STATEMENT TO QLD FLOODS COMMISSION OF INQUIRY

NAME: Mr Anthony Martini

OCCUPATION: Director Engineering Construction and Maintenance – Moreton Bay Regional Council

DATE OF STATEMENT: 2 December 2011

I, ANTHONY MARTINI, Director Engineering Construction and Maintenance, of Moreton Bay Regional Council (MBRC), 220 Gympie Road, Strathpine, Queensland, being under oath, say as to the points raised in the letter dated 29 November 2011 – **Reference Doc 1791134**

1. **Whether the Moreton Bay Regional Council Male Road, Caboolture Flooding Assessment report has been completed; and, if not, when it is likely to be completed.**

   1.1 The report has been completed and has been endorsed by Council at its Coordination Meeting of 15 November 2011.

2. **If the report referred to in paragraph 1 above has been completed, whether the report has been provided to any interested parties (please also provide a copy of the released report).**

   2.1 The report has been provided to the affected residents and property owners of Male Road under cover of a letter inviting these residents to a public presentation and feedback session (about the report and its findings) at Moreton Bay Regional Council's Caboolture office from 6:00pm - 7:00pm on 5 December 2011. A copy of the adopted/endorsed report is enclosed.

3. **If the report referred to in paragraph 1 above has been completed, how and when council is considering implementing the recommendations of the report (please provide copies of council documents discussing the potential implementation of these recommendations).**

   3.1 The adopted/endorsed report lists a number of recommendations. For ease, they are represented below with accompanying advice as to action and timing:

      (a) Formally advise DTMR of bridge maintenance issues (i.e. clearance of minor trees at upstream face) and request consideration for inclusion in their maintenance program.
      Action – DTMR formally advised by letter dated 23 November 2011

(b) The flood risk of the properties at Male Road (in terms of ARI) will be fully quantified once the detailed Tuflow hydraulic model for the Regional Flood Database (RFD) is complete enabling direct comparison of the predicted flood levels with the floor heights of each of the dwellings.

(c) Following the completion of the RFD Council will be able to quantify the impacts of flooding across the region in a consistent manner. At that time Council can re-visit the impacts of the Bruce Highway Bridge(s) however it is not expected that the observations made to date will change.

(d) As part of the MBRC submission for the Bruce Highway Upgrade Project, include the request for DTMR to give consideration to upgrading the bridges at King John Creek to reduce flood risk.
Action – DTMR formally advised by letter dated 23 November 2011

(e) The future zoning of these flood affected parcels should be reviewed as part of the preparation of the MBRC Planning Scheme. It is understood that Council has previously attempted this however due to the properties being located within the SEQ region 'urban footprint' the application was not supported by State Government planners. As part of the preparation of the MBRC Planning Scheme, and in light of the observed flooding in January 2011, a further attempt could be justified.
Action – MBRC's new consolidated planning scheme is targeted for completion in 2013/14.

(f) Give consideration to including the upgrade of the table drain outside 118 & 126 Male Road as a future project.
Action – will be done in the 2011/12 financial year.

(g) The flood affected property owners should consider utilising flood resistance and flood resilience measures to help minimise the damage from floodwaters and greatly reduce the timescale for recovery.
Action – residents to pursue.

- Flood Resistance - these measures are aimed at keeping water out of buildings, or at least minimising the amount that enters by the use of barriers such as door guards to seal entry points; the use of water proof sealants / coating; capping air-bricks; etc.
- Flood Resilience – these measures are aimed at minimising the damage when a building is flooded, thereby facilitating the quickest possible recovery. Resilience measures include the use of flood resistant building materials within walls / floors and in other parts of the structure; the raising of electrical wiring above flood levels; etc.

Other measures which could be adopted by the current or future property owners include:

- Raising the dwelling to above a large design flood level. This is generally only practical when the dwelling reaches the end of its design life and must be replaced.
- Relocate the dwelling to higher ground. This would most likely involve building a raised ground area to relocate the dwelling. Again this is generally only practical when the dwelling reaches the end of its design life and must be replaced.
- Flood levees and / or flood walls around the dwelling.

All the facts sworn to in this affidavit are true and correct to my knowledge and belief except as stated otherwise.

[redacted]

Sworn by ANTHONY MARTINI at Strathpine)
this 2nd day of December 2011)
before me, [redacted])

[redacted]

Solicitor

Moreton Bay
Regional Council

Phone: (07) 3480 6452
Fax:
Our Ref: A6285505
Date: 23 November 2011

Regional Director
DTMR North Coast Region
PO Box 1600
Sunshine Plaza Post Shop
MAROOCHYDORE QLD 4558

Dear Mr Tennant,

Male Road Flood Investigation Report

I am writing to advise you that the investigation report entitled *Caboolture Male Road Flood Investigation (October 2011)* is now complete and was endorsed by Council during its Co-ordination Committee meeting held on 15 November 2011.

The adopted recommendations state the following:

> That Council formally advise Department of Transport & Main Roads of waterway maintenance issues adjacent to the Bruce Highway bridge over King John Creek and request vegetation and blockage management in their maintenance programme.
>
> That Council formally request the Department of Transport & Main Roads to investigate the feasibility of upgrading the Bruce Highway bridge(s) as part of any future highway upgrade works to minimise contribution to flooding of Male Road.

I have included a copy of both the Coordination Committee Meeting minutes regarding Male Road Flood Investigation and a copy of the Caboolture Male Road Flood Investigation (October 2011) for your information.

For further information please contact [redacted] on [redacted] or email [redacted]

Yours sincerely,

[redacted]

