KLM SPATIAL

LAND DEVELOPMENT INTELLIGENCE

Berwick Waterways Internal Flood Capacity

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PLANNERS
SURVEYORS
ENGINEERS

Berwick Waterways
Internal Flood Storage Capacity

Introduction

The following has been prepared as a result of discussions held at the offices of the City of Casey (CoC) on 29/1/2014.
At this meeting a proposal for stormwater storage management during development of Berwick Waterway prior to "Bund St 2" works being completed was presented and discussed. The meeting concluded with a request from council for information on how the catchment behaved, specifically in relation to storm water storage volumes but exclusive of the impacts of bund over topping, and in event greater than the 1 in 200yr ARI event. The intent of this document is to present such detail.

This document is divided into two specific sections.

- The first is in relation to the further information request as a result of the previous meeting.
- The second in regards to storage expectations of Berwick Waterways prior the completion of the Stage 2 Bund works. This has been included so as a single source document is available on both items.

Source Documents

The drainage reports used for reference are:
(The subject area has been subject to various studies over many years. The following list includes those known of but not necessarily sighted by this office.
Reports marked with an * have not been sighted, but have been requested from Melbourne Water.
Reports marked with a ** have not been considered as the reports are not related to Councils request for further information.

- *Homestead Road Drainage Requirements Study Catchment No. 0613
  Stormy Water Solutions for Melbourne Water Corporation June 2004
- *Homestead Road Drainage Area Study Proposed Wetland Pondage System Stage 2 Final Concept Design
  Neil M Craigie & Pat Condina 31 January 2005 & 10 August 2007
- *Homestead Road Drainage Area Study Proposed Wetland Pondage System
  Executive Summary & Comments in Relation to 322-340 Centre Road Berwick
  Neil M Craigie 10 August 2007
- *Civil Engineering Development Cost Report Proposed Residential Development Berwick Waterways
  Charter Keck Cramer October 2008
- Berwick Waterways Summary Issues Paper
  Stormy Water Solutions & Neil M Craigie P/L 14 September 2009
- Berwick Waterways Drainage Assessment, Options Development & Appraisal
  (Draft Report for Comment)
  Stormy Water Solutions & Neil M Craigie P/L 23 November 2009
  (It is unknown if there was a final report off the above draft)
- Berwick Waterways Drainage System Requirement
  Stormy Water Solutions 24 February 2011
- Berwick Waterways – Extreme Events – Flood Storage Estimates – Memo
  Stormy Water Solutions 11 March 2014
- Attachments to this report.

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Berwick Waterways Catchment

- **Existing Area Characteristics**

The catchment presently has the following characteristics:

- Area of 193 hectares.
- Undeveloped area of 86 hectares.
- Outfall/Outlet is via a existing siphon outlet.
- Flat surface gradients in the undeveloped portion.
- Declared 100 year flood water level of 18.15 m metres.
- Building floor levels have been determined as 18.15 m AHD plus 0.6 m = 18.75 m AHD.
- Existing storage volume capacities provided by the present undeveloped area are:

Top Water Level (TWL)	Volume	Comment
18.75 m AHD	356,750 m3	
18.65 m AHD	249,000 m3	
18.55 m AHD	208,000 m3	
18.45 m AHD	152,750 m3	
18.15 m AHD	42,750 m3	Present 1 in 100 yr Storage

(This volume calculation is based on using Lida topographic data, refer to attached Plan)

Berwick Waterways Catchment Requirements

- **Prior to Phase 2 Bund Works being undertaken (attachment 2 for Phase 2 detail)**

Key Assumptions and Calculations:

- Storage capacity for existing land use within the PSP area is ***42,750 m3***
  This is based on a TWL of 18.15 m AHD as set by MWC for the 1 in 100 yr ARI event.
  This volume has been derived from surface modelling using Lidar data.

- The additional storage required as a result of development is ***1,000 m3/Ha*** of development
  Calculated,
  (increased storage when developed)÷(area of developed)
  (129,000m3 - 42,750m3)÷(85.47Ha)=1009m3, say 1000m2/Ha
  The 129,000m3 is derived from MWC drainage study of PSP area without the O'Shea Rd connection pipeline. This pipeline is considered secondary until the Stage 2 Bund works are completed as it simply adds risk to floooding and storage availability. Thus it is proposed that this connected pipe be defered until necessary. Should the full storage system be constructed and the O'Shea Rd pipe is connected to provide sustainable flows for the health of the system prior to the completion of the Stage 2 bund works then the rate of storage per developed Ha would need to increas to (176,000m3 - 42,750m3)÷(85.47Ha)=1559 m3/Ha, say 1,600 m3/Ha

- Over topping flows for a 1 in 200 yr ARI event (equivalent to Feb 2011 event) is ***216,000 m3***
  Refer to Attached method of assessment to establish the above volume.

