

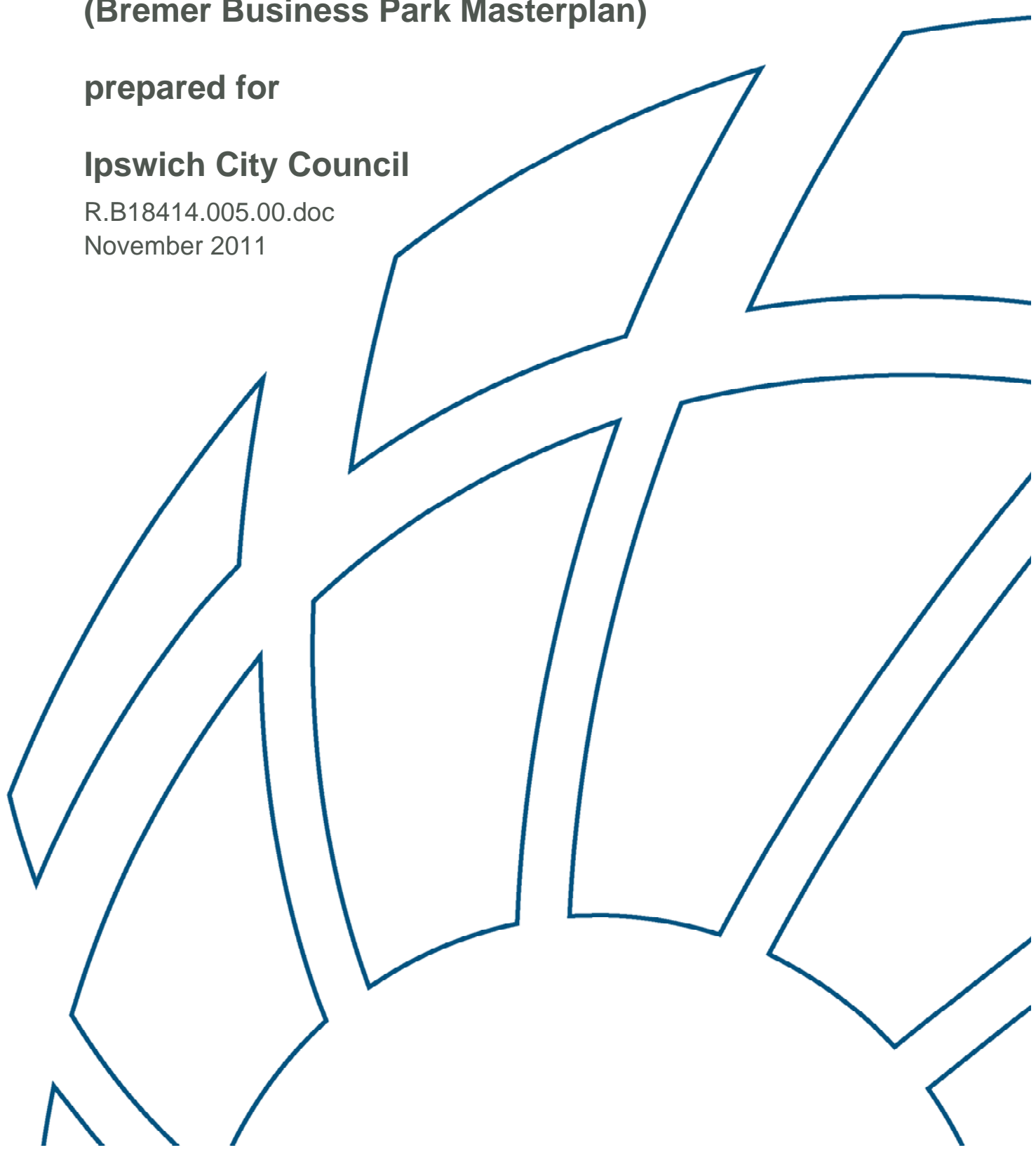
**Response Report to Floods Commission –
Review of Evidence Report on Citiswich
Development by Tony Loveday
(Bremer Business Park Masterplan)**

prepared for

Ipswich City Council

R.B18414.005.00.doc

November 2011



**Response Report to Floods Commission –
Review of Evidence Report on Citiswich
Development by Tony Loveday
(Bremer Business Park Masterplan)**

prepared for

Ipswich City Council

November 2011

Prepared For: Ipswich City Council

Prepared By: BMT WBM Pty Ltd (Member of the BMT group of companies)

Offices
*Brisbane
Denver
Mackay
Melbourne
Newcastle
Perth
Sydney
Vancouver*

CONTENTS

Contents	i
1 PURPOSE OF THE REPORT	1-1
2 HISTORY OF THE BREMER BUSINESS PARK AND CITISWICH FLOOD ASSESSMENTS	2-1
3 REVIEW OF FLOOD ASSESSMENT METHODOLOGY FOR THE PROJECT INCLUDING CUMULATIVE ASSESSMENT AND FLOOD STORAGE	3-1
4 COMPLIANCE WITH THE PLANNING SCHEME	4-1
5 LIMITATIONS OF THE REVIEW AND ASSUMPTIONS MADE BY MR LOVEDAY	5-1
6 SPECIFIC REVIEW COMMENTS ON MR LOVEDAY'S REPORT	6-1
7 CONCLUSIONS	7-1
APPENDIX A: FLOOD AND STORMWATER REPORTS – CITISWICH ESTATE	A-1
APPENDIX B: BCC FILLING AND EXCAVATION CODE	B-1

1 PURPOSE OF THE REPORT

This Report has been prepared by Neil Collins to assist Ipswich City Council with expert advice in relation to flooding in its response to a Report prepared by Mr Loveday for the Queensland Floods Commission dated 7 November 2011, in relation to the Bremer Business Park (Citiswich) Project. I am a recognised expert in the Queensland Planning and Environment, Land and Supreme Courts of Queensland, and have also acted as an expert in New South Wales and Tasmania. I regularly act for local authorities and am currently acting for both Brisbane City and Ipswich City Councils.

This report details the history of the Citiswich Project, a review of flood assessment methodology, review of compliance with the Planning Scheme, limitations of the review and assumptions made and provides specific review comments to the report findings.

I have direct knowledge of the early stages of the development, having been a director of Cardno Lawson Treloar (Cardno) in 2007 when the first detailed master plan flood assessment for the development (Bremer River Business Park Masterplan Flooding Investigation August 2007) was completed. I approved the resultant report which was prepared by John McArthur, a senior and experienced flood engineer with over 25 years experience. I was personally involved in the setting and review of the methodology including the approach adopted for full two dimensional flood modelling and for cumulative effects testing, and I visited the site on at least two occasions. In late 2007, I resigned from Cardno and have since had no further input to the project.

