries/KRA's Expansion	5
(B2)	Extractive Industries/KRA's Reduction	2
(C)	Other issues	26
	Total	**88**

TOTAL SUBMISSIONS = 190
(NB: Some Submissions involve more than one issue)

Please refer to Attachment A2 for a detailed assessment of the matters raised in the public submissions.

OVERVIEW OF SUBMISSIONS RECEIVED FROM GOVERNMENT AGENCIES:

Twenty-three (23) submissions were received from Government Agencies.

These submissions range from minor, essentially 'editorial' changes to more substantive matters such as significant changes to public utility definitions and changing the regulatory regime for heavy vehicle parking from the planning scheme to a local law.

Please refer to Attachment B2 for a detailed assessment of the matters raised in the submissions from government agencies.

WHERE TO FROM HERE:

The attachments referred to in this report include a summary of the submissions received from the public, and government agencies.

It is proposed that:

- the submissions received be noted and the recommendations arising from those submissions be incorporated in the finalised Draft Ipswich Planning Scheme; and
- the finalised Draft Ipswich Planning Scheme be forwarded to the State Government for final review.

In accordance with the provisions of the *Integrated Planning Act* (1997) (IPA), Council is required to respond to all submissions made during the Draft Ipswich Planning Scheme public display period. In accordance with established Council practice, each of the submitters has been sent a letter of acknowledgment, thanking them for their submission and advising them that their submissions will be considered in the preparation of the Draft Ipswich Planning Scheme. It is proposed that, in accordance with the provisions of the IPA, further correspondence be sent to each submitter detailing the response to their submissions, as outlined in the relevant attachments to this report.

It is further considered that each of the private landowners whose land was proposed to be included in the Rural Conservation Zone should be advised of the new provisions regarding this matter.

Recent discussions indicate that Councillors are desirous of including a recommendation in this report to authorise Councillor Paul Pisasale and the appropriate divisional Councillor to sign correspondence to submitters in relation to the Rural Conservation Zone.

RECOMMENDATION:

A. That the comments received through submissions from the public and from government agencies be noted.

B. That Council resolve to proceed with the Draft Ipswich Planning Scheme, with the modifications as detailed in Attachments A2 and B2 of the Planning Manager's report of 25 November 2003.

C. That the Planning Manager be requested to attend to the relevant matters associated with the proposed amendments including:

1. amending the relevant documentation;
2. advising the submitters and other affected land owners about the outcome of the submissions; and
3. forwarding the relevant documentation to the Minister for the final state interests review.

D. That Councillor Paul Pisasale and the appropriate divisional Councillor be authorised to sign correspondence to submitters in relation to the Rural Conservation Zone.

John Adams
PLANNING MANAGER

I concur with the recommendations contained in this report.

Gary White
PLANNING AND DEVELOPMENT MANAGER

ATTACHMENTS:

Attachment A1: Public Submissions – Summary
Attachment A2: Public Submissions – Assessment
Attachment B1: Government Agencies Submissions – Summary
Attachment B2: Government Agencies Submissions – Assessment


Attach A1


Attach A2


Attach B1


Attach B2

Submission 19: Ipswich City Council
Acting/Deputy Works Manager

1. *The flood data used to prepare Overlay Map OV5 should be reviewed to incorporate the latest data on flooding in the Brisbane River.*

Planning Branch Comments

The approach suggested by the Acting Works Manager is concurred with.

Overlay Map OV5 was compiled using the 'best available data', however the more recent data would appear to indicate that the previous data used was somewhat conservative.

It is also considered desirable to adopt, as far as possible, a consistent approach to flooding along the reaches of the Brisbane River which adjoin both the Ipswich and Brisbane local government boundaries.

2. *Amendments to Planning Scheme Policy for Ipswich Roadworks Infrastructure Contributions.*

A number of amendments to the above planning scheme policy are currently on public display. It is anticipated that these amendments will be 'finally adopted' by Council shortly. Accordingly, they should also be incorporated into the draft new planning scheme.

Planning Branch Comments

The proposed amendments to the current Planning Scheme Policy for Ipswich Roadworks Infrastructure Contributions have also been included on the December 2003 P&D Agenda for 'final adoption'. It is agreed that these amendments should also be included in the draft new planning scheme text and map references.

3. *Warwick Road to Ripley Road – Possible Future Major Intersuburban Link.*

Further to the recent discussion which has occurred in relation to the above, it is requested that the area outlined in the Attachment to this report be included in Map 4 of Schedule 7 to the draft planning scheme, as an 'Intersection/Connection to be further investigated'.

Planning Branch Comments

The importance of this connection will increase as development proceeds within the Ripley Valley. Accordingly, the proposal to include the investigation area on Map 4 (Transport Network) of Schedule 7 is supported.

PLANNING MANAGER'S RECOMMENDATION

That the draft planning scheme be amended as outlined above.

Warwick Rd-Ripley Rd Possible Link

Standard Mtg Ravi 19/12/03

Previous Notes
2) Hold over Rosewood EAP (due to 1 March)
Ravi has provided updated draft.

3) Flood operation manual updated since
17/12 Exercise + corrected
David Trumpy Bridge Albert Gauge U/S until Jan 04
• Ravi is discussing relative/absolute calibration of Height Gauge.

• Outstanding report
Moreton Flood Study (AU)

• Creek sediment analysis
(Ravi to prepare report to WMG seeking direction)

Ravi to organise item on WMG agenda.

1) Brisbane Study Revision.
M. Salisbury advised 18/12/03 that SKM could not deliver report by end of 2003 because there is some conflict with flood frequency analysis.

Norm Case asked him to advise J Davis AU of this.

Melbourne office will be looking at it again in early Jan 2004 and should only take a week or so to get back to BCC.

He also advised that the 2000 Q50 appeared to be a good fit for new Q100 if not a little conservative

2) Flood prediction maps.
• mtg with David Sargent next week
[illegible]

Standing Mtg Raw (21) 19/12/03

6) SGD selection meeting
One Mile Bridge
* being followed up.

7) IRIT Study
- SKM not participating
* - Halliburton/SKM joint submission
* Cardno
* * Sargent
* GHD

Will close 13 Jan
suggest include Moore in consideration.

8) B Gambles request for information

New Bus

1) SWAG enquiry
* ask for item on WMG agenda (Ravi)

* also IRIT Report

2) P+D advice on 212 Pine Mtn Road.
draft email response prepared

3.66
16.99

3) include item on One Mile Bridge
agenda on WMG next week
(invite Tony Jovanovski to attend)

4) Typical Emergency Response Plans would include
(a) Scenario: 7 metres at David Trumpy
no flood in Brisbane
(could use 3-Mile Case 20m)
"near enough"

note This is considered a minor flood.

Action Plan to Determine Property Based Flood Levels

Required property based information:

1. Q100 flood level
2. 1 in 20 development flood level for former Ipswich City Area
3. 1974 flood level
4. highest and lowest ground floor levels

Proposed Action

Information Required	Action and Comments	Action By
1. Q100 flood level	• SKM's Q50 level is going to be the future Q100 flood level for the urban area (Phase 1 and Phase 2 study area)	
	• This SKM's flood line needs to be tidy up (smoothened) probably using 12D	Asset
	• Determination of property based Q100 flood level (this exercise could probably be undertaken along with determination of other above levels to each property)	Asset
2. 1 in 20 development flood level within former Ipswich City Area	• This line has been already prepared as part of the draft Planning Scheme and may need some work to determine the flood level along respective MIKE11 cross sections	Asset/ RR
	• Deebing Creek area needs to be re-checked	Asset/ RR
3. 1974 flood level	• It is presumed that the existing 1974 flood map in the GIS probably be sufficient to determine the property based 1974 flood level. Asset needs to confirm this.	Asset
4. Highest and Lowest ground floor levels	• May need decision to base on which contour information. Probably latest 1m contours?	Asset/ AU

Action Plan
Determine Property Based Flood Levels

- **Pre-Requisites**
  - Process / Create base model
  - Based on .5m Contours where available
  - Concerns over new contours (when changed etc.), Have no break lines etc.
  - Determine who is responsible for maintaining this dataset
  - Determine processes to update this dataset
  - When should this dataset be updated
  - Audit trail to be kept for amendments.

- **Q100 Flood Level**
  - Produce Q100 Flood Inundation line.
  - Based on SKM Q50
  - Smoothing required using 12D
  - Imperative that levels do not exceed previous plan, esp. at small scales.
  - A0 Plans at scale of 1:5000 (Approx'. 20) to test against previously line for Planning

- **Q 20 Flood Level**
  - Based on Former ICC Dev. Control Line
  - Should require no work from Mike II
  - Needs to be checked for accuracy etc.

- **1974 Flood Levels**
  - Only currently covers former ICC area, ~~is there a need to develop levels for remainder of City~~?
  - ~~Could we use former Moreton Autocad drawings~~?
  - ~~Needs to be checked for accuracy etc.~~

- **Property Search Component**
  - Based on .5m Contours
  - Gross checking with highest and lowest levels against flood lines produced.
  - Confirm Qualifying statements
    - Should include how levels were derived (Photogrammetry, Survey etc.)
    - Change name of declared level from Q100 to Development Control Line?
    - How are we proposing to deal with special consideration properties, inc. showing users etc., declaring decisions made etc.
  - What is required to be shown?
    - Highest level of inundation inside property
    - Lowest level of inundation inside property
    - Declaration / Qualification
    - How is this information to be disseminated and by whom?
    - Should this be delivered with GIRT, (security issues)?

JSA:GMH
John Adams
3810 6255

11 December 2003

Dear [redacted]

Re: **Ipswich IPA Planning Scheme**

I wish to advise that at its meeting of 10 December 2003, Council considered the submissions from the public and government agencies made during the consultation period for the draft new planning scheme.

Attachment 1 includes the planning report which provides an overview of the consultation period and the submissions received. Attachment 2 sets out additional matters which were adopted by Council in relation to the draft new planning scheme. Attachment 3 includes the modified planning scheme documentation.

In accordance with Section 18 of Schedule 1 of IPA, Council has determined to proceed with the Structure Plan with modifications as detailed in Attachments 1, 2 and 3. Council is satisfied that the proposed amendments to the Planning Scheme do not make it significantly different from the scheme as notified.