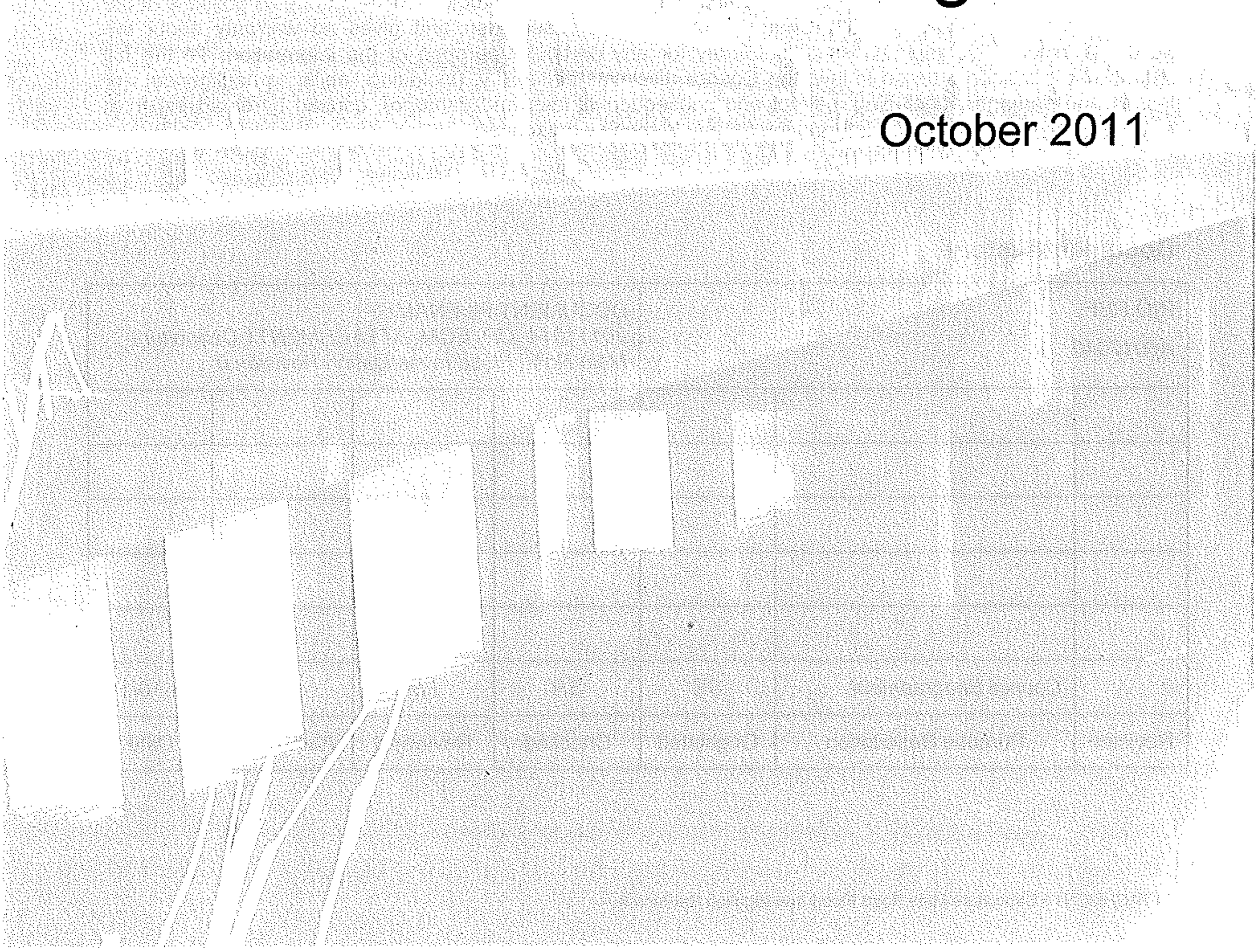
Manager Engineering
Engineering, Construction and Maintenance

Enc

Moreton Bay Regional Council

Caboolture Male Road Flood Investigation

October 2011



Caboolture Male Road Flood Investigation

October 2011

Notice

Document History

RIO REF: *A6017040*			DOCUMENT FILENAME: *20111014_OP_ECM_ATTACHMENT1 Caboolture Male Road Flood Investigation Revision 0*			
0	*Council Endorsement*	[redacted]				31/10/11
Revision	Purpose Description	Originated	Checked	Reviewed	Authorised	Date

Contents

1. Introduction

1.1 Background

Male Road is situated in northern Caboolture adjacent to King John Creek. Properties of Male Road which adjoin the creek are subject to regular flooding. This report has been undertaken to assess the flooding and to identify whether there are any possible mitigation measures to alleviate flooding in the vicinity of Male Road.

This report will assess the following with respect to flooding:

- The generalised flooding pattern at Male Road
- The impact of the Bruce Highway
- The impact of increasing / decreasing the hydraulic efficiency of King John Creek
- The impact and sensitivity to catchment development, and
- Minor local drainage issues

For the purposes of this report:

- A "large flooding event" is of the order of a 50-yr to 100-yr Average Recurrence Interval (ARI) event. A large flooding event has an annual chance of occurrence approximately between 1% and 2%
- A "large to extreme flooding event" is of the order of a 1000-yr Average Recurrence Interval (ARI) event. A large to extreme flood event has an annual chance of occurrence of approximately 0.1%
- An "extreme flooding event" is of the order of the Probable Maximum Flood (PMF). The PMF is statistically the largest flooding event which could occur.

1.2 Limitations

A broad scale Tuflow 2-dimensional hydraulic model was created for the Caboolture River (and tributaries) for Stage 1 of the ongoing Regional Flood Database (RFD) project. This un-calibrated preliminary model was truncated and utilised to simulate both large and extreme flooding events for the purposes of this assessment. Design hydrology for the Stage 1 RFD modelling was only available for the 100-yr ARI and PMF events. The modelling undertaken is based on the most recent aerial survey available circa 2009. Some areas of the floodplain have been altered since that time however these changes are in areas that will not substantially alter predicted flood behaviour at Male Road.

As part of Stage 2 of the (RFD) project a detailed hydraulic model of King John Creek is currently being prepared. At the time of writing this report, this model is yet to be completed and thus some of the estimates in this report may be subject to change.

Smaller frequent flooding events were not simulated as part of this investigation, as the design hydrology for these events was not available as part of the Stage 1 RFD modelling. Also, surveyed levels of the habitable floors for the flood affected Male Road properties were not available. Therefore, it has not been possible to ascertain the standard of flood protection (flood immunity) with respect to habitable floor flooding for each of the flood affected properties.

The limitations described above are unlikely to alter the conclusions / recommendations of this report.

2. General Flooding Pattern at Male Road

Male Road and adjoining properties to the north are largely within the floodplain of King John Creek and have been subject to flooding on numerous occasions in the past. King John Creek is a major tributary of the Caboolture River and flows within private property between Male Road and Flowers Road, upstream of the Bruce Highway. **Figure 2.1** indicates the location of Male Road with respect to the creek, floodplain and Bruce Highway. The floodplain extent is defined by the inundation extents of the PMF, as indicated in blue.

At the Bruce Highway, the contributing catchment area of King John Creek is approximately 19.2 km^2 and the upstream creek length is over 10 km. Lagoon Creek joins King John Creek approximately 1.5 km downstream of the Bruce Highway and the catchment area of Lagoon Creek is approximately 45 km^2.

