

Parcel Tags as on Council Cadastre (GIS Tag)	Photo Name	Number of Buildings	Street Number	Street Name	Easting (m)	Northing (m)	Indicative Ground Level (mAHD)	RESIDENTIAL BUILDING			NON-RESIDENTIAL BUILDING			
								Lowest Habitable Floor Level (m AHD)	Floor Construction Pier (P) Slab (S) Other (describe)	Type Commercial (C) Industrial (I) Public (P)	Name and Nature of Use/Business	Lowest Floor Level (mAHD)	Floor Construction Pier (P) Slab (S) Other (describe)	
194712	<a href="#">63 Vine Street</a>		63	Vine Street	333127.0	6248734.0	13.20	13.38	P					
194713	<a href="#">65 Vine Street</a>		65	Vine Street	333124.0	6248735.0	13.12	13.45	P					
519440	<a href="#">12 Junction Street</a>		12	Junction St	331763.0	6249192.0	14.32	11.76	S	C	Level Of Office at Rear of 3 Storey Building			
519440	<a href="#">12 Junction Street</a>		12	Junction St	331762.0	6249178.0		10.88	S	C	Level Floor Old Building Rear of Site			
521860	<a href="#">1A Hegarty Street</a>		1A	Hegarty St	331967.0	6249623.0	14.00	14.30	S		Bottom Floor of 3 Storey Brick Flats			
188501	<a href="#">16 Eveleigh Street</a>		16	Eveleigh St	333549.1	6248647.6	18.28	18.28	S					
193153	<a href="#">13 Renwick Street</a>		13	Renwick St	332986.9	6247555.6	26.48	26.96	S					
193154	<a href="#">15 Renwick Street</a>		15	Renwick St	332974.6	6247553.2	26.43	26.97	S					
193155	<a href="#">17 Renwick Street</a>		17	Renwick St	332968.5	6247552.0	26.36	26.97	S					
193156	<a href="#">19 Renwick Street</a>		19	Renwick St	332962.3	6247550.8	26.40	26.99	S					
193157	<a href="#">21 Renwick Street</a>		21	Renwick St	332956.6	6247549.7	26.40	26.99	S					
193158	<a href="#">23 Renwick Street</a>		23	Renwick St	333728.3	6248579.0	26.35	26.99	S					
246249	<a href="#">25-27 Renwick Street</a>		25 to 27	Renwick St	333728.0	6248576.8	26.35	26.47	S					
249952	<a href="#">29 Renwick Street</a>		29	Renwick St	333726.9	6248569.0	26.29	26.56	S					
613353	<a href="#">35-37 Renwick Street</a>		35 to 37	Renwick St	333724.0	6248549.7	26.51	26.72	S					
203082	<a href="#">32-134 Shepherd Street</a>		132 to 134	Shepherd St	333064.0	6248657.0	14.47	14.60	S	P(COMMUNITY)				
183743	<a href="#">138 Shepherd Street</a>		138	Shepherd St	333052.6	6248622.9	14.98	15.20	P	R				
183744	<a href="#">140 Shepherd Street</a>		140	Shepherd St	333051.3	6248619.1	14.98	15.22	P	R				
202408	<a href="#">1-19 Regent Street</a>		1 to 19	Regent Str	333724.1	6248648.0	28.22			C	Various Retail Stores	28.14	S	
621684	<a href="#">21 Regent Street</a>		21	Regent Str	336143.8	6248968.7	26.30			C	Various Retail Stores	26.95	S	
518066	<a href="#">55-59 Regent Street</a>		55 to 59	Regent Str	333772.0	6249050.0	17.81			C	Various Retail Stores	18.10	S	
627845	<a href="#">60-65 Regent Street</a>		60 to 65	Regent Str	333764.0	6249027.0	17.81			C	Various Retail Stores	17.81	S	
515495	<a href="#">67-69 Regent Street</a>		67 to 69	Regent Str	333757.0	6249020.0	17.94			C	Various Retail Stores	17.94	S	
516920	<a href="#">71-75 Regent Street</a>		71 to 75	Regent Str	333745.0	6249006.0	18.11			C	Various Retail Stores	19.16	S	
518418	<a href="#">80 Broughton Street</a>		80	Broughton St	32498.2	6249935.8	6.75		S	P(COMMUNITY)	BROUGHTON ST CHILD CARE CENTRE	7.09	S	
202206	<a href="#">12 Boundary Street</a>		12	Boundary St	333135.0	6248876.0	13.06	13.06	P					
522340	<a href="#">32 Burton Street</a>		32	Burton Street	332326.8	6250060.1	6.69	8.38	S					
522341	<a href="#">34 Burton Street</a>		34	Burton Street	332324.8	6250063.4	7.37	8.82	S					
522022	<a href="#">27 Cardigan Street</a>		27	Cardigan St	332508.5	6249942.3	7.53	7.61	S					
522023	<a href="#">29 Cardigan Street</a>		29	Cardigan St	332500.1	6249936.4	7.01	7.18	S					
522024	<a href="#">31 Cardigan Street</a>		31	Cardigan St	332501.1	6249937.1	7.01	7.18	S					
201521	<a href="#">36-38 George Street</a>		36 to 38	George Street	333780.9	6248550.2	26.51			P	Carpark	26.73	S	
514080	<a href="#">47-53 Jones Street</a>		47 to 53	Jones Street	333146.1	6249954.8	3.12			P	School	4.42	S	
521045	<a href="#">42 Lombard Street</a>		42	Lombard St	33261.6	6249961.2	19.41	20.60	S					
612303	<a href="#">1-73 Mount Vernon</a>		1 to 73	Mount Vernon	332197.0	6249431.0	24.85	25.17	P		Level Dwelling No.146 Corner St Johns Road and Mt Vernon Lane			
613427	<a href="#">2-8 Wentworth Street</a>		2 to 8	Wentworth St	332903.4	6249726.3	3.07	0.47						





# Blackwattle Bay Catchment Floodplain Risk Management Study and Plan

August 2013

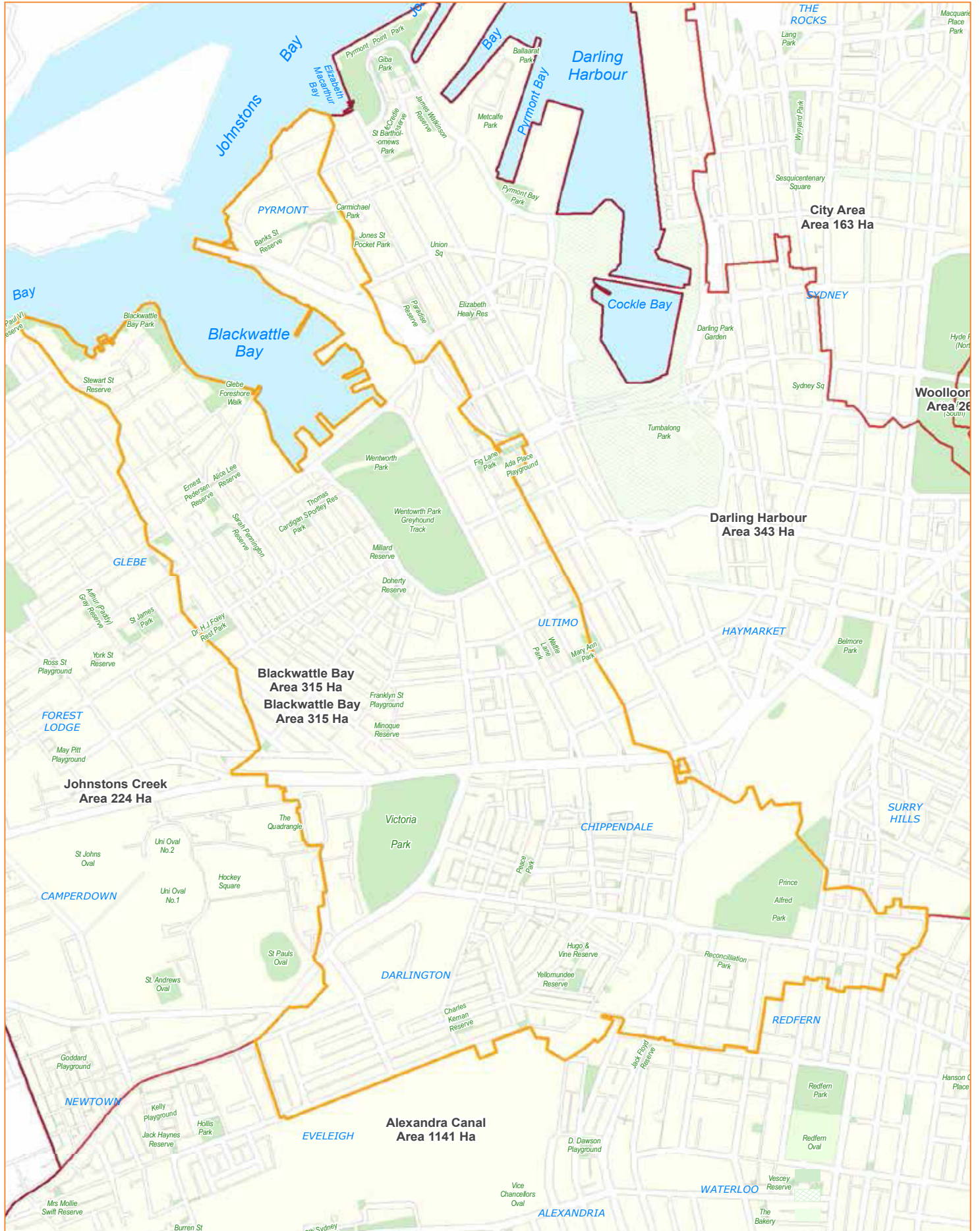


**The City of Sydney is preparing a Floodplain Risk Management Study and Plan for the Blackwattle Bay catchment area and we would like your help.**

**The study will tell us about the type of flood mitigation solutions feasible for the catchment and help us plan for and manage any flood risks.**

**Good management of flood risks can help reduce damage and improve social and economic opportunities.**

# Blackwattle Bay Floodplain Risk Management Study and Plan





The City of Sydney has engaged WMAwater to assist with the preparation of the Blackwattle Bay Floodplain Risk Management Study and Plan.

The Blackwattle Bay Flood Study was completed by WMAwater in 2012, giving the City of Sydney a better understanding of the nature of flooding in your area. The next step in the NSW Government Flood Management Process is the preparation of a Floodplain Risk Management Study and Plan. The purpose of this study and plan is to identify and recommend appropriate actions to manage flood risks in the Blackwattle Bay area.

This brochure is an introduction to the Floodplain Risk Management Study and Plan and its objectives.

### Stages of the NSW Government Flood Prone Land Policy

1. Formation of a Committee – complete
2. Data Collection – complete
3. Flood Study – complete
4. Floodplain Risk Management Study
5. Floodplain Risk Management Plan
6. Implementation of Plan.

### Study area and flooding issues

The Blackwattle Bay study area includes parts of Glebe, Ultimo, Pyrmont, Chippendale and Darlington.

Much of the flooding in this catchment occurs due to natural depressions and low points. In the past, flooding has caused property damage and posed a hazard to people and property located near drainage areas. The Floodplain Risk Management Study and Plan currently being undertaken is to manage these flood risks.

### Have your say

We want your comments about previous flood experiences and potential mitigation options.

The local knowledge of residents and business operators, including your personal experiences of flooding is a valuable source of information.

The information you provide in the accompanying questionnaire will help the City of Sydney determine how to manage the floods in your area.

For more information about this project, please contact the City of Sydney or WMAwater via the details provided.

### Floodplain risk management options

The following list of floodplain risk management options are examples of the type of strategies that could be considered to minimise risk and reduce the impact of flooding in the catchment. These options will be investigated in more detail during the preparation of the Management Study and Plan. There are general categories of options.

#### Flood modification options.

Examples include:

- Construction of detention/retarding basins to reduce the peak flow downstream;
- Upgrading of drainage systems, upgrade of existing pipes or construction of new pipes; and
- Regrading of roads to provide better overland flowpaths.

#### Property modification options and planning control.

Examples include:

- Building and development controls,
- Flood-proofing measures, such as flood barriers.

#### Response modification options.

Examples include:

- Revision of the Local Disaster Plan;
- Public awareness and education – locality-based flooding information for residents;
- Public awareness and education – flooding information for schools;
- Flood depth markers at major (flood-affected) road crossings;
- Continuation of existing public awareness and education campaigns; and
- Data collection strategies for future floods.

For more information please contact:

**WMAwater**  
Steve Gray  
Phone 02 9299 2855  
Fax: 02 9262 6208  
mailto:gray@wmawater.com.au  
gray@wmawater.com.au

# Local Resident/Land Owner Survey

The City of Sydney is carrying out a Floodplain Risk Management Study and Plan for the Blackwattle Bay catchment. Please return your completed questionnaire in the reply-paid envelope by Monday 16 September 2013. Or complete the questionnaire online at [cityofsydney.nsw.gov.au](http://cityofsydney.nsw.gov.au)

## 1

Please provide the following details as we may contact you to discuss some of the information you have provided us.

Name: .....

Address: .....

Contact phone number:.....

Email: .....

## 2

What is the best way to contact you?