In preparing this report, I have had the benefit of access to the full history of the project, and the full suite of 27 reports produced to date in relation to flooding issues.

2 HISTORY OF THE BREMER BUSINESS PARK AND CITISWICH FLOOD ASSESSMENTS

In total, 27 hydrology and flood related reports have been prepared for this project to date, from initial investigations in 2002 through to various detailed stage plans to support reconfiguration of lot applications and more recently operational works applications for Citiswich (formally known as Bremer Business Park), the most recent of which is dated October 2008.

To date, only Citiswich stages 1A, 1B, 1C, 1D, 2 and 6 have progressed through to operational works – change to ground level approval.

Appendix A provides a detailed description of all 27 reports.

Of these 27 reports, Mr Loveday has only had the opportunity to review two, being the August 2007 Flood Investigation Report for the Bremer Business Park Masterplan, and the June 2008 Citiswich Masterplan –local flooding investigations report, both of which were prepared by Cardno.

Critical to the review is the timing of Masterplan approvals, which occurred in 2007, for the Citiswich Regional Flood Masterplan, and in 2008 for the Citiswich Local Flooding Masterplan, and the standards and requirements that were in place at that time.

Whilst there have been many other reports prepared and detailed design work done since the 2007 Cardno report, it is the 2007 Cardno report that deals with river flooding. The 2007 Cardno report details an assessment of the entire ultimate development proposed at an early stage before bulk earthworks cut and filling, and civil design details were available, and the approach taken was to conservatively assume bulk filling of the floodplain with no compensatory excavation works and to test the effects of this in a flood model. The design intent has always been to carry out cut and fill works to ensure a balance of flood storage at least to the ARI 20 year flood level and this is reflected in subsequent reporting and design details.

To understand fully the flooding implications of the project, knowledge of the overall cut/fill strategy and of subsequent reports and design, and the history of the matter and the associated conservative assumptions incorporated into the 2007 flood modelling work is required. A review solely based on the 2007 and 2008 reports could lead to concerns about flood storage impacts that are addressed in the subsequent work.

The 2007 and 2008 Cardno reports were prepared to refine the previous SKM master plan work which was submitted in support of a preliminary Material Change of Use application, and was based conservatively on the previous SKM full site filling assumption. As detailed design of subsequent stages progressed, a flood storage balance was achieved up to the ARI 20 year flood line with associated detail provided in the various subsequent reports listed in Appendix A, including those submitted in support of reconfiguration of lot applications, and operational works applications for stage 1, 2 and 6.

Despite the conservative assumptions of full site filling without compensatory excavation, the 2007 river flood assessments were detailed and comprehensive. These were based on a fine scale hydrodynamic full two dimensional flood model which is far more detailed than the previously used

one dimensional MIKE11 model by SKM. Flood modelling was carried out for 18 and 30 hour durations for ARI 2, 5, 10, 20 and 50 year flood events, based on the SKM 2000 flood study report (with the 50 year being adopted by Council to represent the 100 year event in light of the Independent Expert review in 2003).

Modelling was also carried out to consider the cumulative effects of development in the entire Bremer River reach from the site to the confluence of the Bremer and Brisbane Rivers some 2.5km to the east.

Up until that time, flood assessments of development within the Bremer River floodplain had been based on one dimensional modelling, with assessments often restricted to just the ARI 100 year event.

3 REVIEW OF FLOOD ASSESSMENT METHODOLOGY FOR THE PROJECT INCLUDING CUMULATIVE ASSESSMENT AND FLOOD STORAGE

Cardno Lawson Treloar based their flood assessments on the July 2000 SKM flood model as detailed in Chapters 4 & 5 of their August 2007 report as follows:

“ICC commissioned SKM to carry out a hydraulic investigation of the major creeks and rivers within the Ipswich City Council district. The hydraulic assessment was undertaken using DHI’s dynamic one-dimensional MIKE11 model (version 1999b). Both existing and ultimate flow cases were modelled with calibration of the model to historic data. It also investigated both local and regional (Brisbane River) flooding.

Details of the modelling are presented in the report prepared by SKM ‘Ipswich Rivers Flood Studies Phase One and Phase Two’ (July 2000). Since the release of this report, ICC has recommended that the 50 year ARI discharge and levels presented in the report be adopted as the 100 year ARI, due to updates in the Brisbane River assessment also completed by SKM for Brisbane City Council (BCC). (Also confirmed by the 2003 Independent Expert Review for Brisbane City Council).

From the MIKE11 Model, the Brisbane River flooding dominates the 100 year ARI (SKM ultimate 50 year ARI) flood levels in the Bremer River and Bundamba Creek (within the site extent). The design 100 year ARI (SKM ultimate 50 year ARI) flood level for the site is RL16.22m AHD. Fill levels will be greater than this to ensure appropriate freeboard is maintained.

To test the impact of the proposed overall masterplan of the Bremer Business Park, the following work was carried out:

- *Develop hydrologic models to test the impact of the site with external catchments in an ultimate developed condition. Size detention basins, if required, to attenuate any increase in flow.*
- *Develop hydrologic models to test the impact of the site with external catchments in their current developed condition. Test the abovementioned detention basins.*
- *Compare the two tests above to see if the proposed mitigation measures for the site give similar attenuation.*
- *Develop hydraulic models to test the impacts of the site for the regional flood event. Calibrate the base case hydraulic model to the SKM built MIKE11 model.*
- *Carry out a cumulative impact assessment in a sub-model of the SKM MIKE11 model and the SOBEK 2D model previously set up by CLT.”*

Flood modelling carried out considered two coincident flood events for combined Bremer and Brisbane River flooding, being the 30 hour duration event (leading to peak Brisbane River flows) and the 18 hour event (leading to peak Bremer River flows), in accordance with the SKM (2000) approach. This is detailed in Section 7.1 and table 7.1 of the 2007 Cardno report.

For the 30 hour event, there was 2,781 m³/s flow down the Bremer, coincident with a high tailwater condition due to Brisbane River flooding (RL16.2m AHD) assumed in the Brisbane River at its junction with the Bremer River. This event produced peak flooding levels at the site, of RL 16.22m.

Flood assessments used a full two dimensional hydrodynamic sub-model of the SKM 2000 MIKE11 model to assess existing case and post development flooding conditions, and to assess any predicted impacts due to the development.

This modelling indicates that the proposed development had no impact on either the 30 hour or 18 hour duration ARI 100 year events, including no effect on the Warrego Highway or on any other property in the floodplain.

As requested by Council, cumulative effects testing was also carried out, with filling of all floodplain storage assumed from the site to the confluence of the Bremer and Brisbane Rivers, with filling assumed to the ARI 1 in 20 year Bremer River flood line (RL13.3m AHD).

