GLENN HAIG
& Associates Pty Ltd

PROPOSED RESIDENTIAL DEVELOPMENT

81-95 Boronia Road

Greenacre NSW 2190

STORMWATER DRAINAGE FLOW ASSESSMENT REPORT

CLIENT:

Mode Design
Studio 12, level 5
35 Buckingham Street
Surry Hills NSW 2010

HYDRAULIC SERVICES CONSULTANT:

Glenn Haig & Associates Pty Ltd
Suite 509/55 Holt Street
Surry Hills NSW 2010
(T): 02 9280 3100
(F): 02 9280 3122

09 June 2011

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B	**27/01/11**	**DA Issue**	**GH**	**JD**	**GH**
C	**09/06/11**	**DA Re-Issue**	**GH**	**JD**	**GH**

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1 INTRODUCTION

The proposed development is located at 81-95 Boronia Road, Greenacre.

It is proposed to construct 149 “Affordable Housing” Residential Units along with associated driveways, carparks and landscaped areas.

Mode Design acting upon the initial design brief by Impact project Management Pty Ltd, requested a flood study be prepared to determine the 1 in 100 years ARI water level through the development property.

Glenn Haig & Associates Pty Ltd has been engaged to undertake a hydrologic assessment of the upstream catchment, determine stormwater flows potentially running through the site, and assess the impact of the stormwater flows on the proposed development.

2 SUMMARY OF EXISTING CONDITIONS AND UPSTREAM CATCHMENT

The upstream stormwater catchment and stormwater drainage network were determined by analyzing the orthophoto map of the area, Council stormwater network map and were later verified by site inspection conducted on 28 October 2010. .

Refer to appendix A for the catchment and drainage network maps.

The upstream catchment has an area of 60.96 ha and falls to the North East towards Chiswick Road.

The site has a single frontage to Boronia Road of 114.27 metres with a site area of 11,479m^2. The site falls from a height of approximately 46 metres in the southern portion to a height of 41 metres in the northern portion of the site, distance form front to back is 105 metres with an average grade of 1 in 21.

Existing stormwater infrastructure consists of a 225mm stormwater pipeline and associated 2 metre wide private drainage easement located along the northern site boundary adjacent to the site.

There is an existing “open channel” trunk drainage system running through the property number 74Chiswick Road to the north of the proposed development site.

The site is currently subject to stormwater inundation from the trunk drainage system and current overland flow paths during larger storm events. All lots that form the subject site are identified as “Flood Control Lots” by Bankstown City Council, flood hazards are related to localized stormwater flooding and are categorized as predominantly being a “medium flood risk”.

3 UPSTREAM CATCHMENT ANALYSIS AND ASSESSMENT OF IMPACT OF STOMWATER FLOWS ON PROPOSED BUILDINGS

DRAINS input and output files and overland flow path calculation are included in APPENDIX B.

The discharge from the catchment upstream of the subject property was determined using “DRAINS” Urban Drainage Simulation Model. The DRAINS model was prepared on the basis of examining the flow rate at the overland flow path within the subject property.

It is not intended to represent the exact flow within each pipeline and sub-catchment. As a result the catchment was modeled as a one reach.

The information provided below is a discussion about the method used to determine the input data and parameters to the DRAINS model.

4 Rainfall Intensity-Frequency-Duration Relationship

Table 9-3 Bankstown City Council Engineering and Drainage Standards, Version June 2009

AUSTRALIAN RAINFALL INTENSITY FOR BANKSTOWN CITY COUNCIL AREA

BASE DATA TO CONSTRUCT IFD CURVES:

	1I1	12I2	72I2	1I50	1I50	1I50	F2	F50	G
	35.5	7.6	2.5	72	15.1	5.2	4.29	15.8	0
					ARI(y)				
TIME	**1**	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**500**
1.1									
				(mm/hr)					
5 mins	88.5	114	145	163	187	219	242	266	299
6 mins	83.0	107	136	153	176	206	228	251	281
7 mins	78.3	101	129	145	167	195	216	238	266
8 mins	74.4	95.6	123	138	159	185	206	226	254
9 mins	70.9	91.2	117	132	152	177	197	216	243
10 mins	67.9	87.4	112	126	145	170	189	208	233
12 mins	62.8	80.8	104	117	135	158	175	193	217
14 mins	58.6	75.5	97.1	110	126	148	164	181	203
15 mins	56.8	73.1	94.2	106	122	144	160	176	198
16 mins	55.1	71.0	91.5	103	119	139	155	171	192
18 mins	52.1	67.1	86.6	97.9	113	132	147	162	182
20 mins	49.5	63.8	82.4	93.2	107	126	140	155	174
25 mins	44.2	57.1	73.8	83.6	96.5	113	126	139	157
30 mins	40.2	51.9	67.3	76.3	88.1	104	115	127	143
40 mins	34.5	44.5	57.9	65.7	75.9	89.4	99.6	110	124
50 mins	30.4	39.4	51.3	58.3	67.4	79.4	88.6	98.0	111
1 hour	27.4	35.5	46.3	52.7	61.0	72.0	80.4	88.9	100
1.5 hour	21.5	27.8	36.2	41.2	47.7	56.2	62.7	69.3	78.3
2 hour	18.0	23.3	30.3	34.4	39.8	46.9	52.4	57.9	65.3
3 hour	14	18.1	23.5	26.7	30.8	36.3	40.5	44.7	50.5
4.5 hour	10.8	14.0	18.2	20.7	23.9	28.1	31.3	34.6	39.0
6 hour	9.1	11.7	15.2	17.2	19.9	23.4	26.1	28.8	32.4
9 hour	7.0	9.1	11.8	13.3	15.4	18.1	20.2	22.3	25.1
12 hour	5.9	7.6	9.8	11.1	12.9	15.1	16.8	18.5	20.9
15 hour	5.2	6.7	8.7	9.8	11.3	13.3	14.9	16.4	18.5
18 hour	4.6	6.0	7.8	8.8	10.2	12.0	13.4	14.8	16.7
24 hour	3.9	5.1	6.6	7.5	8.7	10.2	11.4	12.6	14.2
30 hour	3.4	4.4	5.8	6.6	7.6	9.0	10.0	11.1	12.6
36 hour	3.1	4.0	5.2	5.9	6.8	8.1	9.0	10.0	11.3
48 hour	2.5	3.3	4.3	4.9	5.7	6.8	7.6	8.4	9.5
72 hour	1.9	2.5	3.3	3.8	4.4	5.2	5.8	6.5	7.3

The Overland Flow Travel Time Aid table shown below, was generated to be used to determine the time of concentration (t_c) of the relevant sub-catchments. This will then be used as input to the ILSAX model.

DURATION	1 Year	2 years	5 years	10 years	20 years	50 years	100 years
5 Mins	30.04328	33.24543	36.60304	38.35704	40.52347	43.16658	44.92583
6 Mins	35.13844	38.89598	42.81213	44.87741	47.46312	50.54732	52.64113
10 Mins	54.04405	59.7867	66.02178	69.20671	73.20609	78.01526	81.39256
20 Mins	95.25156	105.4286	116.7887	122.6864	129.6533	138.4134	144.3714
30 Mins	131.4655	145.609	161.5576	169.8756	179.9333	192.2802	200.1706
1 Hr	225.5545	250.1742	278.217	293.0053	310.6585	331.9588	346.9394

Table 2: Table of I x $F^{0.4}$ where f is time in min. And I is intensity in mm/hr

5 Catchment Area

The total catchment area as contributing to the side of the subject property was estimated to be 60.96ha. A detailed catchment plan is shown in Appendix A.

It was estimated from site inspections that the impervious fraction of the catchment is between 50-55% overall. However, a future increase in impervious area has been allowed for in this study.

6 Time of Concentration

The time of concentration is the time runoff takes from the most remote part of the catchment to its outlet. This was calculated by determining the travel times of the various components of flow. These travel times are those of the following:

- Roof and Property
- Sheet Flow (grassed & paved surfaces)
- Channel flow kerb & gutters and natural channels
- Underground pipe flow

DRAINS require separate input for the time of concentration for pervious and impervious areas, which includes the travel time for roof, property, kerb & gutter and underground pipes for impervious. For pervious areas the travel time required is for sheet flow and natural surface.