From review of the results of the Tuflow modelling the following could be ascertained:

- Upstream of the Bruce Highway in the vicinity of Male Road, the floodplain of King John Creek (as defined by the PMF) is up to approximately 800 m wide and inundates areas outside of Male Road and Flowers Road. These extents are based on the most recent aerial survey circa 2009; therefore any recent topographic changes (e.g. development south of Male Road) may not be fully reflected in the extent shown.
- Downstream of the Bruce Highway to the confluence with Lagoon Creek, the flooding extent in a large flooding event (~50 to 100-yr ARI) is up to approximately 600 m wide.
- There is little difference in flood level between the downstream of the Bruce Highway to the confluence with Lagoon Creek. This would indicate that the geometry of the channel / floodplain at the confluence with Lagoon Creek is the limiting factor (hydraulic control) on flood levels in this reach.
- In the flooding events modelled, the much larger flow in Lagoon Creek would appear to be responsible for producing backwater from the confluence up to the downstream side of the Bruce Highway.
- Upstream of the Bruce Highway there is little change in flood level for approximately 1 km upstream. The impact of the Bruce Highway is discussed further in **Section 3.**
- In the flooding events modelled, there is flow transfer from the Lagoon Creek Catchment to the King John Creek Catchment upstream of the Bruce Highway.
- The detention basin serving the new development (opposite 94 Male Road) would become significantly inundated by floodwater backing up from King John Creek in a large flooding event.
- It is estimated that the critical duration for the storm event which produces the highest flood levels at Male Road is of the order of 3 to 6 hours. This will be confirmed in the RFD Stage 2 modelling.

Figure 2.1 – Floodplain Extent at Male Road

3. Impact of the Bruce Highway

A hydraulic investigation was undertaken for the Bruce Highway waterway crossing of King John Creek to ascertain whether the Bruce Highway was contributing to the flooding of properties at Male Road. **Figure 3.1** indicates the upstream face of the northbound bridge.

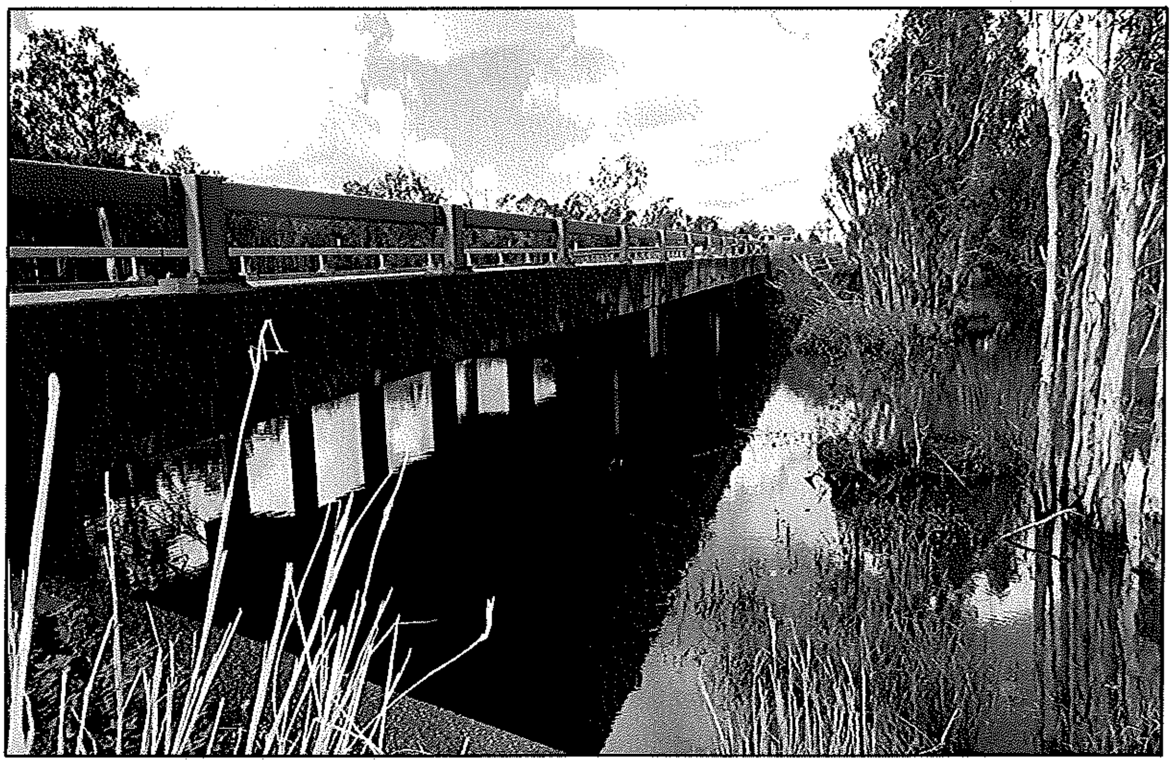


Figure 3.1 – Upstream Face of the Bruce Highway Bridge

The figure indicates that there are some minor trees immediately upstream of the bridge face. This vegetation could potentially increase the potential for blockages and as such should be removed as part of routine maintenance by the Department of Transport and Main Roads (DTMR).

Design drawings for the Bruce Highway construction were sourced from DTMR. Currently, the Bruce Highway is a dual carriageway with the northbound carriageway approximately 1.2 m higher than the southbound carriageway at the creek centreline. The lower southbound carriageway was constructed prior to the northbound carriageway circa 1968. The northbound carriageway was subsequently constructed circa 1980. Both bridges are approximately the same span (~35 m); however the southbound bridge has three sets of piers whereas the northbound has only two sets of piers. The northbound carriageway embankment is up to 2.75 m above the ground level and the southbound carriageway embankment is up to 1.5 m above the floodplain.

Hydraulic modelling of the waterway crossing was undertaken using the HEC-RAS software with boundary conditions taken from the preliminary Stage 1 RFD Tuflow model. Modelling of the large to extreme event (~1000-yr ARI) required interpolation between the 100-yr ARI and PMF to obtain a flow rate and downstream boundary condition and therefore should be regarded as approximate only. Bridge details and carriageway levels were taken from the DTMR drawings. The creek cross-section geometry was taken from the DTMR drawings and the floodplain geometry from MBRC Airborne Laser Scanning (ALS) data.

Results indicate that in a large flooding event (~50 to 100-yr ARI) the impact of the Bruce Highway is to increase upstream flood levels in the order of 0.27 m. This difference is indicated by the red and red-dashed lines in **Figure 3.2**. In a large to extreme flooding event (~1000-yr ARI) this increases to approximately 0.56 m. This difference is indicated by the blue and blue-dashed lines in **Figure 3.2**. This results in increases in flood level at Male Road of the order of 0.3 m and 0.6 m respectively for these flooding events. However, as there are no surveyed habitable floor levels, it is not possible to report with any certainty how this increase impacts on dwelling flooding at Male Road.

