



Flood and Stormwater Management Report

330 Church Street Parramatta

December 2011

Meriton Apartments

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Meriton Apartments, Level 11 Meriton Tower, 528 Kent Street, Sydney

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Executive Summary

The 'Flood and Stormwater Management Report' is the outcome of an assessment of the existing flood and stormwater issues at the site with respect to the current development proposals. This report addresses the outcomes of a meeting with Parramatta City Council on 7th November 2011 and comments from Parramatta City Council's flood consultant Bewsher consulting in correspondence dated 12th September 2011 with respect to flooding at the site. The report meets the Director General's requirements for the current submission to the Department of Planning. It does not constitute a flood study rather it draws on conclusions from an existing modelling exercise and an assessment of local topographic conditions to address the impact of flooding at the site.

The development proposal comprises two residential towers and ground floor retail premises. The areal building footprint of the proposed development is approximately 17% less than the existing building footprint. The balance of the site area along the river frontage is to be dedicated public domain. The proposal for the development of this public domain strip frontage has not been confirmed by Council at this stage. It is understood that this will be integrated with a comprehensive upgrade of the public domain along this corridor beyond this development. As the scope and extent of these works are unclear it is not considered that flood modelling will be of any benefit until the river frontage can be assessed in a holistic manner.

It is considered that there are five (5) flood management issues relevant to the development of the site. The relevance and impacts of these are summarised below.

a) The impact of flooding from the Parramatta River

Downstream of Lennox Bridge

Existing 100 year ARI flood levels for the Parramatta River were provided by the UPRCT. The Regional flood planning control level at the site was determined as 6.32m AHD using the Q100 flood level + 500mm freeboard. This is 1.48 metres lower than the lowest proposed ground floor access level of 7.8m AHD and 0.78m lower than the proposed basement access crest level of 7.1m AHD.

Upstream of Lennox Bridge

The regional flood Q100 level provided by UPRCT is 7.26m AHD. The subsequent regional Flood Planning level related to this upstream catchment is 7.76m AHD adopting a freeboard of 500mm. The proposed Flood Planning Level proposed for floor levels along the Church Street frontage is 8.8m AHD as dictated

by the local catchment flooding controls – see b) below. The proposed floor levels are 1.14m higher than the regional flood planning level.

Climate Change

MMHT drawing No 290699 DG03 indicates the proposed flood planning level for the Parramatta River is 6.32m AHD. This is approximately 1.48m lower than the lowest floor level access of 7.8m AHD and 0.78 metres lower than the proposed basement access of 7.1m AHD. Climate flood level information has been obtained from the UPRCT flood model. The climate change flood planning level of 6.59 m AHD including 500mm for freeboard is 1.21 metres below the lowest floor level at 7.8m AHD and 0.51 metres below the basement access flood planning level of 7.1 m AHD.

The climate change flood level immediately upstream of Lennox Bridge has been provided by the UPRCT. The flood planning level at this location is 7.41m AHD including a 500mm freeboard allowance. This water level is sufficient to inundate Church Street however is below than the proposed local catchment Flood Planning Level of 8.8m AHD. Further flood levels in Church Street are controlled by a crest level of 8.20 m AHD at the junction of Phillip Street which is lower than the proposed flood planning level for Church Street.

b) The impact of local drainage at Church Street

There is a trapped lowpoint in Church Street to the south of the proposed development. The level of the road gutter at the lowpoint is 7.33m AHD (Ref MMHT Plan 290699C-DG03 Rev A). In the event of a pipe blockage or a rainfall event in excess of pit and pipe capacities in the stormwater reticulation system in Church Street stormwater may pond in Church Street before overtopping via the crest in the in the public access lane to the west of Church Street at a level of approximately 8.2m AHD (The extent of ponding and crest control is shown on MMHT's plan 290699C-DG01 Rev A). To protect against flooding from this event a Flood Planning Level of 8.8m AHD has been adopted for all floor levels vulnerable to flooding from this local catchment. This level was determined as follows – Crest level (RL8.2) + 100mm weir depth + 500mm freeboard = RL8.8m AHD. This is considered to provide a conservative level of protection at the relevant accesses. This level has also been proposed as a 'ridge' level along the proposed northern colonnade to protect accesses east of the ridge line from flooding. This outcome has been accepted by Bewsher Consulting in comments dated 12th September 2012.

c) The impact of local drainage from Phillip Street and at the east side of the development

Another local catchment drains from Phillip Street to the east of the site. This continues to fall to the east to the rear of the building and will not impact on the basement access ramp and floor levels along this frontage. The UPRCT modelled flood level is RL6.95 at Philip Street however survey indicates that ground levels fall away from the rear of the building and that inundation is unlikely. The proximity to local flooding whilst not being directly impacted by flood water dictates the flood planning level for the basement access ramp. This has been based on the crest level control located on the access road of RL6.8. The minimum flood planning level for the basement access ramp is proposed as RL7.1 including 300mm freeboard. This provides adequate flood protection from the local flooding in Phillip Street and mainstream flooding from the Parramatta River discussed in (a) above.

