FIGURE 13

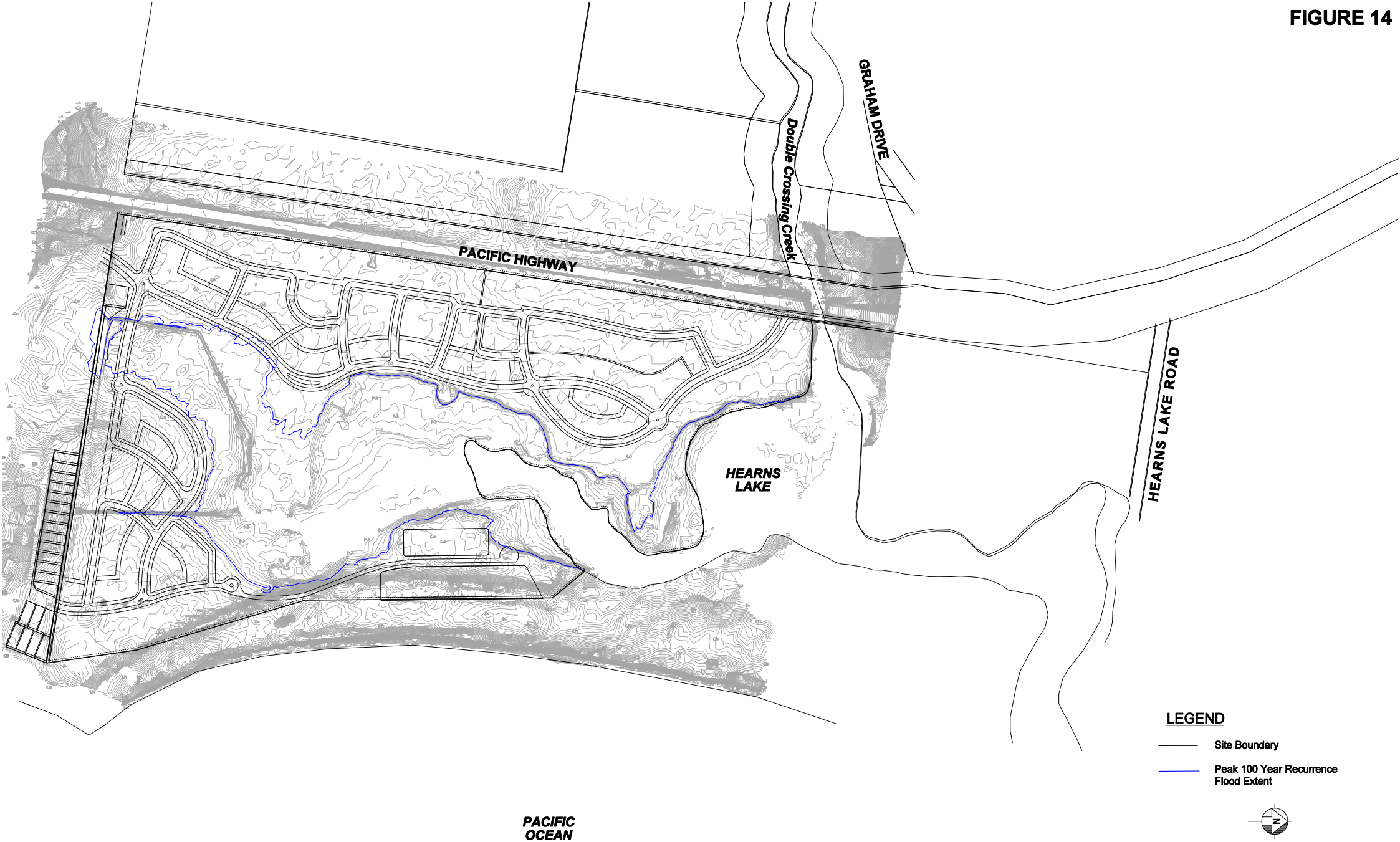
Patterson Britton & Partners Pty Ltd

rp5319_00 - Sandy Beach North FIA

fig13-fill_reqd.dgn

APPROXIMATE EXTENT OF PROPOSED FILLING

FIGURE 14



Patterson Britton & Partners Pty Ltd

rp5319_00 - Sandy Beach North FIA

fig14-100yr fill reqd.dgn

PEAK 100 YEAR RECURRENCE FLOOD EXTENT WITH PROPOSED DEVELOPMENT

As is the case for predicted flood levels, peak flow velocities during the 100 year recurrence flood are not expected to be impacted by the proposed development. This is a direct reflection of the negligible encroachment of the proposed filling into the existing 100 year recurrence flood extent (*refer* **Figure 14**).

Impact on Flood Hazard

As discussed, the proposed site filling is not expected to impact on peak flood levels and flow velocities during the 100 year recurrence flood. As a result, the velocity-depth product of flooding in the vicinity of the site is not expected to increase.

Hence, the impacts of the proposed filling on flood behaviour during the existing 100 year recurrence event are considered to be negligible and the development will not worsen flood conditions on adjoining properties.

5.3 POTENTIAL IMPACT OF PROPOSED FILLING ON "YEAR 2100" FLOODING

5.3.1 Hydraulic Modelling Results

As discussed above, the RMA-2 flood model was modified to incorporate the proposed filling at the site according to the extent shown in **Figure 13**.

The modified model was also used to simulate the 100 year recurrence flood that incorporates an allowance for Year 2100 climate change predictions, to define flood behaviour under post-development conditions (*i.e., with the proposed filling and buildings in place*). The magnitude of any changes in flood behaviour arising from the proposed filling were established by comparing model results for pre and post-development scenarios that incorporate climate change predictions.