6.1 Roof and Property

The exact travel times over roof and properties are difficult to predict. However, they are known to be short, hence flow from roofs and other surfaces that drains quickly through downpipes and underground pipes a single response time can be nominated. This could be in the order of 5 min for single dwellings and between 5-15 min for larger commercial and industrial buildings. (Australian Rainfall and Runoff 1997, book 8 part 1.5.4).

For this case, say the time of concentration for roof and property is 5.0min.

6.2 Channel Flow, Kerb & Gutters and Natural Channels

Travel time is calculated using the following equation:

$$t = 0.025 \times L / S^{0.5}$$

where t is the time of gutter flow (min)

L is the length of gutter flow in meter's (200m)

S slope of gutter in % (4)

So, t = 2.5min

6.3 Sheet Flow (Grassed Surfaces)

Sheet flow is assumed to travel between 20 and 50m before it is deemed to be channel flow. This distance is the average length of a block of land in the sub catchment area. Hence, the sheet flow travel time is determined using the Kinematics Wave equation (with an L = 50m):

$t = 6.94 \times (L \times n^*)^{0.6} / (I^{0.4} \times S^{0.3})$

where t is the overland flow time (min)

L is the flow path length (5om) approx

n* is the surface roughness coefficient (0.2)

I is the rainfall intensity (mm/hr)

S is the slope (0.04m/m)

$t \times I^{0.4}$ = 73.0

So, t = 9.5min for 100 yrs ARI refer to Table 2

Hence, the total time of concentration for impervious area could be estimated to be about:

5 + 2.5 = 7.5 min

And the total time of concentration for pervious area could be estimated to be about:

9.5 + 2.5 = 12.0 min

7 Peak Flowrate

The peak discharge from the catchment was determined using the "DRAINS" Urban Drainage Simulation model with the following parameters as input to the pipe file (RAW.PIP).

Reach	Area	Impervious		Pervious		Supplementary	
	(ha)	(%)	(t_c)	(%)	(t_c)	(%)	(t_c)
A	60.96	65	7.5	30	12.0	5	5

Table 3: "DRAINS" Input Parameters

The drains analysis and assessment indicate that the 1 in 100 years ARI stormwater flow upstream from the development site is:

- Paved: = 19.02m^3/s
- Grassed = 7.443m^3/s
- Max flow = 26.108m^3/s (100 year ARI 25 minute storm)

8 Flow Arrangement

Currently when an overflow occurs in the existing open channel the majority of the stormwater runoff will flow towards the subject property in the south Eastern direction. The subject site flood extent, flood depth and velocity depth for the subject site as provided in the Greenacre Park Catchment Study" are as follows:

- Flood contour levels to approx RL: 42.5 metres
- Flood depths varying from 0.1 to 1.25 metres at the Northern boundary
- Velocity depth varying from 0.05 to 0.6sq m/s

9 Conclusion

From the investigation into the subject matter, it was concluded that:

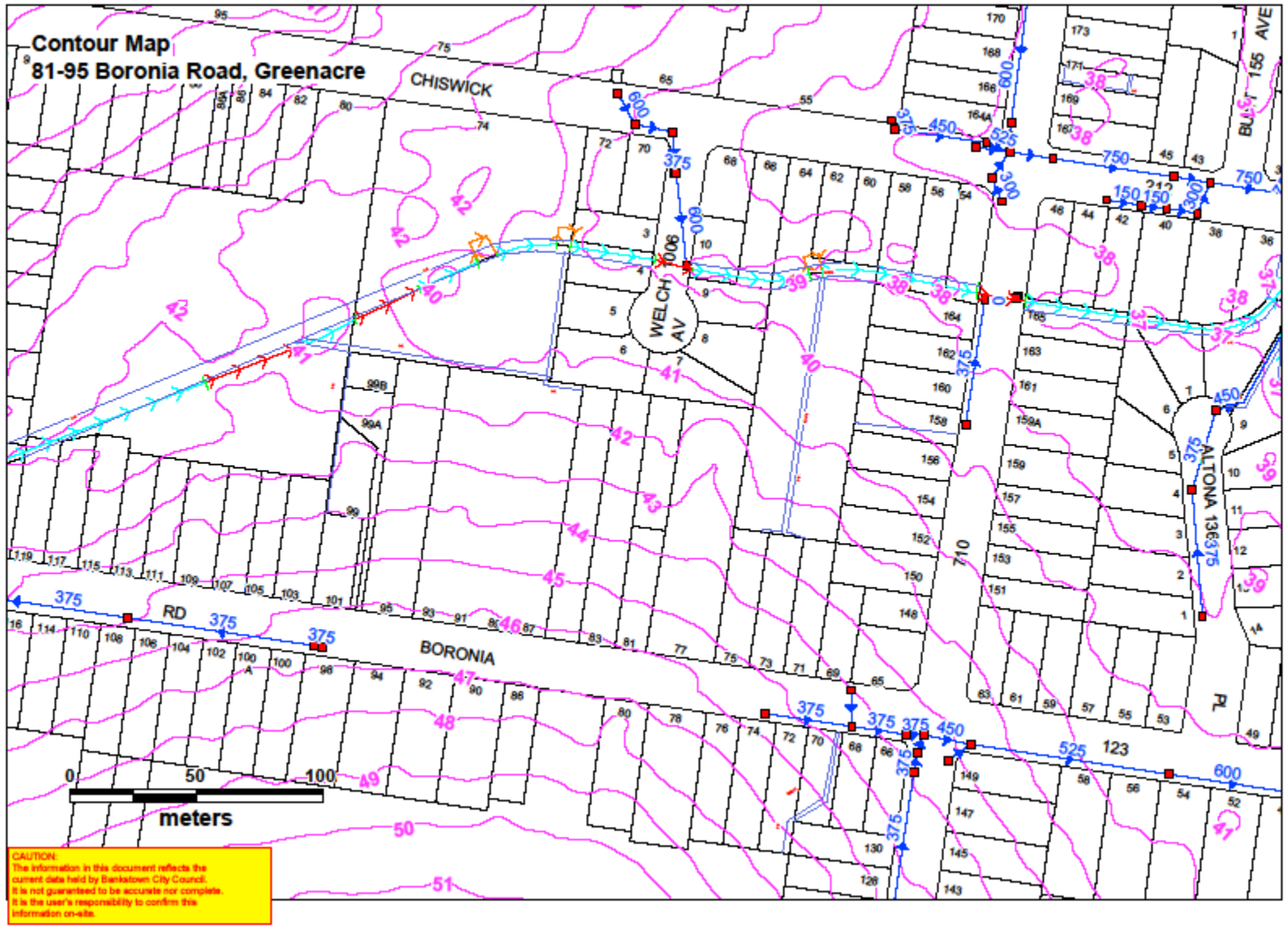
- The total catchment area drainage through the subject property was estimated to be 60.96ha.
- The total flow rate arriving to subject property was estimated to be 26.108m3/s at the 100yrs ARI
- The part of the site along the Northern boundary with surface levels less than RL: 41.70 will have a velocity depth product higher than 0.4 at the 100 years ARI. Any proposed car parking in this portion of the site should have a minimum RL or 41.70 giving a velocity depth product lower than 0.4 which indicates a low hazard flow.
- The proposed finish floor levels for all units will provide for the minimum 500mm required freeboard above the estimated 100yrs ARI
- A minor cut located between the Northern boundary and the proposed building is required in order to achieve the finished level of RL: 41.70 needed to provide the low hazard flow are this will not cause a raise in the estimated water surface level at the 100yrs ARI
- Open bar type pool fence must be used in the flow path along the rear boundary.
- No permanent solid structure can be constructed or located in the overland flow path
- All water sensitive instruments such as gas meters and hot water heaters etc…, are to be located above estimated flood level.
- The proposed building will have negligible additional negative effect on the estimated water surface levels at the subject flow path.

