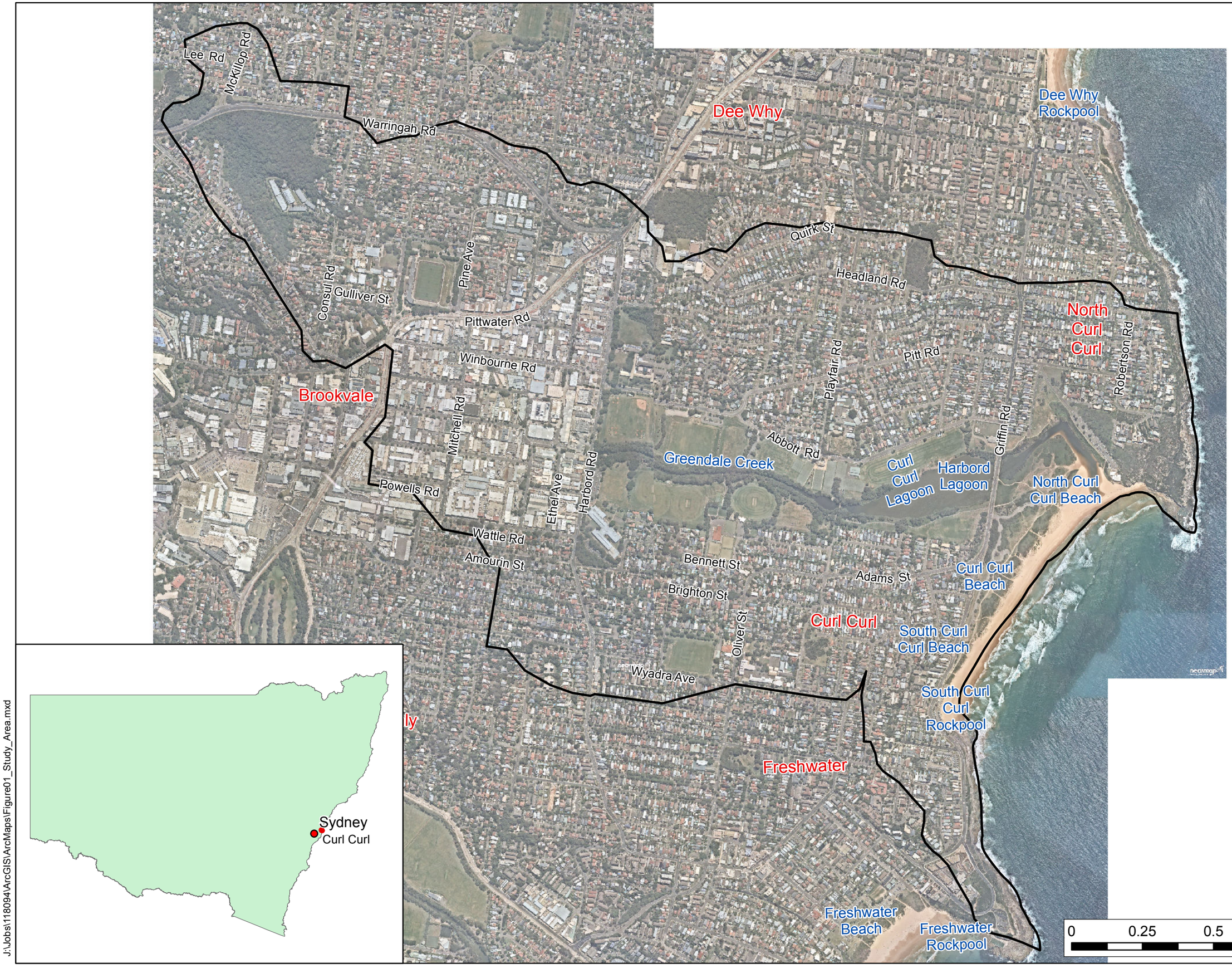
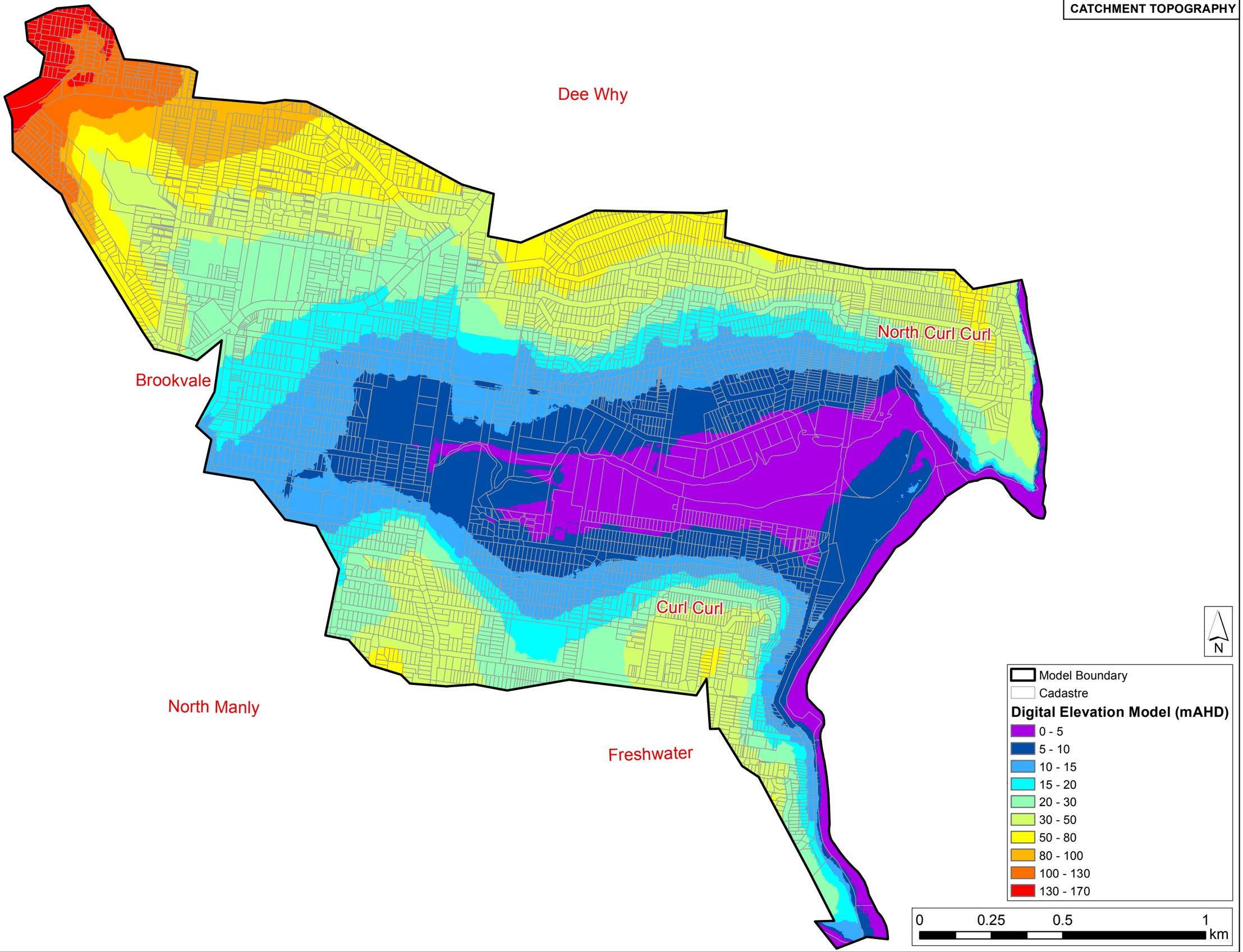
Figures

FIGURE 1
STUDY AREA



J:\Jobs\118094\ArcGIS\ArcMaps\Figure01_Study_Area.mxd

FIGURE 2
CATCHMENT TOPOGRAPHY



J:\Jobs\118094\ArcGIS\ArcMaps\Figure02_Catchment_Topography.mxd

FIGURE 3
PITS AND PIPES
STORMWATER NETWORK

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

N

Study Area
Pits
Pipes
Culverts

0 0.25 0.5 1 km

J:\Jobs\118094\ArcGIS\ArcMaps\Figure03_Pits_and_Pipes_Stormwater_Network.mxd

FIGURE 4
RAINFALL GAUGE LOCATIONS

66141
66059
66206
66188
66126
566152
213426
566151
66080
66011
66214
66062
66006
66209