Impact on Peak Flood Level

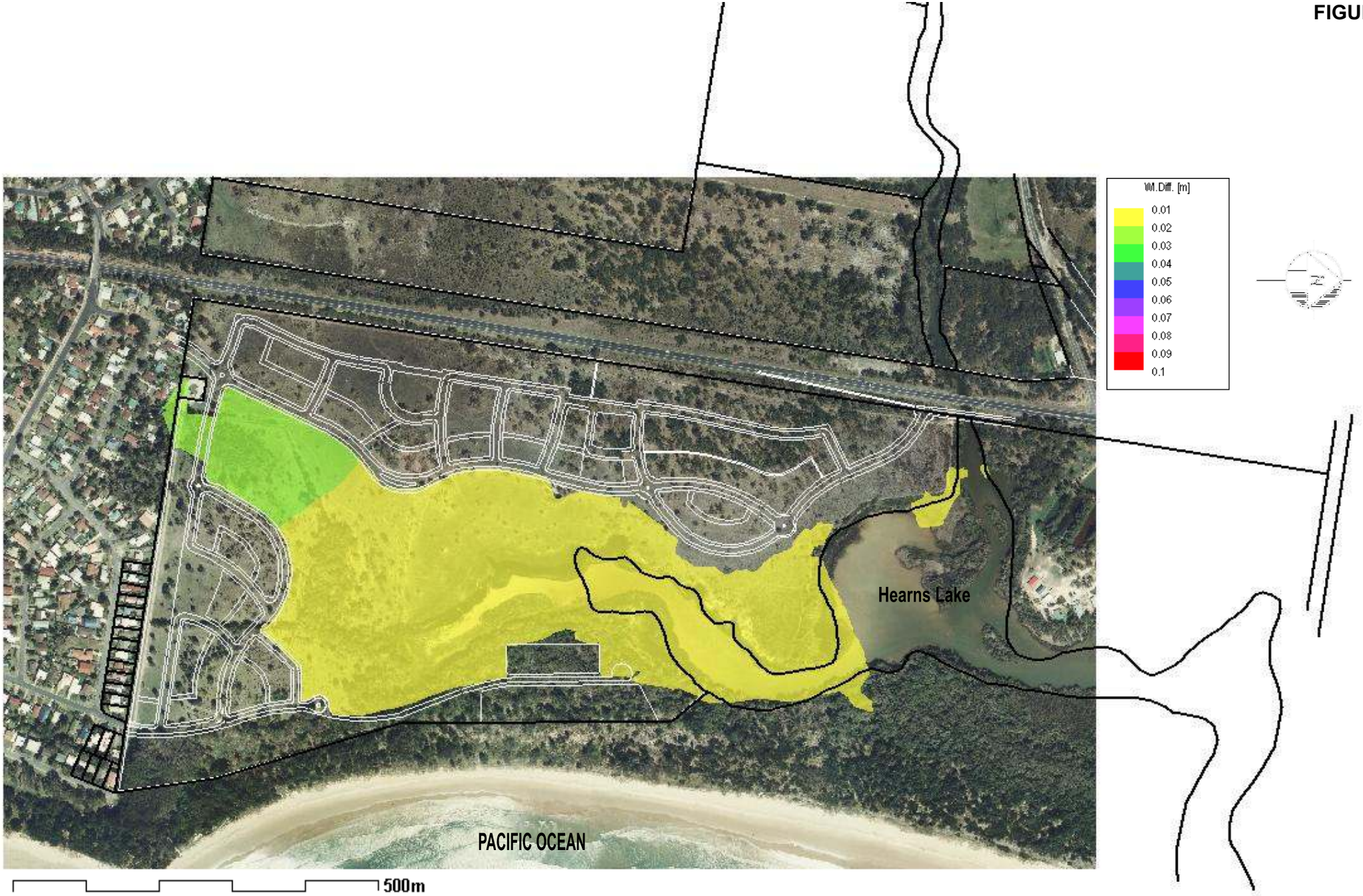
The results of the simulation were extracted and combined with results generated from simulations for the existing scenario (*i.e., those shown in* **Figures 7** *and* **8**) to generate a flood level difference map. This map presents a graphical representation of the magnitude and location of changes in flood levels by comparing the water levels for both the pre and post-development scenarios at each node in the hydraulic model. This effectively creates a contour map of predicted post-development "affluxes" and allows easy determination of the impact of the proposed development on flood levels.

The flood level difference map for the Year 2100 design 100 year recurrence flood, which shows the location and magnitude of increases in peak flood level, is presented in **Figure 15**.

Figure 15 indicates that the proposed filling will result in increases in peak flood level in some areas across the floodplain of the Hearns Lake / Double Crossing Creek system. However, the maximum increase in peak flood level is predicted to be less than 20 mm, within and outside of the development site. This change is considered to be negligible.

Therefore, the peak Year 2100 design 100 year recurrence flood level for the post-development scenario is estimated to be a maximum of 2.98 mAHD.

FIGURE 15



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Rp5319 - Sandy Beach North FIA
Fg5319.00rg080903_fig15-ClimCh Level Diff.doc

PREDICTED INCREASE IN PEAK "YEAR 2100" DESIGN 100 YEAR RECURRENCE FLOOD LEVELS AFTER FILLING

Impact on Peak Flow Velocity

Peak flow velocities were extracted from the *'post-development'* model results and compared with peak flow velocities from the pre-development scenario. A difference map was created to quantify any increases in peak flow velocities associated with the proposed filling.

The velocity difference map created for the Year 2100 design 100 year recurrence flood is presented in **Figure 16**. As shown, the proposed filling of part of the development site will result in localised increases in peak flow velocity both within and outside the site.

However, the increases in peak flow velocity outside the development site are predicted to be less than 0.1 m/s and primarily occur within Hearns Lake and near the entrance to the ocean. At this location, the peak flow velocity is predicted to increase from 0.5 m/s to 0.6 m/s, which is not considered to be a significant change and would therefore have no discernable impact on flood behaviour.

Typically, increases in peak flow velocity during the Year 2100 design 100 year recurrence flood are predicted to be less than 0.05 m/s (*refer* **Figure 16**).

Impact on Flood Hazard

As discussed, the proposed filling will prevent inundation of part of the development site in events up to and including the Year 2100 design 100 year recurrence flood. Therefore, the hydraulic flood hazard across those areas that are proposed to be filled, as shown in **Figure 9**, will be effectively eliminated in events of this magnitude.