This testing demonstrated no impacts on flood levels even if all the available land was fully filled.

The modelling assessments that were carried out were to a level that was considered suitable for the early stage of the project, in support of a Material Change of Use application. It is normal industry practice to carry out full development flood assessments based on preliminary layouts and preliminary civil design at this early stage of a project, with refinement to be carried out as the detailed design progresses in subsequent stage by stage design, with associated refinement.

In subsequent work, flood storage balance and associated site grading, waterway corridor detailing and civil design was refined as detailed in the reports listed in Appendix A.

4 COMPLIANCE WITH THE PLANNING SCHEME

Chapter 11 of the August 2007 Report provides an assessment of the development proposal's compliance with the Planning Scheme. The report concludes that, subject to suitable detailed design, the development complies with provisions 11.4.7(1), 12.15.3, Planning Policy 2 and Planning Policy 3.

In particular, the development exceeds the requirements for industrial land, providing greater than ARI 100 year immunity based on the SKM 2000 findings, as modified by the Independent Expert Review Panel (2003).

The assessments presented in the August 2007 and June 2008 Reports comply with the requirements and standards in force at that time.

5 LIMITATIONS OF THE REVIEW AND ASSUMPTIONS MADE BY MR LOVEDAY

It is acknowledged that Mr Loveday responded to a limited brief provided by the Floods Commission (specifically to answer 7 questions as outlined in his report), based on two flood reports by Cardno Lawson Treloar (August 2007 and June 2008), a statement by Gary Ellis and a transcript of his evidence. The greatest difficulty Mr Loveday would have experienced was that he wasn't given the full history of the matter, nor the basis of the 2007 Masterplan report, which was to carry out a conservative assessment based on the assumption of bulk filling without any compensatory cut works as a worst case scenario, when the actual design intent was to ultimately provide a flood storage balance through compensatory cut works, up to the ARI 20 year flood level, which significantly reduces site filling. It is also acknowledged that he had less than two weeks to prepare his report. Nevertheless, there are a number of limitations to the review, and assumptions have been made by Mr Loveday that need to be understood when considering his report. Once fully appraised of the history of the project and the full suite of flood related reports, these assumptions need to be reconsidered.

Limitations include:

- (a) The review was carried out considering only two of 27 reports prepared to date on the project. In particular, more refined work has been carried out subsequent to these two reports, particularly in relation to local flooding and on balancing flood storage.
- (b) The review does not have the benefit of finalised staging plans detailing flood storage or refined design information on detention and bulk earthworks contained in subsequent reports.
- (c) Mr Loveday has assumed that flood modelling did not consider coincident flooding in the Bremer and Brisbane Rivers. This is incorrect. Coincident events consistent with the SKM (2000) report and as recommended by the 2003 Independent Expert Review were considered by Cardno as detailed in Section 7.1 and table 7.1 of their 2007 report. This is discussed in Section 6(d) of this report in more detail.
- (d) The assumption that Brisbane City Council requires consideration of flood storage balance and the application of the Compensatory Earthworks Planning Scheme Policy for Brisbane River corridor flooding is incorrect. This requirement relates only to Waterway Corridors beyond and excluding the Brisbane River corridor. It is my experience acting regularly as an expert witness for Brisbane City Council, that there is no requirement for flood storage balance in the Brisbane River floodplain beyond that associated with the creek tributaries at their junction with the river. I address this further in Chapter 6. In any case this compensatory earthworks policy only came into force in a 1 January 2008 Planning Scheme amendment, after the stage 1A and original Masterplan approvals. This was not a requirement in relation to river flooding in the Ipswich City Planning Scheme; however Council assessment officers were clearly mindful of flood storage effects in requiring a cumulative effects test which formed part of the 2007 Cardno work.

6 SPECIFIC REVIEW COMMENTS ON MR LOVEDAY'S REPORT

My detailed review comments on Mr Loveday's report are as follows:

1. Page 2, Opinions, topic 1;
 - (a) 1st dot pt; In relation to staging, the flood assessments were of the entire proposed development which is a worst case. Intermediate stages would produce less impacts than the fully developed site;
 - (b) 2nd dot pt; the eastern tributary discharges directly to the Bremer River which has normal standing water levels over 15 metres below the dominant Brisbane River flood levels. No increase in discharge from this tributary due to the development will have any effect on critical flood events in the Bremer or Brisbane Rivers as this peak flow occurs on localised storm events where the rivers are not in significant flood. On site detention could actually worsen flooding slightly on the critical river flood events as it would delay the local site discharge peak to be closer to the Bremer river peak but in any case has no effect on critical flooding in the Bremer or Brisbane Rivers;
 - (c) 3rd dot pt; in relation to the detention requirements on the western tributary, whilst I agree with Mr Loveday's comments in a broad sense, this work detail should and is provided at operational works application stage;
 - (d) 4th dot pt; In relation to consideration of coincident flooding in the Bremer and Brisbane Rivers, the approach in relation to joint Brisbane and Bremer River flooding employed is consistent with the recommendations of Sargent in 2003 and SKM in 2000. For the 100 year Brisbane River flood, a coincident flow of 2,781m³/s was adopted for Bremer River flood flow. Whilst Monte Carlo simulation has previously been recommended for future studies, and joint probability was considered by both SKM and Sargent, it is only in very recent times with improvements in analysis techniques and in computer power, that such work is feasible in a comprehensive manner for the Brisbane and Bremer Rivers. The requirement now for such an investigation is recognised, as detailed in the joint experts statement provided by the flood expert witnesses to the Floods Commission late last month. It also needs to be recognised that the land is proposed for industrial use, which means that there may be commercial risks associated with flooding but there are not residents at risk. (e) 5th dot pt; Figure I2 is schematic but shows what exactly was assumed in the flood model for additional storages. Results are shown in Appendix H.
 - (f) 6th dot pt; the intent was to balance flood storage below the 20 year flood level in the ultimate development. In relation to the third paragraph, when consideration is given to the low probability of encountering a 100 year flood within the life of an individual stage (perhaps 1 to 2 years), the requirement for flood storage balance on all stages is not reasonable since the chance of having a 100 year flood over the time that it would take to develop and complete an individual stage is low. In addition, the storage loss from the individual stage is an even smaller percentage of the flood volume in the Brisbane and Bremer Rivers flood. The modelling by Cardno is also based on the conservative assumption of bulk floodplain filling with no compensatory cut works.

In any case, the site is in a part of the floodplain that is not sensitive to loss of floodplain storage, because of the dominance of Brisbane River flooding. I note that Brisbane City Council recognises that flood storage balance is not required within Brisbane River Corridor because it is such a very small volume compared to the volume of a 100 year Brisbane River flood. Mr Loveday has referenced the Compensatory Earthworks Policy but this applies to Waterway Corridors beyond the Brisbane River Corridor.