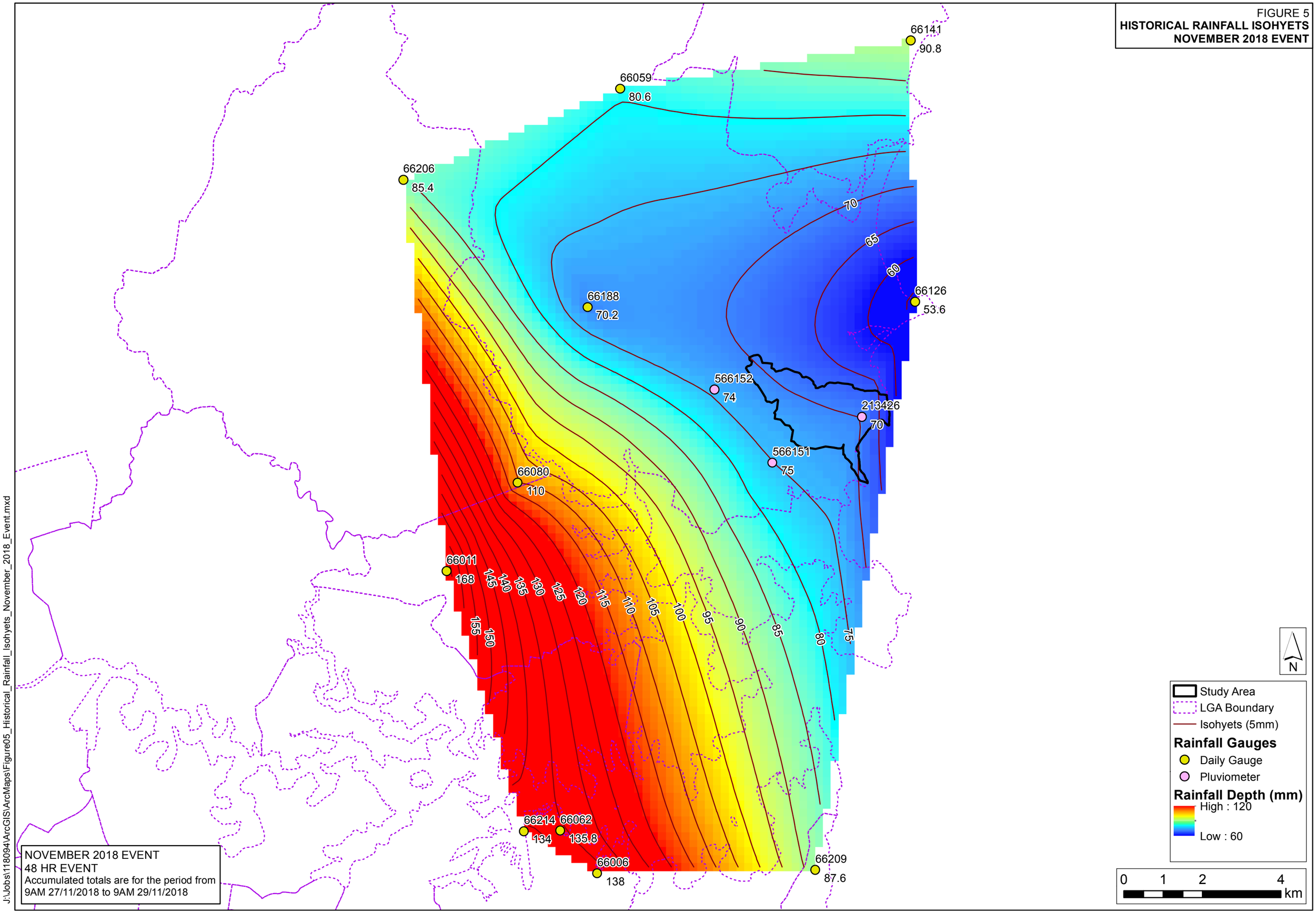
N

Study Area
LGA Boundary
Rainfall Gauges
Daily Gauge
Pluviometer

0 1 2 4
km

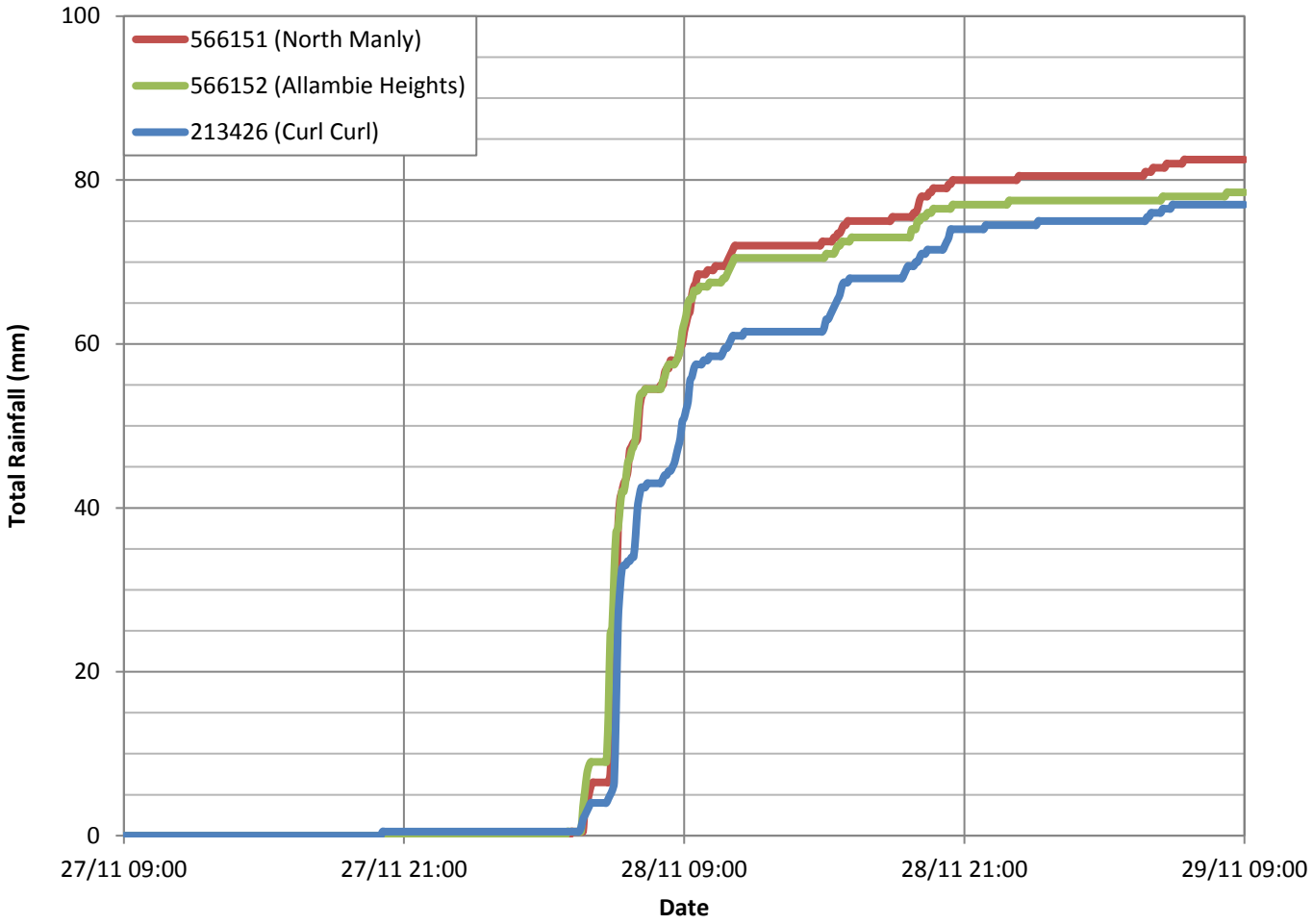
J:\Jobs\118094\ArcGIS\ArcMaps\Figure04_Rainfall_Gauge_Locations.mxd

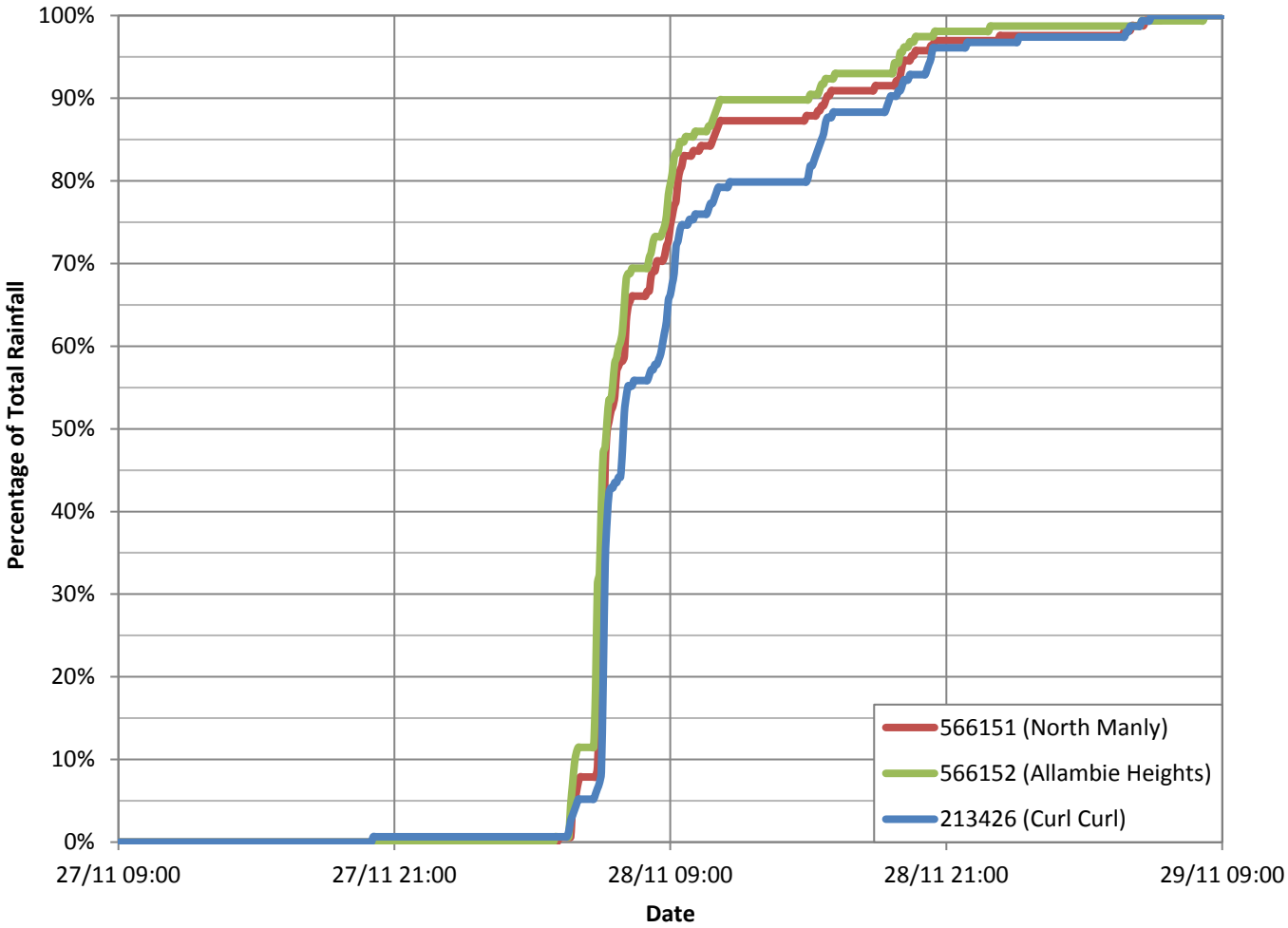
FIGURE 5
HISTORICAL RAINFALL ISOHYETS
NOVEMBER 2018 EVENT



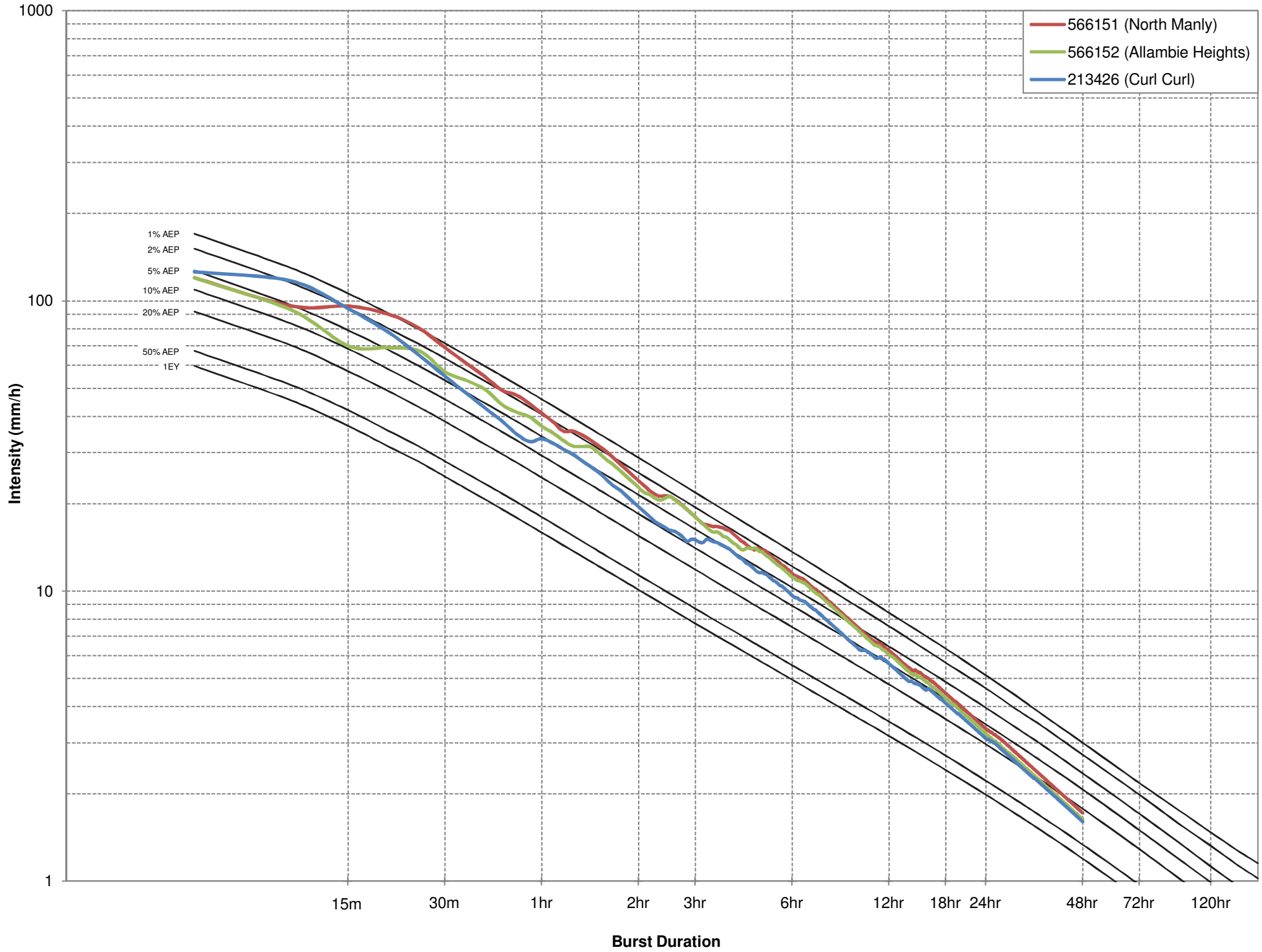
J:\Jobs\118094\ArcGIS\ArcMaps\Figure05_Historical_Rainfall_Isohyets_November_2018_Event.mxd

FIGURE 6
CUMULATIVE RAINFALL DATA
NOVEMBER 2018 EVENT





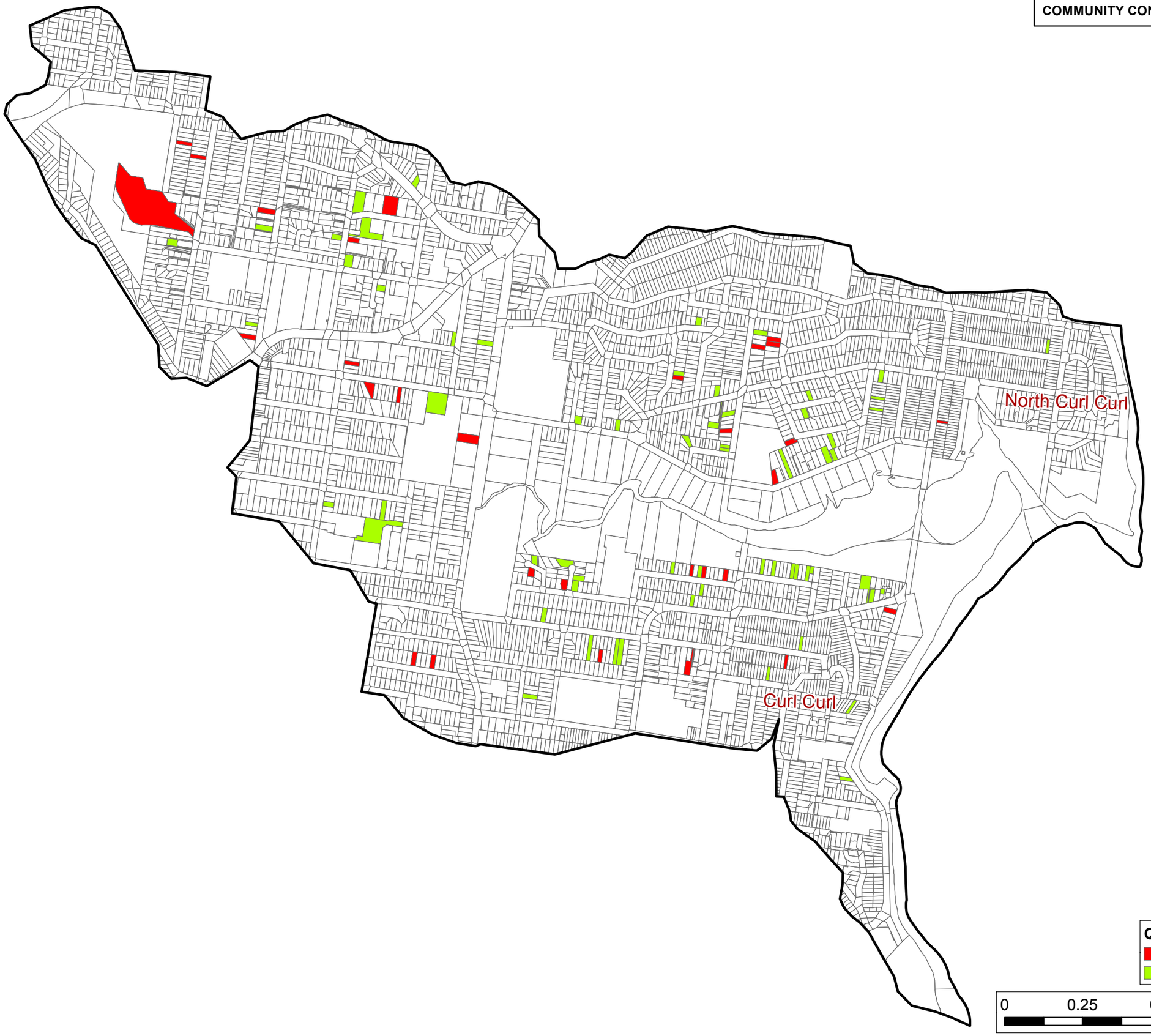
J:\Jobs\118094\Hydrology\Rainfall\Cumulative_Rainfall_Plots\Historical_Burst_IFD_Comparison_Catchment_2018.xlsm