As shown in **Figures 15** and **16**, the filling is predicted to cause an increase in peak Year 2100 design 100 year recurrence flood levels and flow velocities of typically less than 20 mm and 0.1 m/s, respectively.

The maximum change in velocity-depth product would occur over the small area where the maximum increase in flow velocity is predicted. However, in this area the increase in velocity-depth product would only be 2.0×10^{-3} m^2/s (*i.e., 0.1 m/s x 0.02m*). Accordingly, the provisional flood hazard classification in this area would effectively remain the same.

Therefore, while the proposed filling will increase the peak velocity-depth product at some locations across the southern floodplain of the Hearns Lake / Double Crossing Creek system, the increases are not sufficient to alter the hazard classification that would apply at any location across the floodplain.

Hence, the proposed filling is considered to have a no measurable impact on flooding during the Year 2100 design 100 year recurrence event and the development is not expected to worsen flood conditions on adjoining properties.

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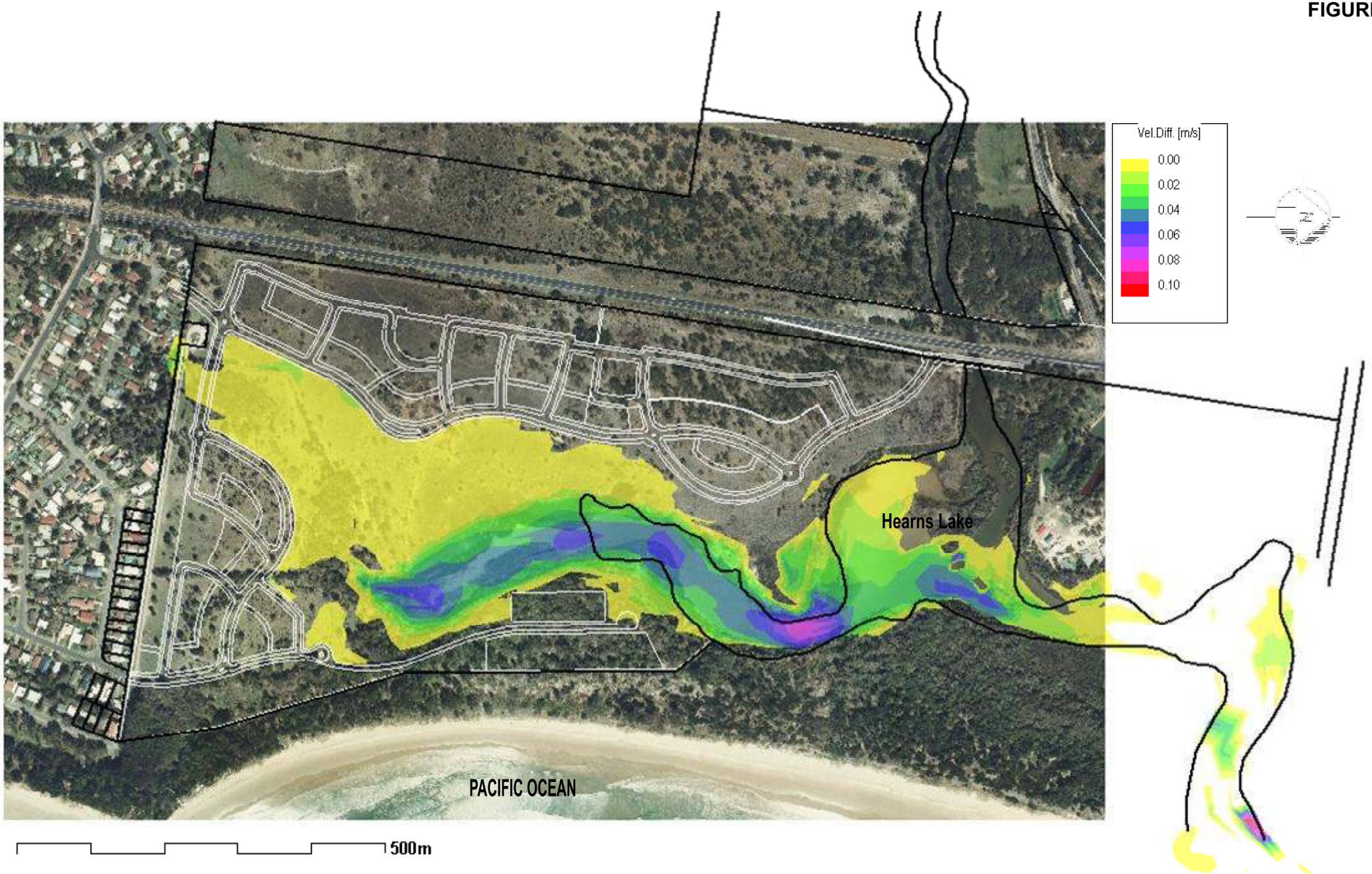
FIGURE 16



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Rp5319 - Sandy Beach North FIA
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PREDICTED INCREASE IN PEAK "YEAR 2100" DESIGN 100 YEAR RECURRENCE FLOOD FLOW VELOCITIES AFTER FILLING

6 CONCLUSIONS

Sandy Shores Development Pty Ltd plans to develop a residential subdivision on a 49 hectare parcel of land that adjoins Hearns Lake immediately north of the village of Sandy Beach. The proposed development is to involve the creation of up to 280 residential lots and the construction of an internal road network to provide access to the site from Sandy Beach and the Pacific Highway.

Due to its proximity to Hearns Lake, it is recognised that there is potential for inundation of low lying areas of the site during flooding of Double Crossing Creek or when elevated ocean water levels occur. Furthermore, "closed" lake entrance conditions occur for most of the time and are likely to influence peak flood levels in the lake when storms occur across the catchment.