Letter (post)

Email

Phone

## 3

How many people regularly live/work on this property?

.....  
.....  
.....

## 4

How many of the permanent residents/workers are in age group below:

0-4 years

5-14 years

15-64 years

65+ years

## 5

What is the main language spoken at this address?

English

Other (please specify) .....

6

Is your property (please tick)

- Owner occupied       Occupied by a tenant       Business
- Other (please specify) .....

7

What type of structure is your property/business? (please tick)

- Freestanding house.....
- Apartment.....
- Dual occupancy.....
- Industrial.....
- Commercial.....

8

How long have you lived, worked at, and/or owned this property?

Years .....

Months .....

9

Have you ever experienced flooding since living and/or working in the Blackwattle Bay catchment? (please tick relevant boxes)

- Yes, floodwaters entered my house/business
- Yes, floodwaters entered my yard/surrounds of my business
- Yes, the road was flooded and I couldn't get to my car
- Yes, other parts of my neighbourhood were flooded
- No, I haven't experienced flooding

10

Do you have any materials or photos you can provide to evidence the flooding you experienced? If yes, when did this flood occur?

- No
- Yes – the flooding occurred on: .....

As a local resident who may have witnessed flooding/drainage problems, you may have your own ideas about how to reduce flood risks. Which of the following management options would you prefer for the Blackwattle Bay catchment (1=least preferred, 5=most preferred)?

Proposed option	Preference
Stormwater harvesting, such as rainwater tanks — Suggested location/other comments:	1 2 3 4 5
Retarding or detention basins (these temporarily hold water and reduce peak flood flows) — Suggested location/other comments:	1 2 3 4 5
Improved flood flow paths — Suggested location/other comments:	1 2 3 4 5
Culvert/bridge enlarging — Suggested location/other comments:	1 2 3 4 5
Pit and pipe upgrades — Suggested location/other comments:	1 2 3 4 5
Levee banks or flood walls — Suggested location/other comments:	1 2 3 4 5
Strategic planning and flood related development controls — Suggested location/other comments:	1 2 3 4 5
Education of the community, providing greater awareness of potential hazards — Suggested location/other comments:	1 2 3 4 5
Flood forecasting, flood warnings, evacuation planning and emergency response measures — Suggested location/other comments:	1 2 3 4 5

Other (please specify any options you think are suitable):.....  
 .....  
 .....

If you have any further comments that relate to the Blackwattle Bay Flood Management Study and Plan, please write them in the space below. Feel free to attach additional pages if necessary.  
 .....  
 .....  
 .....

**Glossary**

- Culvert** – a piped drain or covered channel that passes under a road or railroad.
- Levee bank/flood wall** – an embankment or wall, usually constructed from earth or concrete, built along the banks of a watercourse to help prevent overflow of its waters.
- Retarding/detention basin** – depression in the land surface that captures and holds stormwater runoff allowing it to slowly drain out of the basin into the adjoining natural drainage line or creek.
- Stormwater harvesting** – the collection, storage, treatment and use of stormwater run-off from urban areas.

**Privacy notice:** The information obtained from the survey will be used by staff from the City of Sydney Council and WMAwater only. The information supplied will remain completely confidential.



# The Floodplain Risk Management Process

## Flood Risk – What Is It?

Flooding occurs when land is inundated with water, often from a river, creek or the ocean. The flood risk of an area is a product of the severity of the flood threat (including its magnitude and likelihood) and the extent of human development in the area. For instance, a section of houses built adjacent to a creek that regularly floods will have a much higher flood risk than a single property in an elevated area.

### ► Properties affected by flooding



### ► Flooding on Sparkes St, Camperdown



## Flood Risk - Where is it in NSW?

Flood risk in NSW is spread across the entire state, with nearly all local government areas affected in some form. The threat that flooding poses ranges from coastal inundation to the flooding of creeks and rivers, to surcharge of drainage systems in urban areas



## Who has responsibility for managing flooding?

Generally speaking, Councils are responsible for carrying out the management process, with the NSW Government and SES providing assistance where necessary. Consultants with expertise in flooding are commonly engaged by the City to assist in each stage. Council's knowledge of its community, including their flood risk, is combined with a consultant's technical knowledge of flood behaviour and how to manage it, and both are guided by the NSW Government and the SES's policies, which ensures state-wide consistency.



## How is flooding planned for?

The flood risk in a particular area is managed through the NSW Government's Flood Prone Land Policy, which sets out a multiple stage process for managing flood risk. The process determines the flood behaviour in an area, assesses what impact a possible flood event will have on the area, and then produces a series of recommendations as to how to manage the flood risk. The stages are shown below.

## How does the process work?

The process builds a complete picture of flooding in an area (both past and future) and then decides upon a strategy that will best manage the flood risk in the area. The process is cyclical. The last stage, implementing the chosen plan, is followed by a re-assessment of the flood behaviour, the management options, and so on. Flood threat is constantly changing, as uses evolve and the understanding of the lands hydrology grows. A better understanding of the possible impacts of climate change makes re-assessment of flood hydrology more important than ever.

### ► The Floodplain Risk Management Process

**WE ARE  
HERE**



# Managing the Flood Risk – What Can Be Done?

## The Three Types of Measure

The ideal approach to manage flood risk varies greatly between areas, and as such, many measures exist and are currently in use. The measures can be divided into three categories: **Property Modification**, **Response Modification** and **Flood Modification**. The suitability of a particular measure will depend on its benefit to the area, the cost of the measure, its negative impacts, and a range of other factors. A full description of each category is given in the Floodplain Development Manual

### Examples of the three types of measure

Property Modification Examples	Response Modification Examples	Flood Modification Examples
<ul style="list-style-type: none"> <li>• House Raising</li> <li>• Flood Proofing</li> <li>• Zoning controls</li> </ul>	<ul style="list-style-type: none"> <li>• Warning System</li> <li>• Evacuation Plan</li> <li>• Education</li> </ul>	<ul style="list-style-type: none"> <li>• Drainage Upgrade</li> <li>• Detention Basins</li> </ul>

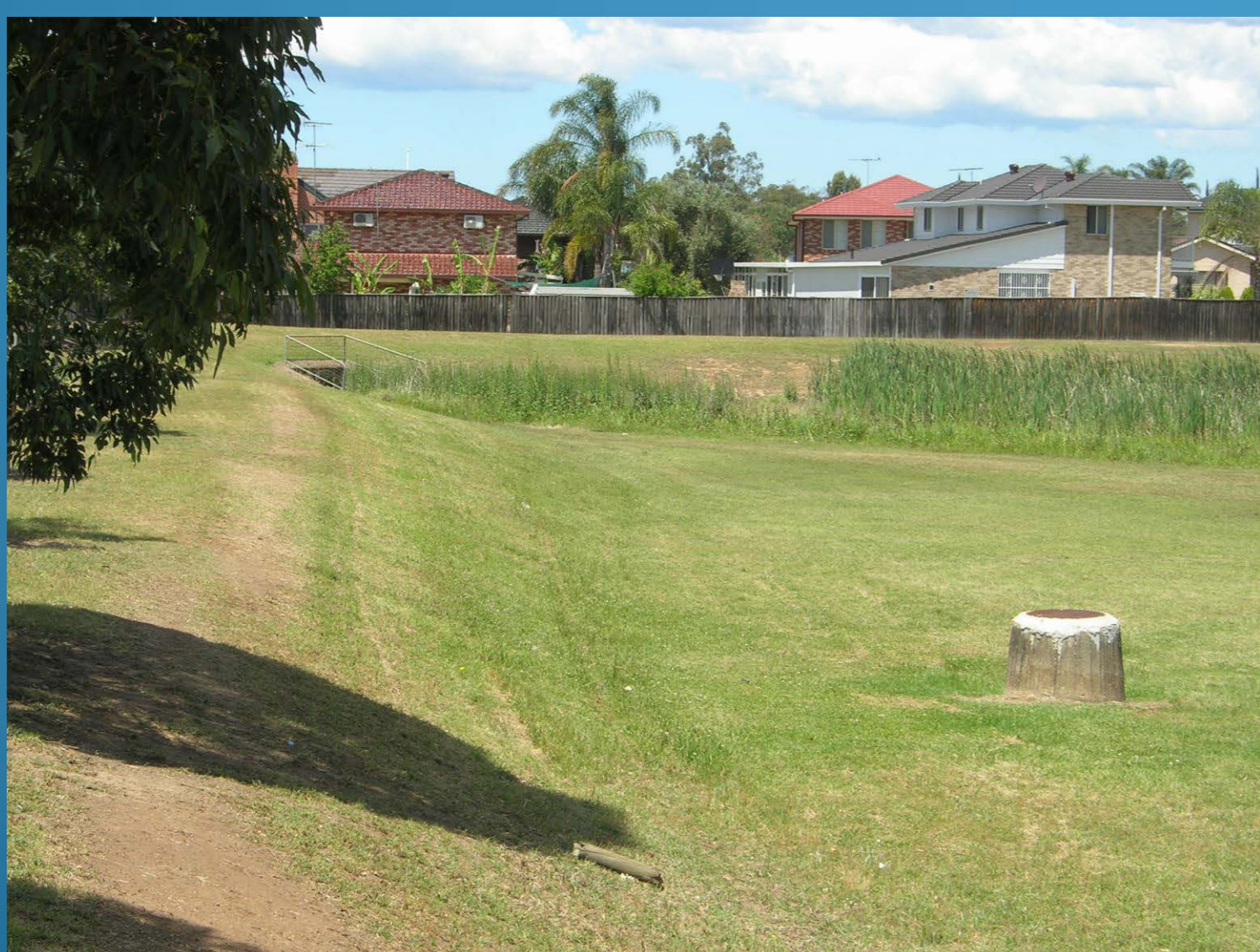
## Property Modification

Property modification measures refer to those that modify an existing property or place a control that limits future development. These measures include voluntary purchase of high risk properties, zoning controls in at-risk areas, house raising, flood proofing and flood access. The measures do not attempt to control the extent of the floodwaters, but rather act to lower the impact of the flood.



► House raising is an example of property modification

Property modification measures are only effective in some areas. For example, the cost of raising or purchasing a house must be balanced with the monetary benefit of that action. Similarly, house purchasing may be unpopular with landowners who value the location and intrinsic worth of their property.



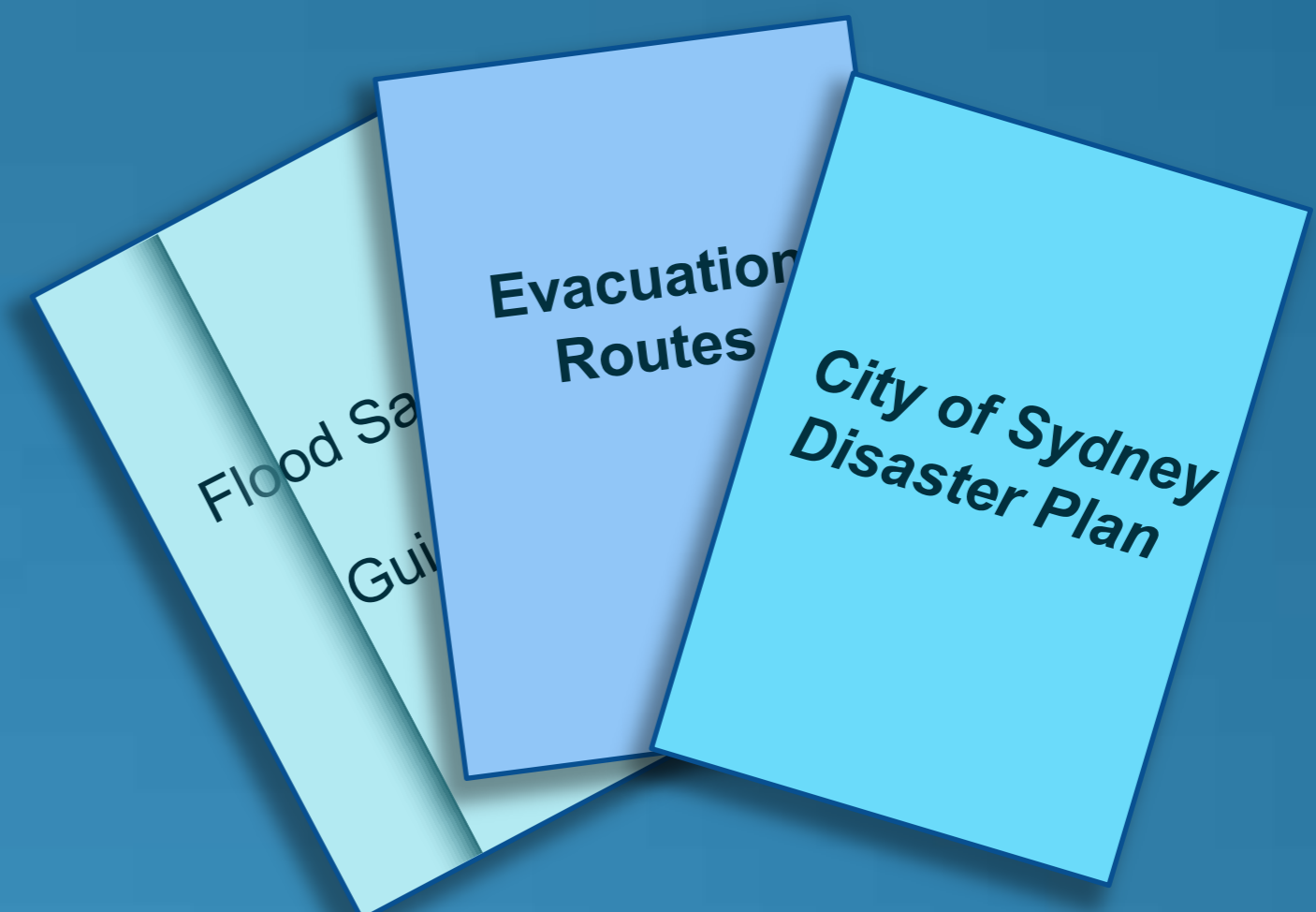
► Detention basin is an example of flood modification

### Designating floodways is an important zoning measure



## Response Modification

Response modification measures are those that increase the community's ability to react to floods when they occur. This typically relates to writing or amending plans used in emergency situation. Examples of plans that may be affected are those for flooding warning, the protection of an area, community education and readiness, the relief of evacuees and the post-flood recovery.