APPENDIX A

Bankstown City Council

Stormwater System Report


Contour Map
81-95 Boronia Road, Greenacre
CHISWICK
WELCH AV
BORONIA RD
0
50
100
meters
CAUTION:
The information in this document reflects the current data held by Bankstown City Council.
It is not guaranteed to be accurate nor complete.
It is the user's responsibility to confirm this information on-site.


Contour Map
81-95 Boronia Road, Greenacre
CHISWICK
WELCH AV
ALTONA
BORONIA
RD
PL
710
123
0
50
100
meters
CAUTION:
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APPENDIX B

Contour Map

Contour Map with Pipe Network

Level 1, 66 - 72 Rickard Road, Bankstown NSW
PO Box 8, Bankstown NSW 1885
Tel: (02) 9707 9020 - Fax: (02) 9707 9408
DX 11220 BANKSTOWN
council@bankstown.nsw.gov.au

BANKSTOWN CITY COUNCIL

To: Glenn Haig & Associates Pty Ltd
Suite 509
55 Holt Rd
SURRY HILLS NSW 2010

STORMWATER SYSTEM REPORT
81, 83 & 95 Boronia Road, GREENACRE NSW 2190

Date: 19-Oct-2010
Ref: WP-SIA/961/2010
Development type: **Residential Flat Building**

NO	FLOOD/OVERLAND FLOW STUDY REQUIRED

The site is affected by the following Sydney Water & Private stormwater system components:

- An unknown diameter stormwater pipeline and associated 2m wide private drainage easement located along the northern site boundary adjacent to the site.

- Stormwater inundation from excess stormwater runoff from the upstream catchment and associated with the trunk drainage system through the property number 74 Chiswick Road.

The site will be subject to stormwater inundation from this overland flowpath during large storm events. Refer to the attached **"100 Year ARI Flood Extent, Flood Depth & Velocity Depth Product Maps from Greenacre Park Catchment Study"**. Provision should be made on site, and at boundary fences, for this stormwater runoff to pass unobstructed over the site. Stormwater flowing naturally onto the site must not be impeded or diverted.

The proposed development including floor levels, shall comply with the development controls specified in Part E3.5 Schedule 5, of Bankstown's Development Control Plan 2005 - Catchments Affected by Stormwater Flooding.

All structures that may be subject to stormwater inundation should be built using flood compatible materials, methods and requirements as set out in Part E3 of Bankstown's Development Control Plan 2005 - Flood Risk Management (Schedule 1).

Runoff on the site, and naturally draining to it is to be collected and disposed of to Council's requirements detailed in Bankstown Council's *Development Engineering Standards****.

All structures and buildings must be located clear of pipelines and easements and overland stormwater flowpaths.

This report is given without the benefit of development plans or a site survey. Council may choose to vary some report requirements following evaluation of detailed plans when they are submitted.