In relation to monitoring future fill, subsequent operational works applications would be required before any filling could occur on site, and at that stage more refined detailed design information would be provided. It is not reasonable to require full and complete final civil design at a master planning stage.

2. Page 3; Opinions, Topics 2 and 3; whilst I do not agree with Mr Loveday's assessment, these are a matters for Council officers to comment on. Mr Loveday has not been fully briefed on all the material provided to Council. This would have included design terrain detail and associated models. Council also rely on certifications by both the civil engineers (VDM) and the hydraulic engineers (Cardno) both of whom are large organisations and publicly listed companies. Council officers required detailed assessments of flood storage and required a balance to the ARI 20 year flood line, then required cumulative effects testing to ensure no adverse impact would result.
3. Page 3, Topic 4; hydrodynamic modelling was used to show no significant downstream impacts due to the development. Flood storage is only important where its volume is significant compared to the volume of runoff in the flood event. In the lower floodplains of major river systems it is recognised that flood storage is not important. This is the case for the Barron River in Cairns, for the Pioneer River in Mackay, and for the Fitzroy River in Rockhampton.
4. Page 3, Topic 5; The situation we have is a relatively small loss of floodplain storage compared to the volume of the flood event in a large river system. The Brisbane River 100 year flood storage volume is in excess of 3 billion cubic metres. The total flood storage volume of the entire site to ARI 20 year level is 870,000 m³.
5. Pages 3 and 4, Topic 6;
 - (a) Local flooding Investigation; there is no need to locate detention devices for local flood management above severe river flood levels (Brisbane or Bremer River flood events) as the detention devices are designed for local storm events of short duration and are not required on major river events as river flooding dominates and local flooding is irrelevant. The local flood events occur when river levels are over 10 metres lower than in major river flood events.
 - (b) In relation to the channel widening of the Eastern waterway, this is a matter for detailed design. Given that for local flood events the tailwater levels in the Bremer River are below RL 2m AHD, by widening the local waterway the desired aims of reducing flood levels within the tributary under local flood events can be readily achieved.
6. Page 4, Topic 7;

- (a) at master planning stage is would not be normal to detail construction staging or associated timetabling. As each operational works application is produced, each stage of development will need to demonstrate how they comply with the overall masterplan intent.
- (b) my comments on the Western waterway are the same as my comments on the Eastern waterway above.

7. Additional Comments

- (a) Incremental Effects; whilst I agree with Mr Loveday's comments as a general principle, it must be recognised that loss of floodplain storage alone in the lower reaches of the Brisbane and Bremer River has no significant effect on flood levels, because of the relatively small flood storage volume available compared to the volume of the flood event. This is recognised by Brisbane City Council who do not require balancing of flood storage in relation to Brisbane River flood events, provided flow conveyance is maintained. This is not unique to Brisbane. For example, in Cairns, any loss of flood storage in the Barron River delta has no effect on flood levels, provided flood conveyance is maintained.
- (b) in relation to the coincident event, the Cardno approach was consistent with the approaches by SKM in 2000, Sargent in 2002, and the Independent Expert Panel in 2003, and is discussed further in 6,1(d) above. The use of HEC-22 is not a recommended method in industry standards in Australia, including the Institute of Engineers 'Australian Rainfall and Runoff'. To my knowledge, it is not generally used on river or creek flood studies in Queensland and New South Wales. It is also not as a comprehensive method as the Monte Carlo analysis now proposed by the joint flood experts report before the Floods Commission.
- (c) Mr Loveday has not appreciated that Brisbane City do not require flood storage balance for Brisbane River flooding. The compensatory earthworks approach only applies to waterways of Brisbane beyond the Brisbane River floodplain. This is because the floodplain storage loss effects in the lower portion of major river systems has only a very minor effect on flooding even in a cumulative sense. It would unnecessarily inhibit development to require a complete balance of floodplain storage in the lower end of major river systems such as the Brisbane, Bremer and Barron Rivers.

In layman's terms, the placement of fill as proposed has no measurable effect, because it is being placed only in backwater areas where there is no flow so therefore does not restrict flow carrying capacity, and because the volume of flood storage lost due to the filling is extremely small compared to the volume of runoff in the flood event. This means that the effect on flood attenuation is not measurable, even when cumulative effects are taken into account.

7 CONCLUSIONS

Based on my review, I conclude the following:

1. Mr Loveday was only provided with a very limited brief which included only two technical reports, out of 27 that have been produced to date for the project.
2. Given the very short time available to Mr Loveday to complete his review, he had no opportunity to clarify a number of points of uncertainty and confusion raised in his report with Council officers.
3. Mr Loveday may not have been fully aware of the status of the SKM 2000 work, or of the 2003 Expert Panel review recommendations, which underpin the Cardno Lawson Treloar approach. This includes the selection of coincident Bremer and Brisbane River flood events.
4. Because of the above, Mr Loveday has made a number of assumptions that are incorrect, and these go to the core of his criticisms presented, and these findings ought to be reviewed.
5. In my opinion, a more comprehensive review would result in the following answers to the 7 questions posed by the Floods Commission.

1. **Whether the conclusion in the Bremer Business Park Masterplan – Flooding Investigation dated August 2007 (Masterplan Flood Report) is accurate, in that the proposed development “will not impact adversely on flood levels external to the site and the flood immunity of the Warrego Highway has not been reduced”.**

Answer: Based on the flood modelling and code requirements that were current up until the adoption in early 2011 of the temporary planning instrument, I believe this conclusion is accurate. Clearly, in light of the January 2011 floods, a review of the design is warranted; however, in my opinion, it is very unlikely that any significant adverse impacts would result, since higher and larger flood events than those considered to date will result in overtopping of the estate, with significant additional flow area available.

2. **With respect to topic 1, if no determination can be made as to accuracy, whether it was reasonable for the Ipswich City Council to rely on the Masterplan Flood Report in support of the development approval.**

Answer: In my opinion, Ipswich City Council used the best available information available at the time, including the SKM 2000 modelling and report, and the 2003 Independent Expert Review Report which underpins the Cardno work. This information was still valid up until the January 2011 floods. Council also required cumulative effects testing and required no significant adverse off site impacts. The actual flood modelling carried out by Cardno conservatively assumed full site filling with no compensatory cut works. Hence, I conclude that it was reasonable for Ipswich City Council to rely on the Masterplan Flood Report.