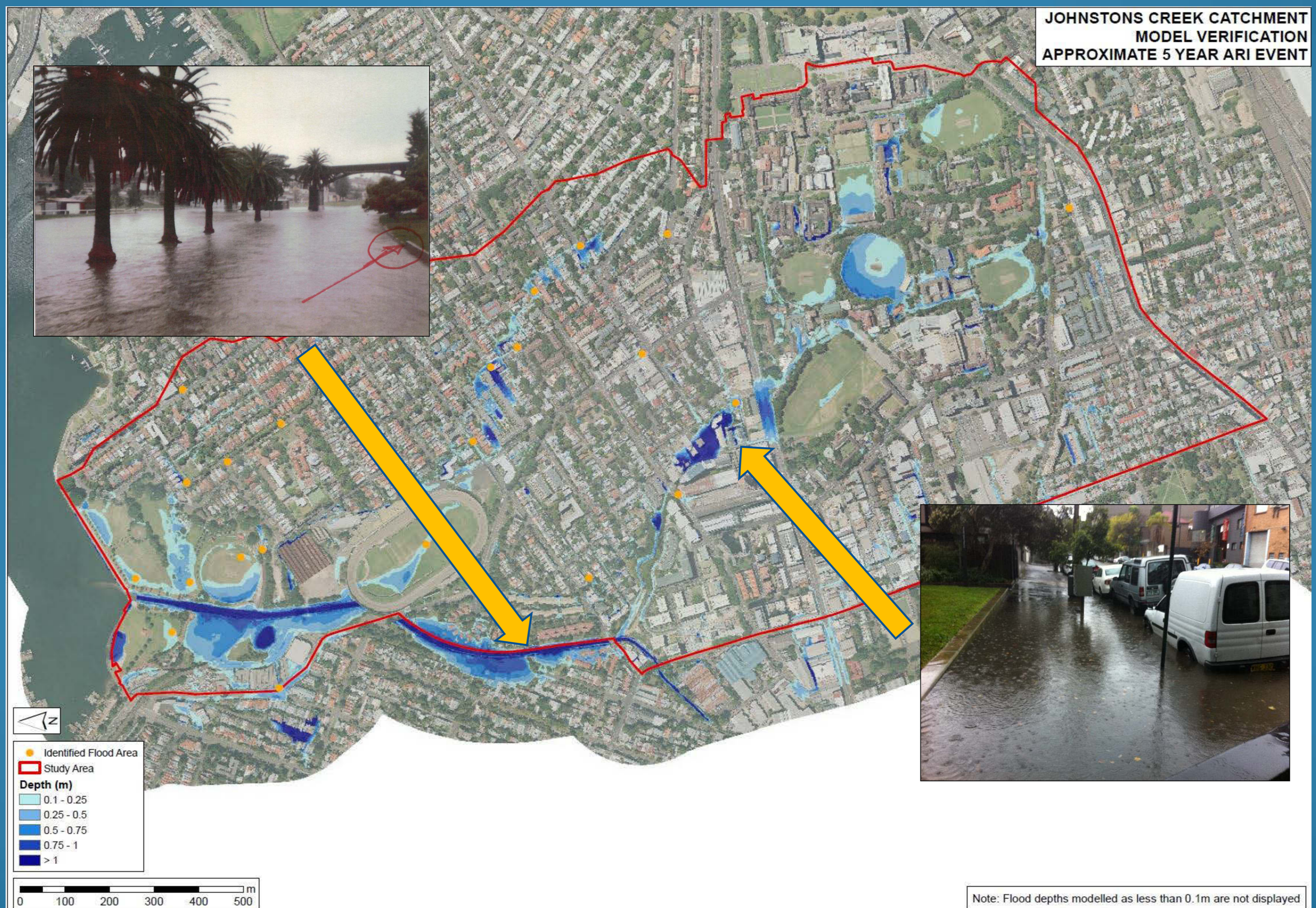
### Knowledge of flooding in an area should be well documented

While response modification measures will not alter the course of floodwaters, they have the advantage of generally being a cost-effective option. Plans such as those mentioned are typically easy to establish relative to other measures, and their benefits are immediate. A community that is well versed in the local flood risk, including their readiness, can minimize the impacts of a flood when it does occur.

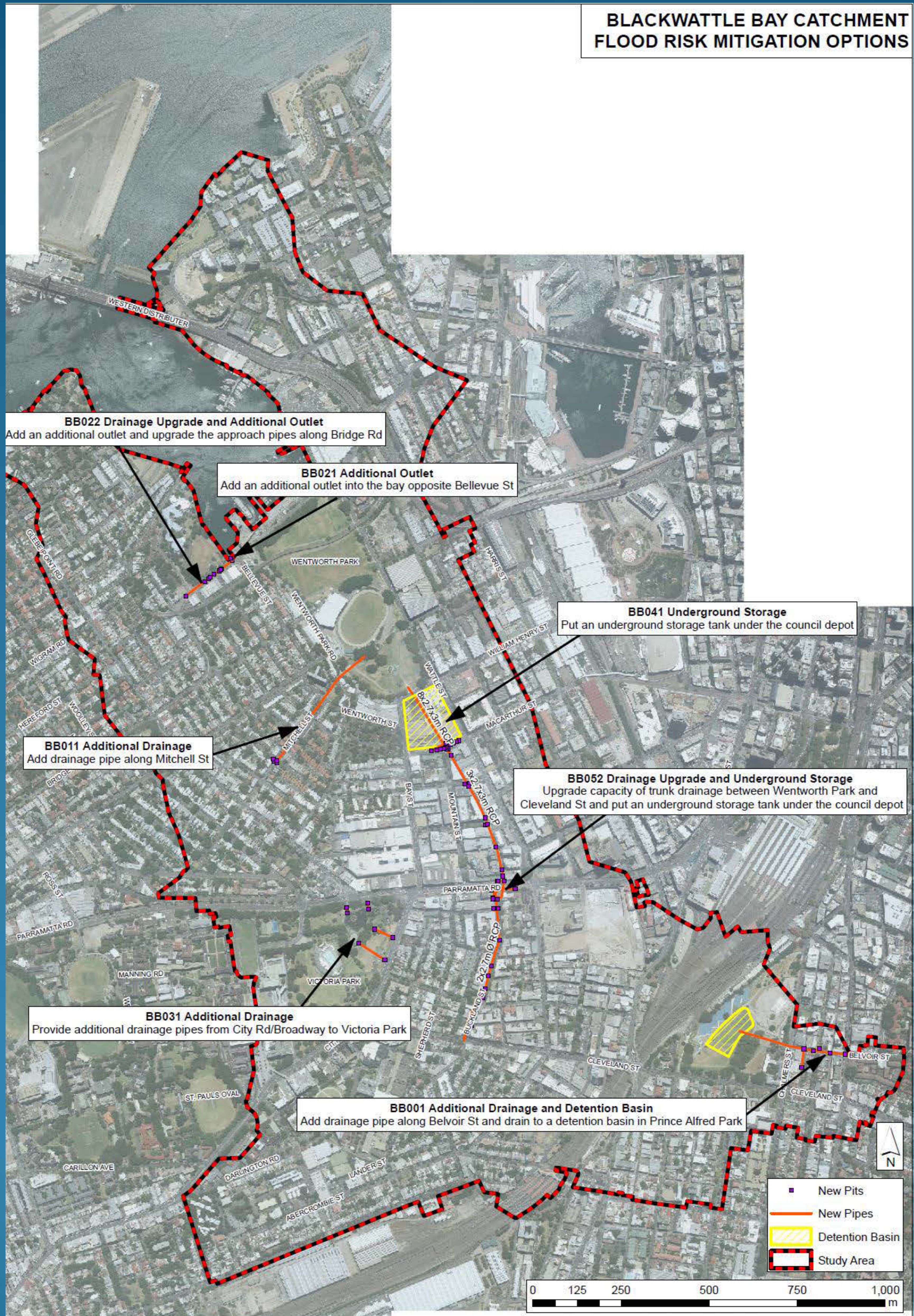
## Flood Modification

Flood modification measures aim to alter the behaviour of the floodwaters, be it their extent, velocity or height. These can be large scale projects, such as levees or seawalls around towns, or flood mitigation dams, or smaller modifications, such as altering the river channel, installation of sub-surface drainage, or local retarding basins. While they have the ability to re-route or diminish a river's flow, lowering the flood risk for large areas of land, modifying an area's hydrology can be both expensive and ecologically harmful. Furthermore, these structures may lead to a false sense of security, for example, that a levee or dam will protect an area indefinitely when in fact it will always fail once a large enough flood occurs.

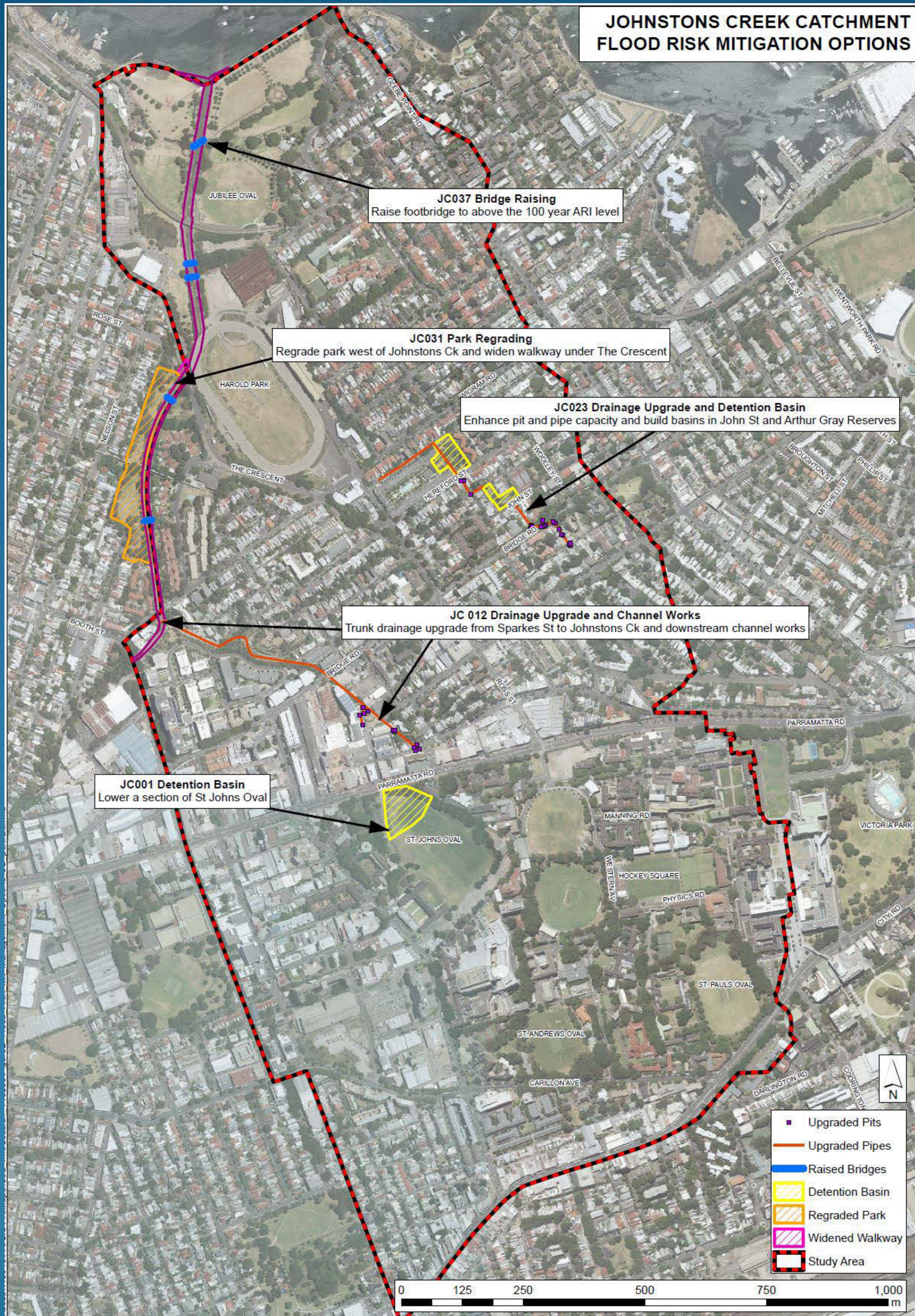
# Historical floods in Blackwattle Bay and Johnstons Creek catchments