J:\Jobs\118094\Hydrology\Rainfall\Cumulative_Rainfall_Plots\Historical_Burst_IFD_Comparison_Catchment_2018.xlsm

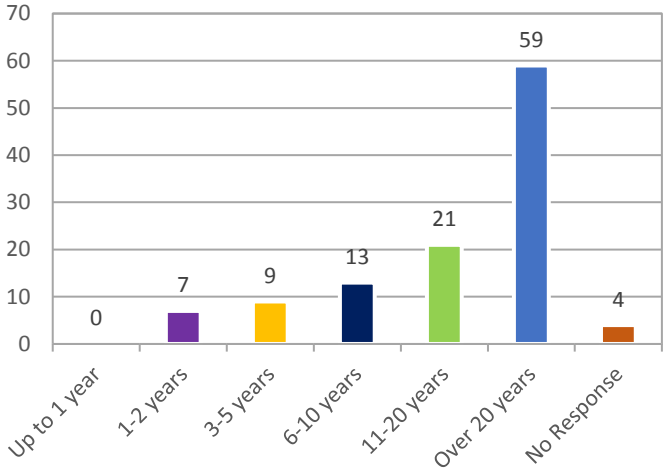
FIGURE 7
BURST INTENSITIES AND FREQUENCIES NOVEMBER 2018 FLOOD EVENT

FIGURE 8
COMMUNITY CONSULTATION RESPONSES MAP

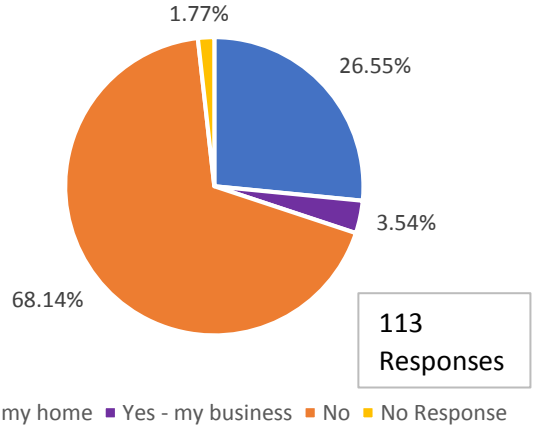


J:\Jobs\118094\ArcGIS\ArcMaps\Figure08_Community_Consultation_Responses_Map.mxd

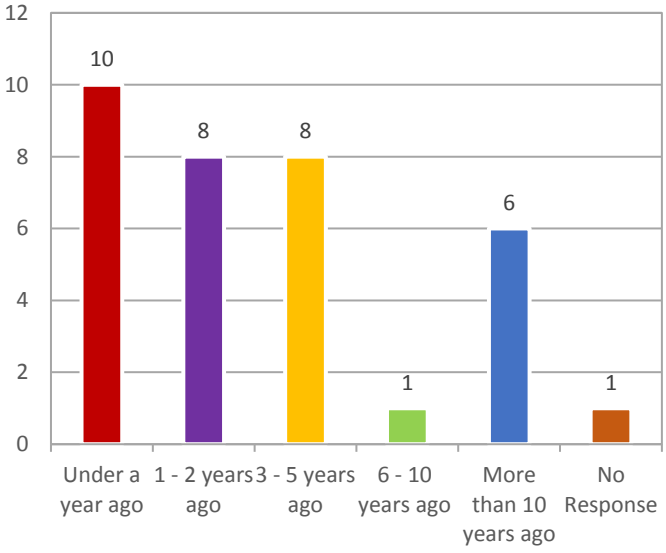
How long have you lived and/or worked in the Greendale Creek Catchment?



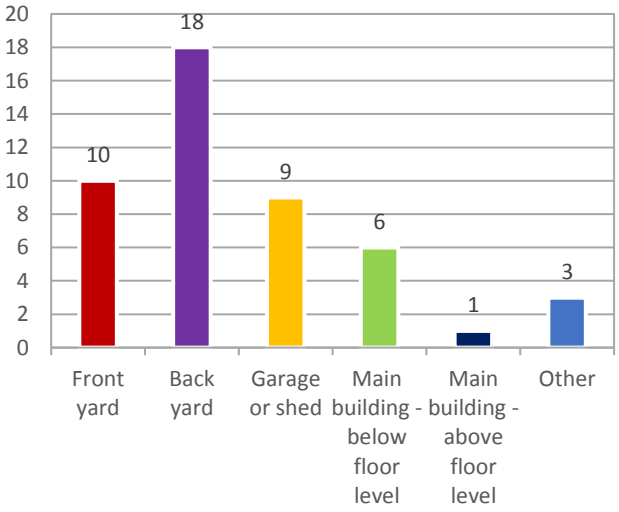
Have you ever experienced flooding due to flood water/stormwater in this catchment?



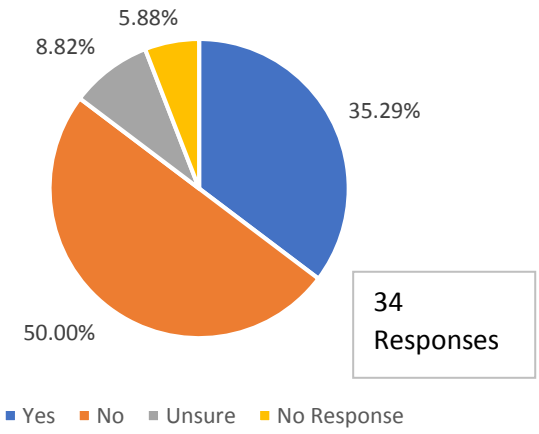
When did you experience the flooding?



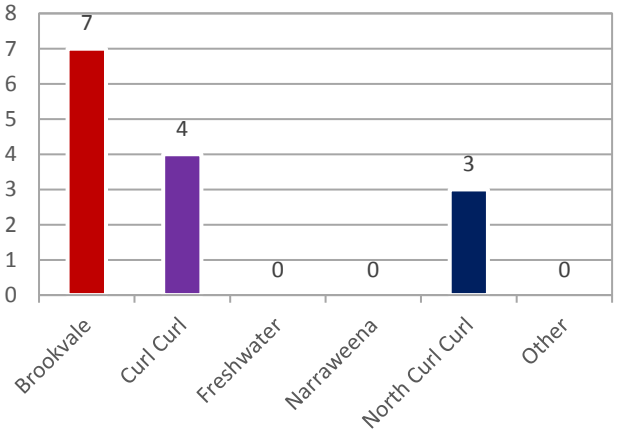
What part(s) of your property was flooded?

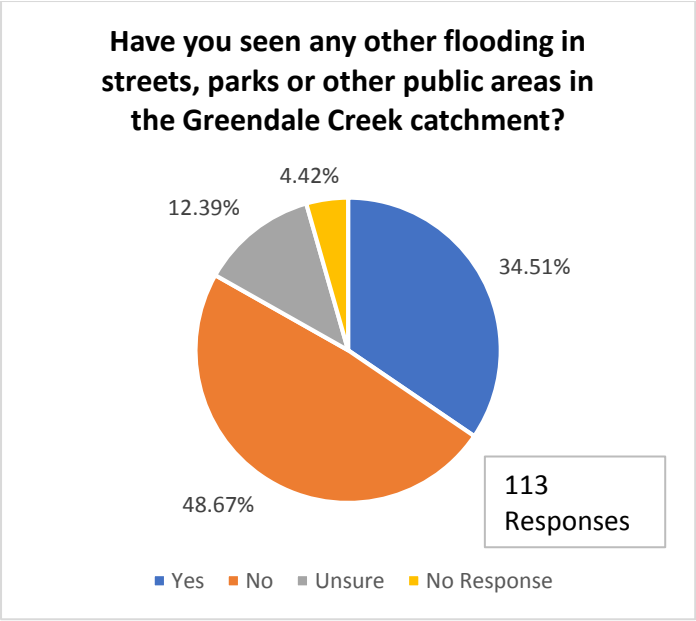


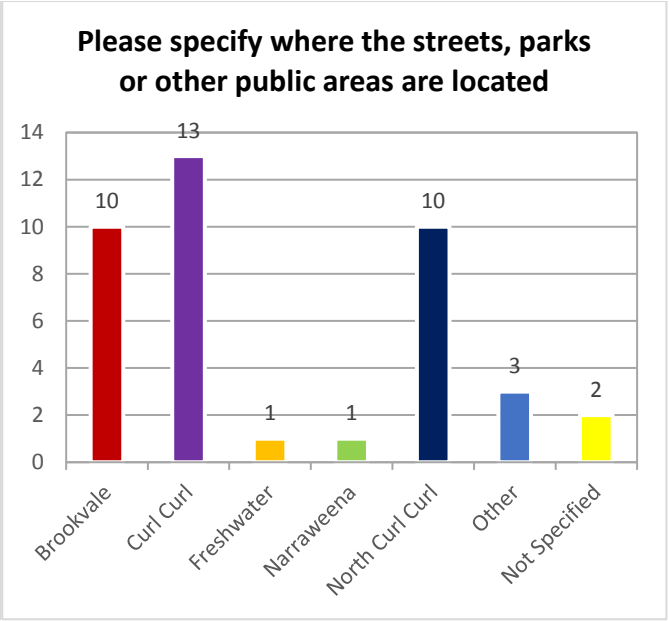
Did you notice any culverts or drains blocked during the flood?