3. **Whether there is any aspect of the Master Flood Report which ought to have caused the Ipswich City Council to have the Masterplan Flood Report reviewed by someone external to the Council or seek a further report.**

Answer: External review is always an option for Council, but there is a cost. In my opinion, any review would conclude that the work was appropriately based on the SKM 2000 work combined with the findings of the Independent Expert Review of 2003, and was in accord with Council's Policies and flood codes in force at that time. It is highly unlikely that any such review would question the adoption of the SKM 2000 ARI 50 year flood as the ARI 100 year event based on the Independent Expert Review findings.

4. **Whether the assertion that placing fill on land that is affected by flood flows of low or zero velocity would result in no impacts, or a negligible impact on flood levels is accurate, both in general terms and with respect to the Citiswich site.**

Answer: Whilst some impacts will occur, they have been demonstrated to be extremely small and less than 1 mm from cumulative effects testing assuming full filling of the floodplain over the 2.5km river floodplain length from the site to the Brisbane River confluence. The volume of floodplain storage is extremely small compared to the volume runoff from a river flood, hence, no significant flow attenuation will occur due to the flood storage.

5. **The circumstances in which flood levels and the area of land inundated by floods are not affected by reduction in the flood storage capacity of a river.**

Answer: The Cardno Lawson Treloar report not only considered the filling of the subject site, but also assessed further hypothetical filling of all land above ARI 20 year flooding level from the site to the confluence of the Bremer and Brisbane Rivers, some 2.5km to the east. It is acknowledged that loss of floodplain storage has some effects on downstream flooding, but as the testing carried out demonstrates, the flood storage volume is very small compared to the volume runoff of the flood, so the flood attenuation potential is equally small. This is why Brisbane City Council does not require flood storage balance for development within the Brisbane River corridor. The modelling suggests less than 1mm impact due to full hypothetical floodplain filling.

6. **Whether the contents of the Local Flooding Investigation alter any of the conclusions drawn in response to the Commission's initial scope of work.**

Answer: In my opinion, the Local Flooding investigation provides a suitable framework for subsequent detailed design of local flood management. These floods are very different in their nature to river floods, with critical storm durations of only a few hours or less, and under these local thunderstorm type events, more widespread river flooding is unlikely.

7. **Whether the combined contents of the Masterplan Flood Report and the Local Flooding Investigation support a conclusion that the proposed development will have no adverse flood impacts external to the site.**

Answer: These are only two reports out of a total of 27 produced to date, with many more reports yet to come for subsequent operational works applications. All these reports together support the conclusion of no adverse impacts in my view.

APPENDIX A: FLOOD AND STORMWATER REPORTS – CITISWICH ESTATE

Flood and Stormwater Reports – Citiswich Estate

PREPARED BY Sinclair Knight Mertz (SKM)

1. 'Development Application Volume F: Engineering Studies – Flooding' dated September 2002 SUPERSEDED

- This report was prepared on behalf of the applicant and formed part of the initial application material for 3356/02/CA.
- This report details that no earthworks were proposed below the 1 in 100 flood line and that all earthworks on the site would be compensatory.
- This report details to achieve a “no worsening” affect in terms of stormwater as a result of ultimate development that ‘offstream’ detention basins are supported.
- Section 3.2.1 Brisbane River Flood states *“The Brisbane River flood backs up through the site. The water ponds and is very slow moving. To ensure that this flood level is not increased, the development must not fill areas of the floodplain without providing complimentary areas of excavation.”* Further the report states *“there is more volume available on the floodplain in the developed case than the existing case.....On this basis , the development should not increase flood levels generated by the Brisbane River flood mechanism”*.
- Section 3.2.2 Bremer River Flood states *“The Bremer River design flood events produce lower flood levels than the Brisbane River floods however, the flow has higher velocity and relies on the conveyance of the channel and floodplain. To ensure that the development has no impact of flood levels, the cross sectional area of the channel and flood plain should not be reduced by development. If encroachment occurs, it should be limited and tested to find potential for increasing flood levels within the site and in adjacent land.”* The report concludes that the development is not likely to cause detrimental impacts on the flood levels and will provide adequate flood immunity for the proposed land use.

2. 'Response to Council Issues – Concept Master Plan for Stormwater Quality Management' dated September 2003 SUPERSEDED

- This report was prepared on behalf of the applicant and formed of a further response to Council issues during the assessment process for 3356/02/CA.
- This report provided a framework for stormwater management (for both quality and quantity) for the site.
- This report concludes:
 - Developed conditions flows can be mitigated to existing conditions flows for each sub-catchment by placement of detention basins at various locations.
 - Detention basin sizes and locations presented in this report are preliminary and should be considered indicative. The construction of the detention basins identified is considered to be feasible based on the data available at this stage of the site’s development. Final detention basin sizing’s and locations should be undertaken as part of the detailed design.

PREPARED BY CARDNO LAWSON TRELOAR

1. ***'Bremer Industrial Park Stage 1A Flooding Investigation'* dated October 2006 (Ref J8714/R1) CURRENT REPORT, THOUGH FURTHER REPORTING HAS SUPERSEDED ANALYSIS PRESENTED**

The flood assessment detailed in this report considered the filling for Stage 1A only and tested the flooding for the regional Brisbane River (30 Hour) event. We understand that this was submitted to Ipswich City Council (ICC) get the earthworks moving as soon as possible. We understand that based on the results of this report ICC were willing to accept the predicted flood impacts and approved the details in this report.

ICC was also interested to see the total master plan effect, hence additional modelling and reporting was requested by Council.

2. ***'Bremer Industrial Park Stage 1A Stormwater Management Strategy for Operational Works – Change to Ground Level Approval'* dated October 2006 (Ref J8714/R2) CURRENT REPORT, THOUGH FURTHER REPORTING HAS SUPERSEDED ANALYSIS PRESENTED**

The water quality management detailed in this report provided conceptual information only in accordance with the preliminary approval reports. Due to time constraints no detailed numerical assessments were undertaken as part of this report. This also provided the opportunity to flush out any of the water quality concerns that Council had for the project.

We believe that this report was not approved at the time as ICC had a number of further items they wanted to clarify or update from the preliminary approval conditions and in addition also wanted Healthy Waterways (HW) to review the strategy.

3. ***'Bremer Business Park Masterplan Flooding Investigation'* dated March 2007 (ref J8714/R3) SUPERSEDED**

This flood assessment considered the full fill extent for the proposed Masterplan Citiswich site and tested the impacts during the Bremer (18 Hour) and Brisbane (30 Hour) River regional events. This report also assessed the predicted impact on the peak flows in the local tributaries.