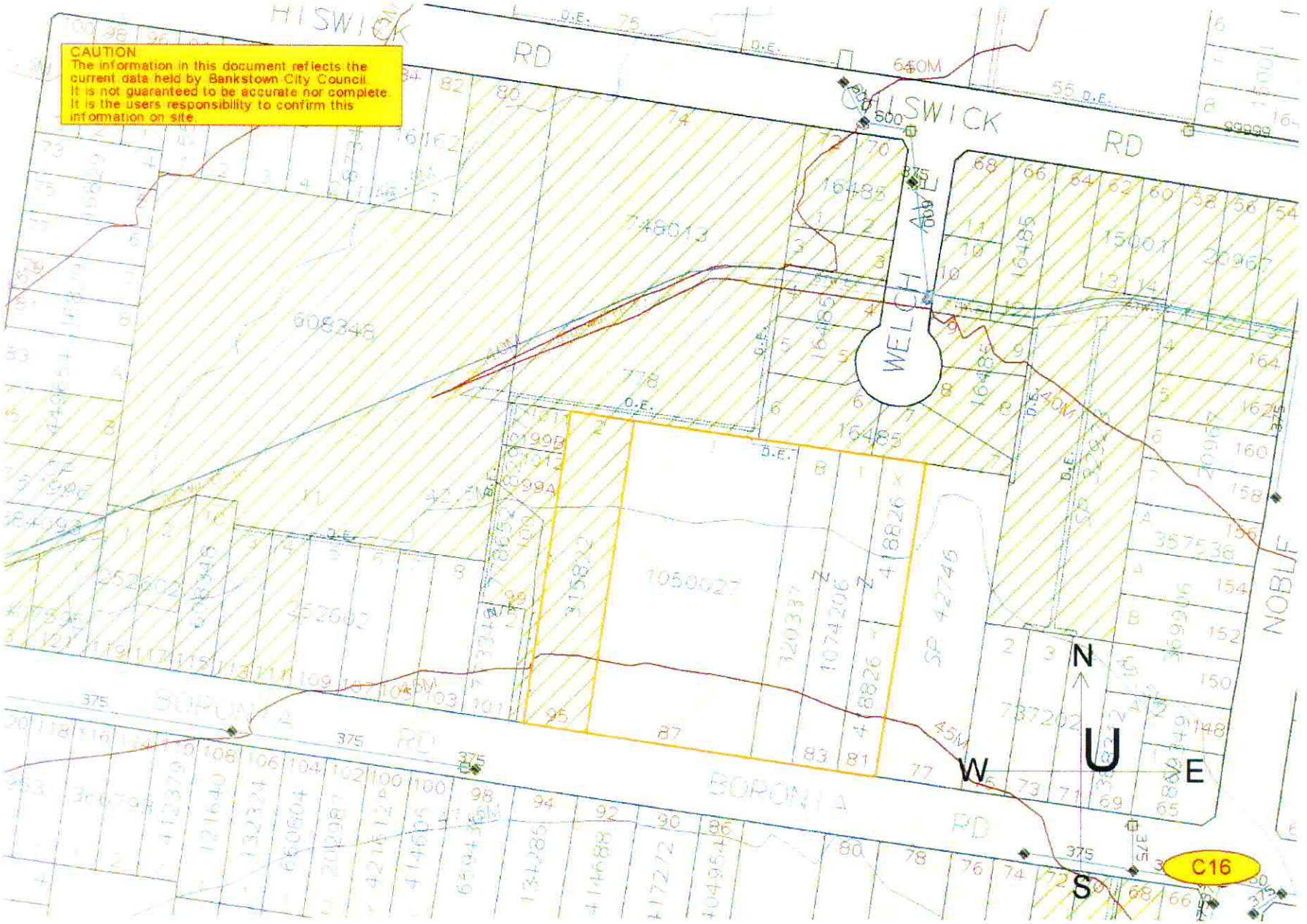
This report relates to the exposure of the subject site to Sydney Water's & Private stormwater system, both underground and overland. It does not assess the suitability or otherwise of this site for the proposed development.

* Average Recurrence Interval

** Australian Height Datum

*** Bankstown Council's *Development Engineering Standards* and *Bankstown's Development Control Plan 2005* is available from Council's Customer Service Centre, and from http://www.bankstown.nsw.gov.au/planb/guidelines/dcp.cfm