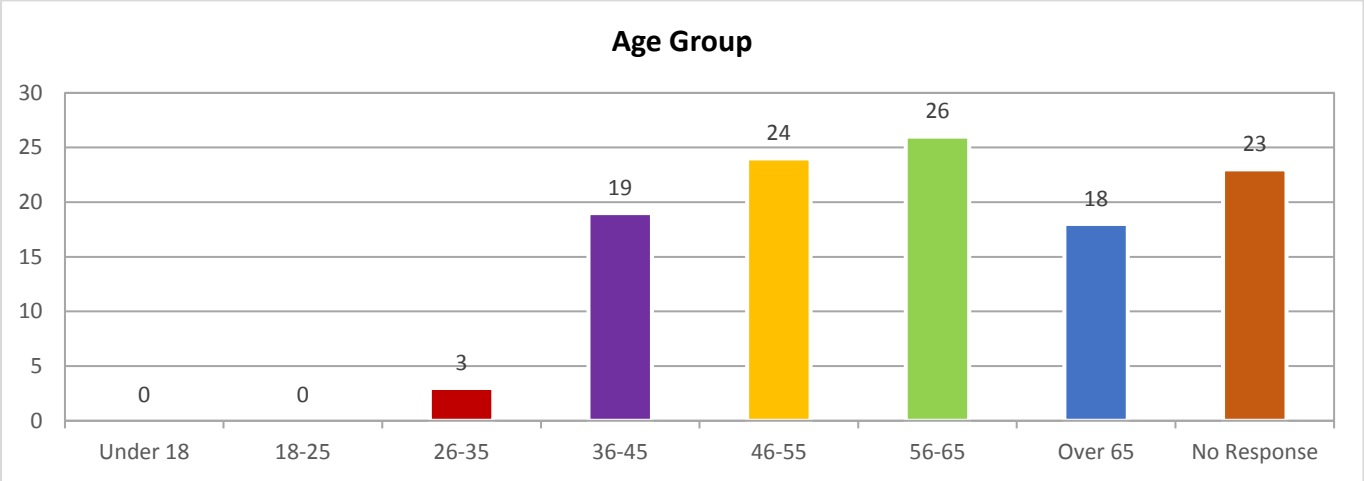


Please specify where the blocked culvert or drain was located




Have you seen any other flooding in streets, parks or other public areas in the Greendale Creek catchment?
4.42%
12.39%
34.51%
48.67%
113 Responses
Yes
No
Unsure
No Response


Please specify where the streets, parks or other public areas are located
14
12
10
8
6
4
2
0
10
13
1
1
10
3
2
Brookvale
Curl Curl
Freshwater
Narraweena
North Curl Curl
Other
Not Specified


Age Group
30
25
20
15
10
5
0
0
0
3
19
24
26
18
23
Under 18
18-25
26-35
36-45
46-55
56-65
Over 65
No Response

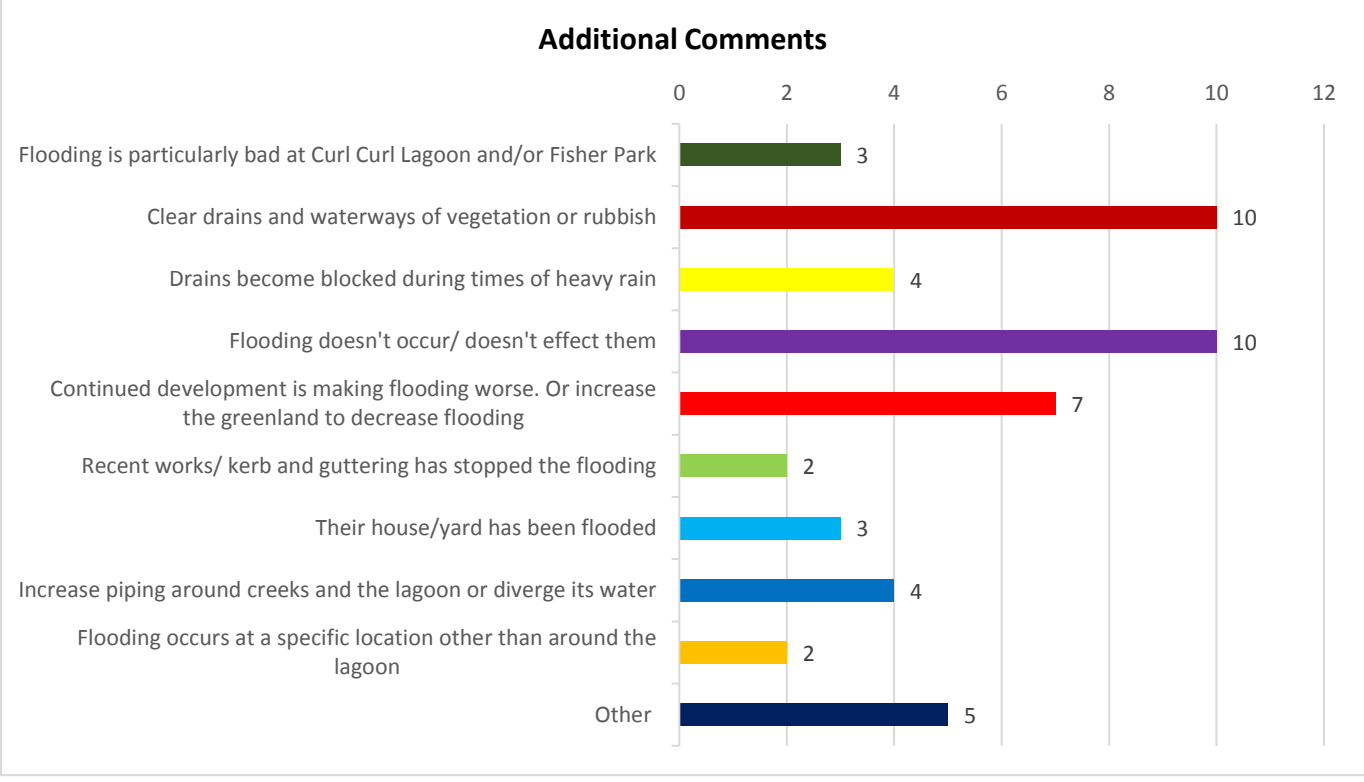

Additional Comments
0
2
4
6
8
10
12
Flooding is particularly bad at Curl Curl Lagoon and/or Fisher Park
3
Clear drains and waterways of vegetation or rubbish
10
Drains become blocked during times of heavy rain
4
Flooding doesn't occur/ doesn't effect them
10
Continued development is making flooding worse. Or increase the greenland to decrease flooding
7
Recent works/ kerb and guttering has stopped the flooding
2
Their house/yard has been flooded
3
Increase piping around creeks and the lagoon or diverge its water
4
Flooding occurs at a specific location other than around the lagoon
2
Other
5

FIGURE 10
WBNM HYDROLOGIC MODEL LAYOUT

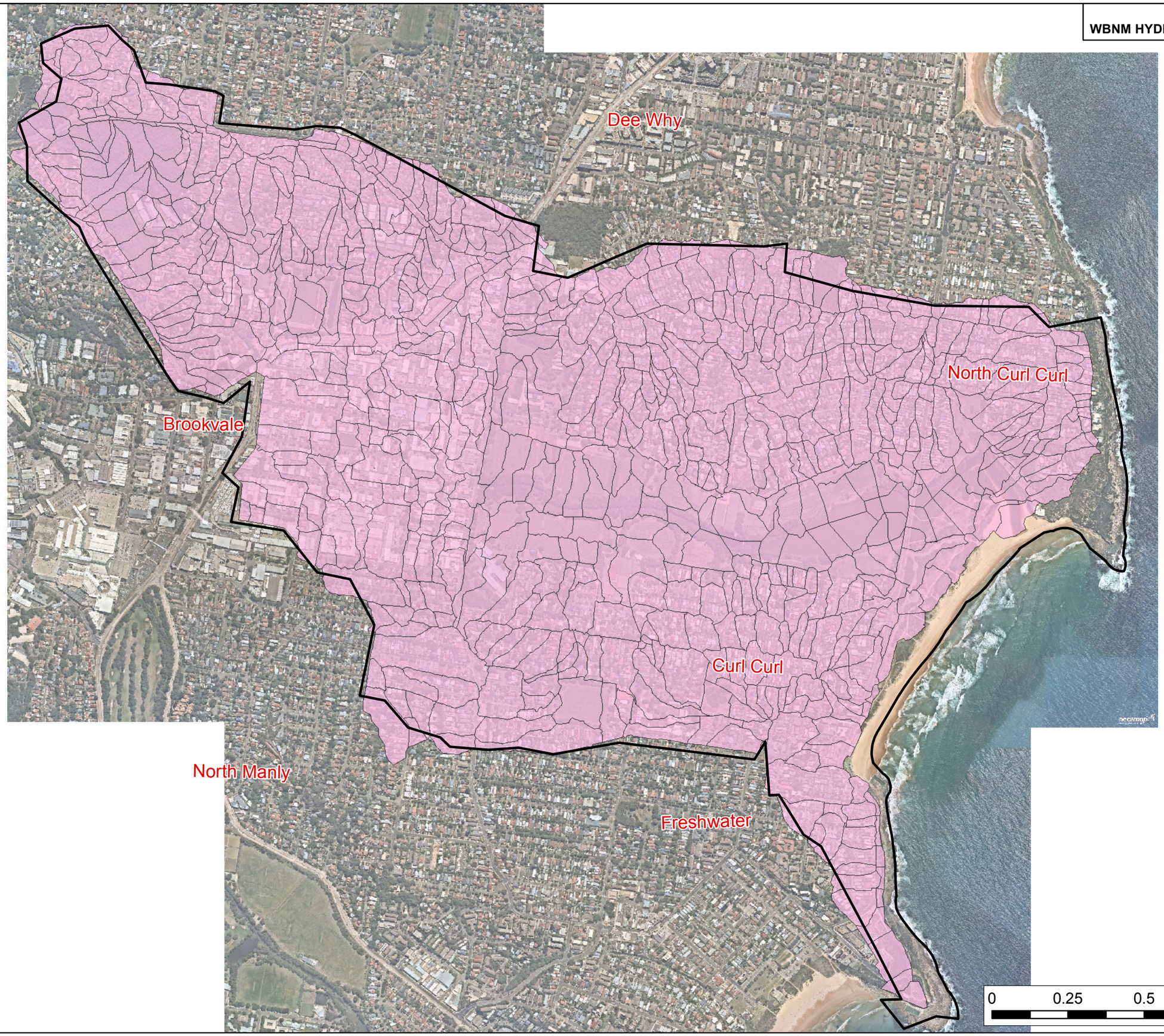


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FIGURE 11
TUFLOW MODEL MANNINGS ROUGHNESS

Dee Why

Brookvale

North Curl Curl

Curl Curl

North Manly

Freshwater

N

Model Boundary

Material (n)

- Grass (0.04)
- Light Vegetation (0.06)
- Medium Vegetation (0.07)
- Waterways (0.05)
- Vegetated Creek (0.09)
- Paved Area (0.02)
- Lakes/Ponds/Dams (0.1)
- Urban Properties (0.065)
- Dense Vegetation (0.12)
- Industrial (0.2)
- Sand (0.03)
- Ocean (0.1)

0 0.25 0.5 1 km

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FIGURE 12
TUFLOW MODEL SCHEMATISATION