Climate Change

The 100 year ARI climate change flood level in Phillip Street of 6.99mAHD is a 30mm increase on the pre climate change flood level of 6.95mAHD. The increase is considered minor - local flooding from Phillip Street is controlled by ground levels falling away from the building to the east.

d) The impact of proposed development on flooding to 3rd parties.

The impact of the development on flooding to 3rd parties was assessed in terms of flood storage. The proposed building footprint is smaller than the existing building and the encroachment into the Parramatta River floodplain is less than the existing building encroachment. This presents an improved situation with respect to flooding. The flood displacement area at the site is increased and as a consequence there will not be any impact to third parties, and therefore a full post development flood study is no longer required. This outcome has been accepted by Bewsher Consulting in comments dated 12th September 2012.

Flood depths and velocities at the riverside walkway are significant for the existing situation and whilst a post development flood study that reflects the staged outcome of development proposals cannot fully represent the future conditions in a holistic manner a full post development flood study should be considered by Council when the ultimate public domain development scenario along the Parramatta River frontage is firmed up and agreed.

Council has indicated that stormwater detention is required at the site and this has been considered. Using the UPRCT code of practice, a storage volume of 300m³ has been derived. It is proposed to locate the above the 100 year ARI Parramatta River flood level in accordance with the UPRCT code. It is proposed to connect the outlet from the storage into existing stormwater lines that directly connect to the river. This shall be addressed in the building hydraulics final design.

e) Flood Risk Management

Flood risk is will be managed at the site by providing access and egress to floors located above the PMF level. During a PMF event, the estimated flood level is approximately RL9.94 inundating the immediate area with water to depths of 2-4 metres. An evacuation plan or flood risk management plan will be considered by Meriton as part of the development proposals.

1. Introduction

1.1 Background

Mott MacDonald Hughes Trueman (MMHT) has been commissioned by Meriton to provide advice on stormwater and flood management for 330 Church Street Parramatta to assist with the planning approval.

The development proposal ground floor access layout is shown on the attached architectural plan A100 by Tony Caro Architecture Pty Ltd. The development proposal includes the following:

- Ground level retail premises
- Podium level outside area
- Residential units – 36 Floors
- Basement access on east side

The site is the existing David Jones building located adjacent to the Parramatta River. Existing retail levels are currently elevated at the river frontage. The building foot print occupies 100% of the site.

This report is based on the following information:

- Meeting with Parramatta City Council 17th May 2011
- Site inspections 20th May 2011 and 20th June 2011
- River Bank Development Controls, Parramatta City Council November 2010
- Local Floodplain Risk Management Policy Parramatta City Council June 2006
- BASIX Assessment 18th May 2011
- Architectural Dwgs – Tony Caro Architects Elevations April 2011, Ground floor and Podium Plans A100 and A102 Dated March 2011
- 100 year ARI flood levels (UPRCT) 12th May 2011
- Meeting with Parramatta Council 7th November 2011
- Memo from Bewsher Consulting dated 12th September 2011

1.1.1 Objectives

The objectives of this assessment are to assess the current stormwater and flood issues that impact on the site so that the site complies with the Director Generals requirements that specifically relate to stormwater management:

- Issue 15 Flooding/ Climate Change

The EA shall provide an assessment of any flood risk on site in consideration of any relevant provisions of the NSW Floodplain Development Manual including the potential impacts of climate change, sea level rise and an increase in rainfall intensity

- Issue 16 Drainage

The EA is to address drainage issues associated with the development site including stormwater, drainage infrastructure and the incorporation of Water Sensitive Urban Design Measures

1.1.2 Aim of the current exercise

The aim of this current exercise is to address the Architectural Plans in context with the requirements of Issue 15 and 16 above, and to provide Flood Planning Levels for the site to guide design and consider potential third party impacts of the development.

This report addresses issues raised by Parramatta City Council flood consultant Bewsher Consulting identified in Section 2.2.1 of this report.

2. Site Constraints and Issues

2.1 Site Context

The site is shown at MMHT Dwg 290669 DG01. It is approximately 6000m² in total area. The building is currently retail premises (the existing David Jones building) with an elevated ground floor level above the Parramatta River.

Generally, ground levels fall away to the Parramatta River from the site with threshold levels at the northern boundary at approximately 3.0-3.5m AHD. A typical cross section showing the existing boundary connection between the site and the Parramatta River is shown at MMHT Dwg 290669 DG04.

2.1.1 Church Street Catchment

Survey indicates a low point (RL7.33m AHD) in Church Street adjacent to the site (MMHT Dwg 290699 DG01-02). Runoff drains to this 'trapped' low point from a catchment in Church Street and Phillip Street. If stormwater pits are blocked or pipes/pit capacity is exceeded water will pond at the lowpoint to an approximate depth of 8.3m AHD before overtopping the controlling crest level (estimated to be approximately 8.2m AHD) located at the junction of Phillip and Church Street. Flooding extent at the trapped lowpoint in Church Street and crest level controls are shown at MMHT Dwg 290699C-DG01 Rev A. The Council stormwater system in Church Street and is shown at MMHT dwg 290669 DG02 Rev A.