The main changes proposed comprise:

- creating a new Sub Area (FU5) within the Future Urban Zone;
- creating three (3) new Sub Areas (SA41, SA42 and SA43) within the Special Opportunity Zone;
- scaling back the intensity of development within the Stables Residential Zone at Marburg, by effectively establishing an 'investigation area' and undertaking further, detailed community consultation about the precise development standards for the zone;

[redacted]
Central-Southern Team SEQ Planning Division
Department of Local Government & Planning
PO Box 31
BRISBANE ALBERT STREET QLD 4002

- a reworking of the zoning provisions for the Rural Conservation Zone such that publicly owned land will remain in the Rural Conservation Zone and privately owned land will be included in a Rural Special Land Management Zone which seeks to achieve a balanced approach to maintaining important nature conservation values whilst allowing a sustainable economic return from the land;
- some rewording of the provisions for the Springfield Structure Plan (which is a 'transitional DCP') as a result of further negotiations with the Springfield Land Corporation; and
- revising the flooding data used to formulate the flooding overlay maps based on more recent data obtained as a result of a joint project with the Brisbane City Council involving the Brisbane River.

Council has also requested that consideration be given to:

- the applicability of the expanded use rights for the Rural Special Land Management Zone to the Rural Agricultural and Rural Pastoral Zones; and
- the protection of endangered ecosystems and reconciliation of mapping details under the Vegetation Management Act.

I look forward to further discussions with you (and other relevant state agencies) as to whether these matters may be addressed through further modifications to the draft planning scheme, or a subsequent amendment, or through some other planning mechanisms.

As a further protection and support for rural landowners and in recognition of community concerns, Council adopted a further recommendation that the Minister for Natural Resources and Mines and other relevant Ministers and agencies be advised that, in relation to the new Ipswich Planning Scheme, any compensation payable for the acquisition of land under a coordinated conservation plan or otherwise for conservation purposes, should be based on the land's zoning prior to the gazettal of the new planning scheme.

I look forward to receiving confirmation that Council may proceed to the final adoption of the plan following the final State Interest Review.

Should you wish to discuss any relevant matters further, please do not hesitate to contact me direct on [redacted]

Yours sincerely

John Adams
PLANNING MANAGER

Attachment 1: Planning Report.
Attachment 2: Additional matters adopted by Council at its meeting of 10 December 2003.
Attachment 3: Four (4) copies of the draft planning scheme documents and one (1) copy of the zoning and overlay maps.

JSA:GMH
Planning\IPA Planning Scheme\Stage 6 – Second SIR & Adoption\Miscellaneous[Final Adoption P&D Report.doc]

Planning & Development Committee	
Mtg Date: 02.03.04	OAR: YES
Authorisation: Gary White	
Committee to prepare letter: No	
Program No: 02	

19 February 2004

MEMORANDUM

TO: PLANNING AND DEVELOPMENT MANAGER

FROM: PLANNING MANAGER

RE: FINAL ADOPTION OF NEW IPSWICH PLANNING SCHEME

INTRODUCTION:

This is a report by the Planning Manager dated 19 February 2004, in relation to the final adoption of the Ipswich Planning Scheme.

BACKGROUND:

At its meeting of 10 December 2003, Council resolved to proceed with the draft new planning scheme, subject to a number of modifications, which arose primarily as a result of the public notification process.

The modified planning scheme documents were forwarded to the Department of Local Government and Planning for Ministerial approval as part of the second State Interests Review on 11 December 2003.

By letters received on 18 February 2004 (see Attachment A), advice has been received from the Minister that Council may now proceed to the final adoption stage. The Minister's letters are highly complimentary of Council's effort in preparing the new planning scheme and the level of technical competence achieved.

SECOND STATE INTERESTS REVIEW:

As part of the second 'State Interests Review' a number of essentially minor amendments to the planning scheme documents were required to be made. These amendments comprised:

- correction of some typographical errors and terminology inconsistencies;
- updating references to the CASA aviation guidelines and the Synergy Park Industrial Estate;
- amending the definition of 'gross floor area' to clarify exclusion of shopping centre mall areas used exclusively as public thoroughfares;
- adjustment of the Hills Terrace KRA Haul Route (at the request of DNRM);

.../2

- changing the order in which height restriction and obstruction clearance surfaces provisions occur and including an additional note in relation to Defence Department approval (at the request of the Department of Transport);
- the inclusion of overall performance indicators based on the Desired Environmental Outcomes contained in the planning scheme; and
- amending the 'information request' provisions contained in Planning Scheme Policy 2 to include references to the SEQ Regional Nature Conservation Strategy and Common Nature Conservation Classification System, where appropriate.

The EPA has also requested that Council include the following 'activities' for further consideration in the future:

- review the planning scheme's conservation provisions to take account of the "SEQ Regional Nature Conservation Strategy";
- review of Council's vegetation mapping using terminology consistent with the "Common Nature Conservation Classification System";
- review of the biodiversity provisions for areas zoned 'Urban' and 'Business and Industry Investigation';
- direct and early consultation with the EPA regarding any refinement or review of the Ripley Valley/Deebing Creek Land Use Concept Master Plan; and
- review of indigenous cultural heritage provisions based on revised/updated information to be provided by the EPA.

PLANNING SCHEME IMPLEMENTATION – ASSOCIATED ADMINISTRATIVE MATTERS:

There are a number of matters associated with the efficient and effective implementation of the new Ipswich Planning Scheme which should be addressed. These matters are discussed under the sub headings listed below and are further dealt with in Attachments to this report.

1. Policy/Implementation Guidelines:

Each of the Policy Guidelines developed under the current planning scheme will cease to have 'force and effect' upon commencement of the new planning scheme. The new planning scheme includes a 'head of power' [section 2.3(2)] which allows a similar approach – to be known as 'Implementation Guidelines'.

Most of the Policy Guidelines from the current planning scheme should be 're-adopted' as Implementation Guidelines under the new planning scheme, subject to minor changes to:

- style and set out;
- the titles – to include reference to the terminology 'Implementation Guidelines'; and
- include reference to the 'head of power' under section 2.3(2) of the new planning scheme.

Four (4) of the Policy Guidelines from the current planning scheme will be redundant under the new planning scheme and accordingly should not be 're-adopted'. They are:

- Policy Guideline No. 2 [Earthworks (including allotment filling)], whose provisions have been incorporated within the Earthworks Code, refer Part 12, Division 15 of the new planning scheme;
- Policy Guideline No. 3 [Rural Subdivisions for Previous Family Subdivisions, Farm Transfers and Rural Housing Lots], wherein the former family and other rural subdivision provisions of the former Moreton Shire Planning Scheme have now expired by in excess of four (4) years;
- Policy Guideline No. 11 [Home Based Activities], whose provisions have been incorporated within the Home Based Activities Code, refer Part 12, Division 2 of the new planning scheme; and
- Policy Guideline No. 13 [Infrastructure Contribution Discounts for Student Accommodation Developments], whose provisions have been incorporated within the new Planning Scheme Policy No. 5 – Infrastructure.

Two (2) new Implementation Guidelines are proposed to be adopted to assist with the implementation of the new planning scheme. The new guidelines are:

- No. 11 – New Rural Living Lots, Created as a Result of Transferable Dwelling Entitlements; and
- No. 12 – Character Code, Probable Solutions – Overview Package.

Attachment B to this report contains the details for the Implementation Guidelines which are proposed to be adopted with the new planning scheme.

2. Delegated Authority – to Improve Processing Efficiency for Minor Development Applications:

As a result of the focus of IPA and DLGP on 'codifying' all forms of development, there is likely to be a greater amount of minor types of development which will need a formal development approval under the new planning scheme.

These forms of development will include:

- carrying out building works which do not meet the 'exempt' or self assessable provisions, such as carports and outbuildings in heritage places and dwellings greater than 8.5m in height;
- single dwellings within mining affected areas or other areas subject to development constraints;
- trimming of historic trees listed in Schedule 2 to the planning scheme, which exceeds the specified 'exempt' criteria; and
- placing an advertising device on premises.

In order to avoid complaints regarding delays in processing minor development applications, it is proposed to amend the existing delegated authority provisions to enable 'stream lined' processing (see Attachment C). The essential change proposed for minor development applications involves deleting the mandatory Councillor consultation phase prior to the issue of a decision notice. It is further proposed that immediately upon issue of decision notice, the Divisional Councillor and the Chairperson of the Planning and Development Committee be notified of the decision so that they can make an informed response if contacted by a constituent.

3. Users Guides and Assessment Checklists:

DLGP have produced a number of 'proforma' user's guides and assessment checklists which they are requesting Councils use in order to increase the state wide awareness of development assessment processes under the new style IPA planning schemes.

These documents are considered useful and have been adapted by Planning Branch staff to incorporate the specific provisions of the new Ipswich Planning Scheme.

A copy of the revised documents are contained in Attachment D to this report.

4. Staff Training:

A comprehensive training package on the new Ipswich Planning Scheme has already been undertaken for key Planning and Development Department staff. Some 'refresher' training will also be undertaken immediately prior to the 'commencement date' for the new planning scheme.

It is also intended that Planning Branch staff will be available to assist Development Branch staff with the implementation of the new planning scheme, particularly during the initial three months.

Further 'awareness' training will also be undertaken for key internal and external stakeholders during this initial implementation period.

5. Commencement Date:

In accordance with the requirements of IPA the new Ipswich Planning Scheme will take effect either:

- on the day the adoption of the planning scheme is notified in the Queensland Government Gazette; or
- such later date which Council may determine to be the 'commencement date'.

There are a number of logistical elements which are yet to be commenced/implemented in relation to the new planning scheme. For example the printing of the actual planning scheme documents is expected to take at least 3 weeks to complete.

It would also be preferable for the new planning scheme to commence on a Monday as this would enable 'uploading' of the necessary GIS and other relevant property data over a weekend.

Accordingly, it is proposed that the commencement date for the new Ipswich Planning Scheme be Monday, 5 April 2004.

RECOMMENDATION:

A. That Council resolve to adopt the new Ipswich Planning Scheme, inclusive of the modifications negotiated during the second State Interests Review.

B. That Council resolve to adopt the planning scheme policies associated with the new Ipswich planning scheme, inclusive of the modifications negotiated during the second State Interests Review.

C. That Council resolve that the commencement date for the new Ipswich Planning Scheme and associated planning scheme policies, implementation guidelines and other related administrative matters be Monday, 5 April 2004.

D. That the Planning Manager be requested to attend to the relevant matters associated with the implementation of the new Ipswich Planning Scheme including:

1. placement of public notices; and
2. forwarding copies of relevant documentation to key stakeholders.

E. That Council adopt the Implementation Guidelines as contained in Attachment B to the Planning Manager's report of 19 February 2004, for use in conjunction with the new Ipswich Planning Scheme.

F. That the Chief Executive Officer be delegated the power to determine development applications in the manner outlined in Attachment C to the Planning Manager's report of 19 February 2004.

G. That Council adopt the Users Guides and Assessment Checklists contained in Attachment D to the Planning Manager's report of 19 February 2004 for use in conjunction with the new planning scheme.


Attachment A


Attachment B


Attachment C


Attachment D

John Adams
PLANNING MANAGER

I concur with the recommendations contained in this report.