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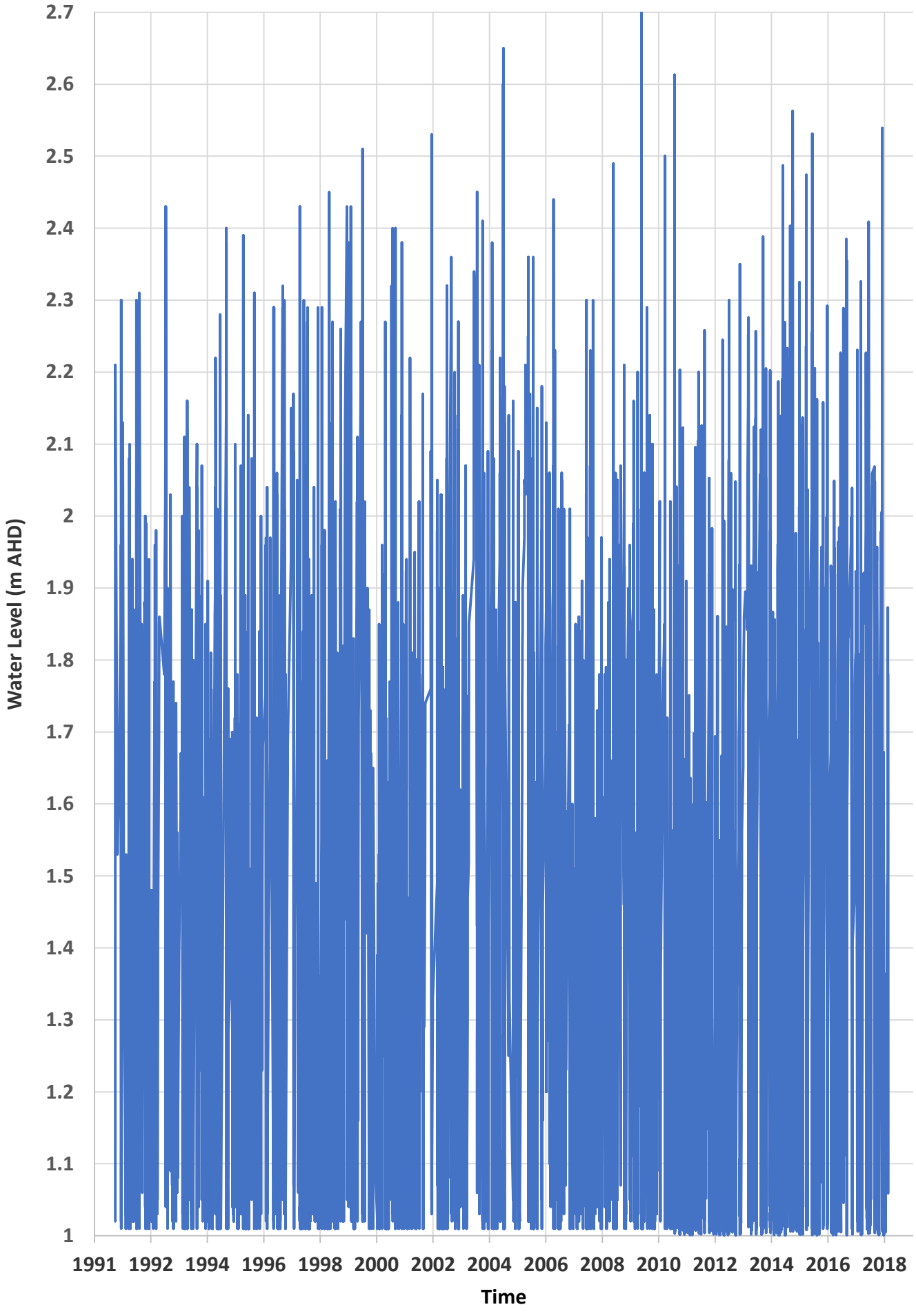
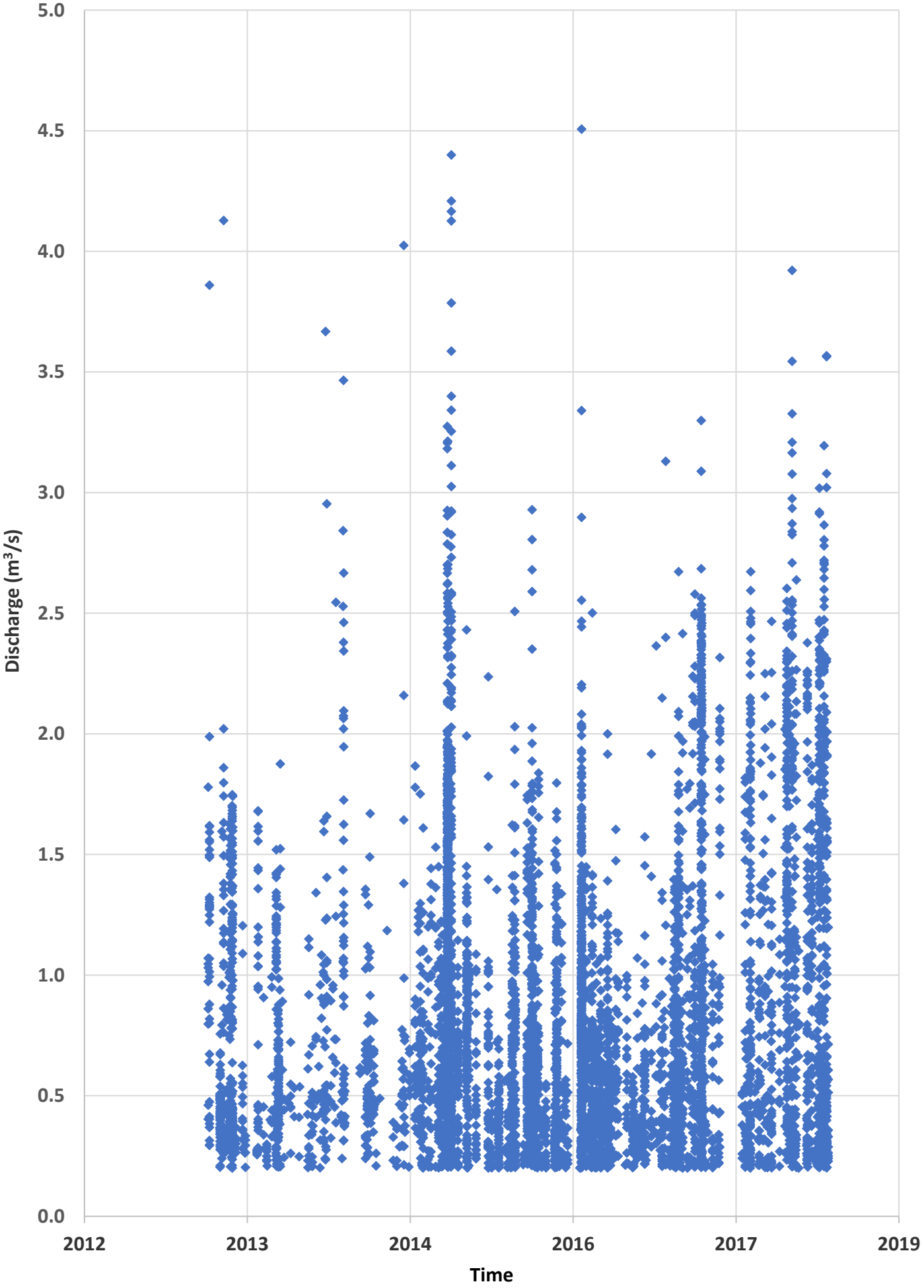
FIGURE 13
STREAM GAUGE RECORDS
CURL CURL GAUGE (213426)
1991 to 2019



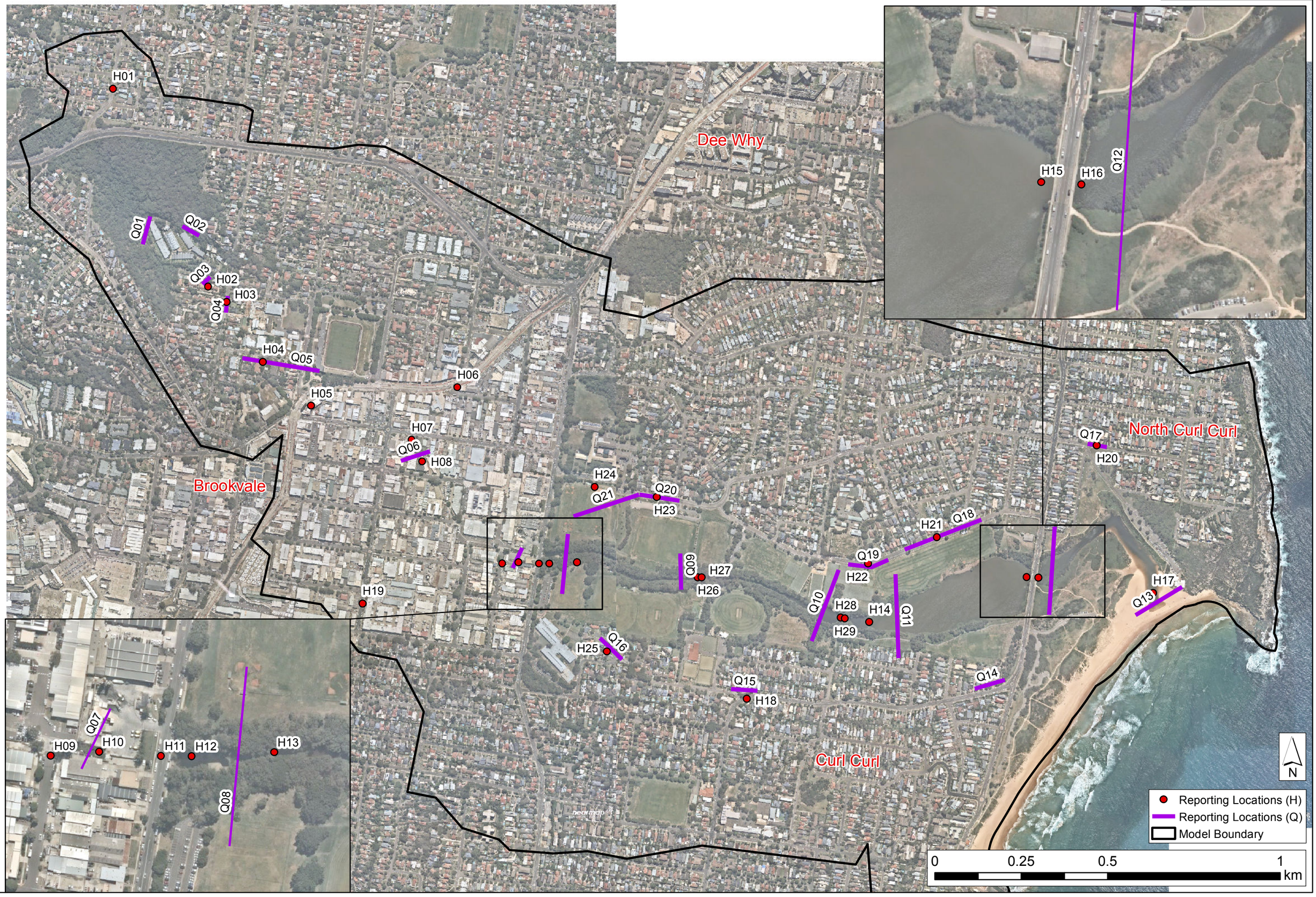
J:\Jobs\118094\PDFy\Data_for_Figures\Figure13_Water_Level_Records_213426.xlsx

FIGURE 14
STREAM GAUGE RECORDS
GREENDALE CREEK BROOKVALE FLOW GAUGE (213499)



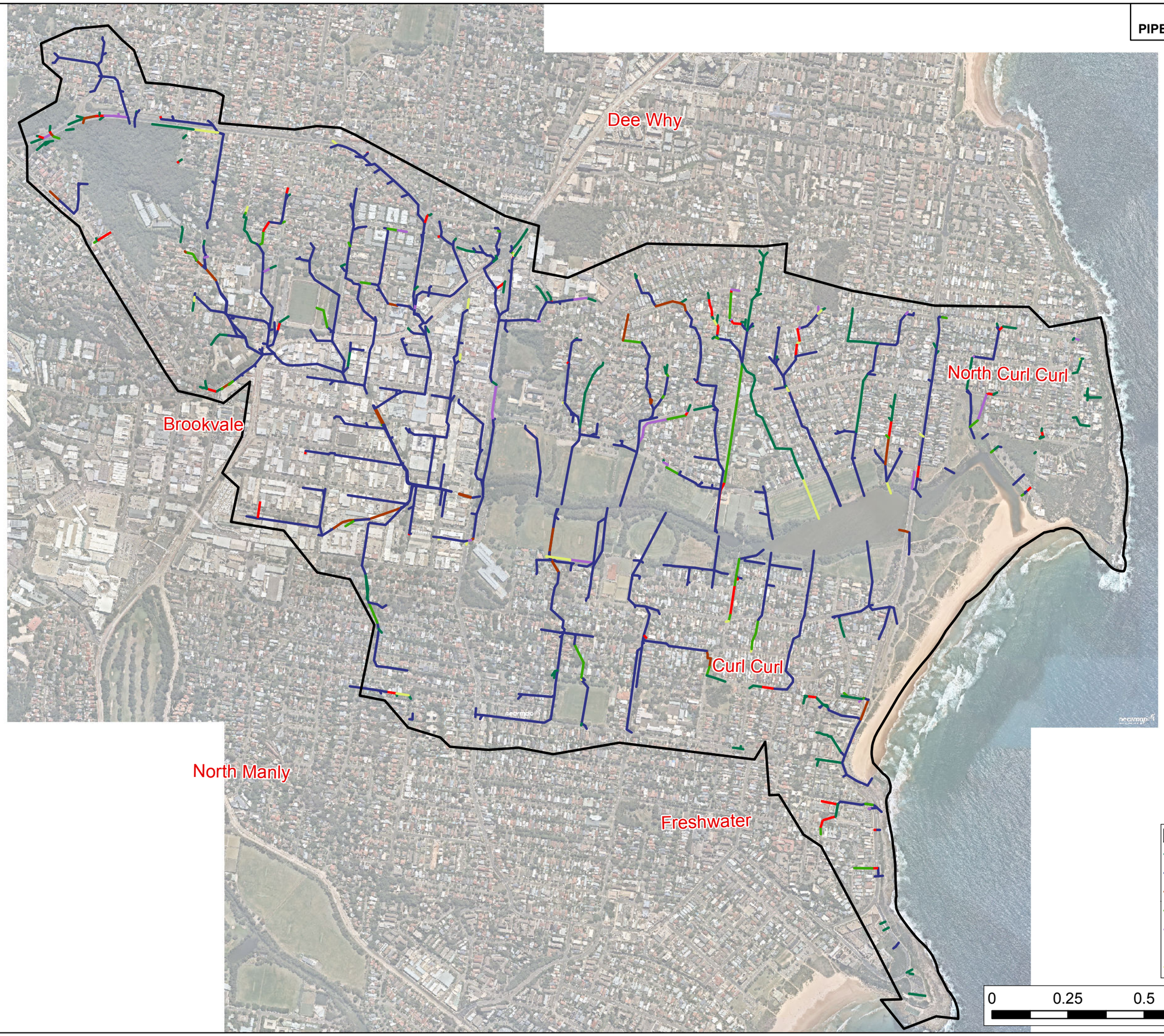
J:\Jobs\118094\PDF\Data_for_Figures\Figure14_Water_Level_Records_213499.xlsx