DTMR are currently in the consultation phase for the upgrade of the Bruce Highway in the vicinity of King John Creek. In correspondence with DTMR, they have indicated that they are intending to upgrade the southbound lane in the future. However, other projects are likely to take precedence and therefore at this stage works will not be undertaken before 2019.

In the event that DTMR raised the level of the southbound carriageway to match the northbound carriageway (and duplicated the northbound bridge); current modelling indicates that this would reduce levels in a large flooding event (~50 to 100-yr ARI) by 0.13 m. In a large to extreme flooding event (~1000-yr ARI) this would increase flood levels by 0.03 m.

In the event that DTMR raised the level of the southbound carriageway to match the northbound carriageway (and upgraded both bridges to say 60 m span), current modelling indicates that this would reduce levels in a large flooding event (~50 to 100-yr ARI) by 0.24 m. In a large to extreme flooding event (~1000-yr ARI) this would reduce flood levels by 0.49 m.

A blockage analysis for the existing bridge(s) was not undertaken for this report; however it would be expected that flood levels at Male Road would be sensitive to any major blockages of the Bruce Highway bridge(s). Therefore, it is important maintenance activities are continued to ensure debris in close proximity to the bridge, such as large dead trees are removed routinely.

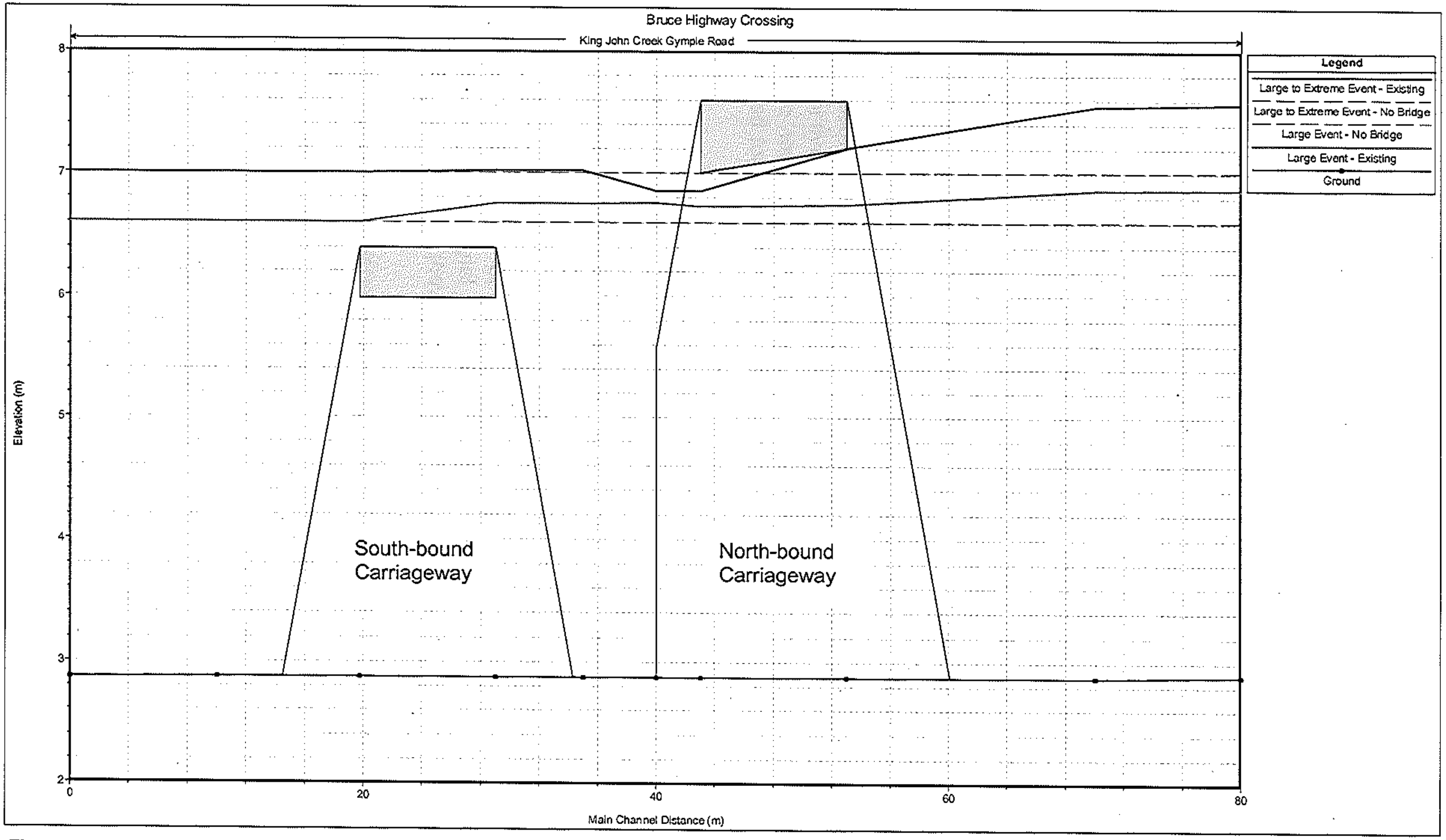


Figure 3.2 – Long Section through Bruce Highway Crossing

4. Impact of Increasing / Decreasing the Conveyance of the Creek

An analysis was undertaken using the broad scale Tuflow hydraulic model to determine the impact on flood levels at Male Road to increasing / decreasing the conveyance of King John Creek in the Male Road reach. The simulation was undertaken for a large flooding event (~50 to 100-yr ARI) to assess whether this was an effective option for reducing flood levels at Male Road.

To simulate the increase in conveyance, the hydraulic roughness was decreased from a Manning's 'n' roughness value of 0.06 to 0.015 in the channel / floodplain. **Figure 4.1** indicates the modified area, which is over 1.2 km in length and has an average width of 150 m. A Manning's 'n' value of 0.015 would be typical of rough finished concrete and is a hypothetical scenario to demonstrate the hydraulic impact of significantly increasing the creek conveyance.

To simulate the decrease in creek conveyance, the hydraulic roughness was increased from a Manning's 'n' roughness value of 0.06 to 0.15 over the same modified area as indicated in **Figure 4.1**. A Manning's 'n' value of 0.15 would constitute extremely dense vegetation comprising of large trees (1 m spacing), fallen trees, dense shrubs, low branches which would be difficult and slow to walk through. This is a hypothetical scenario as the roughness in this reach would never reach this value over this entire width.