2.1.2 Phillip Street Catchment

Localised ponding in Phillip Street is indicated to have flood level of 6.95m AHD. The low point is approximately 6.5m AHD. The access road at the junction of Phillip Street rises to a level of 6.88m AHD in the carpark behind the existing building. Ground levels fall away from the existing building east to west across the car park.

2.1.3 Regional Flooding – Parramatta River

The site is currently considered flood prone land in Parramatta Council's Local Flood Plain Risk Management Policy (2006) and is indicated to be at risk from the 100 year ARI event

Flood level information has been provided by the Upper Parramatta River Trust (UPRCT) and MMHT Dwg 290699 DG02 indicates the relevant cross section locations and associated 1 in 100 year flood levels at these cross sections as identified by UPRCT. A 1-Dimensional

model of the Parramatta River (MIKE 11 by UPRCT) indicates the 100 year ARI regional flood peak to be at RL5.82m for cross section CH 2467. This has been identified in Council's DCP as the relevant Flood Planning level for the site.

Upstream of Lennox Bridge cross section CH 2341.9 indicates a 100 year ARI flood level of 7.26mAHD. This level indicates significant backing up within the Parramatta River due to Lennox Bridge. This flood level is lower than the low point (7.33mAHD) in Church Street indicating that flooding in Church Street is controlled by local flood hydraulics and is not impacted by the 100 year ARI flood within the Parramatta River.

A more detailed assessment of existing flood conditions related to the Parramatta River is considered in Section 3.

2.2 Parramatta City Council

2.2.1 Meeting with Parramatta City Council 17th May 2011

Parramatta City Council is the custodian of the New South Wales Floodplain Development Manual and has been consulted with respect to Flood and Stormwater Management at the site. A meeting was held at Council Offices on 17th May 2011 with Jim Tsom, Louise Kerr, Eli Azzi, Katie Westlake and Natalie Swannack of MMHT. The following is a summary of issues discussed at the meeting:

1) Flood Study

Council officers requested a site specific flood study to be undertaken to address the potential impact resulting from changes to the site frontage to the river. Subsequent meeting (7th November) and comments from Bewsher Consulting (Correspondence 12th September) have indicated no further need for a post development flood study.

2) Flood Risk Management

Council confirmed that there will be an increase in Flood Risk at the site as a result of the following:

- a) Changes in land use and
- b) Physical changes to the river frontage.

To manage flood risk it is proposed we will briefly identify flood risk management items as part of the report and identify items that will require inclusion in a future evacuation plan that will be required.

An evacuation plan will ultimately need to be prepared that includes reference to the basement parking levels. The evacuation plan will need to be agreed with the SES. For the development this includes consideration to access and egress –need to consider in the report provision for people to move to upper floors located above the PMF level. Information obtained from the UPRCT has indicated the PMF flood level to be 9.94mAHD.

3) Flood Planning Levels -Building Floor level and Basement Carparking Access Crest Level

Council officers have confirmed the following:

- In flood prone areas, a Q100 +500mm freeboard shall apply to building floor levels, basement parking ramp crest level at entrances and all building penetrations.

4) Climate Change

Council officers confirmed that council does not have an existing policy on the inclusion of climate change on flood levels. They stated that climate change however must be considered as part of the flood modelling to establish the potential impact on flooding at the site. They have indicated that climate provision will be included in Development Controls later this year.

NOTE – Levels previously released by Parramatta Council in Nov 2010 do not include provision for climate change, the impacts of Climate Change on flood levels may be significant.

5) Local Flooding

Local flooding may occur in Church Street. It was agreed that MMHT would confirm the magnitude and potential impacts on the development. In particular floor level implications would be considered.

6) Stormwater Concept and OSD

Council officers confirmed

- That despite the sites' proximity to the river On Site Detention was required for ANY connection to council drainage system with adherence to the UPRCT code of practice for OSD design.
- The requirements for OSD are as follows:
 - a) for any development or redevelopment
 - b) if located in flood liable or non flood liable land
 - c) 520m³ storage per hectare

The total storage required for the site will be approximately 300m³. Council officers indicated a potential offset associated with rainwater tank however this is not expected to be significant.

7) BASIX

Council officers indicated that the site requires WSUD which can be assisted by the implementation of rainwater tanks required as part of BASIX. BASIX information received on 19th May 2011 indicates that rainwater tanks will be supplied for irrigation purposes only and must be 20,000L capacity.

2.2.2 Meeting with Parramatta City Council 7th November 2011

A subsequent meeting held with Parramatta Council offices on 7th November 2011 with Council Officers (Jim Tsom, Susan Weatherly and David Little) to discuss requirements for the flood assessment based on a review by Bewsher Consulting (12th September 2011). The significant issues relating to the flood assessment for 330 Church Street resulting from the review are:

- a) The need for a post development flood study is not required as the review concedes that the impact on downstream flood levels will not be significant
- b) The review confirms that the controlling flood levels arise from local ponding in Church Street
- c) The review requests further assessment of climate change impacts from the Parramatta River particularly with respect to water levels upstream of Lennox Bridge

- d) Further investigation of Flood Risk Management measures.
The issues relating to flood risk management are indicated in this report however a flood risk management plan for the site will need to be undertaken separately to this report.
- e) Investigate the impact of flooding on Phillip Street with respect to floor levels and potential evacuation measures.