Gary White
PLANNING AND DEVELOPMENT MANAGER

Attachments:

Attachment A – Minister's Letter of Final Approval
Attachment B – Proposed Implementation Guidelines
Attachment C – Proposed Changes to Delegated Authority to Improve Processing Efficiency for Minor Development Applications
Attachment D – Proposed User's Guides and Assessment Checklists

From: [redacted]
To:
Date: 25/02/2004 6:01:22 pm
Subject: IPSWICH RIVERS FLOOD STUDIES - FURTHER INVESTIGATIONS

[redacted]

with reference to your email and draft report of 29 January 2004 please find enclosed a draft discussion paper prepared by [redacted] and myself regarding certain issues.

I understand that [redacted] has already raised most of these issues with you in a recent telephone conversation.

Could you have a look at our comments and consider please.

At a recent meeting between [redacted] and [redacted] it was suggested that [redacted] and [redacted] meet with [redacted] yourself and I to discuss the draft report. Is it possible to organise that meeting in the near future please.

Thanks [redacted]
Deputy Works Manager
[redacted]
phone [redacted]

>>> [redacted] 29/01/2004 4:45:05 pm >>>

-------- Original Message --------
Subject: REPORT
Date: Thu, 29 Jan 2004 11:46:42 +1000
From: [redacted]
Reply-
To: [redacted]

[redacted]

Attached is a draft of the report for the revision of the Ipswich Rivers Flood Studies. Please review and make comments.

Essentially, I have discussed the issue of flood level reduction with Rory Nathan at length and they feel there is enough uncertainty to warrant not revising the estimates in the 2000 study.

I am happy to discuss the outcomes. I am sorry about how long this has taken but there have been circumstances outside my control.

Regards
[redacted]

CC: [redacted]

Discussion on Report Titled 'Ipswich Rivers Flood Studies – Further Investigations' by SKM dated 9/12/2003 (received by email on 29/1/2004)

1. As regards the section headed Methodology on Page 2 of SKM's above letter report, see [redacted] email of 28/11/03, 4th dot point.

   Information of FFA on Bremer River upstream of the Bremer-Warrill Confluence and information on 1:50 AEP on either site has not been provided.

   The Deputy Works Manager (DWM) and Specialist Design Engineer (SDE) believe that more useful results would have been obtained if FFA analysis was carried out upstream of the Bremer-Warrill Confluence and at the Moggill Gauge as per IRFS (2000). The Moggill Gauge provides a good indication on whether backwater levels will affect Ipswich and the results of the FFA upstream of Bremer-Warrill Confluence will provide a good indication of likely flows impacting on the Bremer River.

   Further on Page 84 of IRFS, SKM (2000) accuracy of performing FFA at David Trumpy Bridge site was discussed and it was stated in Paras 2 and 3 as:

   "This site is also affected by backwater from the Brisbane River. No discharge data was obtained, but the discharge rating for this site would be unreliable because of the significant backwater influence. Frequency analysis for this site was therefore performed on river stage, not discharge."

   "The flood frequency analysis for the David Trumpy Bridge site was conducted over a period ranging from 1893 to 1999. Within this period both Somerset Dam and Wivenhoe Dam were constructed and since the David Trumpy gauge is effected by backwater levels at this site will be effected by the construction of these dam structures. Unfortunately there is no direct correlation between Brisbane River flooding and Bremer River flooding and hence no adjustment can be made to modify the David Trumpy record to account for the introduction of the dams. This site can therefore only be used as an indicative check when analysing loss rates within the RAFTS hydrological model."

2. On Page 3, Table 2 of the SKM's letter report dated 9/12/03,

   The SDE believes that the incorrect figures have been reported. The 1in 50 AEP flood peak should read 2822m^3/s not 2693m^3/s and the factor should read 15.17 not 14.48. The 1 in 100 AEP flood peak should read 16.34 not 16.87. If both flow figures come from Bremer River only case there is inconsistency between them. These need to be confirmed and corrected.

   Changing the above factors changes the flows calculated in the two dot points on the top of Page 7. The 1 in 50 AEP changes from 2190m^3/s to 2291m^3/s. The 1 in 100 AEP changes from 2870 to 2780.

   It is noted that the new 1 in 100 AEP flow is less than 2822m^3/s which is the 1 in 50 AEP flood peak that should be listed in Table 2.

3. On Page 4 in the section headed "Regional Analysis of Flood Peak Based on Catchment Area"

   In second dot point it is noted that the 1 in 100 AEP peak flow is estimated to be 2700m^3/s. This is less than the IRFS, SKM (2000), 1 in 50 AEP flow of 2822m^3/s.

4. On Page 5 in the section headed "Peak level investigations"

   The DWM and SDE believe that it is not reasonable to use the Ipswich Alert gauge data to analyse the likely performance of the Bremer River as the levels at this location are significantly affected by the backwater levels from the Brisbane River and without any adjustment for the post dams flows. It is supported in Note 1 above.

   Further it is noted that this report does not address significant parts of Ipswich located on the Brisbane River (Karalee to Goodna) which are not directly affected by the Bremer River flooding. One would have to expect that the findings of the BCC's Independent Review Panel would be valid in these reaches of the Brisbane River. Please confirm.

5. As regards the discussion on the bottom of Page 5 regarding the estimation of the 1 in 100 AEP flood level, SKM 2000 report

   The following table gives the extract of the results from the SKM, (2000) at David Trumpy Bridge and Moggill Gauge.

Return Period	***Flow (m^3/s)***	***Peak Level at David Trumpy Bridge***	***Peal Level at Moggill Gauge***
1 in 500 AEP	*4903*	*20.76*	*20.59*
1 in 200 AEP	*3965*	*19.62*	*19.37*
1 in 100 AEP	*3431*	*18.47*	*18.25*
1 in 50 AEP	*2822*	*16.87*	*16.18*
1 in 20 AEP	*2115*	*14.92*	*13.49*
1 in 10 AEP	*1428*	*12.31*	*7.08*
1 in 5 AEP	*953*	*9.84*	*4.11*
1 in 2 AEP	*459*	*6.45*	*2.03*

   *This information does not support the figure of **5540m^3/s** at a height of **18.91m** at the David Trumpy Bridge as stated in the Table 3 on Page 8. Further Rating Curves produced by the BOM for internal use appears to indicate that this flow estimate is too high.*

   This above table highlights the impact that the Brisbane River backwater has on the level at the David Trumpy Bridge at higher return periods. It appears to have significantly more influence than the flows generated in the Bremer River upstream of this site.

6. On Page 7 in the section headed "Conclusions" in the second paragraph last sentence.

   The words "the new 1 in 100 AEP estimate may lie slightly above the original 1 in 50 AEP estimate" should be changed to "the new 1 in 100 AEP estimate is slightly below the original 1 in 50 AEP flood estimate".

In the third paragraph last sentence the figure "2693m^3/s" should be changed to "2822m^3/s".

As discussed in Note 2 above, certain figures in Table 3 should be changed.

- *Original 1 in 50 AEP peak from 2693m^3/s to 2822m^3/s and*
- *Original 1 in 100 AEP peak from 3543m^3/s to 3431 m^3/s*

As discussed in Note 5 above, the "Inferred from flood frequency analysis of 1 in 100 AEP peak flow" figure of 5540m^3/s appears to be too high and not consistent with SKM, (2000), the BCC's Independent Panel Review report or the Bureau of Meteorology's rating information.

7.

A) In the section headed "Recommendation", we are not happy with the first recommendation as it does not appear consistent with the BCC's Independent Review Panel's Report and other advice referred to in the notes above.

B) It is noted that this report does not address significant parts of Ipswich located on the Brisbane River (Karalee to Goodna) which are not directly affected by the Bremer River flooding. One would have to expect that the findings of the BCC's Independent Review Panel would be valid in these reaches of the Brisbane River. Please confirm.

C) It is agreed however that further investigation is warranted

D) We would like to meet and discuss this with you before you finalise your submission.

From: [redacted]
To: [redacted]
Date: 22/03/2004 2:24:33 pm
Subject: Sinclair Knight Merz - Letter

Hi [redacted]

Attcahed is the revised letter report as per your comments and the meeting. The only thing that han't been addressed specifically in the report is the flood level FFA. If you want us to get into this it will be very complicated and will involve aspects of joint probability and Monte Carlo. This is outside the brief and I think it is suffice to say that the flood level FFA is relevent. We discussed this at the meeting however if you would like to discuss it further I will organise for Rory Nathan or [redacted] to call you and discuss.

[redacted] is not around to review so He will need to review the document before we can finalise.

If you need to discuss, please call me

regards

[redacted]

Sinclair Knight Merz
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PO Box 246
Spring Hill QLD 4004 Australia

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Fax: +61 7 3244 7306
Web: www.skmconsulting.com

[redacted]
Ipswich City Council
Deputy Works Manager
PO Box 191
Ipswich QLD 4305

9/12/2003

1_final report_rev0
QE09168

Dear [redacted]

IPSWICH RIVERS FLOOD STUDIES - FURTHER INVESTIGATIONS

Sinclair Knight Merz were commissioned to undertake further investigations of the 1 in 100 AEP flood for the Brisbane and Bremer Rivers within the local government boundary of Ipswich City.

The need for further investigations were triggered by the following:

- *Derivation of CRC Rainfall estimates and Areal Reduction Factors (ARFs)* – rainfall depth estimates and ARFs have recently been revised by the DNRM. While the rainfall depth estimates are similar to those used in the Ipswich Rivers Flood Studies (IRFS), the introduction of ARFs reduce rainfall depths by approximately 20%. The current ARFs were not available when the original Ipswich Rivers Flood Studies were undertaken (SKM 2000)
- *Supply of Wivenhoe and Somerset Dam Operations Model* – the Wivenhoe and Somerset Dams Operations Model was not available for the original Ipswich Rivers Flood Studies (SKM 2000). Therefore, a simplified inflow/release procedure was adopted. This was based on emergency release procedures and basically assumed that all floodgates were opened and free overflow from the dams could occur. The Wivenhoe and Somerset Dam Operations Model looks at inflows upstream and downstream of the dams, and adjusts dam releases accordingly thus providing a more conservative estimate of actual dam releases than was previously modelled.
- *Review of the Brisbane River Flood Study* – a recent review of the Brisbane River Flood Study investigated the impacts of the CRC Forge Rainfalls, ARFs and the Dam operations and found that flows in the Brisbane River could be reduced by approximately 25%.

Given that flooding of the Brisbane River has significant affect on flooding in Ipswich (particularly in the lower reaches of the adjoining tributaries), Ipswich City Council Officers contacted Sinclair Knight Merz and requested a that a review be undertaken to determine

SKM

whether flood flows and levels could be reduced. The methodology outlined in the subsequent section was proposed to determine if a simple adjustment was possible for assigning the 1 in 100 AEP flood level in a 'cost effective' manner. This method was proposed to determine whether it is plausible to reduce the current 1 in 100 AEP flood levels in Ipswich pending a more detailed investigation.