Table 4.1 – Impact of Creek Roughness

Scenario	Change from Existing Flood Level (m)		
	[redacted] Male Road	[redacted] Male Road	[redacted] Male Road
Significantly Increasing Creek Conveyance at Male Road	-0.05	-0.05	-0.08
Significantly Decreasing Creek Conveyance at Male Road	0.12	0.14	0.17

The results in **Table 4.1** indicate that in a large flooding event (~50 to 100-yr ARI) the impact of significantly increasing the creek capacity is very small. Therefore, a potential flood mitigation option of increasing the creek size and removing trees from the riparian zone of the creek / floodplain would show very limited benefit. This is expected as the two main hydraulic controls are the (i) Bruce Highway and / or (ii) the channel / floodplain capacity in the vicinity of the confluence with Lagoon Creek, as noted previously.

The results also indicate that in a large flooding event (~50 to 100-yr ARI) the impact of significantly reducing the creek conveyance is to slightly increase flood levels at Male Road. As the scenario modelled is extreme and totally hypothetical it can be deduced from the results that flooding in Male Road is not sensitive to roughness increases in the creek due to limited maintenance, debris accumulation, minor siltation, in the channel / floodplain.

Figure 4.1 – Extent of Roughness Modification

5. Impact of Development in the Catchment

5.1 General

It is the opinion of the residents of Male Road that recent development within the King John Creek Catchment has resulted in more severe flooding of their properties, with particular reference to the recent flooding events of May 2009 and January 2011. To assess this claim an analysis of the historic rainfall and flood level records has been undertaken. Also, hydraulic modelling has been undertaken to assess the sensitivity of flood levels at Male Road with respect to increased impervious area within the King John Creek and Lagoon Creek Catchments.

Increases in impervious areas such as buildings, roads, footpaths, etc through catchment development will generally increase flood impacts within the catchment, unless controlled. Uncontrolled development will generally increase flood discharges, flood volumes, flood velocities, catchment response time, etc.

Development within the Moreton Bay Regional Council (Caboolture District) area is controlled by development policy. The policy requires that the stormwater runoff rates from newly developed areas does not exceed the pre-developed runoff rates and has been in effect for more than 20 years. This is primarily achieved by providing storage facilities such as detention / retention basins and also through the use of infiltration devices to limit the discharge to the pre-developed rate. These control devices are designed for flows up to the 100-yr ARI event in most cases. This is standard stormwater design practice in Australia and developed countries throughout the world.

For events greater than the 100-yr ARI, there may be some uncontrolled discharges as the capacity of stormwater attenuation devices is exceeded. However, this is not likely to result in increased flood risk as the flood sensitivity to impervious cover declines dramatically due to the large degree of catchment saturation in these extreme events.

5.2 Historic Flooding at Male Road

Historical flood data exists for five flooding events, of which the source and quality of this data varies. **Table 5.1** indicates the source of this data as well as an opinion as to whether the data is suitable for the purpose of this analysis.

The available rainfall records for the April 1988 and April 1989 events are limited. Therefore it was necessary to source the data from rainfall stations a considerable distance from the King John Creek Catchment. There was no continuous rainfall (pluviograph) data available at locations within the catchment or nearby during these events. The rainfall data used in this analysis has been averaged from stations at Samford, Ferny Hills, Caloundra, Mt Glorious, Dayboro, Margate and Landsborough and as such could be considerably different to what the catchment experienced.

Nonetheless, it was important in this analysis to at least make a coarse estimate of the size of these two storm events.

Table 5.1 – Historic flooding data

Flooding Event	Historic Rainfall Record		Historic Flood Mark	
	Source	Appropriate for Purpose	Source	Appropriate for Purpose
April 1988	MBRC records	No, but limited alternative data available	MBRC records	Yes
April 1989	MBRC records	No, but limited alternative data available	MBRC records	Yes
February 1999	MBRC records	Yes	MBRC records	Yes
May 2009	Floodwise database	Yes	Resident photos	Yes
January 2011	Floodwise database	Yes	MBRC records	Yes

The historic flood levels have been surveyed from debris marks after the flooding event had passed. Therefore, they would be considered representative, but not of extreme accuracy due to the nature of establishing the flood level from a debris mark, which may or may not be clearly defined. MBRC did not have flood level records for the 2009 event, so the levels were estimated from photos provided by the resident of [redacted] Male Road.

Some characteristics of the rainfall events are as follows:

5.2.1 3rd to 7th April 1988

This event occurred for around 4 to 6 days with on average approximately 300 to 400 mm of rain falling in the region. The gauge readings varied from 200 to 440 mm total rainfall depth. There doesn't appear to be any significant rainfall events in the preceding weeks leading up to the event. However, because of the long length of the storm event it is likely that the catchment was very saturated when the rainfall burst that produced the flood peak occurred.

Within the regional area, the ARI for all durations during this event was determined as approximately 1 to 2 years. However, because this rainfall analysis is not based on any gauges close to the catchment, the actually storm ARI on the King John Creek Catchment could vary significantly and in this case would appear to be greater than 1 to 2 years.

5.2.2 1st to 4th April 1989

This event occurred for around 3 days with on average approximately 350 to 400 mm of rain falling over the King John Creek Catchment. There appears to be significant rainfall experienced approximately 10 days prior to the event.

Within the regional area, the 12 to 24 hour durations for this event were the most intense with an estimated ARI of 10 years. The ARI for the critical duration was approximately 2 to 10 years. However, because this is rainfall analysis is not based on any gauges close to the catchment, the actually storm ARI on the King John Creek Catchment could vary.

5.2.3 7th to 10th February 1999

This event occurred over 2.5 days with on average approximately 250 to 300 mm of rain falling over the King John Creek Catchment. There was significant rainfall in the week preceding the event, meaning the catchment would have been quite saturated prior to the onset of the event.

Within the King John Creek Catchment, the most intense rainfall was over approximately 24 hours and was between 5 and 10-yr ARI. The ARI for the critical duration was approximately 1 to 2 years.

5.2.4 18th to 21st May 2009

This event occurred over 2.5 to 3.5 days with on average approximately 350 to 450 mm of rain falling over the King John Creek Catchment. The most intense rainfall which produced the flood peak occurred on the 19th and 20th May, meaning the catchment would have been fully saturated at the onset of this burst.

Within the Upper King John Creek Catchment, the most intense rainfall was over approximately 24 hours and was close to a 20-yr ARI. The ARI for the critical duration was approximately 5 years.