FIGURE 15
REPORTING LOCATIONS



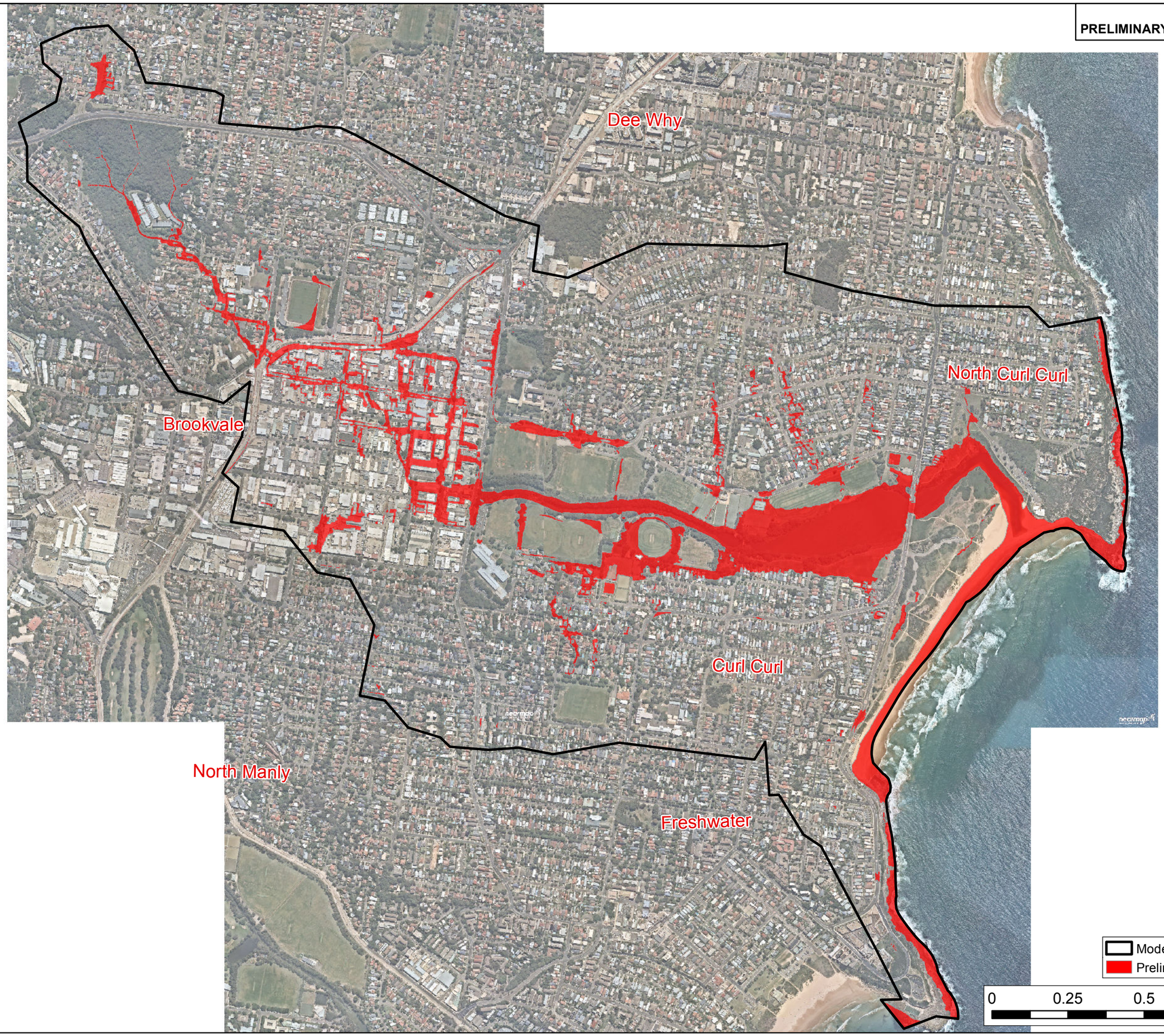
J:\Jobs\118094\ArcGIS\ArcMaps\Figure15_Reporting_Locations.mxd

FIGURE 16
PIPE CAPACITY ASSESSMENT



J:\Jobs\118094\ArcGIS\ArcMaps\Figure16_Pipe_Capacity_Assessment.mxd

FIGURE 17
PRELIMINARY FLOOD PLANNING AREA



J:\Jobs\118094\ArcGIS\ArcMaps\Figure16_Pipe_Capacity_Assessment_v1.mxd

APPENDIX A. ARR2019 Metadata

Appendix A

ATTENTION: This site was updated recently, changing some of the functionality. Please see the changelog (./changelog) for further information

Australian Rainfall & Runoff Data Hub - Results

Input Data

Longitude	151.284
Latitude	-33.764
Selected Regions (clear)	
River Region	show
ARF Parameters	show
Storm Losses	show
Temporal Patterns	show
Areal Temporal Patterns	show
BOM IFDs	show
Median Preburst Depths and Ratios	show
10% Preburst Depths	show
25% Preburst Depths	show
75% Preburst Depths	show
90% Preburst Depths	show
Interim Climate Change Factors	show
Probability Neutral Burst Initial Loss (./nsw_specific)	show

Data

River Region

Division	South East Coast (NSW)
River Number	13
River Name	Sydney Coast-Georges River

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2016_v1

ARF Parameters

$$ARF = Min\{1, [1 - a(Area^{b-c\log 10(Duration)})Duration^{-d+e Area^{f Duration^{g(0.3+\log 10(AEP))+h}}}10^{i Area Duration}}{1440(0.3+\log 10(AEP))}]\}$$

Zone	a	b	c	d	e	f	g	h	i
SE Coast	0.06	0.361	0.0	0.317	8.11e-05	0.651	0.0	0.0	0.0

Short Duration ARF

$$ARF = Min[1, 1 - 0.287(Area^{0.265 - 0.439\log 10(Duration)}).Duration^{-0.36 + 2.26 \times 10^{-3} \times Area^{0.226}.Duration^{0.125(0.3+\log 10(AEP))} + 0.0141 \times Area^{0.213} \times 10^{-0.021(Duration-180)}}{2 1440(0.3+\log 10(AEP))}]$$

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2016_v1

Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

Note: As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub (./nsw_specific) is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. The continuing storm loss information from the ARR Datahub provided below should only be used where relevant under the loss hierarchy (level 5) and where used is to be multiplied by the factor of 0.4.

ID	17135.0
Storm Initial Losses (mm)	28.0
Storm Continuing Losses (mm/h)	1.6

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2016_v1

Temporal Patterns | Download (.zip) (static/temporal_patterns/TP/ECsouth.zip)

code	ECsouth
Label	East Coast South

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2016_v2

Areal Temporal Patterns | Download (.zip) (./static/temporal_patterns/Areal/Areal_ECsouth.zip)

code	ECsouth
arealabel	East Coast South

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2016_v2

BOM IFDs

Click here (http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-33.764433133&longitude=151.283701599&sdmin=true&sdhr=true to obtain the IFD depths for catchment centroid from the BoM website

Layer Info

Time Accessed	25 September 2019 12:07PM

Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	7.0 (0.211)	7.7 (0.177)	5.6 (0.110)	3.5 (0.060)	2.1 (0.030)	1.0 (0.013)
90 (1.5)	13.2 (0.351)	9.5 (0.193)	6.5 (0.113)	3.6 (0.055)	2.1 (0.028)	1.0 (0.012)
120 (2.0)	12.8 (0.311)	7.7 (0.144)	6.6 (0.106)	5.6 (0.079)	4.2 (0.051)	3.2 (0.034)
180 (3.0)	5.3 (0.114)	6.5 (0.107)	6.3 (0.090)	6.2 (0.076)	6.9 (0.073)	7.4 (0.070)
360 (6.0)	7.3 (0.122)	11.0 (0.141)	13.4 (0.147)	15.7 (0.150)	18.9 (0.152)	13.0 (0.094)
720 (12.0)	6.2 (0.080)	11.0 (0.106)	14.1 (0.115)	17.1 (0.120)	26.1 (0.153)	30.3 (0.157)
1080 (18.0)	1.8 (0.020)	9.3 (0.075)	14.3 (0.096)	19.1 (0.110)	22.2 (0.107)	28.3 (0.120)
1440 (24.0)	1.8 (0.017)	5.6 (0.039)	8.1 (0.048)	10.5 (0.053)	21.1 (0.088)	26.9 (0.099)
2160 (36.0)	0.0 (0.000)	1.8 (0.010)	2.9 (0.014)	4.0 (0.017)	9.4 (0.033)	11.5 (0.035)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	1.0 (0.003)	1.7 (0.005)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	1.2 (0.003)	2.2 (0.005)

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	0.0 (0.000)	0.2 (0.005)	0.1 (0.002)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
90 (1.5)	0.0 (0.001)	0.5 (0.010)	0.2 (0.004)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
120 (2.0)	0.1 (0.003)	0.1 (0.001)	0.0 (0.001)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
180 (3.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
360 (6.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.4 (0.003)	0.0 (0.000)
720 (12.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
1080 (18.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	1.2 (0.006)	2.2 (0.009)
1440 (24.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.4 (0.002)	0.7 (0.003)
2160 (36.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
2880 (48.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)
4320 (72.0)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)	0.0 (0.000)

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	40.6 (1.232)	37.9 (0.873)	36.4 (0.717)	34.9 (0.602)	28.4 (0.418)	23.5 (0.310)
90 (1.5)	36.7 (0.976)	39.7 (0.809)	35.1 (0.613)	30.6 (0.469)	27.8 (0.364)	25.7 (0.302)
120 (2.0)	53.4 (1.298)	37.7 (0.703)	34.8 (0.558)	32.0 (0.450)	35.9 (0.431)	38.7 (0.417)
180 (3.0)	33.4 (0.713)	45.5 (0.749)	43.8 (0.619)	42.2 (0.522)	57.0 (0.601)	68.1 (0.642)
360 (6.0)	45.2 (0.759)	54.8 (0.705)	61.1 (0.671)	67.2 (0.641)	86.5 (0.698)	90.0 (0.646)
720 (12.0)	30.1 (0.386)	43.5 (0.419)	52.3 (0.426)	60.8 (0.426)	67.0 (0.393)	76.8 (0.398)
1080 (18.0)	22.9 (0.248)	34.7 (0.279)	42.5 (0.286)	50.0 (0.288)	71.4 (0.343)	82.2 (0.348)
1440 (24.0)	24.9 (0.240)	31.9 (0.225)	36.4 (0.214)	40.8 (0.205)	67.1 (0.280)	74.8 (0.275)
2160 (36.0)	5.0 (0.041)	15.4 (0.091)	22.3 (0.109)	28.9 (0.120)	51.5 (0.178)	60.1 (0.183)
2880 (48.0)	12.3 (0.089)	12.5 (0.065)	12.7 (0.055)	12.8 (0.047)	22.7 (0.070)	30.2 (0.082)
4320 (72.0)	0.0 (0.000)	0.3 (0.001)	0.5 (0.002)	0.7 (0.002)	20.9 (0.056)	33.8 (0.080)

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	95.5 (2.894)	94.8 (2.181)	96.9 (1.909)	98.9 (1.705)	103.6 (1.525)	107.1 (1.415)
90 (1.5)	72.3 (1.924)	105.2 (2.142)	103.3 (1.805)	101.4 (1.552)	113.6 (1.488)	122.8 (1.443)
120 (2.0)	88.3 (2.148)	94.6 (1.766)	98.1 (1.575)	101.5 (1.428)	108.2 (1.301)	113.2 (1.220)
180 (3.0)	86.3 (1.843)	102.2 (1.680)	108.8 (1.537)	115.1 (1.423)	126.6 (1.334)	135.2 (1.274)
360 (6.0)	78.0 (1.310)	89.9 (1.156)	97.7 (1.073)	105.2 (1.005)	158.1 (1.276)	175.3 (1.257)
720 (12.0)	62.3 (0.799)	86.2 (0.831)	102.0 (0.831)	117.2 (0.821)	133.6 (0.783)	148.3 (0.768)
1080 (18.0)	47.4 (0.514)	64.9 (0.522)	76.5 (0.516)	87.6 (0.505)	138.3 (0.664)	153.9 (0.651)
1440 (24.0)	58.2 (0.559)	70.3 (0.496)	78.3 (0.461)	86.1 (0.432)	118.4 (0.493)	130.7 (0.480)
2160 (36.0)	32.3 (0.263)	44.7 (0.263)	52.9 (0.259)	60.7 (0.253)	100.0 (0.346)	115.6 (0.352)
2880 (48.0)	26.6 (0.194)	39.1 (0.205)	47.5 (0.206)	55.4 (0.204)	76.8 (0.236)	92.7 (0.252)
4320 (72.0)	10.1 (0.064)	23.0 (0.104)	31.5 (0.118)	39.6 (0.127)	62.7 (0.168)	82.0 (0.195)

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2018_v1
Note	Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

Interim Climate Change Factors

	RCP 4.5	RCP6	**RCP 8.5**
2030	**0.869 (4.3%)**	0.783 (3.9%)	**0.983 (4.9%)**
2040	**1.057 (5.3%)**	1.014 (5.1%)	**1.349 (6.8%)**
2050	**1.272 (6.4%)**	1.236 (6.2%)	**1.773 (9.0%)**
2060	**1.488 (7.5%)**	1.458 (7.4%)	**2.237 (11.5%)**
2070	**1.676 (8.5%)**	1.691 (8.6%)	**2.722 (14.2%)**
2080	**1.810 (9.2%)**	1.944 (9.9%)	**3.209 (16.9%)**
2090	**1.862 (9.5%)**	2.227 (11.5%)	**3.679 (19.7%)**

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2019_v1
Note	ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.