In terms of the regional event assessment, the proposed fill extents assessed included areas within ICC's 20 year ARI development line, which ICC were not happy about. ICC also did not trust the results presented in the report and had further concerns on the cumulative impacts due to the proposed filling. There were a number of meetings with ICC to walk through the results and to find an acceptable solution. This was eventually agreed that encroachment

within the 20 year ARI development line would be acceptable if the following conditions were achieved:

- No external impacts due to the proposed filling in the Regional Bremer (18 Hour) and Brisbane (30 Hour) River events;
- No filling below the 20 year ARI development line on any of the critical conveyance paths, with fringe filling within the backwater areas being acceptable; and
- Balance the flood storage up to the 20 year ARI development line (RL 13.3mAHD)

4. ***'Bremer Business Park Masterplan Stormwater Management Strategy Overall Site Masterplan'*** dated March 2007 (ref LJ8714/R4) **SUPERSEDED**

This report undertook broad water quality assessments and addressed the contaminant management concerns, storm water quality management concerns and the waterway stability concerns as raised by ICC and HW in response to our October 2006 (J8714/R2) report.

This assessment considered a stormwater quality management system that included in-lot treatment and end-of-line systems located in the open space. This report was written to provide the broad concepts for the future detailed stage applications.

Whilst this report met all the requirements that ICC and HW had raised, they were not willing to approve the approach and raised a number of additional items from their review of this report. A number of the items that were raised were more related to detailed design rather than master planning items.

5. ***'Bremer Business Park – Stage 1 Stormwater Management Strategy to Support ROL Development Application'*** dated March 2007 (ref LJ8714/R5) **SUPERSEDED**

This report undertook detailed water quality assessments and addressed the contaminant management concerns, storm water quality management concerns and the waterway stability concerns as raised by ICC and HW in response to our R4 March 2007 report specifically for Stage 1. The management strategy detailed in this report was still undertaken based on the in-lot and regional treatment approach preferred by Walkers that ICC and HW were not in favour of. The intent was to demonstrate to ICC and HW that this strategy would work.

6. ***'Bremer Business Park Masterplan Flooding Investigation'*** dated August 2007 (ref LJ8714/R3/V2) **CURRENT – THIS IS THE MOST REPORT OF THE ASSESSMENT OF THE REGIONAL FLOODS**

This flood assessment considered the full fill extent for the proposed Citiswich site and tested the impacts during the Bremer and Brisbane River regional events. This report also assessed the predicted impact on the peak flows in the local tributaries and included additional cases as requested by ICC.

This report also demonstrated for the proposed fill extents the following conditions were achieved:

- No external impacts due to the proposed filling in the Regional Bremer and Brisbane River events;
- No filling below the 20 year ARI development line on any of the critical conveyance paths, with fringe filling within the backwater areas being acceptable; and
- Balance the flood storage up to the 20 year ARI development line (RL 13.3mAHD)

**7. *'Citiswich Masterplan Stormwater Management Strategy (Response to Stage 1 ROL Decision Notice)' dated June 2008 (Ref LJ8714/R4/V2)*
SUPERSEDED**

This report undertook water quality assessments and addressed the contaminant management concerns, storm water quality management concerns and the waterway stability concerns as raised by ICC and HW in response to our March 2007 (LJ8714/R4) report.

This assessment considered a stormwater quality management system that included in-lot treatment, at-surface treatment for minor roads and end-of-line systems located in the open space for major roads. This report also included additional information on the guidelines for the future stage reports as requested by ICC and HW.

**8. *'Citiswich Stage 1 - Stormwater Management Strategy to Support Operational Works Development Application' dated June 2008 (ref LJ8714/R5/V2)*
SUPERSEDED**

This report undertook detailed local flooding and water quality assessments and addressed the contaminant management concerns, storm water quality management concerns and the waterway stability concerns as raised by ICC and HW in response to our R5 March 2007 report specifically for Stage 1.

This assessment considered a stormwater quality management system that included in-lot treatment, at-surface treatment for minor roads and end-of-line systems located in the open space for major roads. This report also included a 'cookbook' for the individual lots as requested by ICC and HW.

9. ***'Citiswich Masterplan – Local Flooding Investigation'* dated June 2008 (Ref LJ8714/R6) CURRENT, THOUGH FURTHER REPORTING HAS SUPERSEDED ANALYSIS PRESENTED**

This report detailed the local flood assessment for each of the tributary and specified the design of the mitigation measures to meet the water stability requirements. This also defined the culvert crossing requirements and channel dimensions and demonstrated no impact on the Warrego Highway for the local events.

This is that last full report on the local flooding. Meetings have requested changes to the model assumptions for each of the stages and also indicated that local detention is not required.

10. ***'Citiswich Individual Industrial Lot – Stormwater Management Strategy'* dated July 2008 (Ref LJ8714/R9) CURRENT, THOUGH THE HW DEEMED TO COMPLY GUIDELINES HAVE SUPERSEDED THE NEED FOR THIS DOCUMENT**

This report extracted the cookbook details for the individual lot stormwater management. We understand this was intended to form part of the contract documentation for future purchasers of the individual lots.

11. ***'Citiswich Stage 2 - Stormwater Management Strategy to Support Operational Works Development Application'* dated September 2008 (ref LJ8714/R7) SUPERSEDED**

This report undertook detailed local flooding and water quality assessments and addressed the contaminant management concerns, storm water quality management concerns, the waterway stability concerns and the draft decision notice items. This assessment considered a stormwater quality management system that included in-lot treatment, at-surface treatment for minor roads and end-of-line systems located in the open space for major roads. This report also included a 'cookbook' for the individual lots as requested by ICC and HW.

12. ***'Citiswich Masterplan Stormwater Management Strategy (Response to Stage 1 Healthy Waterways Review)'* dated February 2009 (Ref LJ8714/R4/V3) CURRENT – THIS THE MOST CURRENT MASTERPLAN STORMWATER MANAGEMENT STRATEGY**

This report modified the water quality assessments and storm water quality management strategies to comply with correspondence from ICC dated 7 November 2008 which iterated advice they received from Healthy Waterways.

This assessment considered a stormwater quality management system that included in-lot treatment, at-surface treatment for minor roads and end-of-

line systems located in the open space for major roads. This report also included additional information on the guidelines for the future stage reports as requested by ICC and HW.

13. 'Citiswich Stage 1 - Stormwater Management Strategy to Support Operational Works Development Application (Response to Healthy Waterway Review' dated June 2009 (ref LJ8714/R5/V3) CURRENT

This report modified the water quality assessments and storm water quality management strategies to comply with correspondence from ICC dated 7 November 2008 which iterated advice they received from Healthy Waterways.

This report undertook detailed local flooding and water quality assessments and addressed the contaminant management concerns, storm water quality management concerns and the waterway stability concerns as raised by ICC and HW in response to our R5 March 2007 report specifically for Stage 1. This assessment considered a stormwater quality management system that included in-lot treatment, at-surface treatment for minor roads and end-of-line systems located in the open space for major roads. This report also included a 'cookbook' for the individual lots as requested by ICC and HW.