# Preliminary Assessment of Flood Mitigation Measures – Blackwattle Bay Catchment



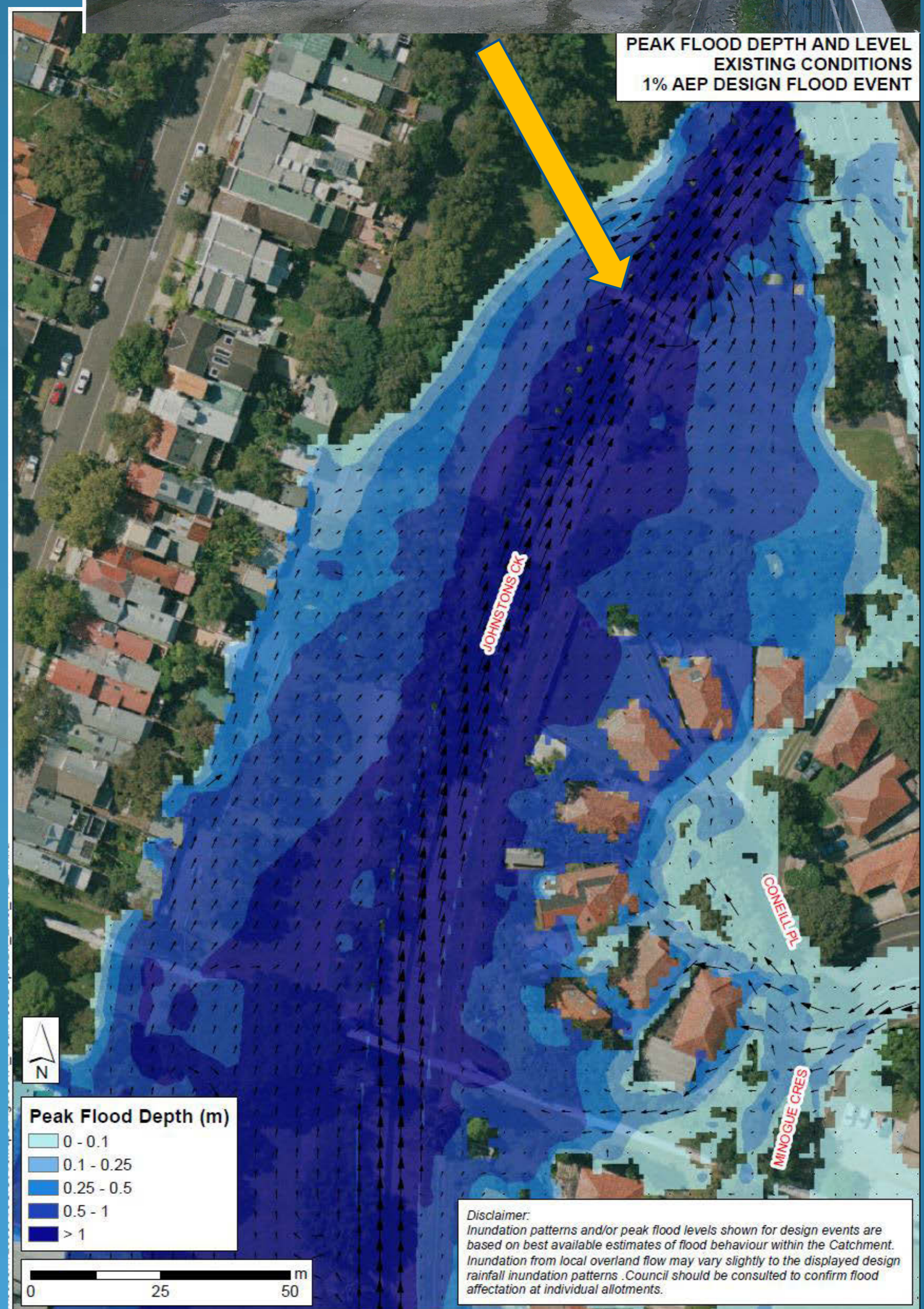
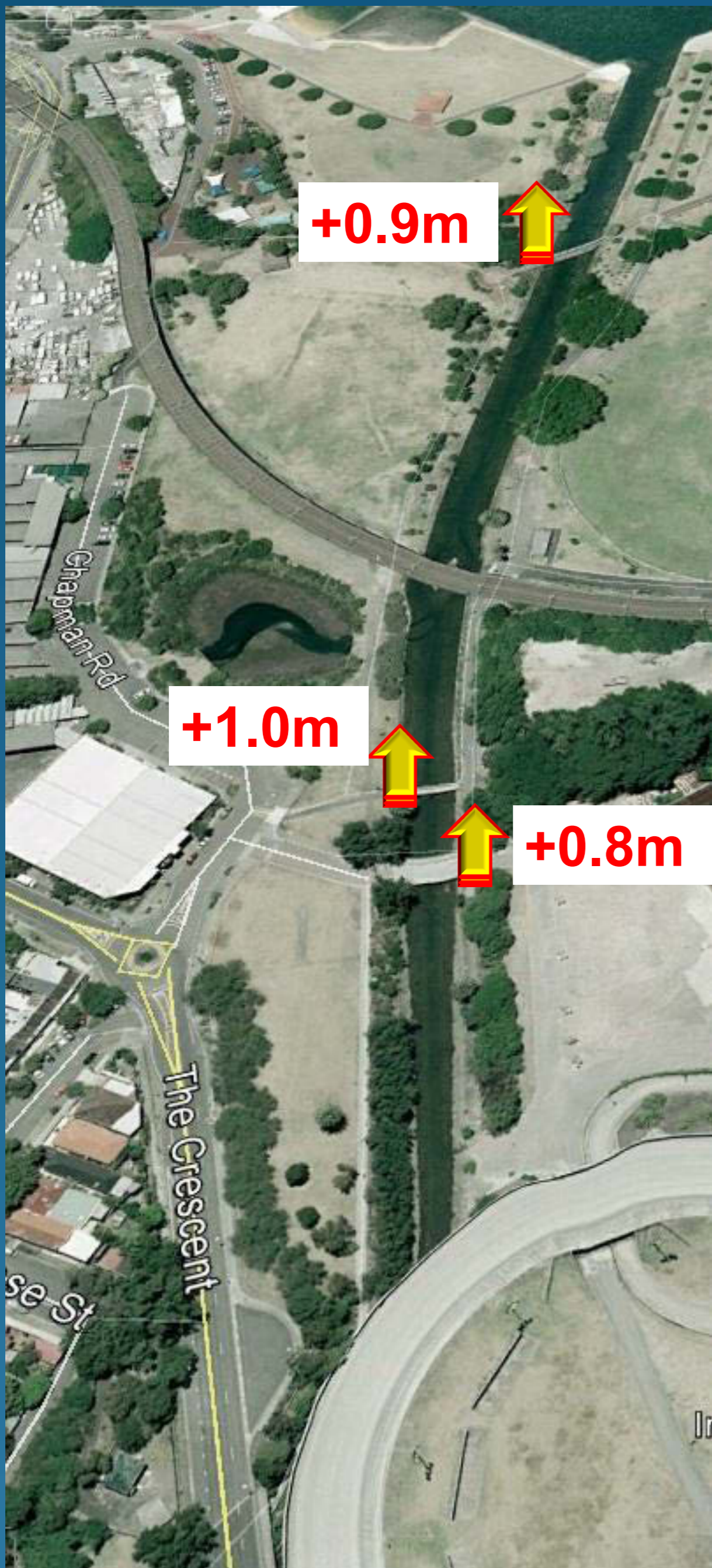
# Preliminary Assessment of Flood Mitigation Measures – Johnstons Creek Catchment



# Johnstons Creek

## Proposed works:

- Regrading adjacent parkland
- Raise pedestrian crossings
- Drainage upgrade





# Blackwattle Bay Catchment Floodplain Risk Management Study and Plan



**The City of Sydney is preparing a Floodplain Risk Management Study and Plan for the Blackwattle Bay catchment area and we would like your help.**

**The study will tell us about the type of flood mitigation solutions feasible for the catchment and help us plan for and manage any flood risks.**

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### Stages of the NSW Government Flood Prone Land Policy

1. Formation of a Committee – complete
2. Data Collection – complete
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4. **Floodplain Risk Management Study**
5. **Floodplain Risk Management Plan**
6. Implementation of Plan.

### Study area and flooding issues

The Blackwattle Bay study area includes parts of Glebe, Ultimo, Pyrmont, Chippendale and Darlington.

Much of the flooding in this catchment occurs due to natural depressions and low points. In the past, flooding has caused property damage and posed a hazard to people and property located near drainage areas. The Floodplain Risk Management Study and Plan currently being undertaken is to manage these flood risks.

### Have your say

We want your comments about previous flood experiences and potential mitigation options.

The local knowledge of residents and business operators, including your personal experiences of flooding is a valuable source of information.

The information you provide in the accompanying questionnaire will help the City of Sydney determine how to manage the floods in your area.

For more information about this project, please contact the City of Sydney or WMAwater via the details provided.

### Floodplain risk management options

The following list of floodplain risk management options are being investigated:

#### Flood modification options.

- Upgrading of drainage systems or construction of new pipes;
- Construction of detention/retarding basins to reduce downstream peak flows; and
- Provision of underground storage, e.g. at council depot; and
- Additional drainage outlet to Blackwattle Bay on Bridge Road.

#### Property modification options and planning control.

- Strategic planning and flood related development controls; and
- Flood-proofing measures, such as flood barriers.

#### Response modification options.

Examples include:

- Revision of the Local Disaster Plan;
- Public awareness and education – locality-based flooding information for residents;
- Public awareness and education – flooding information for schools;
- Flood depth markers at major (flood-affected) road crossings; and
- Data collection strategies for future floods.

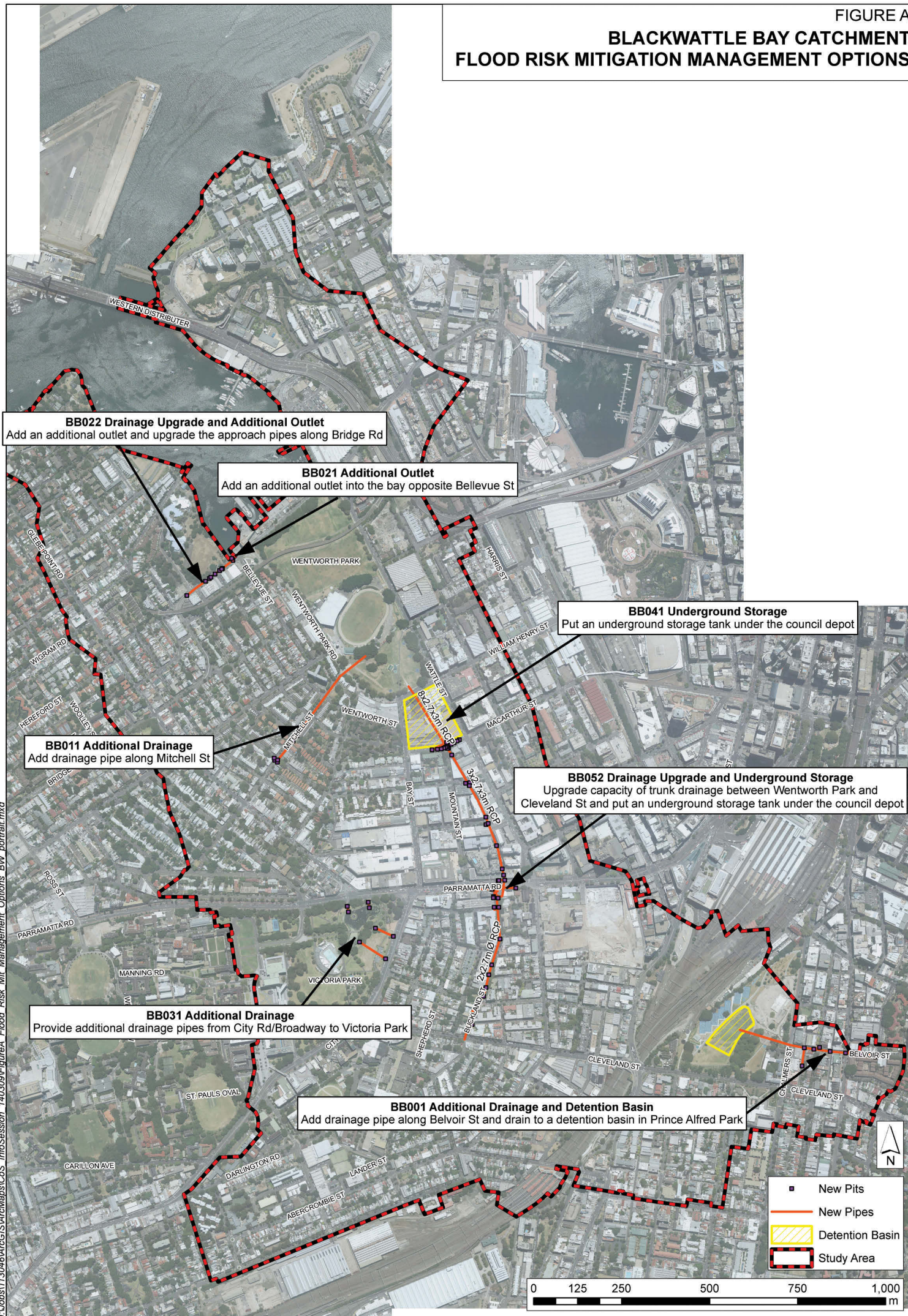
For more information please contact:

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Steve Gray  
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gray@wmawater.com.au

City of Sydney  
Shah Alam  
Phone: 02 9288 5925  
salam@cityofsydney.nsw.gov.au



**FIGURE A  
BLACKWATTLE BAY CATCHMENT  
FLOOD RISK MITIGATION MANAGEMENT OPTIONS**



**As a local resident who may have witnessed flooding/drainage problems, you may have your own ideas about how to reduce flood risks. Which of the following management options would you prefer for the Blackwattle Bay catchment (1 =least preferred, 5=most preferred)?**

Proposed option	Preference
Additional drainage along Belvoir Street and detention basin in Prince Alfred Park —	1 2 3 4 5
Drainage upgrade between Wentworth Park and Cleveland Street and an underground storage tank under the council depot —	1 2 3 4 5
Additional drainage pipes from City Road, Broadway to Victoria Park —	1 2 3 4 5
Additional drainage pipes along Mitchell Street —	1 2 3 4 5
Strategic planning and flood related development controls —	1 2 3 4 5
Education of the community, providing greater awareness of potential hazards —	1 2 3 4 5
Flood forecasting, flood warnings, evacuation planning and emergency response measures —	1 2 3 4 5

Other (please specify any options you think are suitable):.....  
 .....  
 .....