3. Assessment of Flooding Impacts

3.1 Background

The site is currently classified as 'Flood Prone Land' as defined in Parramatta Council's 'Local Floodplain Risk Management Policy' (June 2006). As a result of this classification, Parramatta Council requires an assessment of the pre and post development flooding conditions to assist with the development determination. This requirement was confirmed at a meeting with Council on 17th May 2011.

The site is located at 330 Church Street, Parramatta, immediately adjacent to the Parramatta River downstream of Lennox Bridge. The site is bounded by Church Street and existing buildings to the rear of the proposed development site.

The flood assessment for 330 Church Street addresses the following items:

- 1) Local Flooding on Church Street and Phillip Street
- 2) Regional Flooding from the Parramatta River

3.1.1 Objectives

The objectives of this assessment are based on the available information and aim to

- Assess the flooding implications and determine critical floor level development controls based on the existing available information relating to flooding at 330 Church Street
- Address the current development proposals in relation to the existing flooding information, taking account of the uncertainties regarding the public domain works at the Parramatta River Frontage. Examine any potential impacts on 3rd Parties and changes to the existing flooding regime
- Identify the appropriate flood risk precinct defined by the PCC Local Floodplain Risk Management Policy
- Provide a report to assist with the site planning and to enable the Department of Planning to assess the submission

- Identify flood risk management issues including access, egress and evacuation with respect to the PMF for inclusion within the future flood risk management plan for the site.

This preliminary assessment does not constitute a flood study. It is an assessment to assist with the design and planning assessment for development of 330 Church Street. It is understood the proposed public domain works proposed by council along the waterfront have not yet been confirmed.

This assessment has been based on the following information:

- 100 year ARI flood levels for the Parramatta River (UPRCT 11th May 2011)
- Survey (JBW, 2009)
- Architectural Concepts (Tony Caro Associates March 2011)
- Meeting with Parramatta Council (17th May 2011)
- Riverbank – Site Controls (Parramatta Council 25th November 2010)
- Lennox Bridge Shared Path Feasibility Study (Arup, August 2010)
- Site Inspection (20th May 2011)
- Local Floodplain Risk Management Policy (Parramatta Council, 2006)
- New South Wales Floodplain Development Manual (DECC 2005)

3.2 Existing (predevelopment) Flood Conditions

3.2.1 Local Flooding (Church and Phillip Streets)

The site boundary and existing site levels are shown at MMHT drawing 290669 DG01. The existing building currently extends to the limits of the site boundary except to the rear of the site where Lot 101 DP1031459 provides access to Phillip Street. The survey shows existing levels of the building threshold, Church Street and Parramatta River frontage. Levels on Church Street indicate a low point of

7.33mAHD to the south west of the site rising at the Lennox Bridge approach. The ponding level at the low point is controlled by a crest level of approximately 8.2mAHD at the junction of Church Street and Phillip Street. It is expected that local flood water 'weirs' over the crest, with an allowance of 100mm head overtopping the weir a resultant flood level of 8.3mAHD in Church Street is estimated.

Ponding at the low point in Phillip Street is caused from overland flow from Church Street and Wilson Street. At the junction of the access road to the rear of the site with Phillip Street survey indicates the low point to be approximately 6.5mAHD. The access road reaches a 'crest' level of 6.8mAHD before falling away towards car parking at the rear of the building. A flood level of 6.95mAHD is indicated by the UPRCT model (Chainage 237 at Table 1 below) indicating a maximum flood depth of 450mm at the low point and anticipated flood depth of less than 200mm over the crest level.

The corner of the existing building loading entrance is 6.9mAHD

3.2.2 Regional Flooding (Parramatta River)

The site is located adjacent to the Parramatta River. The following description of existing flooding conditions is based on consultation with Council and a review of existing flood levels provided by the UPRCT.

The Parramatta River Catchment is approximately 130km² in the catchment above the Charles Street weir. Land use through Parramatta is predominantly urban, the river in the vicinity of the site is characterised by concrete and grass engineered embankments (Figure 1).

The Parramatta River frequently overtops its banks in larger storm events and photographs (Riverbank Site Controls, November 2011) show this occurrence (1996 and 2010). Council has indicated that there is potential for significant velocities at the river frontage. The Riverbank Urban Design Strategy shows the 100 year ARI flood envelope (Appendix B) where the existing building is clearly impacted by regional floodwaters. Flood water from the 100 year ARI event is indicated to flow around the existing building towards Phillip Street at the rear. Figure 1 is a photograph of the existing building frontage. Measurements taken on site were used to approximately plot the 100 year ARI flood level of 5.82mAHD plus 500mm freeboard.