14. 'Citiswich Stage 2 – 'Stormwater Management Strategy to Support Re-Configuration of Lot Development Application (Response to Information Request)', dated October 2009 (ref LJ8714/R7/V2) SUPERSEDED

This report is a response to the Information Request from Council and refines the local flooding assessment and provides additional detail on the flood mitigation measures for Stage 2.

15. 'Citiswich Stage 2 – Stormwater Management Strategy to Support Re-Configuration of Lot Development Application' dated October 2009 (ref LJ8714/R7/V3) SUPERSEDED BY R17V2

This report further refines the local flooding assessment and provides additional detail on the flood mitigation measures for Stage 2. This modelling has assumed the greatest fill extents.

16. 'Citiswich Stage 6 - Stormwater Management Strategy to Support Reconfiguration of Lot Development Application', dated July 2009 (ref LJ8914/R10) SUPERSEDED

This report refines the local flooding assessment for Stage 6 and presents the modelling for the diversion channel option as well as the local water quality treatment.

17. ***'Citiswich Stage 6 - Stormwater Management Strategy to Support Reconfiguration of Lot Development Application (Response to Information Request)'*** dated February 2010 (ref LJ8914/R10/V2) **SUPERSEDED**

This report is a response to Councils Information Request and provides additional refinement of the local flooding in Stage 6 assuming the central channel. This report was produced to support the large lot layout.

18. ***'Citiswich Stage 6 – Stormwater Management Strategy to Support Reconfiguration of Lot Development Application'***, dated February 2010 (ref LJ8914/R10/V3) **SUPERSEDED**

This report was produced to support the small lot application, no refinement of modelling was undertaken for this latest version.

19. ***'Citiswich Stage 3 – Stormwater Management Strategy to Support Re-Configuration of Lot Development Application'*** dated July 2010 (ref LJ8714/R14) **CURRENT**

This report further refines the local flooding assessment and provides additional detail on the flood mitigation measures for Stage 3.

20. ***'Citiswich Stage 4 - Stormwater Management Strategy to Support Re-Configuration of Lot Development Application (Response to Information Request)'***, dated September 2010 (ref LJ8714/R12)

This report refines the local flooding assessment for Stage 4 and presents the modelling for the diversion channel option as well as the local water quality treatment.

21. ***'Citiswich - Stage 6 – Stormwater Management Strategy to Support Operational Works Application'***, dated October 2010 (ref LJ8914/R15) **CURRENT**

This report was produced to support the operational works application for Stage 6A and B, but included the engineering design for the channel and stormwater quality management for the entire Stage 6.

22. ***'Citiswich – Archer Street Parklands – Flooding Assessment to Support Operational Works Application'***, dated October 2010 (ref LJ8914/R16) **CURRENT – THIS IS THE MOST CURRENT REPORT OF ASSESSMENT OF THE WESTERN LOCAL TRIBUTARY**

This report was produced to support the operational works application for Archer Street Parklands based on the Cardno design and also included Stage 6 engineering design for the channel.

23. ***'Citiswich Stage 2 – Stormwater Management Strategy to Support Development Application for Reconfiguring a lot and Preliminary Approval to Vary the Effect of a Planning Scheme'*** dated November 2010 (ref LJ8714/R17/V2) **SUPERSEDED**

This report further refines the local flooding assessment and provides additional detail on the flood mitigation measures for Stage 2. The modelling assumed the filled extents except for the Balance lot (Stage 2C), which is model as existing. The report also presented the stormwater quality management.

24. ***'Citiswich Stage 2 – Stormwater Management Strategy to Support Development Application for Reconfiguring a lot and Preliminary Approval to Vary the Effect of a Planning Scheme'*** dated November 2010 (ref LJ8714/R17/V3) **CURRENT – THIS PRESENT THE MOST CURRENT MODELLING FOR THE EASTERN TRIBUTARY (TO BE SUPERSEDED THIS AFTERNOON)**

This report further refines the local flooding assessment and provides additional detail on the flood mitigation measures for Stage 2. The modelling assumed the filled extents except for the Balance lot (Stage 2C), which is model as existing. The report also presented the stormwater quality management. The report was updated to include comments and changes recommended by Walkers.

25. ***'Citiswich - Stage 6C & D – Stormwater Management Strategy to Support Reconfiguration of Lot Development Application'***, dated April 2011 (ref LJ8914/R10/V3) **CURRENT (RESULTS AS PER R15)**

This report was produced to support the small lot application for Stages 6C & D, no refinement of modelling was undertaken for this version, but rather modification of the text and presentation of the report to meet Walker's requirements.

26. ***'Citiswich Stage 4 - Stormwater Management & Flooding Assessment to Support Re-Configuration of Lot Development Application & Preliminary Approval to Vary the Effect of the Planning Scheme (Response to Information Request)'*** , dated March 2011 (ref LJ8714/R12/V2) **CURRENT**

This report provided updated assessments of the local flooding assessment for Stage 4 in particular the diversion channel option as well as the local water quality treatment.

27. ***'Citiswich Stage 2 – Stormwater Management Strategy to Support Development Application for Reconfiguring a lot and Preliminary Approval to Vary the Effect of a Planning Scheme'*** dated October 2011 (ref LJ8714/R17/V4) **CURRENT – THIS PRESENT THE MOST CURRENT MODELLING FOR THE EASTERN TRIBUTARY (TO BE SUPERSEDED THIS AFTERNOON)**

This report further refines the local flooding assessment and provides additional detail on the flood mitigation measures for Stage 2 in response to a Information Request from Council. The modelling assumed the filled extents except for the Balance lot (Stage 2C), which is modelled as cut back to ensure no adverse impacts. The report also presented the stormwater quality management.

APPENDIX B: BCC FILLING AND EXCAVATION CODE

Filling and Excavation Code

1 Application

This Code will apply in assessing:

- a material change of use
- operational work for filling and excavation, where:
 - exceeding 100 vertical millimetres or more depth of top dressing in relation to ground level, on land to which the **Waterway Code, Wetland Code** and/or **Acid Sulfate Soil Code** applies, or
 - exceeding 1 vertical metre or more depth in relation to ground level, in all other circumstances.

This Code does not apply to filling or excavation where part of building work that is only subject to code assessment against the *Building Regulation*.

2 Using this Code

In using this Code reference should also be made to Section 1.1—How to use the Codes, at the front of this Chapter.

When this Code is listed in a level of assessment table in Chapter 3 or a Local Plan in Chapter 4 as an Applicable Code for **code assessment** or a Relevant Code for **impact assessment**:

- the Code is to be read as being the Purpose, Performance Criteria and Acceptable Solutions
- a Local Plan may include a Code that may vary or include additional Purposes, Performance Criteria or Acceptable Solutions.