Investigations undertaken for this report have determined that flooding could occur as a result of a range of ocean and catchment storm scenarios. The investigations have also determined that peak flood levels in the lake are critically controlled by lake entrance conditions and the potential for elevated water levels to cause a "breakout" at the entrance. Computer modelling of the lake and Double Crossing Creek system for a range of breakout scenarios has determined that the critical factor affecting flood behaviour in the lake is the relative differential between lake and ocean water levels. Recent survey of the berm that effectively blocks the entrance indicates that it has typical crest elevations of between 1.6 and 2.0 mAHD. Therefore, depending on ocean water levels, it is likely that a pilot channel will begin to be cut through the berm once flood levels in the lake exceed 1.6 mAHD.

The following conclusions can be drawn from the results of the modelling undertaken for the investigation:

- A peak design 100 year recurrence flood level of 2.6 mAHD can be adopted for the development site. This is based on consideration of the potential for coincident ocean and catchment storms, and assumes that the coincidence of a 100 year recurrence catchment storm with a 20 year recurrence ocean storm, is representative of a 'design 100 year recurrence event' scenario. This design 100 year recurrence flood level is based on a 20 metre wide pilot channel being formed at the lake entrance during the flood and scouring to a minimum elevation of 0 mAHD.
- The maximum design 100 year recurrence flow velocity across the development site is predicted to be 0.3 m/s and will occur in a small area on the western floodplain of Hearns Lake, at the southern extent of the northern site boundary. Generally, the peak flow velocity across the site is less than 0.15 m/s and reflects the impact of the lake in "damping" the velocity of floodwaters as they enter it.

Additional investigations have established that climate change considerations to the Year 2100 could impact on the development site by increasing the peak level of the design 100 year recurrence flood for Hearns Lake from the current estimate of 2.60 mAHD to an elevation of 2.95 mAHD.

On this basis, it is considered that the adoption of a peak 100 year recurrence flood level of 2.95 mAHD will provide sufficient redundancy over the design life of the project. Accordingly, it is recommended that an elevation of 2.95 mAHD be adopted as the "Year 2100" design 100 year recurrence flood level and that building controls for development be based on this. Accordingly, minimum habitable floor levels should be set at 3.45 mAHD.

The results of the flood modelling investigations indicate that inundation of some areas of the site that are proposed for development would occur. Accordingly, Sandy Shores plans to fill some low lying areas of the site to raise the ground surface to acceptable levels for development. It is proposed that currently inundated areas that are to be dedicated for residential lots will be filled to an elevation of 3.25 mAHD.

This allows for construction of a 200 mm thick concrete slab on these lots so that dwellings can be constructed to a floor level that is 500 mm above the predicted peak Year 2100 design 100 year recurrence flood level.

It is also proposed that the roads within the development be constructed to a level above the peak Year 2100 design 100 year recurrence flood level of 2.95 mAHD. This will provide "flood-free" evacuation routes within the site during events up to and including the 100 year recurrence flood with provision for climate change impacts.

The extent of the proposed filling is shown in **Figure 13**.

In order to assess the potential impact of the proposed filling, the RMA-2 flood model was modified to reflect the filling shown and **Figure 13**, and was used to simulate flood behaviour under post development conditions. The following conclusions can be drawn from the results of simulations undertaken to assess post development conditions:

- The proposed filling is not expected to impact on peak flood levels or flow velocities during the existing 100 year recurrence flood.
- The proposed filling will result in some increases in peak "Year 2100" design 100 year recurrence flood level, but these are predicted to be typically less than 20 mm (*refer* **Figure 15**).
- The proposed filling will result in increases in peak flow velocity during the "Year 2100" design 100 year recurrence flood. However, these increases are predicted to range between 0.01 m/s and 0.1 m/s and combined with the minor change in peak floodwater depth, will result in no change to the hazard classification that currently applies to flood affected areas of the site (*refer* **Figure 9**).
- The proposed filling will result in no significant change in flood characteristics (*i.e., flood level or velocity*) across properties that adjoin the development site.

Therefore, it can be concluded that the filling proposed as part of the development will not have a significant impact on flood behaviour in either the existing 100 year recurrence flood scenario or the "Year 2100" design 100 year recurrence flood scenario. It can also be concluded that the majority of the site area to be developed for residential purposes is above the Year 2100 design 100 year recurrence flood level. The remainder of the area that will be developed for residential purposes is able to be modified (*by relatively shallow filling*) to allow residential development to proceed.

7 REFERENCES

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(3) Chow VT (*1959*), *'Open Channel Hydraulics'*; McGraw Hill Book Company, Inc.; Reissued 1988; ISBN 07 010776 9.

(4) Coffs Harbour City Council (*2002*), *'Potentially Flood Prone Land Information Sheet'*.

(5) Griffin AG (*1983*), *'The Effects of Storm Tides on Flooding'*; paper presented to the 23rd Flood Mitigation Conference, Kempsey.

(6) Haines PE (*2005*), *'Determining Appropriate Setbacks for Future Development Around ICOLLs'*; presented at the 14th NSW Coastal Conference, Narooma, 8-11th November 2005.

(7) Institution of Engineers (*1987*), *'Australian Rainfall and Runoff – A Guide to Flood Estimation'*; edited by DH Pilgrim.

(8) NSW Department of Infrastructure Planning & Natural Resources (*May 2005*); *'Draft Floodplain Risk Management Guideline No 5 – Ocean Boundary Conditions'*.

(9) New South Wales Government (*April 2005*), *'Floodplain Development Manual: the management of flood liable land'*; ISBN 0 7347 5476 0, DIPNR 05_020.

(10) NSW Public Works Department (*February, 1987*), *'An Assessment of Coastal Processes Affecting Park Beach, Coffs Harbour'*.

(11) Sainty & Associates (*September 2006*), *'Environmental Constraints Analysis - Lot 22 DP 1070182, Pacific Highway, Sandy Beach North'*; prepared for the NSW Department of Planning.

(12) Willing & Partners Pty Ltd (*1996*), *'RAFTS-XP User Manual'*.

(13) WorleyParsons (*incorporating Patterson Britton & Partners*) (*2009*), *'Climate Change Assessment for Proposed Development at Sandy Beach North'* (*Issue No.3, February 2009*); prepared for Sandy Shores Development Pty Ltd.