If you have any further comments that relate to the Blackwattle Bay Flood Management Study and Plan, please provide your name, address and phone number and any comments below and we will contact you.  
 .....  
 .....  
 .....

**Glossary**

- Culvert** – a piped drain or covered channel that passes under a road or railroad.
- Levee bank/flood wall** – an embankment or wall, usually constructed from earth or concrete, built along the banks of a watercourse to help prevent overflow of its waters.
- Retarding/detention basin** – depression in the land surface that captures and holds stormwater runoff allowing it to slowly drain out of the basin into the adjoining natural drainage line or creek.
- ARI** – Average Recurrence Interval



**Table D1: Residential Tangible Damages - Option BB01**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	156	70	\$ 3,425,382	\$ 21,958
5Y ARI	186	80	\$ 4,016,065	\$ 21,592
10% AEP	195	95	\$ 4,504,265	\$ 23,099
5% AEP	205	102	\$ 4,852,307	\$ 23,670
2% AEP	210	117	\$ 5,327,838	\$ 25,371
1% AEP	225	126	\$ 5,982,537	\$ 26,589
PMF	248	201	\$ 9,723,208	\$ 39,206
<b>Average Annual Damages (AAD)</b>			<b>\$ 2,920,198</b>	<b>\$ 11,775</b>

**Table D2: Commercial/Industrial Tangible Damages - Option BB01**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	40	23	\$ 5,265,056	\$ 131,626
5Y ARI	47	30	\$ 6,909,906	\$ 147,019
10% AEP	49	35	\$ 7,664,050	\$ 156,409
5% AEP	52	38	\$ 8,528,983	\$ 164,019
2% AEP	54	39	\$ 8,910,275	\$ 165,005
1% AEP	57	44	\$ 10,317,399	\$ 181,007
PMF	59	53	\$ 15,270,621	\$ 258,824
<b>Average Annual Damages (AAD)</b>			<b>\$ 4,761,571</b>	<b>\$ 80,705</b>

**Table D3: Combined Tangible Damages - Option BB01**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	196	93	\$ 8,690,437	\$ 44,339
5Y ARI	233	110	\$ 10,925,971	\$ 46,893
10% AEP	244	130	\$ 12,168,315	\$ 49,870
5% AEP	257	140	\$ 13,381,290	\$ 52,067
2% AEP	264	156	\$ 14,238,113	\$ 53,932
1% AEP	282	170	\$ 16,299,936	\$ 57,801
PMF	307	254	\$ 24,993,830	\$ 81,413
<b>Average Annual Damages (AAD)</b>			<b>\$ 7,681,769</b>	<b>\$ 25,022</b>

**Table D4: Residential Tangible Damages - Option BB02**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	153	66	\$ 3,267,665	\$ 21,357
5Y ARI	186	78	\$ 3,932,551	\$ 21,143
10% AEP	194	90	\$ 4,336,991	\$ 22,356
5% AEP	204	98	\$ 4,678,764	\$ 22,935
2% AEP	209	118	\$ 5,206,229	\$ 24,910
1% AEP	221	122	\$ 5,705,185	\$ 25,815
PMF	248	199	\$ 9,662,139	\$ 38,960
<b>Average Annual Damages (AAD)</b>			<b>\$ 2,815,411</b>	<b>\$ 11,352</b>

**Table D5: Commercial/Industrial Tangible Damages - Option BB02**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	40	23	\$ 5,392,378	\$ 134,809
5Y ARI	48	31	\$ 7,166,777	\$ 149,308
10% AEP	49	35	\$ 7,695,297	\$ 157,047
5% AEP	53	39	\$ 8,628,624	\$ 162,804
2% AEP	56	43	\$ 9,234,431	\$ 164,901
1% AEP	57	44	\$ 10,275,357	\$ 180,269
PMF	59	53	\$ 15,367,428	\$ 260,465
<b>Average Annual Damages (AAD)</b>			<b>\$ 4,876,750</b>	<b>\$ 82,657</b>

**Table D6: Combined Tangible Damages - Option BB02**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	193	89	\$ 8,660,043	\$ 44,871
5Y ARI	234	109	\$ 11,099,329	\$ 47,433
10% AEP	243	125	\$ 12,032,288	\$ 49,516
5% AEP	257	137	\$ 13,307,388	\$ 51,780
2% AEP	265	161	\$ 14,440,660	\$ 54,493
1% AEP	278	166	\$ 15,980,541	\$ 57,484
PMF	307	252	\$ 25,029,567	\$ 81,530
<b>Average Annual Damages (AAD)</b>			<b>\$ 7,692,161</b>	<b>\$ 25,056</b>

**Table D7: Residential Tangible Damages - Option BB04**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	157	71	\$ 3,449,978	\$ 21,974
5Y ARI	188	81	\$ 4,064,278	\$ 21,618
10% AEP	197	95	\$ 4,547,427	\$ 23,083
5% AEP	206	102	\$ 4,897,217	\$ 23,773
2% AEP	212	121	\$ 5,392,425	\$ 25,436
1% AEP	227	127	\$ 5,971,083	\$ 26,304
PMF	248	200	\$ 9,713,152	\$ 39,166
<b>Average Annual Damages (AAD)</b>			<b>\$ 2,945,839</b>	<b>\$ 11,878</b>

**Table D8: Commercial/Industrial Tangible Damages - Option BB04**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	36	23	\$ 5,354,956	\$ 148,749
5Y ARI	44	29	\$ 6,843,359	\$ 155,531
10% AEP	49	34	\$ 7,520,912	\$ 153,488
5% AEP	51	37	\$ 8,402,407	\$ 164,753
2% AEP	54	40	\$ 9,008,762	\$ 166,829
1% AEP	57	42	\$ 9,884,472	\$ 173,412
PMF	59	52	\$ 15,127,003	\$ 256,390
<b>Average Annual Damages (AAD)</b>			<b>\$ 4,765,349</b>	<b>\$ 80,769</b>

**Table D9: Combined Tangible Damages - Option BB04**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	193	94	\$ 8,804,934	\$ 45,621
5Y ARI	232	110	\$ 10,907,637	\$ 47,016
10% AEP	246	129	\$ 12,068,340	\$ 49,058
5% AEP	257	139	\$ 13,299,624	\$ 51,750
2% AEP	266	161	\$ 14,401,188	\$ 54,140
1% AEP	284	169	\$ 15,855,556	\$ 55,829
PMF	307	252	\$ 24,840,155	\$ 80,913
<b>Average Annual Damages (AAD)</b>			<b>\$ 7,711,188</b>	<b>\$ 25,118</b>

**Table D10: Residential Tangible Damages - Option BB06**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	152	71	\$ 3,429,959	\$ 22,566
5Y ARI	173	81	\$ 4,003,070	\$ 23,139
10% AEP	193	95	\$ 4,448,989	\$ 23,052
5% AEP	201	100	\$ 4,771,228	\$ 23,737
2% AEP	208	114	\$ 5,156,915	\$ 24,793
1% AEP	224	120	\$ 5,679,995	\$ 25,357
PMF	248	202	\$ 9,747,526	\$ 39,305
<b>Average Annual Damages (AAD)</b>			<b>\$ 2,905,720</b>	<b>\$ 11,717</b>

**Table D11: Commercial/Industrial Tangible Damages - Option BB06**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	40	23	\$ 5,367,854	\$ 134,196
5Y ARI	47	30	\$ 6,925,411	\$ 147,349
10% AEP	49	35	\$ 7,667,317	\$ 156,476
5% AEP	51	39	\$ 8,574,753	\$ 168,132
2% AEP	51	43	\$ 9,210,232	\$ 180,593
1% AEP	52	44	\$ 10,219,075	\$ 196,521
PMF	59	53	\$ 15,288,863	\$ 259,133
<b>Average Annual Damages (AAD)</b>			<b>\$ 4,812,975</b>	<b>\$ 81,576</b>

**Table D12: Combined Tangible Damages - Option BB06**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	192	94	\$ 8,797,813	\$ 45,822
5Y ARI	220	111	\$ 10,928,481	\$ 49,675
10% AEP	242	130	\$ 12,116,306	\$ 50,067
5% AEP	252	139	\$ 13,345,981	\$ 52,960
2% AEP	259	157	\$ 14,367,147	\$ 55,472
1% AEP	276	164	\$ 15,899,070	\$ 57,605
PMF	307	255	\$ 25,036,389	\$ 81,552
<b>Average Annual Damages (AAD)</b>			<b>\$ 7,718,695</b>	<b>\$ 25,142</b>

**Table D13: Residential Tangible Damages - Option BB07**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	124	57	\$ 2,868,463	\$ 23,133
5Y ARI	140	61	\$ 3,183,481	\$ 22,739
10% AEP	156	73	\$ 3,557,137	\$ 22,802
5% AEP	164	78	\$ 3,828,434	\$ 23,344
2% AEP	176	91	\$ 4,122,622	\$ 23,424
1% AEP	191	98	\$ 4,610,017	\$ 24,136
PMF	248	200	\$ 9,499,150	\$ 38,303
<b>Average Annual Damages (AAD)</b>			<b>\$ 2,379,982</b>	<b>\$ 9,597</b>

**Table D14: Commercial/Industrial Tangible Damages - Option BB07**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	22	8	\$ 1,958,618	\$ 89,028
5Y ARI	26	10	\$ 2,275,075	\$ 87,503
10% AEP	27	11	\$ 2,634,439	\$ 97,572
5% AEP	32	15	\$ 2,923,211	\$ 91,350
2% AEP	35	22	\$ 3,928,711	\$ 112,249
1% AEP	43	29	\$ 5,993,308	\$ 139,379
PMF	59	53	\$ 14,691,293	\$ 249,005
<b>Average Annual Damages (AAD)</b>			<b>\$ 1,764,834</b>	<b>\$ 29,912</b>

**Table D15: Combined Tangible Damages - Option BB07**

Event	Properties Affected	No. Of these Flooded Above Floor Level	Tangible Flood Damages	Average Tangible Damage Per Flood Affected Property
2Y ARI	146	65	\$ 4,827,082	\$ 33,062
5Y ARI	166	71	\$ 5,458,556	\$ 32,883
10% AEP	183	84	\$ 6,191,576	\$ 33,834
5% AEP	196	93	\$ 6,751,645	\$ 34,447
2% AEP	211	113	\$ 8,051,333	\$ 38,158
1% AEP	234	127	\$ 10,603,325	\$ 45,313
PMF	307	253	\$ 24,190,443	\$ 78,796
<b>Average Annual Damages (AAD)</b>			<b>\$ 4,144,816</b>	<b>\$ 13,501</b>