5.2.5 9th to 11th January 2011

This event occurred over approximately 2.5 days from the 9th to the 11th January. Over 400 mm of rain fell over this period with the most intense rainfall burst which produced the flood peak occurring on the morning of the 11th January. There was significant rainfall in the weeks preceding the event, meaning that the catchment would have been fully saturated prior to the storm event. Within the Upper King John Creek Catchment, the most intense burst was over approximately 6 hours and was close to a 100-yr ARI.

Table 5.2 indicates a comparison between the historic flood levels and the estimated ARI for the storm durations shown.

Table 5.2 – Comparison between Historic Flood Level and Estimated ARI

Location	Historic Flood Level (m AHD)				
	April-88	**April-89**	**Feb-99**	**May-09**	**Jan-11**
Pumicestone Rd Bridge	-	7.29	-	-	8.20
[redacted] Pumicestone Rd	7.49	-	-	-	-
[redacted] Male Rd	7.18	-	-	-	7.50
[redacted] Flowers Rd	7.23	-	6.94	-	-
[redacted] Flowers Rd	-	7.15	-	7.2 - 7.25	-
[redacted] Male Rd	7.10	7.00	6.83	7.2 - 7.25	7.65
Upstream Bruce Highway	7.11	6.77	6.76	-	-
Downstream Bruce Highway	-	6.66	-	-	-
RANKING	3rd	4th	5th	2nd	1st
Storm Duration	**Estimated ARI (years)**				
	April-88	**April-89**	**Feb-99**	**May-09**	**Jan-11**
3-hour	1 to 2	2 to 5	< 1 to 2	~ 5	15 to 100+
6-hour	1 to 2	5 to 10	< 1 to 2	~ 5	94 to 100+
12-hour	1 to 2	~ 10	2 to 5	10 to 20	31 to 100+
18-hour	1 to 2	~ 10	5 to 10	10 to 20	14 to 100+
24-hour	1 to 2	~ 10	5 to 10	~ 20	8 to 72
RANKING	5th	3rd	4th	2nd	1st

The surveyed flood level records rank the flooding events from most severe to least severe as: (1) January 2011; (2) May 2009; (3) April 1988; (4) April 1989 and (5) February 1999.

The rainfall analysis ranks the storm events from most intense to least intense with respect to producing flooding at Male Road as: (1) January 2011; (2) May 2009; (3) April 1989; (4) February 1999 and (5) April 1988.

The only anomaly with respect to these rankings is the April 1988 event which would appear larger than the rainfall analysis predicts (as noted previously). This is most likely because the rainfall analysis was undertaken on regional rain gauges, rather than rain gauges within the catchment or close by, due to limited rainfall data available.

Apart from this anomaly the results appear as expected and there is correlation between the rainfall ARI and the flood magnitude. The January 2011 and May 2009 events comprised more intense rainfall than the previous events and therefore produced higher flood levels at Male Road.

Flood producing rainfall is dependant on the intensity and duration relationship of the rainfall with respect to the catchment size and response time. For example, a 20-yr

6 hour storm event has a rainfall intensity of 26.33 mm/hr and would produce 158 mm of rainfall, whereas a 20-yr 48 hour storm event has a rainfall intensity 7.55 mm/hr and would produce 362 mm of rainfall. Yet the 20-yr 6 hour storm would produce a much larger flood peak at Male Road than 20-yr 48 hour event even though the total rainfall depth is significantly less.

The total rainfall depth of different storm events cannot be compared to assess the severity of the rainfall which produces the flooding event. Long duration storm events over many days will only produce the most severe flooding in catchments with areas much larger than those within the MBRC area.

In catchments such as King John Creek, a long duration storm event over many days has the hydrologic impact of completely saturating the catchment, which has the affect of making rural / pervious area behave similar to hardstand / impervious areas. The severity of the flooding event is controlled by the intensity / duration relationship of the rainfall bursts which occur within this long duration storm event.

5.3 Sensitivity to Urbanisation

The sensitivity of flood levels at Male Road with respect to increases in catchment impervious area (development) was assessed using the Tuflow hydraulic model. Three distinct scenarios were modelled for a 180-minute duration large flooding event (~50-yr to 100-yr), namely:

- Existing Conditions - the scenario assumes the existing degree of impervious area for both the King John and Lagoon Creek catchments.
- King John Creek Catchment with 100% impervious area – this scenario assumes that the Lagoon Creek Catchment is in its current condition.
- Both King John and Lagoon Creek Catchment with 100% impervious area.

Figure 5.1 indicates the location of Male Road with respect to the King John Creek and Lagoon Creek Catchments.

Both these development scenarios are totally hypothetical and should be considered an upper limit which would be never reached. This is because of the following reasons:

- The percentage impervious area of a fully urbanised catchment would never reach 100% due to the requirement for lawns, parks, green spaces, etc.
- These scenarios assume uncontrolled runoff from developed areas, whereas in reality the runoff is controlled by detention basins, etc, as noted previously.

Table 5.3 indicates the increase in flood level for both scenarios when compared with the existing conditions.

Table 5.3 – Impact of Urbanisation

Scenario	Increase from Existing Flood Level (m)		
	[redacted]ale Road	[redacted] Male Road	[redacted] Male Road
King John Creek Catchment at 100% Impervious	0.15	0.16	0.16
King John Creek and Lagoon Creek Catchments at 100% Impervious	0.15	0.16	0.16

The results indicate that in a large flooding event (~50 to 100-yr ARI), with the catchment fully impervious and allowing totally uncontrolled runoff that the increase in flood level would only be of the order of 0.15 m at Male Road. As this catchment development is a hypothetical upper limit (which would never occur) and the increase in flood level is not significant, it can be deduced that flood levels at Male Road are not sensitive to development within the catchment. The floodplain of King John Creek at Male Road is very wide and therefore small increases in discharge result in negligible changes in flood level.

Figure 5.1 – King John and Lagoon Creek Catchments

6. Local Drainage Issues

6.1 Detention Basin

The detention basin at the corner of Male Road and Elof Road drains a proportion of the recent development in the vicinity of Male Road. As previously noted in **Section 5.1**, detention basins (or similar) are required by MBRC policy to control stormwater discharge from developed areas.

During the recent King John Creek flooding events, the residents of Male Road have noted that the detention basin was close to overtopping (or just overtopping). It is the opinion of the Male Road residents that the detention basin is therefore not operating as intended and / or under capacity, which is contributing to flooding problems at Male Road.