A public footpath is located between the development and the river. This footpath runs between the downstream Smith Street Bridge and

upstream Lennox Bridge continuing further upstream. The path is inundated during high flows. Flood flows and flood depths (indicated by the UPRCT model) at this location are significant approximately 733m/s and 2.6m respectively. MMHT drawing 290669 DG04 shows a typical existing cross section through the river at the site frontage. Using available survey the cross section was used to establish that the approximate average velocity within the channel is in the order of 3.5m/s. This is based on flow data provided by the UPRCT. The hydraulics of flood flow in the vicinity of the proposed development site is likely impacted by the two bridges located upstream and downstream of the development.

Figure 1 shows a photograph of the frontage of the existing building. Measurements taken on site confirm that the 100 year ARI flood level does not overtop the existing building podium.

3.2.3 The UPRCT Hydraulic Model

The UPRCT Parramatta River Hydraulic Model is a 1 Dimensional model developed within the MIKE 11 modelling package. The UPRCT is the custodian of this model and it is used by Parramatta Council to assist with decision making.

Information from the UPRCT upper Parramatta River Hydraulic Model has been released for use in this project. Cross sections relevant to the site are indicated at MMHT drawing 290699 DG01. Associated flood levels are summarised at Table 1 below.

Table 1: 100 year ARI flood levels Parramatta River

Cross Section ID	Flood Level (m)	Description
2323.7	7.29	
2341.9	7.26	U/s Lennox Bridge
2373.3	5.76	D/s Lennox Bridge
2387.8	5.72	
2420	5.74	
2467	5.82	D/s site boundary
2537	5.84	
40	6.94	Access Road
237	6.95	Phillip Street
0	8.07	Jnc Phillip/Church
66.7	7.97	Church St Low Point

The flood levels indicate a backwater effect caused by the location of the two bridges upstream and downstream of the site. The 100 year ARI flow for the Parramatta River in the vicinity of the development is approximately 733m³/s according to the Flood model.

Upstream of Lennox Bridge flood levels are controlled by bridge opening and are significantly elevated upstream (7.26mAHD) from downstream (5.76mAHD). The lowest point in Church Street is identified as 7.33mAHD and is higher than the upstream flood level at Lennox Bridge confirming that inundation from this source is not expected to be an issue.

UPRCT model flood levels at Church Street and Phillip Street are 7.97mAHD and 6.95 AHD respectively.

3.2.4 Climate Change

Table 2 indicates 100 year ARI flood levels on the Parramatta River including the impacts of Climate Change. Climate change levels have been estimated by applying a 15% increase in rainfall intensity.

Table 2: 100 year ARI plus climate change flood levels Parramatta River

Cross Section ID	Flood Level (m) + Climate Change	Description
2323.7	7.93	
2341.9	7.91	U/s Lennox Bridge
2373.3	6.01	D/s Lennox Bridge
2387.8	5.97	
2420	5.99	
2467	6.09	D/s site boundary
2537	6.11	
40	6.98	Access Road
237	6.99	Phillip Street
108	8.09	Jnc Phillip/Church
66.7	8.06	Church St Low Point

The Charles Street weir acts as a control on tidal flood levels from downstream however potential impacts of sea level rise for the lower Parramatta River are currently being assessed by SKM. At the time of writing flood levels including the impacts of sea level rise from Sydney Harbour have not been included in climate change estimates.

Upstream of Lennox Bridge the 100 year ARI climate change flood level is 7.91mAHD indicating potential inundation of Church Street from this source. The coincidence of a peak storm occurring for both the Parramatta River and the local catchment at Church Street is considered unlikely however it is also expected that the crest (RL 8.2) located on Phillip Street will continue to act as a control on flood levels in the vicinity.

The 100 year ARI climate change flood level in Phillip Street of 6.99mAHD is a 30mm increase on the pre climate change flood level of 6.95mAHD. The increase is considered minor as local flooding from Phillip Street is controlled by ground levels falling away from the building to the east.

3.3 Proposed (Post Development) Conditions

The development proposal is indicated at Tony Caro Architecture Drawings Nos A100 at Appendix A. Proposed ground floor level is shown. The proposal for the development provides for basement parking, ground floor retail and lobby entrances and residential units located in two 36 storey tower blocks above the podium level. Vehicular access to the basement levels is to be provided at the rear of the development from Phillip Street.

3.3.1 Potential Development Scenarios

This preliminary assessment examines two (2) potential options for development. MMHT drawing 290699 DG04 indicates a proposed cross section of site frontage for two proposed development options.

Development Option 1

Proposed Scenario (Option 1) provides for the development of the site based on the building fitting to the existing building envelope without change to the existing site boundary. The flood level and flood hydraulics will be the same as the existing. This scenario does not change the existing flooding regime at the site and it is considered that it therefore does not warrant the need for a full flood assessment. There is the need however to manage flood hazard and flood risk to the building and the river frontage.

Development Option 2

This option provides for development of the site that includes a river frontage with a vertical wall and a setback to the property boundary to provide for the future public domain works proposed by Council. Changes to flood level and flood hydraulics are not expected to be significant given the minor changes proposed given the size of the contributing catchment. Council considers that this scenario triggers the need for a full flood assessment under current Council guidelines. We reiterate however that the footprint and extent of the proposed public domain works by council is unclear at this stage and cannot be accurately represented in any flood modelling.