APPENDIX A
ADOPTED SUB-CATCHMENT PARAMETERS

TABLE A1: RAFTS SUB-CATCHMENT PARAMETERS

RAFTS MODEL SUB CATCHMENT	AREA (*ha*)	IMP. AREA (*%*)	MANNINGS 'n'	INITIAL LOSS (*mm*)	CONTINUING LOSS (*mm/hr*)
A	104.4	5	0.035	10	2.5
B	50.5	5	0.035	10	2.5
C	35.3	5	0.035	10	2.5
D	141.9	5	0.035	10	2.5
E	16.1	5	0.035	10	2.5
F	52.7	5	0.035	10	2.5
G	44.1	5	0.035	10	2.5
H	16.8	20	0.035	10	2.5
I	17.5	25	0.035	10	2.5
J	11.3	5	0.035	10	2.5
K	46.9	5	0.035	10	2.5
L	88.5	10	0.035	10	2.5
M	11.5	50	0.025	10	2.5
N	6.1	5	0.035	10	2.5
O	34.4	5	0.035	10	2.5
P	3.7	70	0.025	10	2.5
Q	13.9	25	0.035	10	2.5

TABLE A2: ADOPTED SITE SUB-CATCHMENT PARAMETERS FOR RAFTS HYDROLOGIC MODEL

CATCHMENT	AREA (*ha*)	IMP. AREA (*%*)	MANNINGS 'n'	INITIAL LOSS (*mm*)	CONTINUING LOSS (*mm/hr*)
a	10.6	5	0.025	10	2.5
b	2.5	5	0.025	10	2.5
c	4.1	5	0.035	10	2.5
d	16.6	5	0.035	10	2.5
e	1.7	5	0.035	10	2.5
f	0.9	5	0.035	10	2.5
g	1.3	5	0.06	10	2.5
h	7.2	5	0.035	10	2.5
i	1.5	5	0.06	10	2.5
j	6.2	5	0.035	10	2.5
k	1.2	5	0.06	10	2.5
l	1.5	5	0.06	10	2.5
m	1.4	5	0.035	10	2.5
n	6.7	5	0.06	10	2.5
o	7.4	5	0.035	10	2.5
p	0.8	100	0.035	10	2.5
q	1.2	100	0.035	10	2.5
r	0.8	100	0.035	10	2.5
s	6.2	100	0.035	10	2.5
t	0.7	5	0.06	10	2.5
u	0.9	5	0.06	10	2.5
v	1.5	5	0.06	10	2.5
w	1.6	5	0.06	10	2.5
x	1.7	5	0.06	10	2.5
y	1.6	5	0.06	10	2.5

APPENDIX B
INTENSITY-FREQUENCY-DURATION DATA

IFD ANALYSIS BASED ON AUSTRALIAN RAINFALL & RUNOFF 1987

Site Location: Hearns Lake

Geographical factor for 6 min 2 yr storm = 4.375
Geographical factor for 6 min 50 yr storm = 16.6
Skewness = 0.04

2 Year ARI:
1 hour intensity = 46 mm/hr
12 hour intensity = 9.55 mm/hr
72 hour intensity = 3.26 mm/hr

50 Year ARI:
1 hour intensity = 90 mm/hr
12 hour intensity = 19.4 mm/hr
72 hour intensity = 7.75 mm/hr

IFD Table for Various ARIs and Duration

Duration	1 yr (*mm/hr*)	2 yr (*mm/hr*)	5 yr (*mm/hr*)	10 yr (*mm/hr*)	20 yr (*mm/hr*)	50 yr (*mm/hr*)	100 yr (*mm/hr*)
5 mins	115	146	181	201	228	264	290
6	108	137	170	189	215	249	274
10	88	112	141	157	179	207	229
15	74	94	119	133	151	176	195
20	64	82	104	116	133	155	172
30	52	67	85	96	110	129	143
45	41.9	53.9	69.1	78	90	105	117
1 hour	35.6	45.9	59.1	67	77	91	101
1.5	27.7	35.7	46.2	52	60	71	79
2	23.1	29.8	38.6	43.8	51	60	67
3	17.8	23.0	29.9	34.0	39.3	46	52
4.5	13.7	17.8	23.1	26.3	30.5	36.0	40.2
6	11.4	14.8	19.3	21.9	25.4	30.1	33.6
9	8.82	11.4	14.9	17.0	19.8	23.4	26.2
12	7.34	9.52	12.5	14.2	16.5	19.6	21.9
18	5.81	7.57	10.05	11.6	13.5	16.1	18.1
24	4.92	6.43	8.62	9.96	11.7	14.0	15.8
30	4.30	5.65	7.63	8.85	10.42	12.5	14.2
36	3.85	5.07	6.89	8.02	9.47	11.4	13.0
48	3.22	4.25	5.84	6.83	8.10	9.84	11.20
72	2.45	3.25	4.54	5.36	6.40	7.83	8.96

APPENDIX C
RAFTS MODEL RESULTS

SANDY BEACH NORTH RESIDENTIAL DEVELOPMENT
RAFTS Model Results

```
Max. no. of links allowed =  2000
Max. no. of routing increments allowed = 30000
Max. no. of rating curve points = 30000
Max. no. of storm temporal points = 30000
Max. no. of channel subreaches =    25
Max link stack level =    25
Input Version number =          600
```