At the time of development application, Council was provided with a stormwater management report prepared by the developer's consultant MRG Water Consulting Pty Ltd. This report provided detailed calculations demonstrating the performance of the proposed detention basin. Council engaged an independent peer review of this work by Council's consultant Brisbane Stormwater Management Pty Ltd. This independent review confirmed that the detention basin would effectively mitigate increased peak discharge from the adjoining local catchment that it serves.

As part of this current investigation:

- An inspection of the detention basin was undertaken by Council's Principal Engineer Drainage Waterways and Coastal Planning
- The drawings and stormwater report prepared at the time of development application have been reviewed
- The size of the local catchment draining to the detention basin has been independently confirmed and agrees with the original design (~50 hectares)
- The volume of the detention basin has been independently confirmed and agrees with the original design (~8,000 m3)
- The size of the detention basin outlet has been independently confirmed and agrees with the original design (3 x 2.1m wide by 0.9m high box culverts)
- A similar sized detention based was identified in the upper reaches of the same local catchment (~8,000 m3)
- The ratio of storage to catchment area was calculated to be 320m3 per hectare of catchment. This calculation is based on a total catchment area of 50 hectares and a total detention storage volume of 16,000m3 (i.e. both basins)

Based on these observations and the calculated ratio of storage to catchment area, there is no reason to suggest that the detention basin configuration is in anyway deficient or inappropriate. Indeed the observed arrangement is typical of normal subdivision design practice whereby a detention basin serves a local catchment prior to discharge into a major floodplain. The detention basin is located within the floodplain of King John Creek so it is expected that it would be susceptible to floodwater ingress when the flood level in the creek is very high. The detention basin is not intended to control peak flows from the regional catchment, therefore the observed inundation by floodwaters from King John Creek is not considered to be a design problem. The typical design case for the detention basin will instead be during a much shorter and more intense rainfall event when King John Creek is not experiencing flooding at the same time.

In the event that a large short-duration local catchment storm occurred whilst the flood level in King John Creek was also very high, the capacity of the detention basin would most likely be exceeded. However, this would be expected, as the probability of this joint occurrence (i.e. a large short-duration storm (local catchment critical) and large long-duration storm (King John Creek critical)) is extremely rare and above the current design standards for Australia. Under normal design conditions King John Creek flooding (long duration storm) will not occur at the same time as flooding in the local catchment (short duration storm).

6.2 Table Drain outside 118 & 126 Male Road

The table drain which traverses the frontages of [redacted] Male Road, drains a very small local catchment. The drain is laid at a very flat grade and experiences ponding in local catchment storm events.

The re-construction of Male Road (including the provision of kerb and channel) would have reduced the contributing catchment area to this table drain by intercepting the runoff and discharging it through the underground piped drainage system for the road. DWCP would consider the road re-construction has reduced the frequency of ponding experienced, but may have slightly changed its location / depth.

To further reduce the ponding experienced there could be merit in re-grading the channel and providing a concrete invert (or similar) and upgrading two driveways. However, this may not result in a dramatic reduction in local ponding.

7. Conclusion

Properties of Male Road adjoining King John Creek are subject to regular flooding from the creek. The predominant reason properties of Male Road are subject to regular flooding is because they are low-lying and located within the floodplain of King John Creek.

At the time of subdivision, it is likely that the design standards with respect to flood planning for development were different to current practice. In the past, it was common for flood planning levels to be based on an historical event, rather than the probabilistic techniques used today. Similarly, at the time of subdivision, the tools / technology available to accurately predict flood levels would have been inferior to those used today.

Figure 7.1 indicates a comparison of the contributing factors to flood risk at Male Road. It is apparent that the largest contributing factor is the natural variance in the magnitude of the flooding events.

Another contributing factor which increases flood risk at Male Road is the Bruce Highway. Preliminary modelling results indicate that in a large flooding event (~50 to 100-yr ARI) the impact of the Bruce Highway is to increase upstream flood levels in the order of 0.3 m at Male Road. In a large to extreme flooding event (~1000-yr ARI) this increases to approximately 0.6 m at Male Road. As the calibrated Tuflow hydraulic model of King John Creek is in the process of being completed for the RFD project, it is not possible to report with any certainty how this increase impacts on dwelling flooding at Male Road. Although this afflux is not ideal, it is considered to be consistent with the standard of engineering design that prevailed at the time of the bridge construction.

A blockage analysis for the existing bridge(s) was not undertaken for this report; however it would be expected that flood levels at Male Road would be sensitive to any major blockages of the Bruce Highway bridge(s).

DTMR have indicated they are intending to upgrade the southbound lane in the future. However, other projects will take precedence and these works are unlikely to be undertaken before 2019. However, the feasibility of these works from a cost-benefit perspective would need to be confirmed through a detailed hydraulic investigation and cost-benefit analysis. It is possible that residents may still have flooding concerns even if the bridges were to be upgraded.

In the event that DTMR raised the level of the southbound carriageway to match the northbound carriageway (and duplicated the northbound bridge); current modelling indicates that this would reduce levels in a large flooding event (~50 to 100-yr ARI) by 0.13 m. In a large to extreme flooding event (~1000-yr ARI) this would increase flood levels by 0.03 m.

In the event that DTMR raised the level of the southbound carriageway to match the northbound carriageway (and upgraded both bridges to say 60 m span), current modelling indicates that this would reduce levels in a large flooding event (~50 to 100-yr ARI) by 0.24 m. In a large to extreme flooding event (~1000-yr ARI) this would reduce flood levels by 0.49 m.

Catchment development and potential increases in stormwater runoff are controlled by MBRC development policy. Notwithstanding, an assessment was undertaken to test the sensitivity of the Male Road area to uncontrolled catchment development in the King John Creek and Lagoon Creek Catchments. The results indicated that in a large flooding event (~50 to 100-yr ARI) the Male Road area is not sensitive to uncontrolled development, with a hypothetical 100% impervious catchment area only increasing flood levels by 0.15 m in a large flooding event (~50 to 100-yr ARI).