Proposed Lot Levels and Finished Floor Levels

- All newly created alotments within the PSP area should achieve a minimum Finished Fill Level 18.45m, in accordnance with recommendations in MWC reports dated 23 Nov 2009 & 24 Feb 2011 as this provides opertunities to for additional/default flood storage in extreme and unexpected flood events It also provides another level of risk reduction and robustness to the PSP area.

- All newly buildings within the PSP area should achieve a minimum Finished Floor Level 18.75m.

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Berwick Waterways Catchment Requirements

- **Post completion of Phase 2 Bund Works (attachment 2 for Phase 2 detail)**

Key outputs from previous studies:

The 14/9/2009 report (Stormy Water Solutions and Neil M Craigie) noted relevant storage conclusions:

- That 172,000 m3 of storage was required to manage a 1 in 100 yr storm event.
- The 100 yr ARI flood level being 18.15 m AHD
- The NWL being 16.90 m AHD
- The TED 17.3m AHD

The 23/11/2009 report (Stormy Water Solutions and Neil M Craigie) notes relevant storage conclusions:

- That as a base case 174,000 m3 of storage was required to manage 1 in 100 yr storm event
- The 100 yr ARI flood level being 18.15 m AHD
- That if the O'Sheas Rd DSS inflow of 1 m3/s was removed the storage required reduces top 129,000 m3 This inflow accounts for 26% of the overall storage.
- Recommendation that lot filling limited to TWL + 0.3m i.e. 18.45 m AHD but buildings constructed with floor levels of TWL + 0.6m i.e. 18.75 m AHD

The 24/2/2011 report (Stormy Water Solutions) notes relevant storage conclusions:

- That as a base case 176,000 m3 of storage was required to manage 1 in 100 yr storm event
- The 100 yr ARI flood level being 18.15 m AHD
- Direct some flows from future adjacent subdivisions to retained existing drainage lines to ensure adequate flushing of these systems.
- Modifications of drainage system outlet at HVCD (diag 1101/4)
- Upgrade existing HVCD levee to ensure adequate flood protection

Stormy Water Solutions was requested in March 2014 to run further flood and storage modelling as used in assessing the above storage quantities for 1 in 200 yr ARI and 1 in 500 yr ARI events.

Berwick Waterways – Extreme Events - Flood Storage Estimates
MEMO FROM: Valerie Mag, Stormy Water Solutions, 11 March 2014

	100 Year ARI	200 Year ARI	500 Year ARI
Assumed Previous area Runoff coefficient	0.6	0.7	0.8
Assumed Initial Loss (mm)	10	5	5
Calculated outflow though the Syphon (m^3/s)	2.5	2.75	3
Calculated Maximum upstream flood level within the Berwick Waterways drainage reserve (m AHD)	18.15	18.3	18.5
Calculated Maximum flood storage within Berwick waterways drainage reserve (m^3)	176,000	208,000	249,000

KLMS have modelled the potential storage capacity of the development up to the worst case event of a TWL at 18.75 m AHD for MWC (Drainage Proposal - July 2013 prepared by KLM Spatial).

The results of this assessment were:

TOTAL STORAGE VOLUMES		
Water Level (m AHD)	**Volume (m3)**	**Accumulative (m3)**

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	between each Level	Total Volume
18.85 (Likely minimum FFL post detail design)	24,950	350,300 (1% ARI vol x 200%)
18.75 (TWL + 0.6 m or absolute min FFL)	74,400	325,350 (1% ARI x 185%)
18.45 (TWL + 0.3 m or Surrounding Road level)	62,100	250,550 (1% ARI x 140%)
18.15 (Top Water Level at 100 yr ARI)	50,750	188,850 (176,000 Required)
17.85 (Urban Edge 10 back from Water Edge)	39,200	138,100
17.60 (Urban Edge at Water Edge)	43,400	98,900
17.30 (Top Extended Detention)	55,500	55,500
16.90 (Normal Water Level)	0	0

A comparative Table of all the above needs and capacities is:

m AHD	Existing Pre-Developed Storage	Required Developed Storage RORB Model	Proposed Developed Storage via Urban Drainage Proposal	Comment
18.85	430,000		350,300	FFLL, majority of development will be higher
18.75	356,750		325,350	Min Finished Floor Level
18.50		249,000		RORB model storage for 1 in 500 Yr ARI
18.45	152,750		250,500	Min Finished Lot Fill Level Exceeds the 249,000 m3 to manage finished development storage 1 in 500 Yr ARI
18.3		208,000		RORB Storage for 1 in 200 Yr ARI Although not calculated it is obvious that actual storage will exceed 208,000 m2
18.25			210,000	1 in 200 Yr event exceeded
18.15		176,000	189,000	TWL 1:100yr of Basins Finished development storage exceeds required Development storage
17.85			138,100	FS @ rear of 10m urban Edge
17.6			98,000	FS @ Urban Edge Basins Includes extended detention volume
17.3			55,000	Top Extended Detention Volume release over 30 to 48 hrs
16.9		80,000	80,000	Normal Water Level Basins Required permanent water volume
16.15	0	0	0	Nominated base of Basins