3.3.2 Proposed (Post Development) Flooding Conditions Option 1

Option 1 would not change the existing development footprint. Therefore, it can be reasonably assumed that the existing flood hydraulics would not change as a result of the development. Flood modelling for this scenario is considered unwarranted.

3.3.3 Proposed (Post Development) Flooding Conditions Option 2

MMHT drawing 290699 DG04 indicates that the post development site boundary to be set back approximately 10 metres from the pre development site boundary. The total area of the set back is approximately 990m² which equates to a reduction of approximately 17% of the pre development site area.

In terms of floodplain storage, this represents a potential improvement. The net increase in floodplain storage for the 100 year ARI event is approximately 5762m³. To demonstrate, Figure 2 indicates the typical cross section area at the Parramatta River frontage. The total cross sectional area at Figure 2 for the pre development condition is approximately 208m². This increases to approximately 267m² for the post development scenario representing a net increase in flow-cross sectional area. The reduction in site area shall reduce the stream velocity at the site. This is shown at Table 2 where the relationship between flow, velocity and cross sectional flow area is summarised.

Table 3 Hydraulic Characteristics at CH2420, 100 year ARI FL 5.82mAHD

	Flow (m ³ /s)	Cross Section Area (m ²)	Velocity (m/s)
Pre Development	733	208	3.5
Post Development	733	267	2.8

Further, it should be noted that the increase in available flood storage of 5762m³ (990m² reduction in site area) considered as a change of conditions, is insignificant when compared to the 130km² Parramatta River catchment.

Velocities (average) in Table 2 are likely to decrease as a result of changes to the cross sectional area. The assessment of velocities is based on the assumption that the flood level for the post development scenario will not change as a result of the increase in flood storage.

This is a conservative assumption as it is likely that flood levels will reduce slightly, however due to the backwater impacts from the existing Smith Street bridge downstream, reduction in flood levels would likely be limited.

This investigation shows that the change to the existing building envelope will have a minor impact on the 100 year ARI flood levels and the existing flood regime along the Parramatta River frontage.

Appendix B indicates the existing flood envelope and MMHT drawing 290699 DG01 shows the limit of the Parramatta River flood extent adjacent to the development. The reduction in site shows that Option 2 proposals are unlikely to impact on overland flow paths resulting from Parramatta River flood waters.

4. Flood and Stormwater Management Strategy

4.1 Objectives

The objectives of the Flood and Stormwater Management Strategy are:

- 1) To proposed appropriate flood planning levels to manage identified flood risk
- 2) To identify potential risk issues associated with the PMF flood and propose potential flood risk management solutions that would need addressing as part of a formal flood risk management plan.

4.1.1 Parramatta City Council Local Floodplain Risk Management Policy Planning and Development Controls

The site is located within 'flood prone' land as defined by the Local Floodplain Risk Management Policy. The flood assessment in Section 3 indicates the site to be elevated above the 100 year ARI flood levels (for the regional flooding impacts the potential to cause significant flood damages with potential risk to life can be high) and thus can be considered to be located in a low flood risk precinct. The risk from damages from local flooding still exists (as identified in Section 3) however the Local Floodplain Risk Management Policy states that these risks can be managed by appropriate planning and building controls.

4.1.2 Flood Planning Levels

Based on the flood level information provided by the UPRCT, the existing flood controls indicated at MMHT Dwg 290699 DG01 and freeboard requirements indicated by the Local Floodplain Risk Management Policy, the relevant proposed flood planning levels for the site have been summarised on at MMHT Dwg 290699 DG03 and are as follows:

Local flooding is critical to flood planning levels at the Church Street frontage.

Table 4 summarises flood planning level derivation.

Table 4 Flood Planning Level Derivation (mAHD)

	Parramatta River	Parramatta River u/s Lennox Bg	Church Street	Phillip Street	Basement Access Ramp
Surveyed Control Levels ^a + 500mm FB	-	-	8.80	-	7.10 ^b
100 year ARI +FB (UPRCT)	6.32	7.76	8.47	7.45	-
100 year ARI +CC +FB (UPRCT)	6.59	8.41	8.56	7.49	-

^aFlood Planning Level derived from crest level defined by survey

^b300mm freeboard applied to 'crest' level of 6.8mAHD to the rear of the building

A freeboard of 500mm has been applied to all flood planning levels with the exception of the proposed flood planning level for the rear of the building near Phillip Street. Local flooding is not considered in within the Parramatta Council Local Floodplain Risk Management Policy however it is stated within this document that *'local drainage problems can generally be minimised by the adoption of urban building controls requiring a minimum difference between finished floor and ground levels'*.