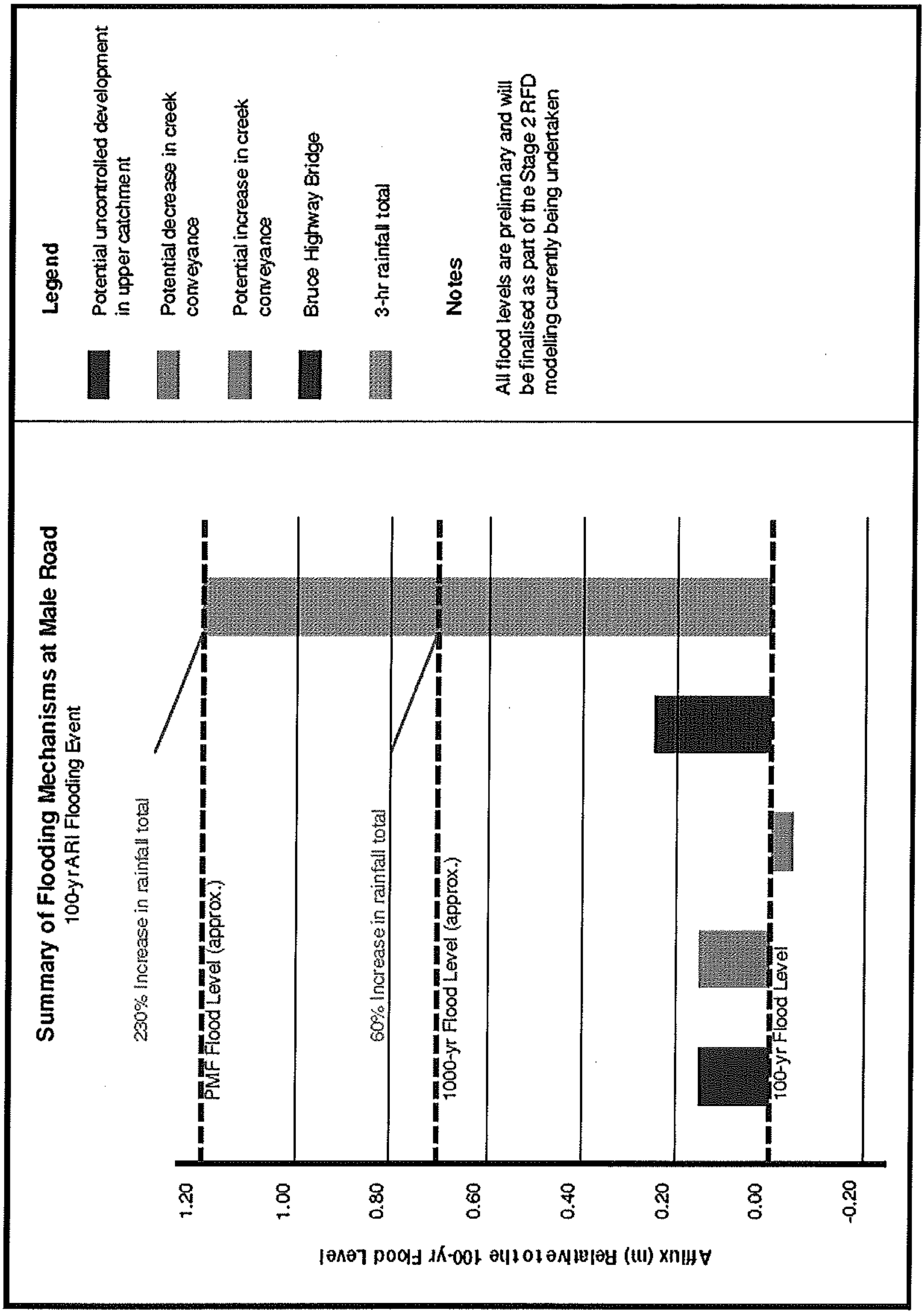


Figure 7.1 – Summary of Male Road Flooding

This was reinforced by the review of the historical flood events, where it was found that there was no correlation with the recent catchment development and an increase in flood peak. The increase in flood peak is a result of the storm events being of greater magnitude than the previous years. In catchments such as King John Creek, a long duration storm event over many days has the hydrologic impact of completely saturating the catchment, which has the affect of making rural / pervious area behave similar to hardstand / impervious areas. The severity of the flooding event is controlled by the intensity / duration relationship of the rainfall bursts which occur within this long duration storm event.

Further sensitivity testing was undertaken on the impact of increasing / decreasing the conveyance of King John Creek in the reach adjacent to Male Road. Results indicated that flood levels were not sensitive to increases / decreases in the creek conveyance at Male Road and thus a potential flood mitigation option of increasing the creek size and removing trees from the riparian zone of the creek / floodplain would show very limited benefit and would not be feasible. The results also indicated that flood levels are not overly sensitive to decreased creek conveyance which could occur through increased vegetation, debris build up, minor siltation, etc.

8. Recommendations

Given the findings of this study it is recommended the following be undertaken:

(a) Formally advise DTMR of bridge maintenance issues (i.e. clearance of minor trees at upstream face) and request consideration for inclusion in their maintenance program.

(b) The flood risk of the properties at Male Road (along with all other similar properties in the region) is fully quantified once the detailed Tuflow model for the RFD has been completed. This would also involve simulating the full range of design events and establishing habitable floor levels for each of the dwellings, to enable a direct comparison with the predicted flood level.

(c) Following the provision of detailed modelling results, re-visit the impacts of the Bruce Highway Bridge(s).

(d) As part of the MBRC submission for the Bruce Highway Upgrade Project, include the request for DTMR to give consideration to upgrading the bridges at King John Creek to reduce flood risk.

(e) The future zoning of these flood affected parcels should be reviewed as part of the preparation of the MBRC Planning Scheme. It is understood that Council has previously attempted this however due to the properties being located within the SEQ region 'urban footprint' the application was not supported by State Government planners. As part of the preparation of the MBRC Planning Scheme, and in light of the observed flooding in January 2011, a further attempt could be justified

(f) Give consideration to including the upgrade of the table drain outside [redacted] Male Road as a future project.

(g) The flood affected property owners should consider utilising flood resistance and flood resilience measures to help minimise the damage from floodwaters and greatly reduce the timescale for recovery.
   - Flood Resistance - these measures are aimed at keeping water out of buildings, or at least minimising the amount that enters by the use of barriers such as door guards to seal entry points; the use of water proof sealants / coating; capping air-bricks; etc.
   - Flood Resilience – these measures are aimed at minimising the damage when a building is flooded, thereby facilitating the quickest possible recovery. Resilience measures include the use of flood resistant building materials within walls / floors and in other parts of the structure; the raising of electrical wiring above flood levels; etc.

Other measures which could be adopted by the current or future property owners include:
- Raising the dwelling to above a large design flood level. This is generally only practical when the dwelling reaches the end of its design life and must be replaced.

- Relocate the dwelling to higher ground. This would most likely involve building a raised ground area to relocate the dwelling. Again this is generally only practical when the dwelling reaches the end of its design life and must be replaced.
- Flood levees and / or flood walls around the dwelling.