Modelling Results for 20 Year Recurrence Storm

```
ROUTING INCREMENT (MINS) =       1.00
STORM DURATION (MINS)    =       120.
RETURN PERIOD (YRS)      =        20.
BX                       =    1.0000
TOTAL OF FIRST SUB-AREAS  (ha) =     694.90
TOTAL OF SECOND SUB-AREAS (ha) =       0.00
TOTAL OF ALL SUB-AREAS (ha)    =     694.90
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
3.01	50.500	0.000	8.200	0.000	5.000	0.000	.035	0.00	.0712	0.000	1.000
2.01	104.40	0.000	8.500	0.000	5.000	0.000	.035	0.00	.1021	0.000	2.000
2.02	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.001
2.03	35.300	0.000	5.500	0.000	5.000	0.000	.035	0.00	.0722	0.000	1.002
2.04	16.100	0.000	3.600	0.000	5.000	0.000	.035	0.00	.0593	0.000	1.003
1.01	141.90	0.000	2.700	0.000	5.000	0.000	.035	0.00	.2122	0.000	3.000
1.02	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.004
5.01	52.700	0.000	11.30	0.000	5.000	0.000	.035	0.00	.0621	0.000	4.000
4.01	44.100	0.000	1.500	0.000	5.000	0.000	.035	0.00	.1550	0.000	5.000
1.03	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.005
7.01	16.800	0.000	9.100	0.000	20.00	0.000	.035	0.00	.0223	0.000	6.000
6.01	17.500	0.000	14.80	0.000	25.00	0.000	.035	0.00	.0154	0.000	7.000
1.04	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.006
1.05	46.900	0.000	.2000	0.000	5.000	0.000	.035	0.00	.4373	0.000	1.007
9.01	11.300	0.000	12.20	0.000	5.000	0.000	.035	0.00	.0268	0.000	8.000
9.02	11.500	0.000	4.900	0.000	50.00	0.000	.025	0.00	.0107	0.000	8.001
8.01	10.600	0.000	6.300	0.000	5.000	0.000	.025	0.00	.0285	0.000	9.000
8.02	4.100	0.000	1.100	0.000	5.000	0.000	.035	0.00	.0526	0.000	9.001
12.01	2.500	0.000	2.800	0.000	5.000	0.000	.025	0.00	.0201	0.000	10.00
12.02	16.600	0.000	1.000	0.000	5.000	0.000	.035	0.00	.1141	0.000	10.00
23.01	1.500	0.000	1.300	0.000	5.000	0.000	.060	0.00	.0438	0.000	11.00
24.01	0.7000	0.000	7.600	0.000	5.000	0.000	.060	0.00	.0122	0.000	12.00
25.01	0.9000	0.000	.2000	0.000	5.000	0.000	.060	0.00	.0854	0.000	13.00
13.01	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	11.00
13.02	1.700	0.000	1.100	0.000	5.000	0.000	.035	0.00	.0333	0.000	11.00

8.03	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.002
8.04	0.9000	0.000	.7000	0.000	5.000	0.000	.035	0.00	.0300	0.000	9.003
14.01	1.300	0.000	1.200	0.000	5.000	0.000	.060	0.00	.0423	0.000	14.00
8.05	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.004
8.06	0.8000	0.000	.0010	0.000	100.0	0.000	.035	0.00	.1055	0.000	9.005
16.01	1.500	0.000	2.100	0.000	5.000	0.000	.060	0.00	.0345	0.000	15.00
15.01	7.200	0.000	.3000	0.000	5.000	0.000	.035	0.00	.1348	0.000	16.00
8.07	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.006
8.08	1.200	0.000	.0010	0.000	100.0	0.000	.035	0.00	.1303	0.000	9.007
18.01	1.200	0.000	2.900	0.000	5.000	0.000	.060	0.00	.0261	0.000	17.00
17.01	6.200	0.000	.4000	0.000	5.000	0.000	.035	0.00	.1080	0.000	18.00
8.09	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.008
8.10	0.8000	0.000	.0010	0.000	100.0	0.000	.035	0.00	.1055	0.000	9.009
19.01	1.500	0.000	2.400	0.000	5.000	0.000	.060	0.00	.0322	0.000	19.00
20.01	1.400	0.000	3.100	0.000	5.000	0.000	.035	0.00	.0179	0.000	20.00
8.11	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.010
8.12	6.200	0.000	.0010	0.000	100.0	0.000	.035	0.00	.3060	0.000	9.011
22.01	7.400	0.000	.5000	0.000	5.000	0.000	.035	0.00	.1060	0.000	21.00
21.01	1.600	0.000	1.500	0.000	5.000	0.000	.060	0.00	.0422	0.000	22.00
21.02	1.700	0.000	1.100	0.000	5.000	0.000	.060	0.00	.0508	0.000	22.00
21.03	1.600	0.000	2.500	0.000	5.000	0.000	.060	0.00	.0327	0.000	22.00
21.04	6.700	0.000	3.400	0.000	5.000	0.000	.060	0.00	.0590	0.000	22.00
8.13	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.012
1.06	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.008
11.01	6.100	0.000	14.10	0.000	5.000	0.000	.035	0.00	.0181	0.000	23.00
11.02	3.700	0.000	4.700	0.000	70.00	0.000	.025	0.00	.0042	0.000	23.00
10.01	34.400	0.000	1.500	0.000	5.000	0.000	.035	0.00	.1362	0.000	24.00
10.02	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	23.00
1.07	13.900	0.000	2.100	0.000	25.00	0.000	.035	0.00	.0361	0.000	1.009

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	#2	Cont. Loss #1 (mm/h)	#2	Excess Rain #1 (mm)	#2	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
3.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	19.025	41.00	0.000
2.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	35.334	41.00	0.000
2.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	54.358	41.00	18.40
2.03	50.699	10.00	0.000	2.500	0.000	86.939	0.000	60.560	59.00	13.70
2.04	50.699	10.00	0.000	2.500	0.000	86.939	0.000	62.390	73.00	0.000
1.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	27.309	60.00	0.000
1.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	85.673	73.00	27.00
5.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	21.333	40.00	0.000
4.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	8.320	60.00	0.000
1.03	50.699	10.00	0.000	2.500	0.000	86.939	0.000	92.721	100.0	18.20
7.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	8.295	37.00	0.000
6.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	9.754	36.00	0.000
1.04	50.699	10.00	0.000	2.500	0.000	86.939	0.000	93.904	118.0	20.50
1.05	50.699	10.00	0.000	2.500	0.000	86.939	0.000	97.074	139.0	0.000
9.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	5.131	40.00	12.00
9.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	8.062	36.00	0.000
8.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	4.744	40.00	8.100