1.1 Methodology

The following methodology was adopted in order to determine whether interim estimates could be provided:

- Review of Rainfall & Flow Estimates
  - Determine the average rainfall depths for 1 in 100 and 1 in 50 AEP events for both the Bremer and Brisbane Catchments, and compare to earlier estimates;
  - Use the ratio of the catchment rainfalls to flood discharge peaks derived from the original study to derive *approximate* flood discharge peaks corresponding to the new rainfall depths.
- Statistical Flood Frequency Analysis
  - Derive an independent estimate of the 1:50 AEP and 1:100 AEP *flood peaks* using regional information derived for the recent study of Brisbane River;
  - Derive an independent estimate of the 1:50 AEP and 1:100 AEP *flood levels* from a statistical analysis of historic maxima.
- Assess differences between the three sets of estimates and provide comment on the likely direction of change in flood estimates.

1.2 Assumptions

- All flow estimates presented in this report are located at the David Trumpy Bridge in Ipswich.

1.3 Brisbane River

Brisbane River Flood Levels have been revised based on work undertaken in recent reports. These reports are as follows:

- Brisbane River Flood Study (IRP 2003)

SKM

- Recalibration of the MIKE11 Hydraulic Model and Determination of the 1 in 100 AEP Flood Levels (SKM 2004).

For revised flood levels in the Brisbane River, these reports should be referenced.

It should be noted that the re-calibration of the MIKE11 Hydraulic Model and Determination of the 1 in 100 AEP Flood Levels Report (SKM 2004) is based on the 'best estimate' flows reported in the Brisbane River Flood Study (IRP 2003). Brisbane City Council have accepted the Independent Review Panel Report and have adopted the 'best estimate' flow at the Brisbane Port Office of 6000 m^3/s. The expert panel have indicated that the 1 in 100 AEP event at the Brisbane Port Office may be higher or lower than this estimate and they recommend that a Monte-Carlo Analysis be undertaken to provide more confidence in their best estimate.

1.4 Bremer River and Brisbane River Minor Tributaries

The Bremer River and Brisbane River Minor Tributaries that are located within the Ipswich area were reviewed. Most importance was placed on the Bremer River however generally the following comments are considered appropriate.

- Brisbane River Flooding will be the dominant flooding mechanism in the lower reaches of the Brisbane River Tributaries.
- The affect that Areal Reduction Factors have on reducing rainfalls will be dependent on the size of the catchment area. The smaller the catchment area, the less the affect areal reduction factors have on rainfall depths.
- Local rainfalls will be dominant in upper reaches of the Brisbane River Tributaries.

To determine the effects that the areal reduction factors have had on all tributaries, a detailed hydrological investigation is required. This investigation would involve determining critical duartion flood events for each catchment using adjusted rainfalls (ARF's applied), and re-running these flows through the hydraulic model.

1.4.1 Review of Rainfall and Flow Estimates

Rainfall depths derived for the Ipswich Rivers Flood Studies (SKM 2000) were derived using Australian Rainfall and Runoff (1987) technique. Since this time the Department of Natural

SKM

Resources and Mines have derived new point rainfalls based on the CRC Forge technique, and also new Areal Reduction Factors (ARF). Estimates of *catchment rainfalls* – that is the product of point rainfall depths and the ARF – based on the new information are now *lower* than were used in the original study.

A comparison of the 1 in 50 AEP and 1 in 100 AEP catchment rainfalls for the Brisbane River and Bremer catchments is provided in **Table 1** for storms of various durations. It is seen that the new catchment rainfalls for the Bremer catchment are around 20% lower than used in the original study.

- **Table 1 Comparison of Average Rainfall Depths**

Duration	1 in 50 AEP Catchment Rainfalls			1 in 100 AEP Catchment Rainfalls		
	Original Depth (mm)	New Depth (mm)	Ratio of New:Old	Original Depth (mm)	New Depth (mm)	Ratio of New:Old
Brisbane						
24	225	171	0.76	256	188	0.73
30*	**239**	**186**	**0.78**	**271**	**209**	**0.77**
36	258	206	0.80	293	228	0.80
Bremer						
12	162	125	0.77	182	140	0.77
18*	**186**	**151**	**0.81**	**210**	**170**	**0.81**
24	213	179	0.84	241	202	0.84

Notes: *bold values indicate the critical duration event.

Note that the minor tributaries have not been investigated however the reduction in rainfall depth would be smaller based on these tributaries having smaller catchment areas.

1.4.2 Bremer River Rainfall to Peak Flow Factors

An approximate indication of the impact of the reduced rainfalls on flood peaks can be obtained from inspection of the factors relating rainfall depth to flood peak. Values of rainfall depth and flood peak obtained from the original study are provided in **Table 2**, along with their corresponding factors. These factors reflect the product of catchment area and runoff coefficient, in a similar fashion to that computed for the probabilistic rational method.

SKM

- **Table 2 Evaluation of Rainfall to Peak Flow Conversion Factors for the critical duration event**

Event	Rainfall depth (mm)	Flood peak (m^3/s)	Factor
1 in 50 AEP	186	2822	15.17
1 in 100 AEP	210	3431	16.33

It is seen that there is some variation in the derived factors, which result from the non-linearities of the flood-producing factors. While it would be expected that the factors would be dependent on rainfall depths, there is too little information with which to reliably estimate (or extrapolate) the results. Thus, for this exercise a conservative approach is adopted in which the factors are linked to the AEP of the event being considered.

Thus, approximate estimates of revised 1:50 AEP and 1:100 AEP flood peaks at the David Trumpy Bridge are as follows:

- 1 in 50 AEP peak = 151*15.17 = 2291 ≈ 2290 m^3/s
- 1 in 100 AEP peak = 170*16.33 = 2776 ≈ 2780 m^3/s

A comparison between the factored flows and the flows determined in the Ipswich Rivers Flood Studies (SKM 2000) are presented in **Table 3**.

- **Table 3 Comparison between Factored Flows and Ipswich Rivers Flood Studies Flows**

Event	Factored Flow (m^3/s)	Ipswich Rivers Flood Studies Flow (m^3/s)	Difference (%)
1 in 50 AEP	2290	2822	-19%
1 in 100 AEP	2780	3431	-19%

From a simple review of the rainfall and flow estimates, there is some evidence that the flow estimates could be lower than previously predicted. Given the approximate nature of the above analysis, further investigations were undertaken.

SKM

1.5 Statistical Flood Frequency Analysis

Given the approximate nature of the foregoing analysis is worthwhile comparing these values with independent estimates derived from other analyses. Two sets of independent estimates can be derived. First, a direct estimate of flood peaks can be obtained from a regional analysis of catchment area and flood peaks, and secondly an estimate can be inferred from a frequency analysis of flood levels of historic maxima. These two approaches are discussed in the following sections.

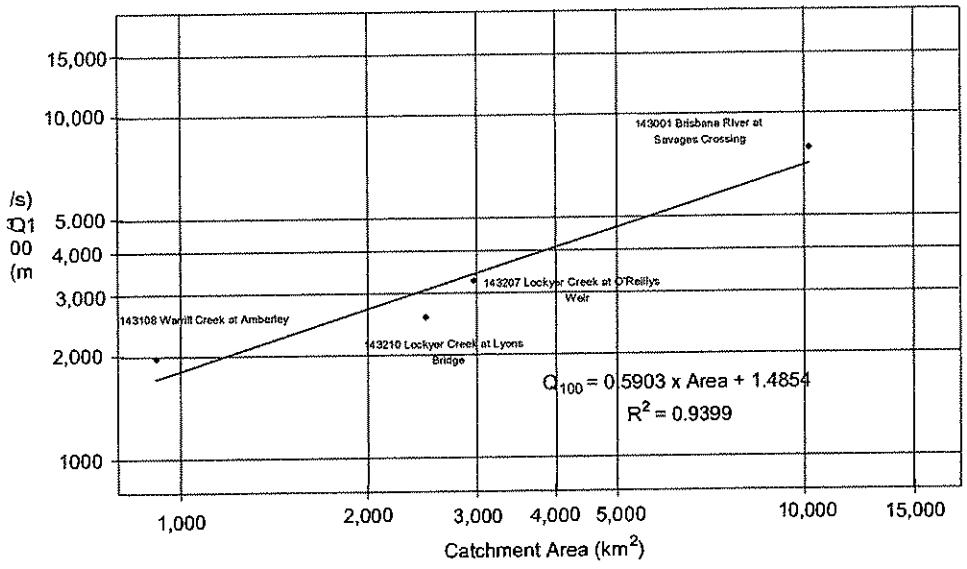
1.5.1 Regional Analysis of Flood Peak Based on Catchment Area

From the regional estimation work undertaken on the Brisbane River done for the Expert Panel review of the Brisbane River flood studies (SKM, 2003) SKM estimates:

- the 1 in 50 AEP peak flow at Ipswich to be 2080 m^3/s and
- the 1 in 100 AEP peak flow to be 2700 m^3/s.

Refer to

Figure 1 and **Figure 2** below for the plot of the regional analysis results for the 1 in 100 AEP



event.

SKM

Figure 1 Derived relationship between catchment area and 1:100 year peak flows for the Brisbane River Catchment (SKM 2003 assessments for Expert Panel review of the Brisbane River Flood Study).

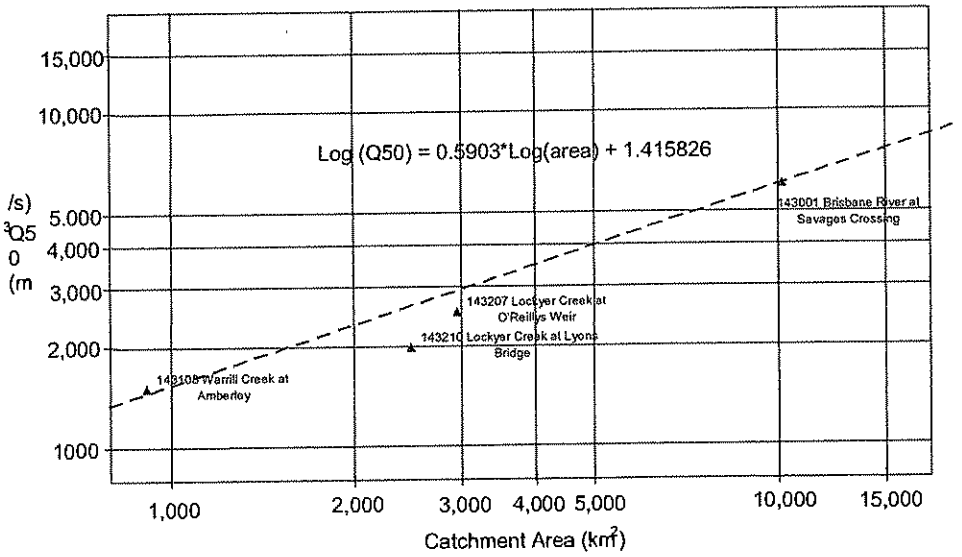


Figure 2 Derived relationship between catchment area and 1:50 year peak flows for the Brisbane River Catchment (SKM 2003 assessments for Expert Panel review of the Brisbane River Flood Study).