**Table E1: Cost Estimate - Option FM-BB01: New Drainage and Detention Basin near Prince Alfred Park**

Item No.	Description of work	Quantity	Unit	Rate	Cost
<b>1</b>	<b>General Construction Costs</b>				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item		
1.2	Provision of sediment and erosion control	1	item		
1.3	Construction setout and survey	1	item		
1.4	Work as executed survey and documentation	1	item		
1.5	Geotechnical supervision, testing and certification	1	item		
	<b>SUBTOTAL (Assumed as 15% of works cost)</b>				<b>\$ 549,021</b>
<b>2</b>	<b>Demolition and Clearing</b>				
2.1	Clearing and grubbing	9,673	sq. m	11	104,467
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	1,451	cu. m	27	39,175
2.3	Dispose of excess topsoil (nominal 10% allowance)	145	cu. m	65	9,402
2.4	Pull up and dispose existing road surface	908	sq. m	38	34,322
	<b>SUBTOTAL</b>				<b>\$ 187,366</b>
<b>3</b>	<b>Excavation and earthworks</b>				
3.1	Excavation of detention basins and swales	20,467	cu. m	49	994,696
3.2	Disposal of excess cut (assuming 80% of total excavation)	16,374	item	65	1,061,009
	<b>SUBTOTAL</b>				<b>\$ 2,055,705</b>
<b>4</b>	<b>Installation of Drainage</b>				
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	9	each	4,320	38,880
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	71,936	item	74,547	71,936
	<b>SUBTOTAL</b>	<b>791,297</b>			<b>\$ 791,297</b>
	<b>CONSTRUCTION TOTAL, exc. GST</b>				<b>\$ 6,313,740</b>
	<b>GST</b>				<b>\$ 631,374</b>
	<b>CONSTRUCTION TOTAL, inc. GST</b>				<b>\$ 6,945,114</b>
	<b>CONSTRUCTION TOTAL, rounded</b>				<b>\$ 6,945,100</b>
11.1	Maintenance of mitigation option		item		<b>\$ 14,540</b>

**Table E2: Cost Estimate - Option FM-BB02: New Drainage – Mitchell St to Wentworth Park**

Item No.	Description of work	Quantity	Unit	Rate	Cost
<b>1</b>	<b>General Construction Costs</b>				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	<b>SUBTOTAL (Assumed as 15% of works cost)</b>				<b>\$ 262,708</b>
<b>2</b>	<b>Demolition and Clearing</b>				
2.1	Clearing and grubbing	0	sq. m	11	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	65	0
2.4	Pull up and dispose existing road surface	830	sq. m	38	31,374
	<b>SUBTOTAL</b>				<b>\$ 31,374</b>
<b>4</b>	<b>Installation of Drainage</b>				
4.1	Supply, excavate, bed, lay, joint, backfill and provide connections 0.45m dia. Pipe	11	lin. m	999	11,189
4.2	Supply, excavate, bed, lay, joint, backfill and provide connections 0.6m dia. Pipe	76	lin. m	1,053	79,923
4.3	Supply, excavate, bed, lay, joint, backfill and provide connections 0.9m dia. Pipe	9	lin. m	1,296	11,664
4.4	Supply, excavate, bed, lay, joint, backfill and provide connections 1.2m dia. Pipe	7	lin. m	1,782	11,761
4.7	Supply, excavate, bed, lay, joint, backfill and provide connections 1.8m dia. Pipe	312	lin. m	3,564	1,113,037
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	8	each	4,320	34,560
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	126,213	item	74,547	126,213
	<b>SUBTOTAL</b>				<b>\$ 1,388,347</b>
<b>7</b>	<b>Footpath and Road Surfaces</b>				
7.1	Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing	830	sq. m	130	107,568
	<b>SUBTOTAL</b>				<b>\$ 107,568</b>
<b>9</b>	<b>Traffic Management</b>				
9.1	Control of traffic during works (nominal allowance) (assumed \$500 per lin.m)	415	lin. m	540	224,100
	<b>SUBTOTAL</b>				<b>\$ 224,100</b>
	<b>CONSTRUCTION SUBTOTAL</b>				<b>\$ 2,014,098</b>
<b>11</b>	<b>Contingencies</b>				<b>\$ -</b>
11.1	50% construction cost				<b>\$ 1,007,049</b>
	<b>CONSTRUCTION TOTAL, exc. GST</b>				<b>\$ 3,021,147</b>
	<b>GST</b>				<b>\$ 302,115</b>
	<b>CONSTRUCTION TOTAL, inc. GST</b>				<b>\$ 3,323,261</b>
	<b>CONSTRUCTION TOTAL, rounded</b>				<b>\$ 3,323,300</b>
<b>11</b>	<b>MAINTENANCE</b>				
11.1	Maintenance of mitigation option		item		<b>\$ 4,150</b>

**Table E3: Cost Estimate - Option FM-BB04: New Outlet to Blackwattle Bay & Drainage Upgrade – Bridge Rd**

Item No.	Description of work	Quantity	Unit	Rate	Cost
<b>1</b>	<b>General Construction Costs</b>				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	<b>SUBTOTAL (Assumed as 15% of works cost)</b>				<b>\$ 148,527</b>
<b>2</b>	<b>Demolition and Clearing</b>				
2.1	Clearing and grubbing	0	sq. m	11	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	65	0
2.4	Pull up and dispose existing road surface	330	sq. m	38	12,489
	<b>SUBTOTAL</b>				<b>\$ 12,489</b>
<b>4</b>	<b>Installation of Drainage</b>				
4.2	Supply, excavate, bed, lay, joint, backfill and provide connections 2.4m x 2.4m culvert	165	lin. m	4,536	749,347
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	3	each	4,320	12,960
4.3	Install new outlet structure, including erosion protection as required	1	each	6,480	6,480
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	76,879	item	74,547	76,879
	<b>SUBTOTAL</b>				<b>\$ 845,666</b>
<b>7</b>	<b>Footpath and Road Surfaces</b>				
7.1	Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing	330	sq. m	130	42,820
	<b>SUBTOTAL</b>				<b>\$ 42,820</b>
<b>9</b>	<b>Traffic Management</b>				
9.1	Control of traffic during works (nominal allowance) (assumed \$500 per lin.m)	165	lin. m	540	89,208
	<b>SUBTOTAL</b>				<b>\$ 89,208</b>
	<b>CONSTRUCTION SUBTOTAL</b>				<b>\$ 1,138,710</b>
<b>11</b>	<b>Contingencies</b>				<b>\$ 569,355</b>
11.1	50% construction cost				<b>\$ -</b>
	<b>CONSTRUCTION TOTAL, exc. GST</b>				<b>\$ 1,708,065</b>
	<b>GST</b>				<b>\$ 170,807</b>
	<b>CONSTRUCTION TOTAL, inc. GST</b>				<b>\$ 1,878,872</b>
	<b>CONSTRUCTION TOTAL, rounded</b>				<b>\$ 1,878,900</b>
<b>11</b>	<b>MAINTENANCE</b>				
11.1	Maintenance of mitigation option		item	0	\$ 1,652

**Table E4: Cost Estimate - Option FM-BB06: Underground Storage at Council Depot**

Item No.	Description of work	Quantity	Unit	Rate	Cost
<b>1</b>	<b>General Construction Costs</b>				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	<b>SUBTOTAL (Assumed as 15% of works cost)</b>				<b>\$ 765,175</b>
<b>2</b>	<b>Demolition and Clearing</b>				
2.1	Clearing and grubbing	0	sq. m	11	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	65	0
2.4	Pull up and dispose existing road surface	100	sq. m	38	3,780
	<b>SUBTOTAL</b>				<b>\$ 3,780</b>
<b>3</b>	<b>Excavation and earthworks</b>				
3.1	Excavation of detention basins and swales	40,000	cu. m	49	1,944,000
3.2	Disposal of excess cut (assuming 80% of total excavation)	32,000	item	65	2,073,600
	<b>SUBTOTAL</b>				<b>\$ 4,017,600</b>
<b>4</b>	<b>Installation of Drainage</b>				
4.8	Supply, excavate, bed, lay, joint, backfill and provide connections 2.1m dia. Pipe	100	lin. m	4,212	421,200
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	2	each	4,320	8,640
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	42,984	item	74,547	42,984
	<b>SUBTOTAL</b>				<b>\$ 472,824</b>
<b>6</b>	<b>Installation of Storage Tank</b>				
6.1	Construction of storage tank (nominal allowance)	1	item	540,000	540,000
	<b>SUBTOTAL</b>				<b>\$ 540,000</b>
<b>7</b>	<b>Footpath and Road Surfaces</b>				
7.1	Reinstate disturbed road pavement, including demolition and disposal of additional material to provide good jointing	100	sq. m	130	12,960
	<b>SUBTOTAL</b>				<b>\$ 12,960</b>
<b>9</b>	<b>Traffic Management</b>				
9.1	Control of traffic during works (nominal allowance) (assumed \$500 per lin.m)	100	lin. m	540	100
	<b>SUBTOTAL</b>				<b>\$ 54,000</b>
	<b>CONSTRUCTION SUBTOTAL</b>				<b>\$ 5,866,339</b>
<b>11</b>	<b>Contingencies</b>				<b>\$ 2,933,169</b>
11.1	50% construction cost				\$ -
	<b>CONSTRUCTION TOTAL, exc. GST</b>				<b>\$ 8,799,508</b>
	<b>GST</b>				<b>\$ 879,951</b>
	<b>CONSTRUCTION TOTAL, inc. GST</b>				<b>\$ 9,679,459</b>
	<b>CONSTRUCTION TOTAL, rounded</b>				<b>\$ 9,679,500</b>
<b>11</b>	<b>MAINTENANCE</b>				
11.1	Maintenance of mitigation option		item	0	\$ 21,000

**Table E5: Cost Estimate - Option FM-BB07: Drainage Upgrade – Cleveland St to Wentworth Park & Underground Storage at Council Depot**

Item No.	Description of work	Quantity	Unit	Rate	Cost
<b>1</b>	<b>General Construction Costs</b>				
1.1	Site establishment, security fencing, facilities and disestablishment	1	item	0	0
1.2	Provision of sediment and erosion control	1	item	0	0
1.3	Construction setout and survey	1	item	0	0
1.4	Work as executed survey and documentation	1	item	0	0
1.5	Geotechnical supervision, testing and certification	1	item	0	0
	<b>SUBTOTAL (Assumed as 15% of works cost)</b>				<b>\$ 2,866,623</b>
<b>2</b>	<b>Demolition and Clearing</b>				
2.1	Clearing and grubbing	0	sq. m	10.8	0
2.2	Strip topsoil and stockpile for re-use (assuming 150mm depth)	0	cu. m	27	0
2.3	Dispose of excess topsoil (nominal 10% allowance)	0	cu. m	64.8	0
2.4	Pull up and dispose existing road surface	13,807	sq. m	37.8	521,905
	<b>SUBTOTAL</b>				<b>\$ 521,905</b>
<b>3</b>	<b>Excavation and earthworks</b>				
3.1	Excavation of detention basins and swales	40,000	cu. m	48.6	1,944,000
3.2	Disposal of excess cut (assuming 80% of total excavation)	32,000	item	64.8	2,073,600
	<b>SUBTOTAL</b>				<b>\$ 4,017,600</b>
<b>4</b>	<b>Installation of Drainage</b>				
4.3	Supply, excavate, bed, lay, joint, backfill and provide connections 0.9m dia. Pipe	98.5	lin. m	1296	127656.0
4.5	Supply, excavate, bed, lay, joint, backfill and provide connections 1.5m dia. Pipe	3.5	lin. m	2430	8505.0
4.7	Supply, excavate, bed, lay, joint, backfill and provide connections 1.8m dia. Pipe	15.2	lin. m	3564	54172.8
4.8	Supply, excavate, bed, lay, joint, backfill and provide connections 2.1m dia. Pipe	142.3	lin. m	4212	599367.6
4.1	Supply, excavate, bed, lay, joint, backfill and provide connections 2.4m dia. Pipe	8	lin. m	4536	37,649
4.12	Supply, excavate, bed, lay, joint, backfill and provide connections 2.7m dia. Pipe	302	lin. m	4860	1,468,692
4.13	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m dia. Pipe	126	lin. m	5184	653,184
4.16	Supply, excavate, bed, lay, joint, backfill and provide connections 2.1m x 1.2m culvert	3	lin. m	3240	9,072
4.21	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m x 2.7m culvert	547	lin. m	5400	2,952,180
4.23	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m x 3.0m culvert	76	lin. m	6156	467,856
4.24	Supply, excavate, bed, lay, joint, backfill and provide connections 3.3m x 2.1m culvert	153	lin. m	6264	959,645
4.25	Supply, excavate, bed, lay, joint, backfill and provide connections 3.0m x 0.9m culvert	6	lin. m	5940	35,640
4.29	Install new drainage/junction pit (assumed 1 pit per 50m of pipe)	28	each	4320	120,960
4.31	Adjustment of existing services (nominal allowance) (assumed 10% of drainage installation cost)	749,458	item	74547	42,984
	<b>SUBTOTAL</b>				<b>\$ 8,244,037</b>
<b>6</b>	<b>Installation of Storage Tank</b>				
6.1	Construction of storage tank (nominal allowance)	1		540,000	540,000
	<b>SUBTOTAL</b>				<b>\$ 540,000</b>