The NSW Floodplain Development Manual recognises local drainage issues separately (although they are outside the scope of the manual) and identifies them as those problems that present little danger to personal safety. This report identifies local flooding controls and provides a general approach mitigating for ponding in Church Street. The local control is the crest level at the junction of Phillip Street and the ponding depth in Church Street is expected to be significant (< 1.0m) directly impacting on the Church Street frontage. A freeboard of 500mm has been adopted for the determination of proposed floor levels along this frontage. Local overland flow depths at the crest located to the rear of the building in the car park are expected to be less than 200mm (based on the depth of water in Phillip Street) and are not expected to directly impact on the building due to the fall away from the building in the car park. A freeboard of 300mm is considered

appropriate as the basis of the flood planning level for the car park entrance to the rear of the building given the proximity of the basement entrance to overland flow. It is proposed therefore that the Flood Planning Level for the basement access ramp should be 7.1m AHD.

4.1.3 Proposed Floor Levels

MMHT Dwg 290699 DG03 indicates proposed floor levels at the critical access locations to the building at ground floor. Ground floor retail premises with access to Church Street have proposed floor levels set at the minimum flood planning level of 8.90m AHD. A crest located on the proposed colonnade near the entrance of the west tower lobby is proposed with a crest level of the minimum flood planning level of 8.90m AHD.

The provision of a crest at this location effectively provides a barrier to overland flow from Church Street, protecting the retail units located at the site frontage and the east and west tower lobbies. Thus, the controlling flood planning level for the retail units at the frontage and lobby entrances along the river frontage and east side becomes the regional flood planning level of 6.32m AHD derived from the flood levels in the Parramatta River. Proposed floor levels in these locations vary between 7.80m and 8.2m AHD.

MMHT drawing No 290699 DG03 indicates the proposed flood planning level for the Parramatta River is 6.32m AHD. This is approximately 1.48m lower than the lowest floor level access of 7.8m AHD and 0.63 metres lower than the proposed basement access.

The regional flood Q100 level provided by UPRCT is 7.26m AHD for the section of river immediately upstream of Lennox Bridge. The subsequent regional Flood Planning level related to this upstream catchment is 7.76m adopting a freeboard of 500mm. The proposed Flood Planning Level proposed for floor levels along the Church Street frontage is 8.9m AHD as dictated by the local catchment flooding controls. The proposed floor levels are 1.14m higher than the regional flood planning level.

The impact of climate change does not impact on the crest controlled flood level identified at Church Street.

Regional flood planning levels derived from the UPRCT flood model are impacted by climate change as a result of increased rainfall and an impact of approximately 300mm is indicated for cross sections at Parramatta River. The resultant climate change flood planning level of

RL6.59 (for section 2467) including 500mm for freeboard is 1.21 metres below the lowest floor level at RL7.8 and 0.51 metres below the basement access flood planning level of RL7.1.

The climate change flood level immediately upstream of Lennox Bridge is estimated to be 7.91mAHD and the Flood Planning Level including 500mm freeboard is 8.41mAHD. This level is 0.49m below the proposed floor level for the Church Street frontage. The flood level is sufficient to inundate Church Street however, it is still expected that flood levels will be controlled Church Street are controlled by a crest level of RL8.20 at the junction of Phillip Street.

4.2 Flood Risk Management

Flood Risk is formally addressed by the preparation of a Flood Risk Management Plan that takes into consideration the outcomes of a flood study. This current study does not preclude the need for a Flood Risk Management Plan for the development however it aims to draw on the conclusions made from the existing assessment. A full flood risk management plan that identifies access and egress, emergency evacuation and disabled access in accordance with the NSW Floodplain Development Manual should be considered in terms of the 100 year ARI and PMF events.

The flood impact assessment in Section 3 confirmed the following items for Option 1 and Option 2 with respect to the NSW Floodplain Development Manual:

- 1) The proposed development for either Option will not significantly impact on existing flood levels in the vicinity of the development
- 2) The proposed development will not significantly impact the existing flooding regime (overland flow and flood velocities) in the vicinity of the development.

Flood risk, to the building is therefore managed by the adoption of Flood Planning Levels.

Ponding in Phillip Street is considered to be local flooding and therefore does not present a significant hazard to life. During the 100 year ARI event flood water from Phillip Street will follow the contours in the car park falling away from the existing building. Higher ground is located close to the basement access ramp, however safe access and egress can also be sought within the upper levels of the building until flood

levels in Phillip Street drop and can be accessed by emergency vehicles.

4.2.1 Flood Risk Management for floods greater than the 100year ARI event

The site has been categorised as a low flood risk precinct in accordance with the PPC Local Floodplain Risk Management Policy. However, the flood impact assessment indicates that whilst the site is not inundated in the 100 year ARI event it is located within flood prone land (PMF flood level approximately 9.94mAHD) and would potentially be isolated during storms rarer than the 100 year ARI event with potentially dangerous conditions occurring in the adjacent streets and the riverside walkway adjacent to the Parramatta River.

Note: Local flooding in Church Street dictates the finished floor levels of the development where there is proposed access to Church Street. The use of the regional flood planning level can be used only when a crest at the approximate location shown with a level of 8.8mAHD is applied to the development.

Provided access to the upper floors is enabled, this would provide suitable access and egress in the event of rising flood levels in the Parramatta River.