8.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	5.835	48.00	0.000
12.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	1.106	40.00	13.80
12.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	4.198	54.00	0.000
23.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.3497	47.00	0.000
24.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.3165	40.00	0.000
25.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.1052	81.00	0.000

13.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.6726	41.00	5.800	
13.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.5415	42.00	0.000	
8.03	50.699	10.00	0.000	2.500	0.000	86.939	0.000	10.102	48.00	4.600	
8.04	50.699	10.00	0.000	2.500	0.000	86.939	0.000	10.326	53.00	0.000	
14.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.3028	48.00	0.000	
8.05	50.699	10.00	0.000	2.500	0.000	86.939	0.000	10.622	53.00	4.500	
8.06	50.699	0.000	0.000	0.000	0.000	101.40	0.000	10.680	58.00	0.000	
16.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.4398	44.00	0.000	
15.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.9858	80.00	0.000	
8.07	50.699	10.00	0.000	2.500	0.000	86.939	0.000	11.851	58.00	5.000	
8.08	50.699	0.000	0.000	0.000	0.000	101.40	0.000	11.954	63.00	0.000	
18.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.4169	41.00	0.000	
17.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	1.010	66.00	0.000	
8.09	50.699	10.00	0.000	2.500	0.000	86.939	0.000	13.141	63.00	4.300	
8.10	50.699	0.000	0.000	0.000	0.000	101.40	0.000	13.210	67.00	0.000	
19.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.4675	42.00	0.000	
20.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.6062	40.00	0.000	
8.11	50.699	10.00	0.000	2.500	0.000	86.939	0.000	13.619	67.00	9.500	
8.12	50.699	0.000	0.000	0.000	0.000	101.40	0.000	13.936	77.00	0.000	
22.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	1.269	65.00	0.000	
21.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.3988	46.00	5.900	
21.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.3532	52.00	5.600	
21.03	50.699	10.00	0.000	2.500	0.000	86.939	0.000	0.5081	41.00	9.800	
21.04	50.699	10.00	0.000	2.500	0.000	86.939	0.000	1.871	45.00	0.000	
8.13	50.699	10.00	0.000	2.500	0.000	86.939	0.000	15.880	77.00	0.000	
1.06	50.699	10.00	0.000	2.500	0.000	86.939	0.000	102.20	139.0	12.90	
11.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	2.929	38.00	7.800	
11.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	3.652	34.00	0.000	
10.01	50.699	10.00	0.000	2.500	0.000	86.939	0.000	6.741	57.00	0.000	
10.02	50.699	10.00	0.000	2.500	0.000	86.939	0.000	9.931	46.00	12.90	
1.07	50.699	10.00	0.000	2.500	0.000	86.939	0.000	103.53	152.0	0.000	

Modelling Results for 100 yr Recurrence Storm

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ROUTING INCREMENT (MINS) =       1.00
STORM DURATION (MINS)    =       120.
RETURN PERIOD (YRS)      =       100.
BX                       =     1.0000
TOTAL OF FIRST SUB-AREAS  (ha) =     694.90
TOTAL OF SECOND SUB-AREAS (ha) =       0.00
TOTAL OF ALL SUB-AREAS (ha)    =     694.90
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SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (ha)	Catch. Area #2 (ha)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
3.01	50.500	0.000	8.200	0.000	5.000	0.000	.035	0.00	.0712	0.000	1.000
2.01	104.40	0.000	8.500	0.000	5.000	0.000	.035	0.00	.1021	0.000	2.000
2.02	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.001
2.03	35.300	0.000	5.500	0.000	5.000	0.000	.035	0.00	.0722	0.000	1.002
2.04	16.100	0.000	3.600	0.000	5.000	0.000	.035	0.00	.0593	0.000	1.003
1.01	141.90	0.000	2.700	0.000	5.000	0.000	.035	0.00	.2122	0.000	3.000

1.02	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.004
5.01	52.700	0.000	11.30	0.000	5.000	0.000	.035	0.00	.0621	0.000	4.000
4.01	44.100	0.000	1.500	0.000	5.000	0.000	.035	0.00	.1550	0.000	5.000
1.03	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.005
7.01	16.800	0.000	9.100	0.000	20.00	0.000	.035	0.00	.0223	0.000	6.000
6.01	17.500	0.000	14.80	0.000	25.00	0.000	.035	0.00	.0154	0.000	7.000
1.04	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.006
1.05	46.900	0.000	.2000	0.000	5.000	0.000	.035	0.00	.4373	0.000	1.007
9.01	11.300	0.000	12.20	0.000	5.000	0.000	.035	0.00	.0268	0.000	8.000
9.02	11.500	0.000	4.900	0.000	50.00	0.000	.025	0.00	.0107	0.000	8.001
8.01	10.600	0.000	6.300	0.000	5.000	0.000	.025	0.00	.0285	0.000	9.000
8.02	4.100	0.000	1.100	0.000	5.000	0.000	.035	0.00	.0526	0.000	9.001
12.01	2.500	0.000	2.800	0.000	5.000	0.000	.025	0.00	.0201	0.000	10.00
12.02	16.600	0.000	1.000	0.000	5.000	0.000	.035	0.00	.1141	0.000	10.00
23.01	1.500	0.000	1.300	0.000	5.000	0.000	.060	0.00	.0438	0.000	11.00
24.01	0.7000	0.000	7.600	0.000	5.000	0.000	.060	0.00	.0122	0.000	12.00
25.01	0.9000	0.000	.2000	0.000	5.000	0.000	.060	0.00	.0854	0.000	13.00
13.01	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	11.00
13.02	1.700	0.000	1.100	0.000	5.000	0.000	.035	0.00	.0333	0.000	11.00
8.03	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.002
8.04	0.9000	0.000	.7000	0.000	5.000	0.000	.035	0.00	.0300	0.000	9.003
14.01	1.300	0.000	1.200	0.000	5.000	0.000	.060	0.00	.0423	0.000	14.00
8.05	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.004
8.06	0.8000	0.000	.0010	0.000	100.0	0.000	.035	0.00	.1055	0.000	9.005
16.01	1.500	0.000	2.100	0.000	5.000	0.000	.060	0.00	.0345	0.000	15.00
15.01	7.200	0.000	.3000	0.000	5.000	0.000	.035	0.00	.1348	0.000	16.00