A comparison between the Regional Flood Frequency Estimates and the flows determined in the Ipswich Rivers Flood Studies (SKM 2000) are presented in **Table 4**.

Table 4 Comparison between Regional Flood Frequency Estimate Flows and Ipswich Rivers Flood Studies Flows

Event	Regional Flood Frequency Flows (m^3/s)	Ipswich Rivers Flood Studies Flow (m^3/s)	Difference (%)
1 in 50 AEP	2080	2822	-26%
1 in 100 AEP	2700	3431	-21%

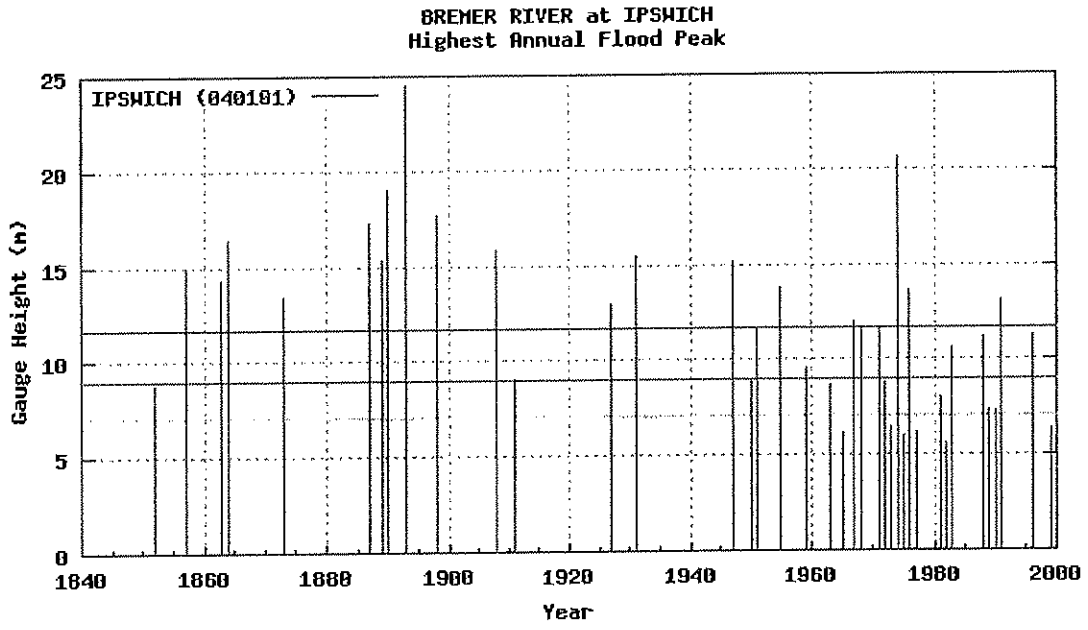
Table 4 shows that the Regional Flood Frequency Estimates at the David Trumpy Bridge are lower than those predicted in the Ipswich Rivers Flood Studies. The Regional Flood

Frequency Flow Estimates are consistent with the factored flow estimates presented in **Table 3.**

As a final check, a statistical flood frequency analysis was undertaken for peak flood level records at the David Trumpy Bridge.

1.5.2 Peak level investigations

To assist in determining whether the conversion from flow to level can be considered to be probability-neutral, a partial series analysis of the peaks at Ipswich Alert (040101) was undertaken. The Bureau's plot of the major events is shown in **Figure 3.** It indicates the typical nature of the data (the actual data has more peaks below 10 m and there is one event in 1850s on the plot that is not in the peak data obtained from the Bureau of Meteorology).



- **Figure 3 Peak flood heights at Ipswich (040101) (Source: Bureau of Meteorology, 2003).**

The data was treated as a partial series and was analysed using a peaks over a threshold (POT) method. The Generalised Pareto distribution was fitted and used to estimate a distribution of peak flood heights for peaks over a threshold of 10 metres or 12 metres for various periods as outlined below:

- If all data greater than 10m from 1840 is included the 1 in 100 AEP flood level is 20.86 m;
- If peaks greater than 12m from 1840-2000 are included the 1 in 100 AEP flood level is 20.67 m; and,

SKM

- If peaks greater than 10m from 1945 –2000 are included the 1 in 100 AEP flood level is 18.91 m.

These compare with the SKM (2000) flood frequency value for the 1 in 100 estimate of 18.60 m.

A comparison for the 1 in 100 AEP flood event at the David Trumpy Bridge is presented in **Table 5.**

- **Table 5 Flood Level Comparison for the 1 in 100 AEP Flood Event at David Trumpy Bridge**

Level/Difference	Flood Frequency Estimate (SKM 2000)	New Flood Frequency Estimate	RAFTS
Flood Level (m AHD)	18.60	18.91*	18.47

Note: * denotes post 1945 data series

It is difficult to determine corresponding flood flows for the levels presented in Table 5 as the flood frequency results represent a combination of flooding mechanisms for the Brisbane and Bremer Rivers. What should however be noted is that there is a flood level increase that conflicts with the results from the regional flood frequency analysis and the flow factor methods presented in this report.

The results post 1945 are the most relevant, and they do not provide clear support for adoption of a lower flood level for the 1 in 100 AEP event. There are a number of reasons why this information may differ from the regional flood frequency analysis and the assessment of the rainfall and flow ratios reported above. In summary they include:

- there is reasonable evidence to suggest that the frequency of recording may be less prior to 1940;
- there are reports of a change from 1945 to a wetter sequence than the previous half century or so; and,
- there is also the effect of Wivenhoe and Somerset dams which would reduce the likelihood of high Brisbane River flows and the associated backwater effects at Ipswich.

The partial series analysis indicated the 1 in 100 AEP quantile from the local level data is 0.5 m above the previous estimate (SKM 2000) of the 1 in 100 AEP level. This may well be an overestimate of what would occur now given the construction of Wivenhoe and how it is operated, though the effect of the gate operation rules should be assessed to quantify the joint probability of flood flows at Ipswich and levels in the Brisbane River.

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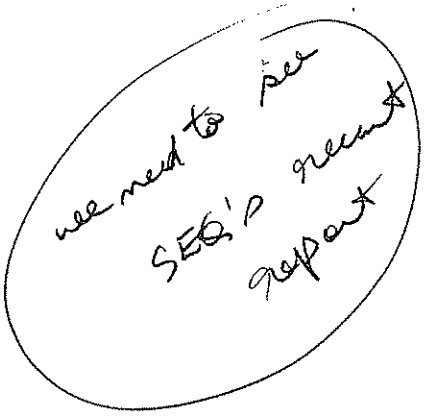
The flood level frequency analyses indicate a 1 in 100 AEP level higher than that indicated from the rainfall based assessments undertaken above. However the large flood events are all prior to Wivenhoe Dam being constructed (1985) and so would be expected to overestimate the flood level at Ipswich post construction of Wivenhoe Dam.

The effect of Brisbane River flow levels can be significant at Ipswich. The coincident flows for the two scenarios of: (i) the Bremer River given a flood on the Brisbane River, and (ii) the flows in the Brisbane River given a flood on the Bremer River is significant and cannot be readily determined from the information available. The reasons for this are firstly, the period of record since Wivenhoe Dam was constructed is short, and secondly, the dam operation rules are dynamic and involve the flows at various upstream and downstream locations. The coincident flow challenge can be solved usimg a joint probability approach and using rainfall-runoff modelling to integrate the flow sequencing.



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1.6 Conclusions

A review of the Ipswich Rivers Flood Studies was undertaken of the peak 1 in 100 AEP flow and flood level estimates in the Brisbane and Bremer Rivers within the boundaries of Ipswich City. This review was prompted by new information being made available. The new information consists of:

- CRC Forge rainfall estimates and Areal Reduction factors;
- Access to the Wivenhoe and Somerset Dam Operations Model; and,
- Revision of the Brisbane River Flood Study.

Following recent additional studies on the Brisbane River, there are two pieces of information that indicate there may be a reduction in the peak water level at Ipswich. The first indicator is the change in the design rainfall depths. The application of CRC FORGE areal reduction factors (ARF) has resulted in the design rainfall depths being reduced by about 20%. Analysis of rainfall to peak flows (Table 2) suggests the new 1 in 100 AEP estimate may lie slightly below the original 1 in 50 AEP flood estimate (IRFS 2000).

The second indication that flow levels should decrease is from the regional flood frequency analysis undertaken for the whole of the Brisbane River catchment, though this is based on the assumption that the flood response in the Bremer catchment is similar to the catchments used in the regional analysis. The regional analysis undertaken for the Brisbane River catchment indicates that the 1 in 100 AEP flow rate for a catchment the size of that upstream of Ipswich Central is about 2700 m^3/s. This is very similar to the 1 in 50 AEP magnitude of 2822 m^3/s from the Ipswich River Flood Study (SKM 2000).

The above evidence leads to the expectation that the peak flow rate and associated level should decrease. However, it does not take into account the effect of:

- The tailwater level in the Brisbane River associated with a local 1in 100 AEP event on the Bremer River catchment.
- The local flow contribution to a flood level caused primarily by a 1 in 100 AEP event on the larger Brisbane River catchment which causes high backwater up the Bremer River.

The results of the third estimate based on a frequency analysis of flood levels suggests that the 1 in 100 AEP flood level may be higher than the original estimate; thus while local design rainfalls may have reduced, other factors may be impacting on the final flood levels at the site.

Table 6 summarises the flow results for each of the methods used in this report. **Table 7** summarises the flood level results for flood level flood frequency analysis used in this report.

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- **Table 6 Summary of Flow Estimates**

Method	1 in 50 AEP event		1 in 100 AEP Event	
	Peak (m^3/s)	Ratio to original estimate	Peak (m^3/s)	Ratio to original estimate
Original	2693	1.00	3543	1.00
Factored rainfalls	2190	0.81	2870	0.81
Regional Flood Frequency estimate based on catchment area	2080	0.77	2700	0.76

Table 7 Summary of 1 in 100 AEP Flood Level Estimates at David Trumpy Bridge

Flood Frequency Estimate (SKM 2000)	New Flood Frequency Estimate (1840-2000, >10m) (m AHD)	New Flood Frequency Estimate (1840-2000, >12m) (m AHD)	New Flood Frequency Estimate (1945-2000, >10M) (m AHD)
18.6	20.86	20.67	18.91

Given the uncertainties in the foregoing analyses and the spread of the results, it is considered that there is insufficient information with which to confidently revise the original flood estimates. While the design rainfalls have decreased by around 20%, it is possible that other factors are influencing flood levels and these should be investigated prior to deriving new design flood estimates.