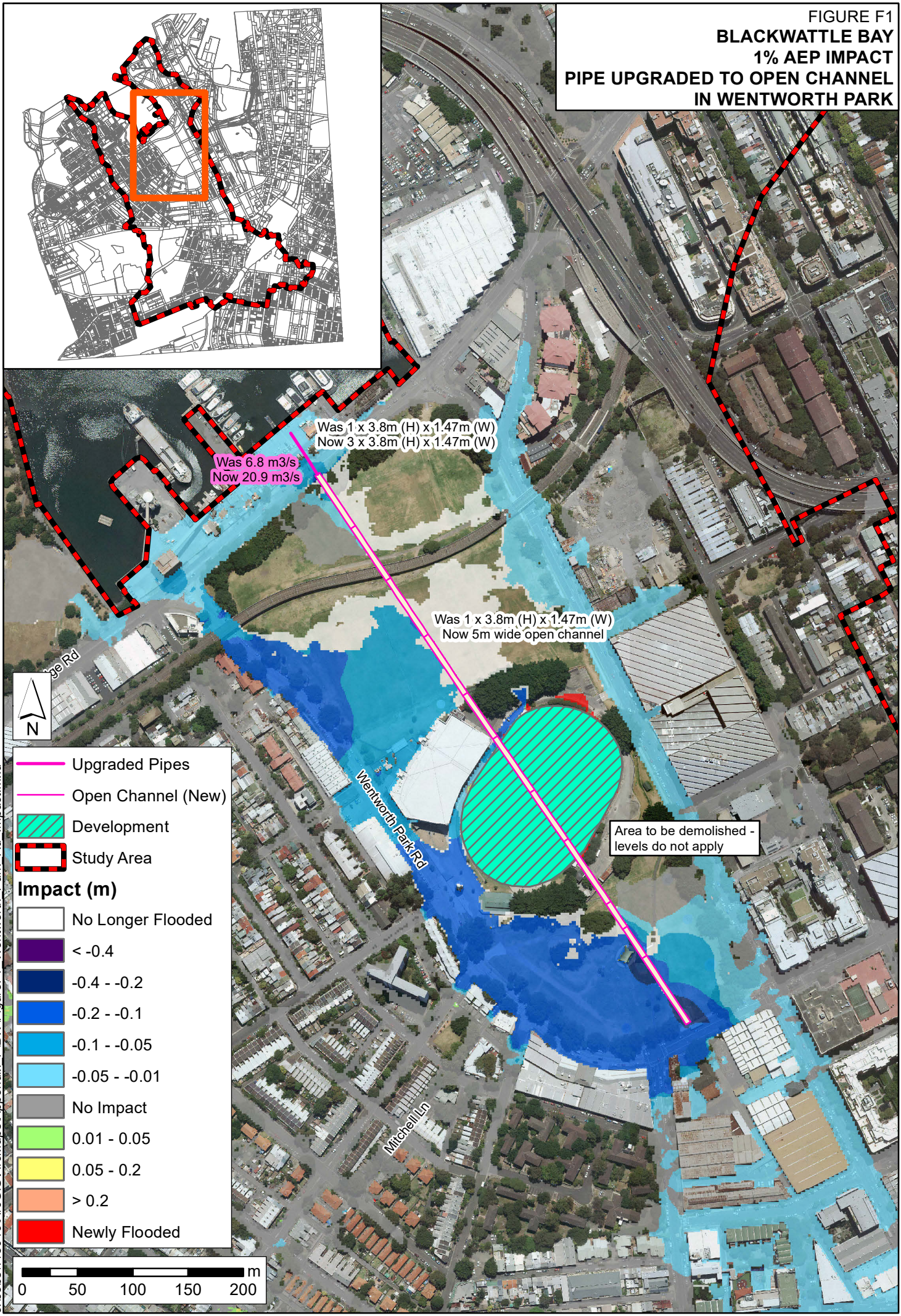
## Blackwattle Bay - Mitigation Options Considered

Location	Description	Type of Measure	Impact	Outcome
Parramatta Rd/Buckland St - Wentworth Park	Double capacity of trunk drainage up to Parramatta Rd/Buckland St intersection	Drainage Upgrade	Drop of 0.1 m between low area between Parramatta Rd and Wentworth Park Rd, as well as along Wentworth Park Rd, in the 1% AEP event.	Comparative to it's limited benefits, there are issues with contaminated fill in Wentworth Park, and the high cost of a ~3 km long pipe upgrade. <b>Discarded.</b>
Wentworth Park	Open channel up to Wentworth Park Rd (see Figure F1)	Drainage Upgrade	Triples the peak flow at the outlet in the 1% AEP event, results in drop of around 0.2 m on Wentworth Park Rd and in the park.	Issues of contaminated fill in Wentworth Park outweigh the limited benefits to the area. <b>Discarded</b>
Mitchell St - Wentworth Park	Double capacity of trunk drainage up to Mitchell Ln East	Drainage Upgrade	Drop of 0.01 in 1% AEP event around flood affected properties near Mitchell St, on Wentworth Park Rd and on Wentworth Park.	Negligible drop in flood level. <b>Refined to become FM - BB02</b>
Pembroke St - Railway	Double capacity of drainage from railway line to Pembroke St	Drainage Upgrade	Drop of 0.1 m in 1% AEP event on Chalmers Street and in trapped depression. Increase from 0.5 m <sup>3</sup> /s to 0.8 m <sup>3</sup> /s at downstream end of Prince Alfred Park.	Negligible drop in flood level. <b>Refined to become FM - BB01</b>
Bridge Rd - Blackwattle Bay	Enhance pit and pipe capacity on Bridge Road where it is parallel to Bridge Lane.	Drainage Upgrade	Drop of 0.01 m in 1% AEP event on Bridge Rd, despite increase of flow at the outlet from 1.7 m <sup>3</sup> /s to 3.4 m <sup>3</sup> /s.	Negligible drop in flood level. <b>Refined to become FM - BB03</b>
Parramatta Rd/Buckland St - Wentworth Park	Double capacity of trunk drainage up to Parramatta Rd/Buckland St intersection (including the south side of Parramatta Road) and double pit capacity around the Parramatta Rd/Buckland St intersection.	Drainage Upgrade	Drop of 0.1 m in low area between Parramatta Rd and Wentworth Park Rd, as well as along Wentworth Park Rd, in the 1% AEP event.	Comparative to it's limited benefits, there are issues with contaminated fill in Wentworth Park, and the high cost of a ~3 km long pipe upgrade. <b>Refined to become FM - BB07</b>
Parramatta Rd/Buckland St	Same as above, but do not change the pipes in Wentworth Park (except the first one). Change the last pit so it surcharges (1528P)	Drainage Upgrade	Drop of 0.1 m in low area between Parramatta Rd and Wentworth Park Rd, slight increase at south end of Wentworth Park, in the 1% AEP event.	Negligible drop in flood level. <b>Refined to become FM - BB07</b>
Wattle St - Blackwattle Bay	Double capacity of trunk drainage along Wattle St, excluding the last two pipes before Broadway.	Drainage Upgrade	Drop of 0.02 m along Wattle St adjacent to Wentworth Park in the 1% AEP event.	Negligible drop in flood level. Issues with pipe upgrade along main road. <b>Discarded</b>
Talfourd St - Bridge Rd	2x 450 to drain Talfourd St up to Bridge Rd, double pit capacity at Talfourd depression.	Drainage Upgrade	Drop of 0.02 m along Talfourd St near Bridge Rd in the 1% AEP event.	Negligible drop in flood level. <b>Discarded</b>

<b>Location</b>	<b>Description</b>	<b>Type of Measure</b>	<b>Impact</b>	<b>Outcome</b>
Talfourd St - Bridge Rd	Same as above, with three 'humps' to divert flow away from the depression. Locations: Talfourd/Marlborough, Talfourd Ln/Marlborough, Talfourd Ln easement.	Flow Path Modification	Drop of 0.02 m along Talfourd St near Bridge Rd in the 1% AEP event. Slight increases upstream of the 'humps'.	Negligible drop in flood level. <b>Discarded</b>
Cleveland St - Parramatta Rd	Cleveland St. Upgrade pits and make pipes 450 at Cleveland low point, upgrade pipes from there until Broadway.	Drainage Upgrade	Drop of 0.01 m on some areas between Cleveland St and Parramatta Road in the 1% AEP event.	Negligible drop in flood level. <b>Refined to become FM - BB07</b>
Wentworth Park - Basin	Detention Basin in Wentworth Park SW corner, connected to deepest water on William Henry Dr with pipes (4 locations). Invert of basin 1.5 mAHD. (see Figure F2)	Detention Basin	Drop of 0.1 m on parts of Wentworth Park Rd at the south end of Wentworth Park. Drop of up to 0.1 m in parts of Wentworth Park.	Issues with loss public space and putting detention basin in area with contaminated fill. Not a significant drop in flood level. <b>Discarded</b>
Blackwattle Lane	Lower Blackwattle Lane by 0.5 m, including through council depot	Flow Path Modification	Drop of 0.1 m in low area between Parramatta Rd and Wentworth Park Rd, slight increase at south end of Wentworth Park, in the 1% AEP event.	Negligible drop in flood level and issues with significant re-landscaping of street. <b>Discarded</b>
Mitchell St	Re-grade the easements parallel to Mitchell St, including straightening and widening, to improve conveyance. (see Figure F3)	Flow Path Modification	Drop of between 0.1 and 0.4 m in the unrelieved low points on small streets perpendicular to Mitchell St. Impact of up to 0.1 m in areas downstream, before Wentworth Park (both in the 1% AEP event).	Significant drop in flood level, however, significant impact downstream would increase flood risk there, for current and future landholders. <b>Discarded</b>
Entire Catchment	Upgrade all pits and pipes to 3x existing capacity	Drainage Upgrade	Drop of up to 0.4 m, near Blackwattle Lane and along Wentworth Park Road in the 5% AEP event. Drop of around 0.1 m along Buckland Street	Not considered as an option per se, rather as a diagnostic tool to see which areas sensitive to pipe upgrades and by how much.



**FIGURE F1  
BLACKWATTLE BAY  
1% AEP IMPACT  
PIPE UPGRADED TO OPEN CHANNEL  
IN WENTWORTH PARK**


















Was 1 x 3.8m (H) x 1.47m (W)  
Now 3 x 3.8m (H) x 1.47m (W)

Was 6.8 m3/s  
Now 20.9 m3/s

Was 1 x 3.8m (H) x 1.47m (W)  
Now 5m wide open channel

Area to be demolished -  
levels do not apply

-  Upgraded Pipes
  -  Open Channel (New)
  -  Development
  -  Study Area
- Impact (m)**
-  No Longer Flooded
  -  < -0.4
  -  -0.4 - -0.2
  -  -0.2 - -0.1
  -  -0.1 - -0.05
  -  -0.05 - -0.01
  -  No Impact
  -  0.01 - 0.05
  -  0.05 - 0.2
  -  > 0.2
  -  Newly Flooded

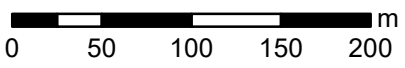
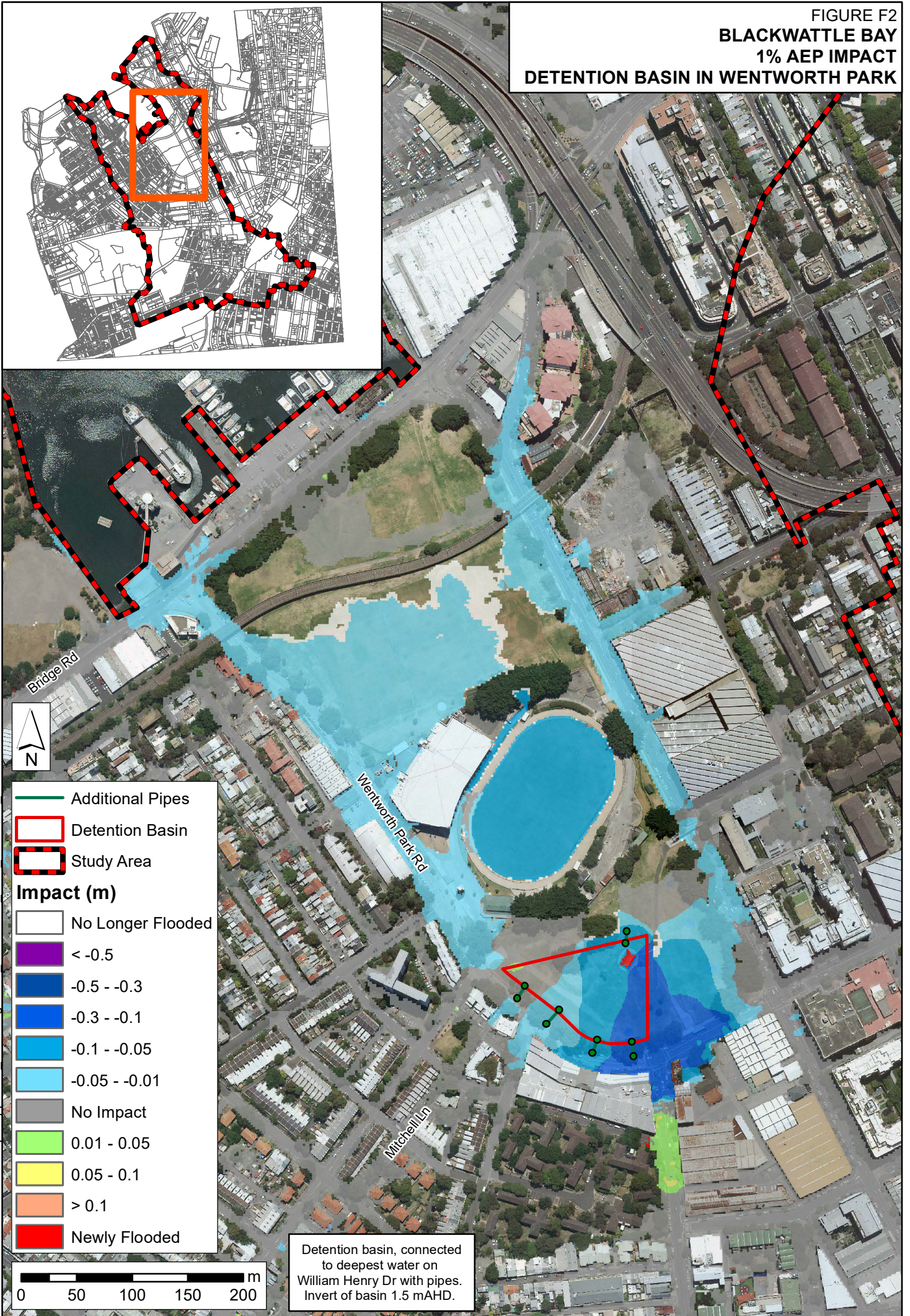
