8.07	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.006
8.08	1.200	0.000	.0010	0.000	100.0	0.000	.035	0.00	.1303	0.000	9.007
18.01	1.200	0.000	2.900	0.000	5.000	0.000	.060	0.00	.0261	0.000	17.00
17.01	6.200	0.000	.4000	0.000	5.000	0.000	.035	0.00	.1080	0.000	18.00
8.09	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.008
8.10	0.8000	0.000	.0010	0.000	100.0	0.000	.035	0.00	.1055	0.000	9.009
19.01	1.500	0.000	2.400	0.000	5.000	0.000	.060	0.00	.0322	0.000	19.00
20.01	1.400	0.000	3.100	0.000	5.000	0.000	.035	0.00	.0179	0.000	20.00
8.11	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.010
8.12	6.200	0.000	.0010	0.000	100.0	0.000	.035	0.00	.3060	0.000	9.011
22.01	7.400	0.000	.5000	0.000	5.000	0.000	.035	0.00	.1060	0.000	21.00
21.01	1.600	0.000	1.500	0.000	5.000	0.000	.060	0.00	.0422	0.000	22.00
21.02	1.700	0.000	1.100	0.000	5.000	0.000	.060	0.00	.0508	0.000	22.00
21.03	1.600	0.000	2.500	0.000	5.000	0.000	.060	0.00	.0327	0.000	22.00
21.04	6.700	0.000	3.400	0.000	5.000	0.000	.060	0.00	.0590	0.000	22.00
8.13	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	9.012
1.06	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	1.008
11.01	6.100	0.000	14.10	0.000	5.000	0.000	.035	0.00	.0181	0.000	23.00
11.02	3.700	0.000	4.700	0.000	70.00	0.000	.025	0.00	.0042	0.000	23.00
10.01	34.400	0.000	1.500	0.000	5.000	0.000	.035	0.00	.1362	0.000	24.00
10.02	.00001	0.000	.0010	0.000	0.000	0.000	.025	0.00	.0021	0.000	23.00
1.07	13.900	0.000	2.100	0.000	25.00	0.000	.035	0.00	.0361	0.000	1.009

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag mins
3.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	24.787	41.00	0.000
2.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	47.513	41.00	0.000
2.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	72.300	41.00	18.40
2.03	66.880	10.00	0.000	2.500	0.000	119.14	0.000	80.092	59.00	13.70

2.04	66.880	10.00	0.000	2.500	0.000	119.14	0.000	82.613	73.00	0.000
1.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	38.213	52.00	0.000
1.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	113.31	72.00	27.00
5.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	27.459	40.00	0.000
4.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	11.620	53.00	0.000
1.03	66.880	10.00	0.000	2.500	0.000	119.14	0.000	123.07	99.00	18.20
7.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	10.482	37.00	0.000
6.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	12.136	36.00	0.000
1.04	66.880	10.00	0.000	2.500	0.000	119.14	0.000	124.86	117.0	20.50
1.05	66.880	10.00	0.000	2.500	0.000	119.14	0.000	129.39	138.0	0.000
9.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	6.512	39.00	12.00
9.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	10.696	36.00	0.000
8.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	6.013	40.00	8.100
8.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	7.490	47.00	0.000
12.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	1.402	40.00	13.80
12.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	5.803	54.00	0.000
23.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.5070	45.00	0.000
24.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.4002	39.00	0.000
25.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.1535	81.00	0.000
13.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.9613	41.00	5.800
13.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.7559	80.00	0.000
8.03	66.880	10.00	0.000	2.500	0.000	119.14	0.000	13.539	48.00	4.600
8.04	66.880	10.00	0.000	2.500	0.000	119.14	0.000	13.821	53.00	0.000
14.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.4284	46.00	0.000
8.05	66.880	10.00	0.000	2.500	0.000	119.14	0.000	14.211	53.00	4.500
8.06	66.880	0.000	0.000	0.000	0.000	133.76	0.000	14.312	58.00	0.000
16.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.6162	41.00	0.000
15.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	1.416	69.00	0.000
8.07	66.880	10.00	0.000	2.500	0.000	119.14	0.000	15.972	58.00	5.000
8.08	66.880	0.000	0.000	0.000	0.000	133.76	0.000	16.112	63.00	0.000
18.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.5669	41.00	0.000
17.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	1.429	65.00	0.000
8.09	66.880	10.00	0.000	2.500	0.000	119.14	0.000	17.776	63.00	4.300
8.10	66.880	0.000	0.000	0.000	0.000	133.76	0.000	17.890	67.00	0.000
19.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.6495	41.00	0.000
20.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.7749	40.00	0.000
8.11	66.880	10.00	0.000	2.500	0.000	119.14	0.000	18.421	67.00	9.500
8.12	66.880	0.000	0.000	0.000	0.000	133.76	0.000	18.925	77.00	0.000
22.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	1.785	63.00	0.000
21.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.5714	45.00	5.900
21.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.5212	46.00	5.600
21.03	66.880	10.00	0.000	2.500	0.000	119.14	0.000	0.6953	41.00	9.800
21.04	66.880	10.00	0.000	2.500	0.000	119.14	0.000	2.551	44.00	0.000
8.13	66.880	10.00	0.000	2.500	0.000	119.14	0.000	21.509	77.00	0.000
1.06	66.880	10.00	0.000	2.500	0.000	119.14	0.000	136.57	138.0	12.90
11.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	3.691	37.00	7.800
11.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	4.761	34.00	0.000
10.01	66.880	10.00	0.000	2.500	0.000	119.14	0.000	9.531	51.00	0.000
10.02	66.880	10.00	0.000	2.500	0.000	119.14	0.000	13.805	46.00	12.90
1.07	66.880	10.00	0.000	2.500	0.000	119.14	0.000	138.40	151.0	0.000