Recommendations

Based on the foregoing we recommend that:

- further investigation be undertaken to reconcile the differences between the rainfall-based and flood frequency estimates, particularly with respect to the joint occurrence of flood-producing factors. Such work could be done in conjunction with Brisbane City Council as many of the issues requiring consideration are common to both parties.

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- The hydrology for all tributaries should be revised using CRC Forge methods and Areal Reduction factors. New rainfall should then be re-run in the calibrated RAFTS model.
- A Monte-Carlo analysis should be performed to determine joint probability affects resulting from starting dam water levels, dam operations, concurrent flooding and tailwater affects.
- The hydraulic model should then be re-run using the appropriate events from the Monte-Carlo work and flood levels be determined

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I trust you find this report satisfactory however should you have further queries, please contact the undersigned at this office.

Yours sincerely

[redacted]

Principal

RPEQ

Ipswich City Council

Natural Disaster Mitigation Programme (NDMP)

Ipswich Flood Study Rationalisation Project Proposed Scope of Work

1. Introduction

Ipswich City Council (ICC) jointly with the Ipswich Rivers Improvement Trust (IRIT) is in receipt of funding to undertake the Ipswich Flood Study Rationalisation Project.

More recently, a joint funding application has been submitted by Brisbane City Council (BCC) and other stakeholders including ICC in respect of another study of flooding in the lower Brisbane River.

There are some areas of overlap between these studies.

The purpose of this paper is to cross reference the proposed project content and methodology of the two projects to ensure their compatibility, and to propose refinement of the Scope of Work of the ICC/IRIT project to enable it to proceed initially ahead of, and subsequently in parallel with, the BCC project.

2. Background

Detailed flood studies have been undertaken for the Brisbane and Bremer River catchments such that flood extent mapping for a range of flood frequencies are available.

However, since detailed flood studies for the urban areas of Ipswich were completed in 2000 (Sinclair Knight Merz) and for the rural areas in 2002 (Halliburton KBR), there have been a number of developments relating to flood studies in the Brisbane River which have resulted in the current flood studies and the corresponding flood extent maps no longer being compatible with those for Brisbane City.

These include:

- Updating of flood hydrology for Wivenhoe Dam operations and the construction of *fuse plug* spillways;
- Availability of new rainfall design data (CRC-FORGE) and a new estimate of probable maximum flood (PMF);

- Revised flood modelling for Brisbane City Council; and
- Review of the latter by an Independent Review Panel (Mein et al 2003) which has led to the 100 year design flood flow being reduced from 8,000 m^3/s to 6000 m^3/s.

In addition, in response to apparent anomalies with predicted 20 year ARI flood levels in particular, Council commissioned Sargent Consulting in 2002 to review the current flood models (Sargent Consulting 2003). This review concluded that the current hydraulic model calibration is skewed towards the replication of major floods with the result that water levels for smaller floods are overestimated, and that the hydrologic model was conservative in respect of design flows.

Also, in the period since the flood study results became available, a number of inconsistencies have been noted which require rectification.

As a consequence of the recent changes to the lower Brisbane Flood Studies, the current studies for the two local government areas are no longer compatible, and the current model is known to have some inconsistencies.

Ipswich City Council successfully applied for funding under the *Natural Disaster Risk Management Studies Programme* (now a component of the *Natural Disaster Mitigation Programme*) for a study to rationalise these flood studies to resolve these anomalies and inconsistencies. This study runs from July 2004 to June 2005.

The funding application gave the following expected key outcomes for the study:

- Refined hydrologic model and design flood discharge hydrographs compatible with the latest rainfall and hydrologic modelling undertaken for Wivenhoe Dam operations and for Brisbane City Council;
- Refined hydraulic modelling based on the refined hydrology, and recalibration using the latest version of MIKE 11 (or a 2-dimensional model such as MIKE 21) to take account of recent improvements in hydraulic roughness representation;
- Consistency of flood estimation and flood mapping across joint boundaries with neighbouring Councils;
- Updated flood mapping for a range of flood frequencies and for PMF;
- Update of flood overlay in the Ipswich Planning Scheme; and
- Preparation of a Flood Study Report.

3. Brisbane Valley Flood Damage Minimisation Study

A funding application under the *Natural Disaster Mitigation Programme* has been submitted in the current round (2004-5) jointly by Brisbane City Council and other stakeholders including Ipswich City Council. The objectives and outcomes of this project as stated in the draft funding application are:

The outputs and outcomes of this project will include:

- *A refined knowledge of the flood/damage relationship in the Brisbane River catchment for improved planning before, during and after a flood event;*
- *A common methodology for collation of data and damage assessment across the Brisbane River catchment;*
- *An updated and regionally consistent series of flood damage models and a consolidated regional flood damage model for the Brisbane River catchment area;*
- *A refined Bureau of Meteorology forecasting model for the Brisbane River catchment area and a better understanding of the modelling process by all flood operation centres;*
- *Potential for a revised set of operating rules with defined downstream consequences from various flood releases, and a greater appreciation of the flood mitigation from the Dams;*
- *Less drain on disaster assistance funds for a given flood event;*
- *A refined warning system leading to a better informed (and hence resilient) community; and*
- *A group of stakeholders with common perceptions and pre-agreed actions in relation to flood mitigation.*

There will always be some negative impacts when managing mitigation from a flood event (e.g. submersion of cross river bridges), but as a result of a better understanding of a regional flood damage model and carefully managing these impacts, the total flood damage downstream can be minimised. This is the main objective of the project.

4. Benefits of Undertaking the IFSR Project

The objectives of both of these projects are consistent and seek to promote:

- Consistency in flood data and modelling across the relevant local authorities and other relevant agencies so that there are no inconsistencies across local authority boundaries;

- Improved and shared understanding of flood behaviour, flood inundation and flood damages including the flood mitigation role of Wivenhoe Dam;
- A refined flood warning system; and
- Reduction in flood damages across the catchment.

The *Ipswich Flood Study Rationalisation* (IFSR) project has been approved for funding in full for 2004-5 whereas the *Brisbane Valley Flood Damage Minimisation Study* has been submitted for funding for 2004-5 with the outcome of this application unlikely to be known until November 2004, or later, and the modelling components are not timetabled to commence until May 2005.

The IFSR project thereby provides an opportunity to bring forward some aspects of the modelling and to resolve a number of the present inconsistencies and anomalies in the current Ipswich and Brisbane flood models.

In respect of Ipswich (ICC and IRIT) the current situation has resulted in the following problems:

1. As noted in Sargent Consulting (2003) and confirmed by the recent Brisbane City Council hydrologic modelling, the design flow hydrographs produced from the RAFTS model used in the recent Ipswich Flood Studies (SKM 2000 and Halliburton KBR 2002) are conservative, resulting in the estimated flood levels derived from them also being conservative. This affects not only the Ipswich reach of the Brisbane River but the whole of the Bremer River catchment;

2. Sargent Consulting (2003) identified that the calibration of the current MIKE 11 model is skewed towards replicating larger floods, and is conservative in respect of smaller floods (eg <=20 year ARI);

3. ICC's flood planning levels are based on an estimated 100 year ARI flow of 6,900m^3/s for the lower Brisbane River (the 50 year ARI from SKM 2000) whereas BCC's are now based on 6,000m^3/s on the basis of advice given by the Independent Review Panel (2004);

4. Due to the above there is an inconsistency in design flood levels on the Brisbane River across the BCC/ICC boundary at Gailes. **For example, at Moggill Gauge, the Q_{100} flood level was estimated to be 18.34 m AHD and 14.36m AHD in the 2000 and 2004 modelling respectively, a difference of 4.0m.**

In addition, the following new information needs to be taken into account:

- Availability of new rainfall design data (CRC-FORGE) and a new estimate of probable maximum flood (PMF); and
- The construction of the fuse plug spillways Wivenhoe Dam.

Resolution of these matters is urgently required by ICC so that:

- The flood overlay in the Ipswich Planning Scheme can be confirmed or updated; and
- The current development of emergency response flood mapping is not compromised.

In order to make the best use of the confirmed resources for the IFSR project without duplicating any of the anticipated scope of the BVFMS, it is proposed to make some modifications to the scope of work and methodology of the former as set out in the following paragraphs.

5. Proposed Refined Study Scope

The study methodology as enunciated in the funding application is given in **Attachment 1** for ease of reference.

The proposed refined study scope comprises:

a) Hydrology

- The Independent Review Panel (Mein et al 2003) were of the view that the direct flood frequency analysis provided the best available flood flow estimates and that the RAFTS model estimates were around 20% low. This component comprises the further refinement of the RAFTS model recommended by the Independent review panel in order to resolve this inconsistency;
- Identification of uncertainties in model parameters and other relevant variables from the RAFTS modelling undertaken by SKM (2003);
- Stochastic modelling (Monte Carlo simulation) as recommended to account for probability distributions of hydrologic model assumptions and combinations of spatial and temporal rainfall distributions to better define design flow hydrographs and to quantify the uncertainty therein;
- Further comparison of hydrologic model design flows with those from direct flood frequency analysis, including frequency analysis of flood volumes;

- Preparation of design hydrographs for input to hydraulic model; and
- Deliverables: Hydrologic Modelling Report and electronic copies of model result files.

b) Hydraulic Model

- Updating the Ipswich Rivers MIKE 11 model (including the Brisbane reach of the Brisbane River) to the latest version – note MIKE 11 will be retained as it will ultimately be used by ICC to refine flood forecasts;
- Updating and extension of some cross sections and modifications to hydraulic roughness in the Bremer River section of the model;
- Recalibrate the MIKE 11 model taking advantage of the ability to now model hydraulic resistance using a triple zone approach, and/or using a functional relationship between resistance and velocity, depth, or (velocity x hydraulic radius) thereby giving equal weighting to medium and large floods;
- Design runs of the hydraulic model will be undertaken as a shared component between the IFSR and BVFMS studies providing the latter goes ahead. In the event that the BVFMS study does not proceed, the design runs of the hydraulic model will be undertaken using stochastic modelling of Wivenhoe Dam releases and of tide levels at the river mouth; and
- Stochastic modelling (Monte Carlo Simulation) to account for probability distributions of hydraulic model parameters and assumptions and of design flow hydrographs (provided by others) and to quantify the uncertainty in model results resulting there from;
- Preparation of flood extent mapping (Ipswich only);
- Hydraulic Modelling Report.

c) Flood Mapping

- Preparation of new flood mapping for Ipswich based on the above;
- Updating of the Flood Overlay map in the Ipswich Planning Scheme; and
- Flood Mapping Report.