Pushpa Goonetilleke
ENGINEER


CAUTION
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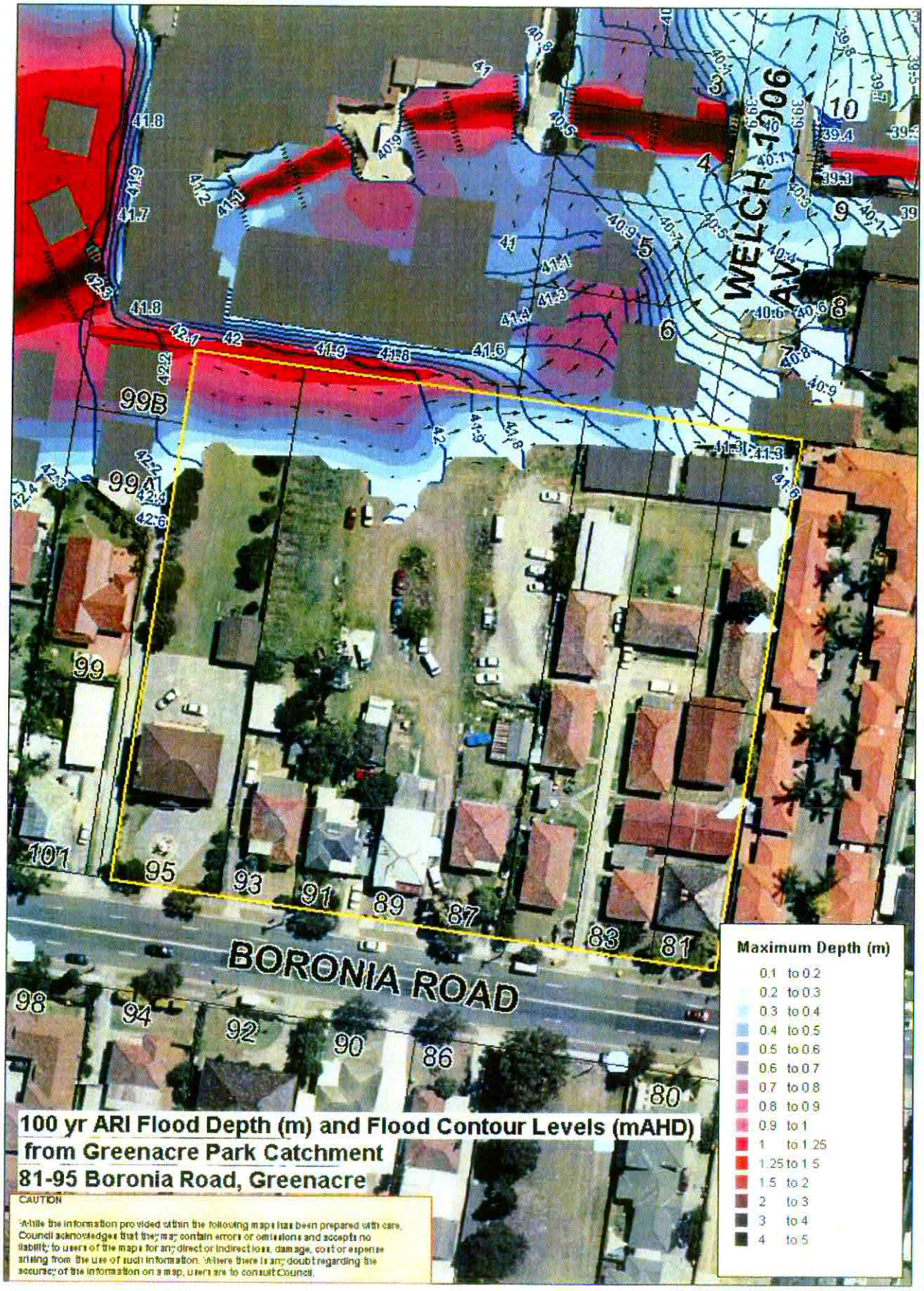
It is not guaranteed to be accurate nor complete.
It is the users responsibility to confirm this information on site.
HISWICK RD
CALLSWICK RD
WELLOW
NOBLE
BOPONIA RD
1050027
N
W
E
S
C16

100 Year ARI Flood Extent and Flood Contour Levels (mAHD) from Greenacre Park Catchment for Boronia Road, Greenacre

CAUTION

While the information provided within the following map has been prepared with care, Council acknowledges that they may contain errors or omissions and accepts no liability by users of the maps for any direct or indirect loss, damage, cost or expense arising from the use of such information. Where there is any doubt regarding the accuracy of the information on a map, users are to consult Council.



100 yr ARI Flood Depth (m) and Flood Contour Levels (mAHD) from Greenacre Park Catchment

81-95 Boronia Road, Greenacre

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100 yr ARI Velocity Depth Products (sqm/s)
from Greenacre Park Catchment for
81-95 Boronia Road, Greenacre
WELCH 1006
AV
BORONIA
99B
99A
99
101
95
93
91
89
87
83
81
98
94
92
90
86
80
3
4
5
6
7
8
9
Velocity-Depth (sqm/s)
0.05 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.4
0.4 to 0.5
0.5 to 0.6
0.6 to 0.8
0.8 to 1
1 to 2
2 to 5
5 to 10
10 to 20
CAUTION
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