Conclusion

The above confirms:

- That the existing PSP area has substantial flood storage capacity before any detrimental effects are imposed on surrounding existing homes.
- That after Phase 1 and before Phase 2 bund works, the flood storage is predictable and manageable such that incremental development of the PSP can be provided with appropriate protection.
- When the Stage 2 Bund works are completed and Berwick Waterways PSP is fully developed the buildings floor levels at or above 18.75 will retain a
    - 500 mm freeboard above a 1 in 200 yr flood event
    - 300 mm freeboard above a 1 in 500 yr flood event

Therefore the proposed minimum Finished Lot Fill Level of 18.45 m AHD and Finished Building Floor Level of 18.75 m AHD provide a robust and secure residential environment during and after development.

Regards,

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Attachments

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Phasing of Hallam Valley Contour Drain Improvements

The HVCD bund augmentation staging proposed is:

Phase 1

- The bund stays in its present position.
- Sections along the bund that are lower than the 1% TWL for HVCD are to be raised to equal the 1% ARI TWL with no freeboard.
- These works to be performed and funded by the landowners within the PSP area.
- This is the maximum level the existing bund can be lifted without detriment to land on the western side of the drain.

Phase 2

- The HVCD bund is to relocated so that the top of the bund is within the Berwick Waterways PSP area and lifted so that it is at the HVCD 1% ARI TWL + 0.6m Freeboard or the 0.2% ARI TWL with no freeboard, whichever is the higher.
- These works to be performed and funded by the landowners within the PSP area at the time of development and at such point adequate storage and protection cannot be otherwise provided.

Phase 3

- Augmentation of the HVCD performed by MWC

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BUND SECURITY

It was estimated that the event of Feb 2011 was between a 100 yr & a 200 yr storm event but was not larger than 200 yr event, according to Val Mag report of 10 August 2011 "Hallam Valley Contour Drain Flood Investigation" (A draft for MWC Comment/Input).

Extract:

> The recorded flood level in the February 2011 event was in the order of 19.15 – 19.43 m AHD. This suggests the ARI of the February 2011 event was between a 100 – 200 Year ARI event. This compares well with the IFD information detail in Section 1.2.

From table 3.2 below (extracted from the Stormy Water's report of 10 August 2011), and considering the bund augmentation Stage 1 works, the 1% ARI (100yr) storm events would no longer spilled over the bund.

Thus the event to be calculated is the 0.5% ARI (200 yr) event and the discharge/spillage over the bund at an equivalent future event after Phase 1 bund works are performed can be calculated as the difference between the 100yr event and the 200 yr event.

Flow at Ward/Greaves Rd levee = (12 m3/s – 10 m3/s) = 2 m3/s
Flow at the Homestead Rd levee = (17 m3/s – 14 m3/s) = 3 m3/s
Total flow overtopping the levee in 200 yr event = 5 m3/s

Table 3.2 Assumed Design Flow Splits – Final Hec Ras Iteration

Average Recurrence Interval	Flow in Conveyed in Hallam Valley Contour Drain	Flow over Ward Road/Greaves Road Levee	Flow over levee between Greaves Road RB outfall and Homestead Road
100 Year ARI	23 m^3/s	10 m^3/s	14 m^3/s
200 Year ARI	30 m^3/s	12 m^3/s	17 m^3/s
500 Year ARI	35 m^3/s	15 m^3/s	35 m^3/s

The duration of the spillage rate is deduced from the same report in extracted table 2.1 below, it is identifies that in the HVCD for the 0.5% ARI the critical storm duration is 12 hrs.
Therefore 1 in 200 (0.5%) yr event duration = 12hrs x 3,600 = 43,200seconds
Thus 43,200s x 5m3/s = 216,000 m3 could be delivered into the PSP area from a 1 in 200 yr storm event external to the PSP from catchments that are serviced by the HVCD prior to the Phase 2 bund works being completed.

Table 2.1 Estimated Design Flows

Average Recurrence Interval	Greaves Road Retarding Basin Water Level	Hallam Valley Contour Drain Upstream of Berwick Town Drain	Berwick Town Drain Upstream of Hallam Valley Contour Drain	Hallam Valley Contour Drain Downstream of Berwick Town Drain
100 Year ARI	21.45 m AHD	46.0 m^3/s 18 Hour Critical Duration	26.3 m^3/s 9 Hour Critical Duration	57.4 m^3/s 24 Hour Critical Duration
200 Year ARI	21.63 m AHD	62.8 m^3/s 12 Hour Critical Duration	31.7 m^3/s 9 Hour Critical Duration	73.9 m^3/s 24 Hour Critical Duration
500 Year ARI	21.75 m AHD	91.1 m^3/s 12 Hour Critical Duration	39.3 m^3/s 9 Hour Critical Duration	107.3 m^3/s 12 Hour Critical Duration

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