6. References

FISHER STEWART QUEENSLAND PTY LTD (2002) *Ipswich Natural Disaster Risk Management Report* prepared for Ipswich City Council

HALLIBURTON KBR PTY LTD (2002) *Local Storm Flood Mapping Final Report* prepared for Ipswich City Council

MEIN R., Apelt C., Macintosh J., Weinmann E. (2003) *Review of Brisbane River Flood Study Independent Review Panel* prepared for Brisbane City Council

SARGENT CONSULTING (2003) *Brief Review of Flood Frequency Analysis and Discharge Rating Curve for Brisbane River at Moggill Gauge* prepared for Ipswich City Council

SINCLAIR KNIGHT MERZ PTY LTD (2000) *Ipswich Rivers Flood Studies – Phase One and Phase 2 Final Report* prepared for Ipswich Rivers Improvement Trust in association with Ipswich City Council

SINCLAIR KNIGHT MERZ PTY LTD (2004) *Recalibration of the MIKE 11 Hydraulic Model and Determination of the 1 in 100 AEP Flood Levels* prepared for Brisbane City Council, City Design

Attachment 1

Ipswich Flood Study Rationalisation
Study Methodology as per Funding Application

The study methodology as enunciated in the funding application comprised the following major components:

- Liaison with Brisbane City Council, Bureau of Meteorology, Dept of Natural Resources Mines & Energy;
- Review of existing RAFTS model of the Bremer and Brisbane River catchments and its calibration with a view to reducing the variance of previous RAFTS results with those from direct flood frequency analysis, including frequency analysis of flood volumes;
- Use of stochastic simulation (Monte Carlo Method) to account for probability distributions and combinations in spatial and temporal rainfall distributions, in model loss rates and in reservoir drawdown;
- Revision of design flood hydrographs using RAFTS model on the basis of outputs from the above;
- Updating MIKE 11 model to latest version and rectification of geometric anomalies or the establishment of a new 2- dimensional model (eg MIKE 21 or MIKE FLOOD);
- Recalibration of MIKE 11 model using "triple zone" roughness definition and giving equal weighting to medium and large floods or equivalent 2-d modelling;
- Inclusion of tidal variations using Monte Carlo simulation to examine the joint probabilities of flow-rates and tide height;
- Use refined hydraulic model to re-estimate design flood levels;
- Prepare revised flood extent mapping for a range of flood ARIs and for PMF;
- Report on the above; and
- Revise Flood Overlay Map in Planning Scheme.

Ipswich
City Council

Ipswich City Council &
Ipswich Rivers Improvement Trust

Ipswich Rivers Flood Study Rationalisation Project

Consultancy Brief 2

Hydraulics

October 2004

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Ipswich Rivers Flood Study Rationalisation Project

Consultancy Brief 2 - Hydraulics

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Ipswich Rivers Flood Study Rationalisation Project Consultancy Brief 2 - Hydraulics

1. Introduction

Ipswich Rivers Improvement Trust (IRIT) is in receipt of Commonwealth and State Government funding in respect of the *Ipswich Rivers Flood Study Rationalisation Project.* This project is funded under the *Natural Disaster Risk Management Studies Sub-programme* of the *Natural Disaster Mitigation Programme* (NDMP).

This project is being undertaken jointly with **Ipswich City Council** (ICC) by a mix of in-house resources and external consultants and is required to be completed by 30th June 2005.

IRIT now wishes to appoint external consultants to undertake the hydrology and hydraulic analysis and modelling components of the project.

This *Consultancy Brief* sets out the requirements for the *Hydraulic Analysis and Modelling* components of the project. A separate brief sets out the requirements for the *Hydrology* component. It is unlikely that the same consultant will be engaged for both components.

Consultants submitting quotations to undertake this commission must comply with the requirements of this brief.

2. Management of the Project

Under the terms of the Funding Agreement for this project, it is required to be managed by a Study Advisory Group (SAG) comprising relevant Trust and Council officers, the District Manager Counter Disaster and Rescue Services of the Department of Emergency Services, and any other persons appointed at Council's discretion.

The successful consultant will be required to attend meetings of the SAG, and for the purpose of completing proposals, consultants should assume that attendance at 4 meetings will be required. Meetings will be held at ICC offices in Ipswich.

2.1. Provision of Data

The successful consultant will be provided (at no cost to the consultant) with electronic copies of all relevant data files, model files and result files and with either hard copy or electronic copies of all relevant reports.

3. Objective and Scope of Consultancy

The objective of the Consultancy is to refine the hydraulic model of the lower Brisbane River within Ipswich and Brisbane, the Bremer River, and Brisbane River tributaries within Ipswich in order to resolve the identified inconsistencies.

The Scope of the Consultancy is to undertake the hydraulic modelling required for this project, as set out in **Section 5**. It will also be necessary for

the Consultant to liaise with the IRIT/ICC Project Manager and, where necessary, with other study consultants.

4. Project Background

Flooding in Ipswich can result from flooding in the Brisbane River, the central reaches of which pass through Ipswich; tributaries of the Brisbane River within Ipswich; and the Bremer River and it is tributaries which joins the Brisbane River near Moggill (within Ipswich City). The lower Bremer River and its lower tributaries and the Brisbane River tributaries can be flooded by backwater from the Brisbane River when it is in flood.

Detailed flood studies have been undertaken for the Brisbane and Bremer River catchments such that flood extent mapping for a range of flood frequencies are available.

However, since detailed flood studies for the urban areas of Ipswich were completed in 2000 (Sinclair Knight Merz) and for the rural areas in 2002 (Halliburton KBR), there have been a number of developments relating to flood studies in the Brisbane River which have resulted in the current flood studies and the corresponding flood extent maps no longer being compatible with those for Brisbane City.

These include:

- Updating of flood hydrology for Wivenhoe Dam operations and the proposed construction of *fuse plug* spillways;
- Availability of new rainfall design data (CRC-FORGE) and a new estimate of probable maximum flood (PMF);
- Revised flood modelling for Brisbane City Council including refinement of the RAFTS model and the use of the CRC-FORGE design rainfalls; and
- Review of the latter by an Independent Review Panel (Mein et al 2003) which has led to the 100 year design flood flow for the lower Brisbane River being reduced from 8,000 m^3/s to 6000 m^3/s.

In addition, in response to apparent anomalies with predicted 20 year ARI flood levels in particular, Council commissioned Sargent Consulting in 2002 to review the current flood models (Sargent Consulting 2003). This review concluded that the current hydraulic model calibration is skewed towards the replication of major floods with the result that water levels for smaller floods are overestimated, and that the hydrologic model was conservative in respect of design flows.

Also, in the period since the flood study results became available, a number of inconsistencies have been noted which require rectification.

As a consequence of the recent changes to the lower Brisbane Flood Studies, the current studies for the two local government areas are no longer compatible, and the current model is known to have some inconsistencies.

The objective of the current project is to resolve these inconsistencies.

5. Detail Scope of Work

The hydrology component of this project comprises the following components, further detail of which is given in subsequent paragraphs.

1) Updating the Ipswich Rivers MIKE 11 model (including the Brisbane reach of the Brisbane River) to the latest version and to include extension of some cross sections and modifications to hydraulic roughness in the Bremer River section of the model;

2) Recalibrate the MIKE 11 model taking advantage of the ability to now model hydraulic resistance using a triple zone approach, and/or using a functional relationship between resistance and velocity, depth, or (velocity x hydraulic radius) thereby giving equal weighting to medium and large floods.

3) Undertake design runs of the hydraulic model for 10, 20, 50 100 and 200 year ARI and PMF.

4) Investigate and quantify the uncertainty in estimated flood levels at key points by running the hydraulic model in a stochastic (*Monte Carlo* simulation) framework.

5) Prepare flood extent mapping for 20, 50 and 100 year ARI events and for PMF.

6) Deliverables i.e. Hydraulic Modelling Report, electronic copies of model input files and result files, and electronic copies of flood extent mapping. The consultant is also required to deliver a copy of the MIKE 11 model including a licensed copy of the software. The cost of providing the software (single licence) shall be included in the consultancy fee.

5.1. Updating and Recalibration of the MIKE 11 Model

As part of the Ipswich Rivers Flood Study SKM (2000) extended the MIKE 11 model it has previously established for Brisbane City Council, recalibrated the model and used it to define peak flood levels on the rivers and creeks in Ipswich.

The Brisbane River reaches of the model were subsequently re-calibrated as part of the updating of the Brisbane River Flood Study for Brisbane City Council (SKM 2004).

As noted above, ICC considers the SKM 2000 modelling to be conservative in respect of smaller floods (eg 20 year ARI). A number of cross sections have also been extended since the initial modelling and these changes need to be incorporated in the model.

SKM (2004) describes the recalibration of the Brisbane River component of the MIKE 11 model, and model runs to simulate the 6,000 m^3/s peak flow (at the Port Office) recommended by the Independent Review Panel (Mein et al 2003).

There are considerable differences in the estimated 100 year ARI flood levels within Ipswich between the 2000 and 2004 modelling. For example, at Moggill Gauge, the Q_{100} flood level was estimated to be 18.34 m AHD and 14.36m AHD in the 2000 and 2004 modelling respectively a difference of 4.0m.

Task 1
Task 1 is the updating and recalibration of the MIKE 11 to resolve the known inconsistencies and to make the model applicable for all floods within the 20 year to 100 year ARI range. It comprises the following sub-tasks:

a) Convert the Ipswich/Brisbane MIKE 11 model to the latest version of MIKE 11 (v 2003b);

b) Modify model cross sections as advised by ICC;

c) Re-calibrate the model using historic data for, at least, the 1974 and 1996 events. In order to improve model calibration (the previous calibration for the Ipswich Rivers Flood Study resulted in different roughness values for "small" and "large" floods due primarily to flow resistance at meander bends) use of the *triple zone* and *bed resistance toolbox* (enables flow resistance to be a function of velocity, depth or hydraulic radius) utilities should be investigated. Calibration should include all watercourses for which historic flood flow and level data are available, with particular emphasis on the Bremer River through Ipswich and the Brisbane River at Moggill and at Goodna;

d) Validate the calibrated model against other events not used in model calibration eg 1955, 1989;

e) Undertake base design runs of the re-fitted model for 10, 20 , 50, 100 and 200 year ARI and for PMF.

5.2. Definition of Uncertainties

Task 2
Define the statistics of hydraulic model roughness parameters, hydraulic structure parameters, tidal variation and any other variables which contribute to uncertainty in model results. These statistics should include appropriate measures of central tendency, variability and range together with an appropriate probability distribution.