4 Performance Criteria and Acceptable Solutions

Any report or management plan required by the Acceptable Solutions in this section will use recognised and locally accepted data and design methodologies.

Performance Criteria		Acceptable Solutions	
P1	Filling or excavation must not impact adversely on visual amenity or the stability of land <i>Note: retaining wall construction will also need to comply with the Building Regulation and embankment gradients will need to comply with the Building Regulation</i>	A1.1	A retaining wall is set back at least half the height of the wall from any boundary of the site
		A1.2	Retaining walls over 1.5m are stepped 0.75m for every 1.5m in height, terraced and landscaped
		A1.3	Retaining wall finishes that present to adjoining land are of a high quality appearance and compatible with surrounding development

List of 'secondary' Codes

When this Code is used in **code assessment** the following Codes are termed 'secondary' Codes and form part of this 'primary' Code. When this Code is used in **impact assessment** the following list should be considered as providing a guide to other Codes that may also be used in assessing the proposal:

- Acid Sulfate Soil
- Biodiversity
- Gas Pipeline
- Stormwater Management
- Transport, Access, Parking and Servicing
- Waterway
- Wetland.

Glossary

Run-off characteristics: hydrograph (representing flow) volume, peak and time to peak

3 Purpose

The purpose of this Code is to:

- ensure that filling and excavation does not adversely affect the visual character and amenity of the site and the surrounding area
- protect the environment through minimising the extent of filling and excavation
- ensure that filling does not adversely impact on flooding of upstream, downstream and adjoining land.

Performance Criteria		Acceptable Solutions	
P2 Filling or excavation must not result in any contamination of land or waters		A2.1 For filling, only clean fill is used A2.2 For excavation, no contaminated material is excavated, or acid sulfate soil or contaminant disturbed A2.3 For excavation or filling acid sulfate soils are not affected by changes to the site's hydrology A2.4 The site is not on the contaminated land register	
P3 Filling or excavation must not directly, indirectly or cumulatively, cause any increase in flooding or drainage problems Earthworks within a Waterway Corridor are to be in accordance with the Compensatory Earthworks Planning Scheme Policy		A3.1 No filling or excavation is located: <ul style="list-style-type: none"> • in any waterway corridor as shown on the Planning Scheme Maps and defined in the definitions • within the waterway corridor or, if there is no waterway corridor, within the 100 year ARI extent • in any wetland as shown on the Planning Scheme Maps and defined in the definitions A3.2 Filling or excavation does not cause ponding on the site or on nearby land A3.3 Changes to flooding due to filling or excavation will not adversely affect the safety or use of any adjoining site and land upstream and downstream A3.4 Any changes to run-off characteristics resulting from filling for storm events, up to at least the 2 year ARI design storm, are minimised in an ecologically sensitive manner A3.5 Filling or excavation does not adversely affect the flow of water in any overland flow path <i>Note: compliance with Acceptable Solutions A3.1 to A3.5 can be demonstrated through the submission of a report detailing:</i> <ul style="list-style-type: none"> • calculations for flood modelling of the riparian zone, including ground cover, understorey and canopy vegetation • management strategies to prevent adverse flooding and minimise changes to run-off characteristics consistent with Council's current Subdivision and Development Guidelines and Environmental Best Management Practice for Waterways and Wetlands 1996 	

Performance Criteria		Acceptable Solutions	
P4	<p>Filling or excavation must not adversely affect environmental values in receiving waterways or wetlands</p> <p><i>Note: for guidance on stormwater management refer to the Management of Urban Stormwater Quality Planning Scheme Policy</i></p>	A4	Filling or excavation complies with the Stormwater Management Code and Council's Erosion and Sediment Control Standard
P5	<p>Emissions of air pollutants from filling or excavation, particularly dust, must not have a significant environmental harm or nuisance impacts</p> <p><i>Note: for guidance on the assessment of air quality, refer to the Air Quality Planning Scheme Policy</i></p>	A5.1	No dust emissions extend beyond the boundary of the site
		A5.2	No other air emissions, including odours, are detectable at the boundary of the site
		A5.3	A management plan for control of dust and air emissions is prepared and implemented
P6	<p>Emissions of noise must not cause significant environmental harm or nuisance impacts</p> <p><i>Note: for guidance on the assessment of noise impacts refer to the Noise Impact Assessment Planning Scheme Policy</i></p>	A6.1	The total duration of filling or excavation operations does not exceed 4 weeks
		A6.2	Filling or excavation operations occur only between 7am to 6pm Monday to Saturday
P7	Traffic generated by filling or excavation must not impact on the amenity of the surrounding area	P7.1	Haul routes used for transportation of fill to or from the site only use Major Roads
		P7.2	Truck movements generated by filling or excavation do not exceed 20 truck movements per day
		P7.3	Truck movements generated by filling or excavation do not occur for longer than 4 weeks



BMT WBM Brisbane
Level 8, 200 Creek Street Brisbane 4000
PO Box 203 Spring Hill QLD 4004
Tel +61 7 3831 6744 Fax +61 7 3832 3627
Email bmtwbm@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Denver
8200 S. Akron Street, Unit 120
Centennial Denver Colorado 80112 USA
Tel +1 303 792 9814 Fax +1 303 792 9742
Email denver@bmtwbm.com
Web www.bmtwbm.com.au

BMT WBM Mackay
Suite 1, 138 Wood Street Mackay 4740
PO Box 4447 Mackay QLD 4740
Tel +61 7 4953 5144 Fax +61 7 4953 5132
Email mackay@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Melbourne
Level 5, 99 King Street Melbourne 3000
PO Box 604 Collins Street West VIC 8007
Tel +61 3 8620 6100 Fax +61 3 8620 6105
Email melbourne@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Newcastle
126 Belford Street Broadmeadow 2292
PO Box 266 Broadmeadow NSW 2292
Tel +61 2 4940 8882 Fax +61 2 4940 8887
Email newcastle@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Perth
Suite 3, 1161 Hay Street West Perth 6005
Tel +61 8 9328 2029 Fax +61 8 9484 7588
Email perth@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Sydney
Level 1, 256-258 Norton Street Leichhardt 2040
PO Box 194 Leichhardt NSW 2040
Tel +61 2 9713 4836 Fax +61 2 9713 4890
Email sydney@bmtwbm.com.au
Web www.bmtwbm.com.au

BMT WBM Vancouver
401 611 Alexander Street Vancouver
British Columbia V6A 1E1 Canada
Tel +1 604 683 5777 Fax +1 604 608 3232
Email vancouver@bmtwbm.com
Web www.bmtwbm.com.au