Probability Neutral Burst Initial Loss

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	12.3	8.1	9.0	8.7	8.6	6.6
90 (1.5)	11.8	8.1	9.5	9.7	9.5	7.0
120 (2.0)	13.4	9.0	10.2	10.0	10.1	6.0
180 (3.0)	13.8	9.3	10.6	10.1	8.9	4.3
360 (6.0)	13.2	8.6	8.8	8.1	9.1	3.7
720 (12.0)	17.6	12.2	12.2	10.6	11.9	3.1
1080 (18.0)	18.3	13.5	14.6	12.0	13.3	3.8
1440 (24.0)	21.5	15.5	15.8	13.8	14.6	4.4
2160 (36.0)	24.2	18.4	18.4	15.9	16.6	6.9
2880 (48.0)	27.2	22.0	21.1	22.9	19.4	9.5
4320 (72.0)	29.4	25.5	25.5	25.7	21.8	10.5

Layer Info

Time Accessed	25 September 2019 12:07PM
Version	2018_v1
Note	As this point is in NSW the advice provided on losses and pre-burst on the NSW Specific Tab of the ARR Data Hub (./nsw_specific) is to be considered. In NSW losses are derived considering a hierarchy of approaches depending on the available loss information. Probability neutral burst initial loss values for NSW are to be used in place of the standard initial loss and pre-burst as per the losses hierarchy.

Download TXT (downloads/5fb0a5b7-6a43-43e2-ba3c-4f0a7b4d1096.txt)

Download JSON (downloads/ca36fbb7-8e04-4352-a53e-5b89827f78e4.json)

Download PDF ()

NORTHERN BEACHES COUNCIL

GREENDALE CREEK FLOOD STUDY

VOLUME 2 – MAPPING APPENDICES

DRAFT

wma water

FEBRUARY 2022

APPENDIX B. Catchment Photographs

Appendix B

Photo B1: Western Channel at The Kilns

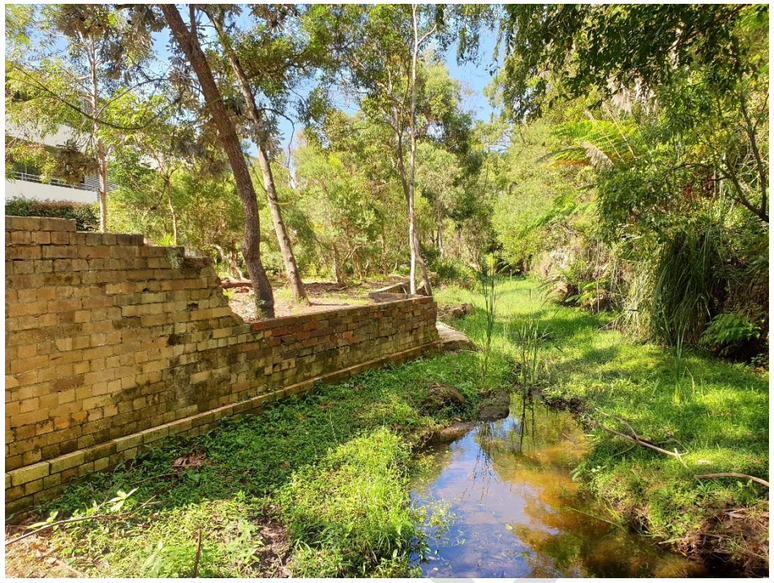


Photo B2: Western Channel at The Kilns

Photo B3: Western Channel at The Kilns

Photo B4: Western Channel at The Kilns

Photo B5: Western Channel at The Kilns

Photo B6: Inlet Pit at The Kilns

Photo B7: Eastern Channel at The Kilns

Photo B8: Eastern Channel at The Kilns

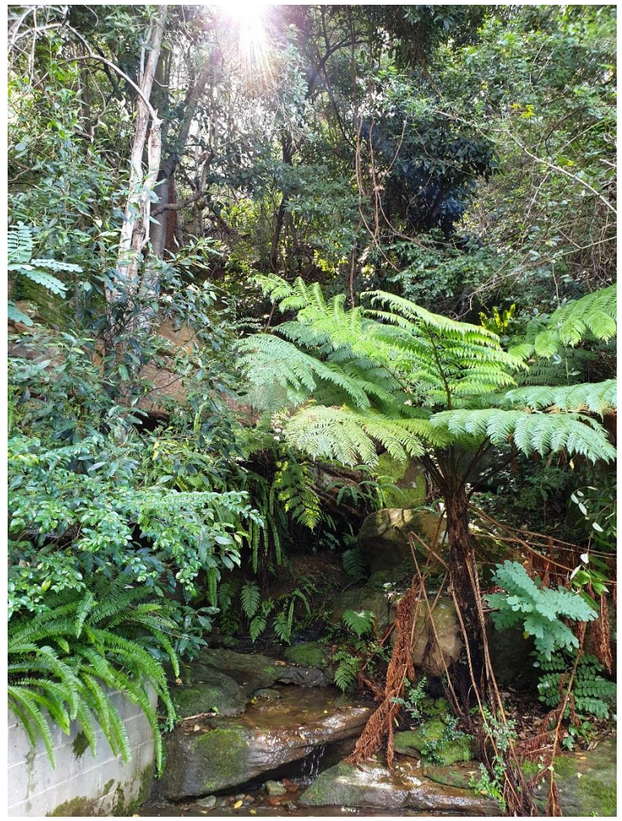


Photo B9: Eastern Channel at The Kilns

Photo B10: Inlet Pit at The Kilns (end of Eastern Channel)

Photo B11: Downstream Channel at The Kilns

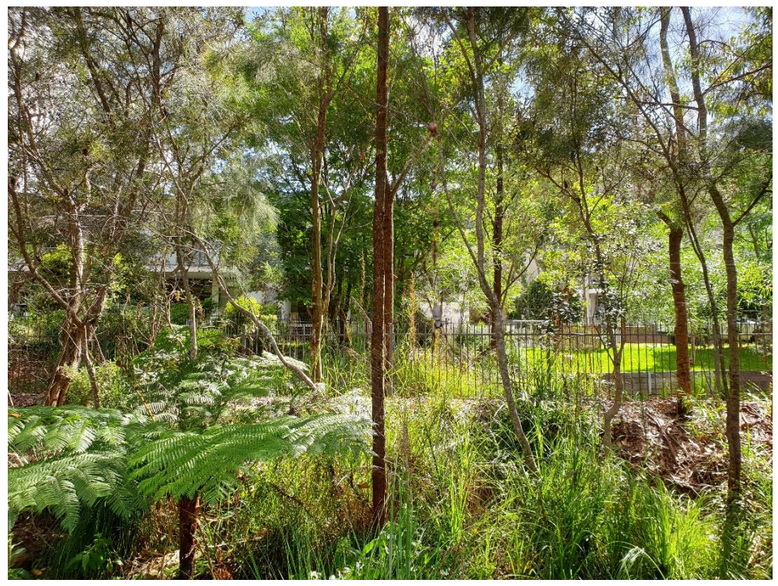


Photo B12: Downstream of The Kilns

Photo B13: Outlets downstream of The Kilns

Photo B14: The Kilns Downstream Channel through Property

Photo B15: The Kilns Downstream Channel through Property

Photo B16 The Kilns Downstream Channel (Private Lane)

Photo B17: Overland flow path south of Gulliver Street

Photo B18: Gulliver Street looking south-east

Photo B19: Properties downstream of Gulliver Street

Photo B20: St Augustine's School (looking upstream from Gulliver Street)

Photo B21: Inlet in Stirgess Reserve (south side)

Photo B22: Brookvale Oval

Photo B23: Brookvale Oval

Photo B24: Pine Avenue

Photo B25: Inlet downstream of Winbourne Road

Photo B26: Outlet downstream of Winbourne Road

Photo B27: Open Channel Downstream of Winbourne Road

Photo B28: Culverts west of Harbord Road

Photo B29: Culverts under Harbord Road

Photo B30: Downstream outlet from Harbord Road

Photo B31: Inlet downstream of Winbourne Road

Photo B32: GPT Downstream Harbord Road

Photo B33: GPT Downstream Harbord Road

Photo B34: GPT Downstream Harbord Road

Photo B35: Eastern Pedestrian Bridge

Photo B36: Upstream Eastern Pedestrian Bridge

Photo B37: Rock Weir Looking Downstream

Photo B38: Overbank Area on Greendale Creek

Photo B39: Greendale Creek

Photo B40: Griffin Road Bridge

Photo B41: Curl Curl Lagoon Entrance

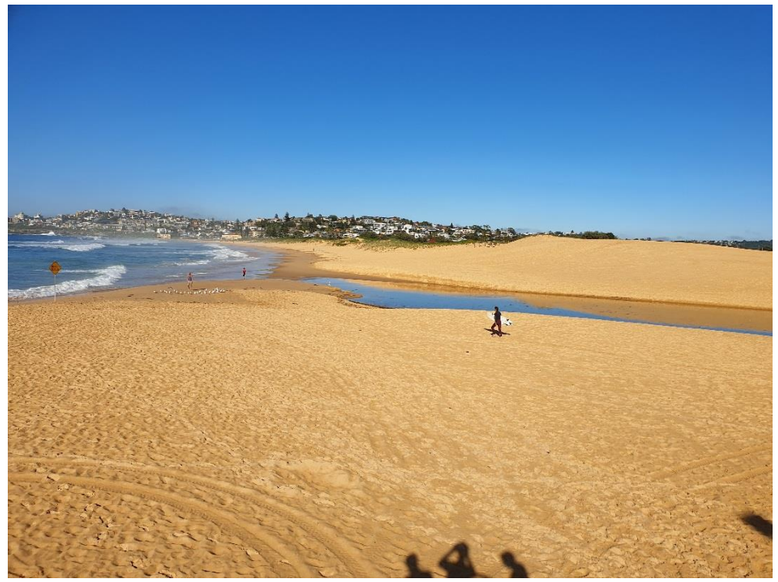
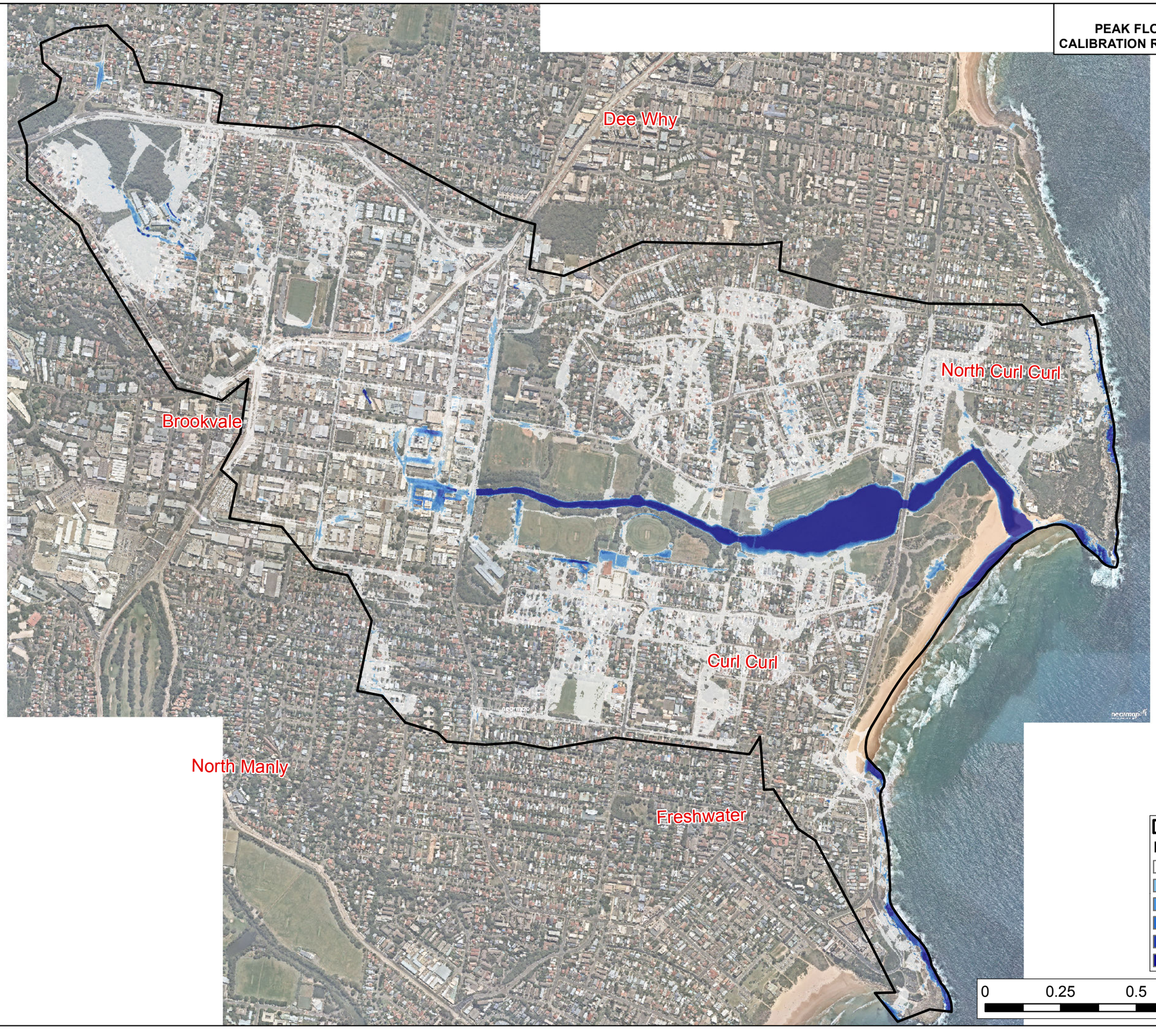