5.3. Stochastic (Monte Carlo) Simulation

Task 3
Undertake further MIKE model runs in a stochastic (*Monte Carlo* simulation) framework to explicitly take account of the natural variation in the parameters and variables identified in **Task 2,** and in design flows. The design flow probability distributions for key locations will be provided by the consultant undertaking the *Hydrology* component of this project. A minimum of 100 sample runs is required for each flood frequency and for PMF.

Analyse the results of these model runs and present the results to:

- Define the overall distribution of modelled peak flood levels (including central values and quantified percentiles) at key locations in both the Bremer and Brisbane River systems for a range of design flood frequencies (10, 20, 50, 100 and 200 year ARI) and PMF;
- Identify and rank those parameters and variables in relation to the degree of uncertainty in modelled peak flows resulting from each;
- Critically compare the results obtained with those obtained in previous studies; and
- Make recommendations regarding the peak flood levels at key locations to be adopted for design purposes in both Ipswich and Brisbane.

5.4. Flood Extent Mapping

Task 4

Prepare flood extent mapping for 20, 50 AND 100 YEAR ARI and for PMF for that part of the study area within Ipswich City only. This is to be prepared and provided in a form compatible with ICC's MapInfo GIS. The base mapping required for this component, namely cadastre and digital terrain model will be provided by Council at no cost to the consultant.

5.5. Deliverables

Task 5

- Prepare Draft Final Report describing the work undertaken including summary tables and graphs and Appendices containing details of models and analysis undertaken. Provide 3 bound copies, 1 unbound copy and 1 electronic copy of the draft final report.
- Prepare Final Report following review of the Draft Report by the SAG, to incorporate suggested amendments. Provide 5 bound copies, 1 unbound copy and 1 electronic copy of the final report.
- Provide electronic copies of all final model files, data files and results files and analysis of results in formats to be agreed. The consultant is also required to deliver a copy of the MIKE 11 model including a licensed copy of the software. The cost of providing the software (single licence) shall be included in the consultancy fee.
- Electronic copies of the flood extent mapping in MapInfo format or a format capable of being imported into MapInfo.

6. Timeframe

In order to facilitate completion of the overall Project by 30th June 2005, it will be a requirement that the final electronic files and at least the Draft Final Report be submitted by **20th May 2005**.

7. Fees

The indicative fee for this commission is **$90,000** plus GST including the cost of software provision. Consultants should not quote fees in excess of this amount unless their quotation is accompanied by a statement in the Consultant's submission justifying the additional cost. Alternatively, consultants may submit a quotation within the indicative fee limit with a revised scope of work. In either case, a clear description and cost breakdown of the proposed scope of work should be provided.

Consultant quotations will be evaluated on the basis of lump sum fees and other criteria given in **Section 11** hereof.

Consultants should provide a breakdown of fees based on the 5 main tasks identified in **Section 5** hereof. Fees for each component should include allowances for project management. Fees should be given both exclusive and inclusive of GST.

Consultants should also provide hourly rates for nominated staff. These will be used only for the valuation of any additions to, or subtractions from, the Scope of Work set out herein.

Payments will be made on invoices submitted at the completion of each major task.

8. Submission Requirements

Submissions for this project shall include the following:

- Completed Quotation Details;
- Company information, and required insurance details;
- Relevant project experience particularly on demonstrated capability to undertake projects of a similar nature including the names and contact details of appropriate referees;
- Methodology to be adopted in response to the Scope of Works;
- A work program in the form of a Gantt Chart complying with the requirements of **Section 6** hereof;
- Names and experience of personnel proposed for the study, their proposed roles and time allocation for each person;
- Lump sum fees for each study component;
- Hourly rates for all nominated personnel; and
- Any other information thought to be of relevance to the submission.

9. Enquiries

All enquiries regarding this project are to be addressed to the Contact Officer nominated on the cover page of this Brief.

10. Closing Date

Quotations close at 2004

Late quotations will not be accepted.

11. Evaluation of Submissions

Consultant submissions will be evaluated on the basis of providing Council with the best "Value for Money" in accordance with the State Purchasing Policy.

Submissions will be checked firstly for compliance with the Submission Requirements given in this Terms of Reference. Non-complying quotations will be excluded from further consideration.

Complying quotations will be evaluated and ranked on the basis of the following criteria:

- General track record in work of a similar nature;
- Relevant skills and experience in floodplain hydraulics and hydraulic modelling of the nominated personnel;
- Proposed methodology and deliverables;
- Time to be spent on the project by key personnel;
- Time performance;
- Price; and
- Degree of Risk.

12. Conditions of Engagement

Council reserves the right not to accept the lowest or any quotation.

The successful Consultant will be engaged in accordance with AS 4122- 2000 *General Conditions of Contract for Engagement of Consultants* with the following specific requirements:

Professional Indemnity Insurance	$2,000,000
Period for maintenance of the above	1 year
Public Liability Insurance	$10,000,000
Intellectual Property Rights	Alternative 2 (vested in Client).

13. References

HALLIBURTON KBR PTY LTD (2002) *Local Storm Flood Mapping Final Report* prepared for Ipswich City Council

MEIN R, APELT C, MACINTOSH J, WEINMANN E (2003) *Review of Brisbane River Flood Study – Independent Review Panel Report* prepared for Brisbane City Council

SARGENT CONSULTING (2003) *Brief Review of Flood Frequency Analysis and Discharge Rating Curve for Brisbane River at Moggill Gauge* prepared for Ipswich City Council

SINCLAIR KNIGHT MERZ PTY LTD (2000) *Ipswich Rivers Flood Studies – Phase One and Phase 2 Final Report* prepared for Ipswich Rivers Improvement Trust in association with Ipswich City Council

SINCLAIR KNIGHT MERZ PTY LTD (2004) *Recalibration of the MIKE 11 Hydraulic Model and Determination of the 1 in 100 AEP Flood Levels* prepared for Brisbane City Council, City Design

Ipswich Rivers Flood Study Rationalisation Project - Consultancy Brief 2 - Hydraulics

Quotation Form

The Chief Executive Officer
Ipswich City Council
P O Box 191
IPSWICH, Qld 4305

Attention: [redacted]
Deputy Works Manager

I/We _____
(Registered Business Name or Trading Name)

ABN _____

Contact Details	
Contact Name	Position
Postal Address	Street Address
Tel:	Fax:
Mobile	Email:

hereby submit this quotation to execute and complete the professional services shown and described in the documentation herein, for the fees given below inclusive of all taxes and charges:

Major Task	Proposed Fee excluding GST $	Proposed Fee including GST $
1. MIKE 11 model update, recalibration and base design runs		
2. Specification of uncertainty in results		
3. Monte Carlo modelling and analysis of results		
4. Flood Extent Mapping		
5. Deliverables – reports and electronic files, plus single licence for MIKE 11		
TOTAL		

Signed for and on behalf of _____

Signature _____ Name_____

Position _____

TY:RR
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6 January 2005

MEMORANDUM

TO: ACTING DEPUTY WORKS MANAGER

FROM: SENIOR ENGINEER

RE: PLANNING SCHEME AMENDMENT – OVERLAY MAP 5 FLOODING

INTRODUCTION:

This is a report by the Senior Engineer dated 6 January 2005 concerning the amendments to the Overlay Map 5 of the current Ipswich IPA Planning Scheme.

BACKGROUND:

The Ipswich IPA Planning Scheme includes Overlay Map 5 which shows flooding constraints. The current map has limitations and needs to be reviewed from time to time.

DISCUSSION:

Since the adoption of the current Ipswich Planning Scheme in April 2004, some anomalies have been identified within the Overlay Map 5 Flooding layers. The issues relate to the accuracy of the topographic mapping and the mapping techniques used to plot the various flood lines. Although the various map layers are thoroughly checked, anomalies come to light from time to time. This is particularly the case where the land surrounding particular waterways is flat and it is hard to discern the flood flow paths that might affect existing or proposed development.

The following items are proposed to be included in the current planning scheme review:

1. Additional 1 in 100 flood mapping at Peak Crossing and Marburg as a result of further technical studies (refer *Attachment A & B* respectively)


Attachment A


Attachment B

2. Minor amendments to the 1 in 100 flood line which do not significantly impact on the affected properties within the following locations:

   - Mihi Creek between Warrego Highway and Pine Mountain Road, Brassall (refer *Attachment C*)

.../2

- Tributary of Mihi Creek between North High Street and Fernvale Road, Brassall (refer *Attachment D*);

- Bremer River at Rosewood, east of Coveney Road (refer *Attachment E*);


Attachment C


Attachment D


Attachment E

3. Minor amendments to the 1 in 20 development line in the upper reaches of Woogaroo Creek and Bundamba Creeks that do not significantly impact the affected properties as per the Attachments F & G respectively.


Attachment F


Attachment G

4. Changes in the form of the urban stormwater flow path line work from continuous to dashed to conform with the wording of the Planning Scheme.

5. Minor adjustments to the urban stormwater flow path line work to better represent the urban stormwater flow paths that might affect existing or proposed development. Attachment H shows a sample map of the amendments and Attachment I gives the list of affected and benefited properties.


Attachment H


Attachment I

Since the adoption of the Planning Scheme, the author and staff of the Asset Information Management Section have carried out considerable cross checking of these layers to improve the quality of these datasets. This checking will continue as better surveys, mapping and further flood studies are undertaken.

RECOMMENDATION:

It is recommended that the amendments to Overlay Map 5 proposed in this report be included in the current planning scheme review.

Ravi Raveenthiran
SENIOR ENGINEER

I concur with the recommendations contained in this report.

[redacted]
A/DEPUTY WORKS MANAGER

I concur with the recommendations contained in this report.

[redacted]
WORKS MANAGER

F. GDM:TA
H:\Flood Study Reports\Ipswich Rivers Flood Study Rationalisation Project.doc

8 December 2006

MEMORANDUM

TO: DEPUTY WORKS MANAGER

FROM: ACTING PLANNING MANAGER

RE: IPSWICH RIVERS FLOOD STUDY RATIONALISATION PROJECT

I refer to the above project and accompanying report and offer the following comments. There does not appear to be final resolution of flood modelling outputs between the Rationalisation Project and the Stakeholder group. This situation exists because:

1. the reduction of flood flows in the Rationalisation Project is dependant on the existence of significant flood storage being available in the dams before a flood event has commenced; and
2. the Stakeholder Group has concerns that the flows identified in this study are significantly less then those identified in both previous studies and flows experienced historically in the catchment.

From a risk management and risk minimisation perspective it is therefore considered that the current GIS mapping that is utilised to identify Q20 and Q100 flood events in the Ipswich Planning Scheme should not be varied or amended.

[redacted]
ACTING PLANNING MANAGER