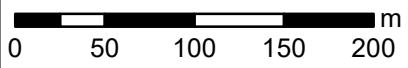
FIGURE F2  
**BLACKWATTLE BAY**  
**1% AEP IMPACT**  
**DETENTION BASIN IN WENTWORTH PARK**



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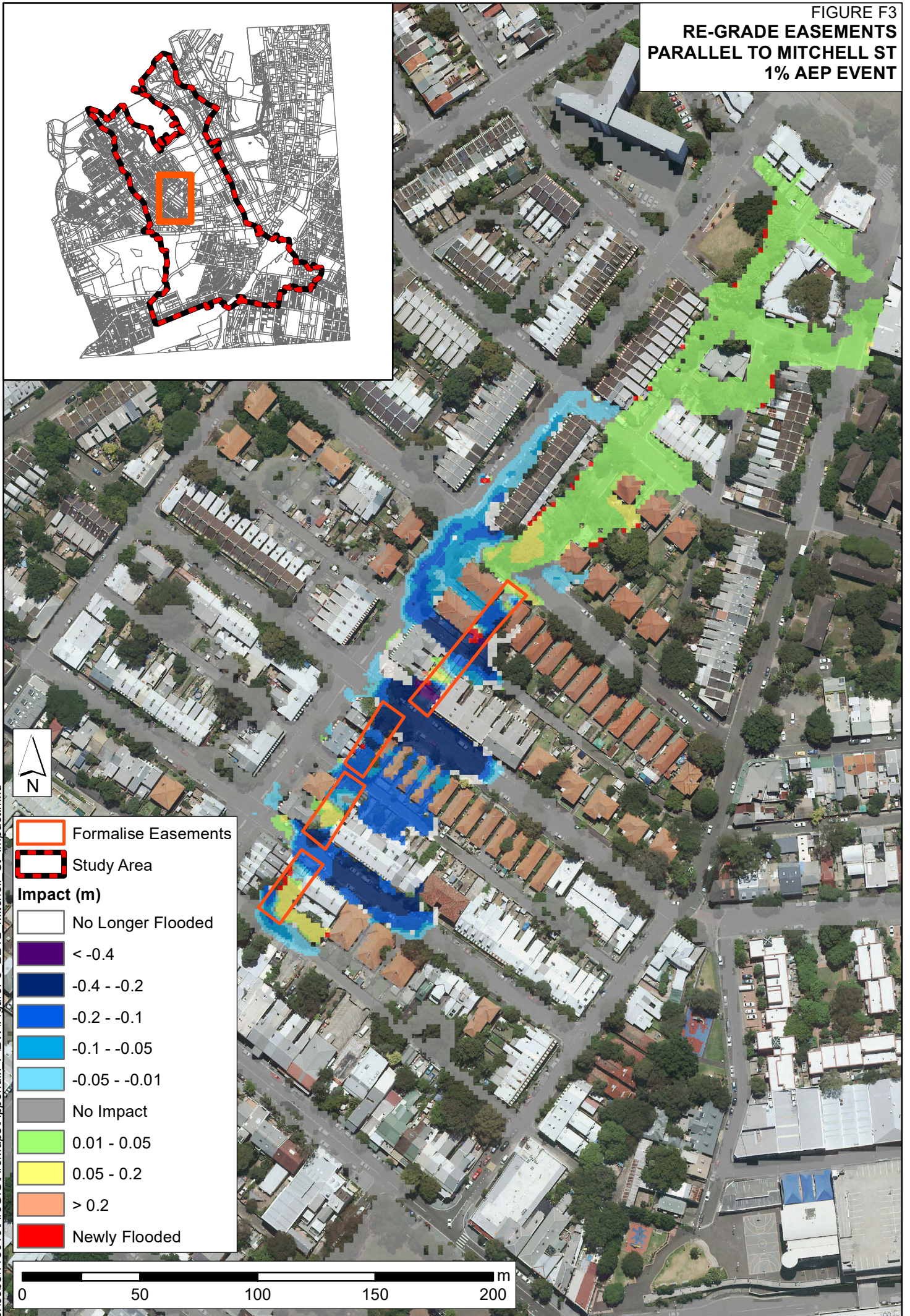


-  Additional Pipes
  -  Detention Basin
  -  Study Area
- Impact (m)**
-  No Longer Flooded
  -  < -0.5
  -  -0.5 - -0.3
  -  -0.3 - -0.1
  -  -0.1 - -0.05
  -  -0.05 - -0.01
  -  No Impact
  -  0.01 - 0.05
  -  0.05 - 0.1
  -  > 0.1
  -  Newly Flooded



Detention basin, connected to deepest water on William Henry Dr with pipes. Invert of basin 1.5 mAHW.

FIGURE F3  
**RE-GRADE EASEMENTS  
 PARALLEL TO MITCHELL ST  
 1% AEP EVENT**

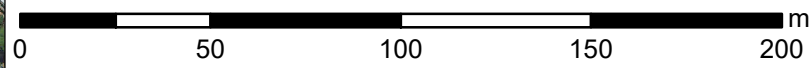


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**Formalise Easements**  
 Study Area

**Impact (m)**

- No Longer Flooded
- < -0.4
- 0.4 - -0.2
- 0.2 - -0.1
- 0.1 - -0.05
- 0.05 - -0.01
- No Impact
- 0.01 - 0.05
- 0.05 - 0.2
- > 0.2
- Newly Flooded





## APPENDIX G: EARLY CATCHMENT CONDITIONS

The Blackwattle Bay catchment has undergone extensive urbanisation over the past 200 years. Development has occurred uniformly across the area, with the suburbs of Glebe, Ultimo, Chippendale, Darlington and Redfern growing as Sydney expanded outward from what is now the Central Business District. Urbanisation of the catchment had a significant effect on flood behaviour, with watercourses and depressions being re-directed, blocked or sometimes removed, as streets and buildings were laid out and constructed. Understanding of the original catchment facilitates comprehension of the current flood liability and the general functioning of the catchment.

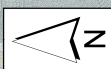
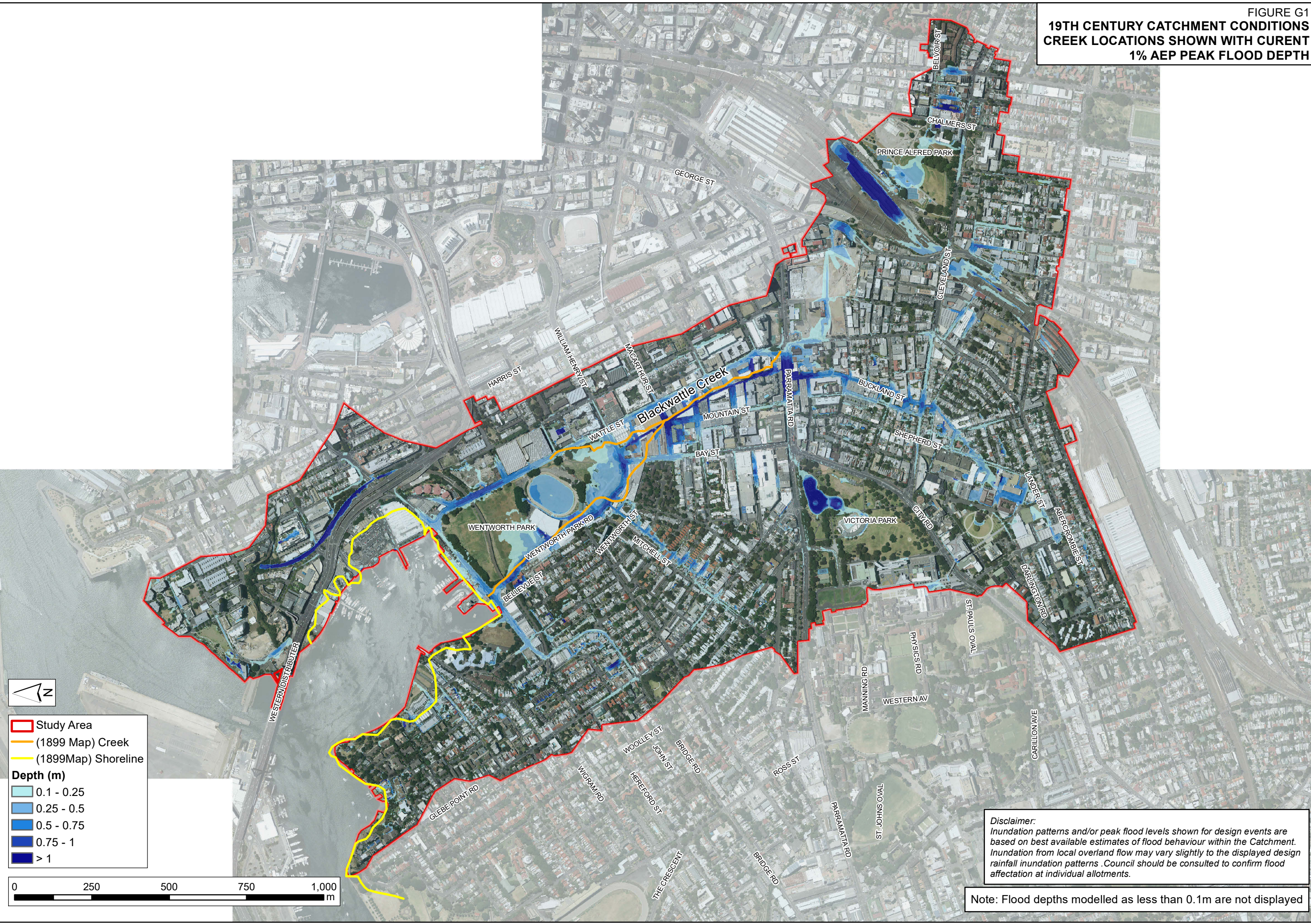
The following is a summary of what is known about the catchment features in the 19th century:

1. Blackwattle Creek was a significant watercourse. A map from Atlas of the Suburbs of Sydney (ca 1885) shows it flowing from Parramatta Road to Wentworth Park along the depression that is now Mitchell Lane.
2. The creek is known to have extended upstream of Parramatta Road, likely in the vicinity of what is now Buckland Street. The Francis Webb Shields Plan of Sydney (1844) shows the creek was dammed upstream of Parramatta, with the resultant reservoir used by the Brisbane Distillery.
3. Wentworth Park was previously an intertidal area that was filled to create a recreational area. The Atlas of the Suburbs of Sydney (ca 1885) shows a cricket and football grounds in the park. The Trigonometrical Survey of Sydney (1855-1865) labels the area as "Black Wattle Swamp Cove".

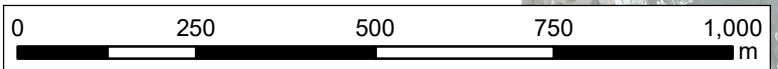
Figure G1 shows Blackwattle Creek and the shoreline as they were recorded in the Atlas of the Suburbs of Sydney (ca 1885), overlaid on the current 1% AEP peak flood depth. The figure shows that the concentration of flow in Mitchell Lane and the surrounding area is in fact where Blackwattle Creek was, before it was covered over and replaced with a stormwater drain. Although the map does not show it, the creek can be assumed to have continued upstream of Parramatta Road, likely in the vicinity of Buckland Street.

**19TH CENTURY CATCHMENT CONDITIONS  
CREEK LOCATIONS SHOWN WITH CURENT  
1% AEP PEAK FLOOD DEPTH**

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- ▭ Study Area
- ▭ (1899 Map) Creek
- ▭ (1899Map) Shoreline
- Depth (m)**
- ▭ 0.1 - 0.25
- ▭ 0.25 - 0.5
- ▭ 0.5 - 0.75
- ▭ 0.75 - 1
- ▭ > 1



*Disclaimer:*  
 Inundation patterns and/or peak flood levels shown for design events are based on best available estimates of flood behaviour within the Catchment. Inundation from local overland flow may vary slightly to the displayed design rainfall inundation patterns. Council should be consulted to confirm flood affectation at individual allotments.

**Note:** Flood depths modelled as less than 0.1m are not displayed