The PMF event the immediate locality will be inundated under 2-4 metres of water depending on local ground levels. Such flood levels represent a significant flood hazard, flooding ground floor basements. A flood risk management man would need to consider suitable signage and direction out of the basement to the upper floor levels located above the PMF flood. It is anticipated, given the size of the Parramatta River catchment that flood response times would be sufficiently long to allow an early warning system to be implemented. An early warning system would need to be considered as part of a flood risk management plan or flood evacuation strategy for the site.

4.3 Climate Change

The NSW Floodplain Development Manual requires the assessment of Climate Change so that flood risk is managed for a reasonable period of time.

To assess the impacts of climate change any future flood study would require sensitivity analysis for increased rainfall events. This would be

in accordance with 'Practical Considerations of Climate Change' DECC 2007.

The outcome of the study could lead to management considerations such as

- a) The adoption of a higher Flood Planning Level to incorporate flood risk and
- b) Accepting a reduced level of flood protection in the future

The NSW Floodplain Development Manual states that *'an appropriate FPL for residential development is generally the 100 year ARI flood event plus 0.5mm freeboard. Freeboard could be expected to account for reasonable change in risk over time and therefore selection of a more conservative FPL may not generally be necessary'*

Downstream of Lennox Bridge

The Regional flood planning control level at the site was determined as RL6.32m AHD using the Q100 regional flood level + 500mm freeboard. This is 1.48 metres lower than the lowest proposed ground floor access level of RL7.8m AHD and 0.63m lower than the proposed basement access crest level.

Upstream of Lennox Bridge

The regional flood Q100 level provided by UPRCT is RL7.26m AHD. The subsequent regional Flood Planning level related to this upstream catchment is RL7.76m AHD adopting a freeboard of 500mm. The proposed Flood Planning Level proposed for floor levels along the Church Street frontage is RL8.9m AHD as dictated by the local catchment flooding controls. The proposed floor levels are 1.14m higher than the regional flood planning level.

The proposed crest level in the colonnade of RL8.9m AHD protects floor levels to the east side of the crest from flooding and increases in levels due to climate change.

4.3.1 Onsite Stormwater Management –Water Quantity and Quality

2 broad concepts have been considered. They relate to the location of discharge at the site. These are as follows:

- Discharge to Council's piped system in Church Street
- Discharge to Parramatta River

Discharge to the Council stormwater system in Church Street will be controlled by existing invert levels of the stormwater system (surface level low point at 7.33mAHD) and levels will control the location of the OSD tank. Discharge to Church Street will be feasible only from the Ground Floor level.

There is potential for discharge to the 900mm dia outfall at the Parramatta River, however invert levels will be required to confirm and connection to this outfall may also control the location of the OSD within the building.

A site visit has indicated that there are 3/4 existing outfalls located in the channel of the Parramatta River at the frontage to the site. Site visits indicated the outfalls are approximately 225-300mmdia pipes.

MMHT Sketch Plan 290669 SK100 shows OSD located in the basement (4.4mAHD) in accordance with Meriton requirements (email dated 9th June 2006). To accommodate requirements, Option 1 and Option 2 indicated at Sketch Plan 290669 SK100 indicate discharge to the Parramatta River by connecting to the existing outfalls. By locating the tanks in the basement, the orifice plate must be elevated above the 100 year ARI flood level in accordance with the UPRCT On-Site detention code.

Stormwater will be collected from the roof and the podium level of the development. The podium level will comprise paved and landscaped areas. To manage stormwater quality leaving the site, Council requires a GPT located upstream of the OSD tanks. The BASIX assessment requires the provision of a 20000L rainwater tank which will form part of the stormwater quality treatment train.

5. Conclusions

5.1 Conclusions

This report has assessed the site in terms of flooding. The conclusions are summarised as:

- The existing site is affected by the 100 year ARI flood event from local and regional flooding. Local flooding at Church Street dictates the finished floor levels where accesses are related to this frontage. At other accesses the regional flood planning level from the Parramatta River presides.
- Development Option 1 presents no change to existing the regional flooding conditions
- Development Option 2 presents insignificant changes to existing flooding conditions. A slight increase in flood footprint and a reduction in velocity resulting from the increase in floodplain storage provides for a slight improved situation over the existing. Flood levels at the site can be expected to slightly reduce however changes will be minor due to the backwater effect from Smith Street bridge downstream
- Proposed finished floor levels shall be above at or above the Flood Planning Level for present day flood risk and future flood risk as a result of climate change
- Changes to the floodplain as a result of increased flood storage are very minor and a full flood study is not considered warranted to demonstrate this, however a flood management plan based on the existing flood study results should be considered.
- Changes to the public domain (riverside walkway) have not yet been determined by Council. This is considered to be outside the scope of this report. It is suggested that flood modelling at this stage is premature and should not be undertaken until the proposal for the public domain area is firmed up by council. Future modelling should consider the proposed ultimate development of the public domain area.
- This report confirms that the proposed finished floor levels provided at Appendix A (Tony Caro Dwg Plan_Level 00 Retail

A100) agrees with the proposed flood planning levels proposed for the site.

This assessment does not preclude the need for post development flood study (using the UPRCT model) and a formal flood risk management plan to manage current flood risk at the site.