Photo B42: Curl Curl Lagoon Entrance

APPENDIX C. November 2018 Calibration Event Results

Appendix C

FIGURE C1
PEAK FLOOD DEPTHS AND LEVELS
CALIBRATION RESULTS NOVEMBER 2018



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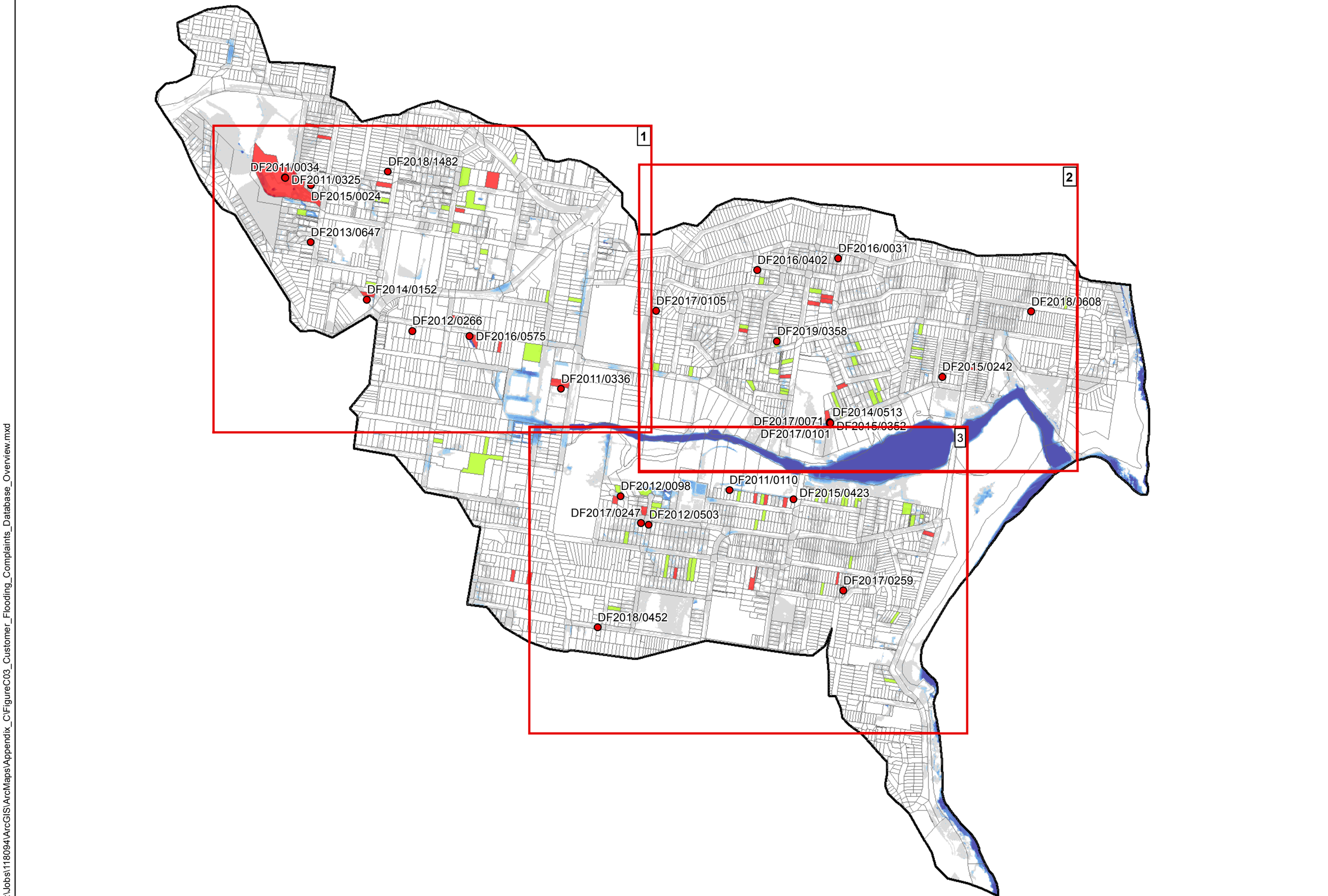
1
2
3
DF2011/0034
DF2011/0325
DF2015/0024
DF2018/1482
DF2013/0647
DF2014/0152
DF2012/0266
DF2016/0575
DF2011/0336
DF2016/0031
DF2016/0402
DF2017/0105
DF2018/0608
DF2019/0358
DF2015/0242
DF2014/0513
DF2017/0071
DF2015/0352
DF2017/0101
DF2011/0110
DF2012/0098
DF2015/0423
DF2017/0247
DF2012/0503
DF2017/0259
DF2018/0452
J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_C\FigureC03_Customer_Flooding_Complaints_Database_Overview.mxd

FIGURE C3
NOVEMBER 2018 EVENT VALIDATION COMPARISON OVERVIEW

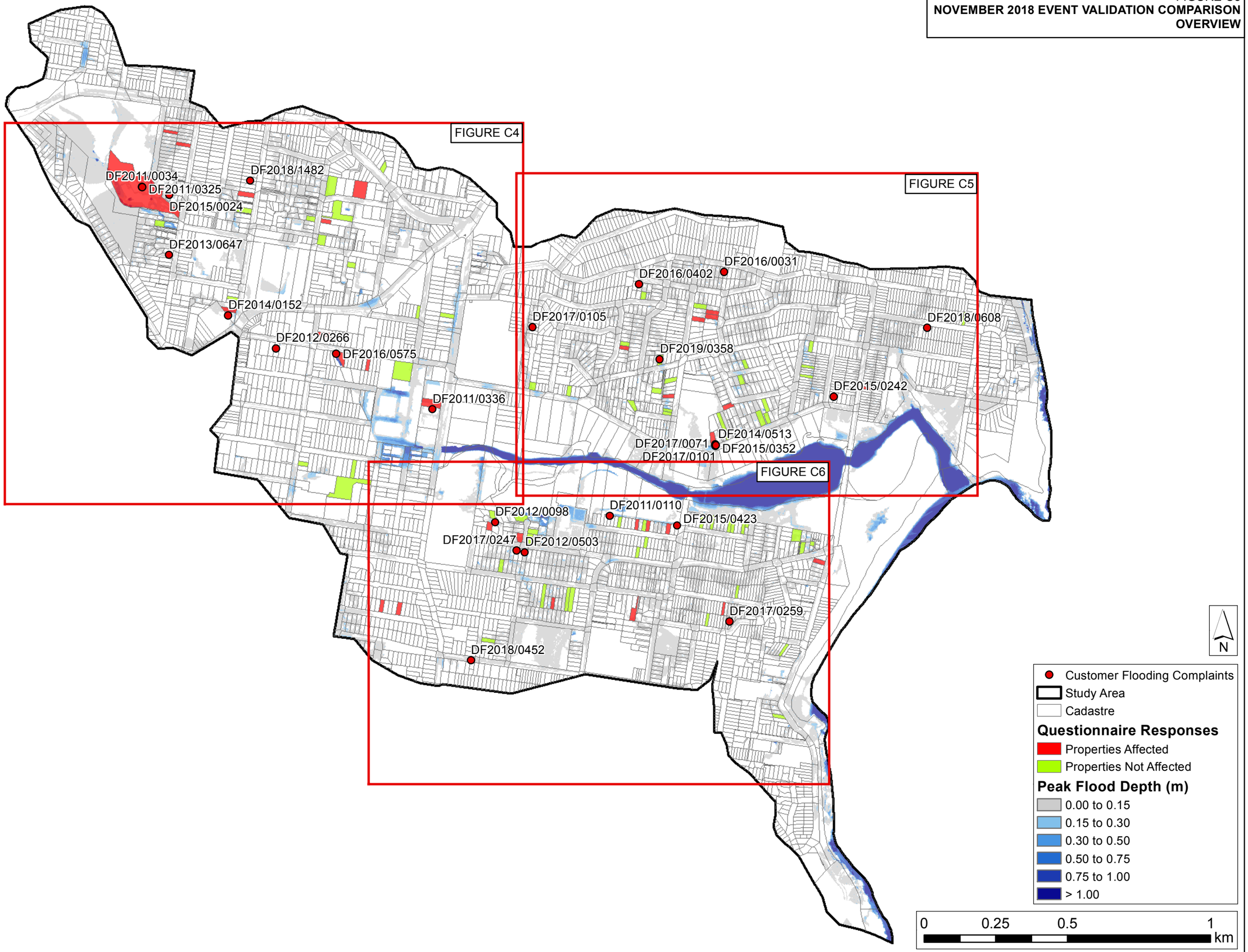

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FIGURE C4
NOVEMBER 2018 EVENT VALIDATION COMPARISON (EXTENT 1)

DF2011/0325
Land slide at the back of property. About a metre high and blocking the creek

DF2011/0034 Landslip to the south of building, blocking creek and water flowing onto property

DF2018/1482
Pit lid blown off by water frequently. Pushed up and half open, a hazard for pedestrians and reversing cars

DF2015/0024
Claims neighbours stromwater is directed into property

DF2013/0647
Blocked stormwater drain outside property. Capacity problem, could not take the flow of water

DF2014/0152
Stormwater floods down Beacon Hill Road into Elizabeth Place, and into Early Learning Centre buildings and playground

DF2016/0575
Fast flowing flood water eroded the creek bank, collapse of bank towards Council footpath. Small cracks appeared on road and side of footpath

DF2012/0266
Flooding is coming into the back of 16 Chard Rd Brookvale from 77-79 Winbourne Rd Brookvale. Water is pooling up from 77 Winbourne Rd and flooding into the factory building of 16 Chard Rd

DF2011/0336
Tradelink premises flooded

W_027, W_026, W_053, O_106, W_043, O_098, W_077, O_091, O_109, O_101, W_010, W_022, W_032, W_035, W_007, W_036, O_093, W_050, W_021, W_044, O_108, W_054, W_045, O_082, W_031, W_080, W_066, O_081, W_051

N

Flooding Hotspots
Study Area
Local Flood Investigations
Cadastre

Questionnaire Responses
Properties Affected
Properties Not Affected

Peak Flood Depth (m)
0.00 to 0.15
0.15 to 0.30
0.30 to 0.50
0.50 to 0.75
0.75 to 1.00
> 1.00

0 62.5 125 250 m

J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_C\FigureC04_November_2018_Event_Validation_Comparison_Extent1.mxd

FIGURE C5
NOVEMBER 2018 EVENT VALIDATION COMPARISON (EXTENT 2)

DF2016/0031
Water coming into property from the main road

DF2016/0402
Front of property flooded, creating a sinkhole

DF2017/0105
Water flooding from stormwater

DF2019/0358
Path out the front of property floods, cracked and subsided slightly towards the street causing water to pool

DF2018/0608
Major flooding problems, 10cm flooded at garage whilst using sandbags

DF2015/0242

DF2017/0101
Street flooded, issues at school pick up time as children need to walk on road

DF2014/0513
Street flooded, cars having to turn back

DF2015/0352
Flash flooding across garden, footpath and the entire road

DF2017/0071
Road flooded, a car had to be towed out

W_019
W_039
W_046
W_009
W_011
W_041
O_113
O_094
O_099
O_103
O_090
W_037
W_068
W_014
W_060
W_029
W_012
W_065
W_048
W_070
W_023
W_063
O_102
W_034
O_087
W_042
W_020
O_085

N

Flooding Hotspots
Study Area
Local Flood Investigations
Cadastre

Questionnaire Responses
Properties Affected
Properties Not Affected

Peak Flood Depth (m)
0.00 to 0.15
0.15 to 0.30
0.30 to 0.50
0.50 to 0.75
0.75 to 1.00
> 1.00

0 62.5 125 250
m

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FIGURE C6
NOVEMBER 2018 EVENT VALIDATION COMPARISON (EXTENT 3)

DF2011/0110
Water from Weldon Oval along fence line

DF2015/0423
Large deep pool of water forms and does not drain away

DF2012/0503
Overland flows occur through site

DF2017/0247
Water eroded soil now exposing concrete

DF2018/0452
Water flow when there is heavy rain

DF2017/0259
Water runs through like a river under property, might be due to a broken council stormwater pipe

W_071 W_028 W_076 W_073 W_052 W_067 W_001 W_017 W_016 O_083 O_104 W_038 W_025 W_069 W_056 W_078 W_057 W_079 W_030 W_062 W_008 O_092 W_047 O_115 W_064 W_059 W_055 W_013 O_105 W_074 W_018 W_024 W_033 O_110 W_005 W_075

N

Flooding Hotspots
Study Area
Local Flood Investigations
Cadastre

Questionnaire Responses
Properties Affected
Properties Not Affected

Peak Flood Depth (m)
0.00 to 0.15
0.15 to 0.30
0.30 to 0.50
0.50 to 0.75
0.75 to 1.00
> 1.00

0 62.5 125 250 m

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APPENDIX D. Design Flood Depths, Levels and Velocities

Appendix D

FIGURE D1
PEAK FLOOD DEPTHS AND LEVELS
50% AEP EVENT

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

Model Boundary
Major Contour (5m Intervals)
Minor Contour (2.5m Intervals)

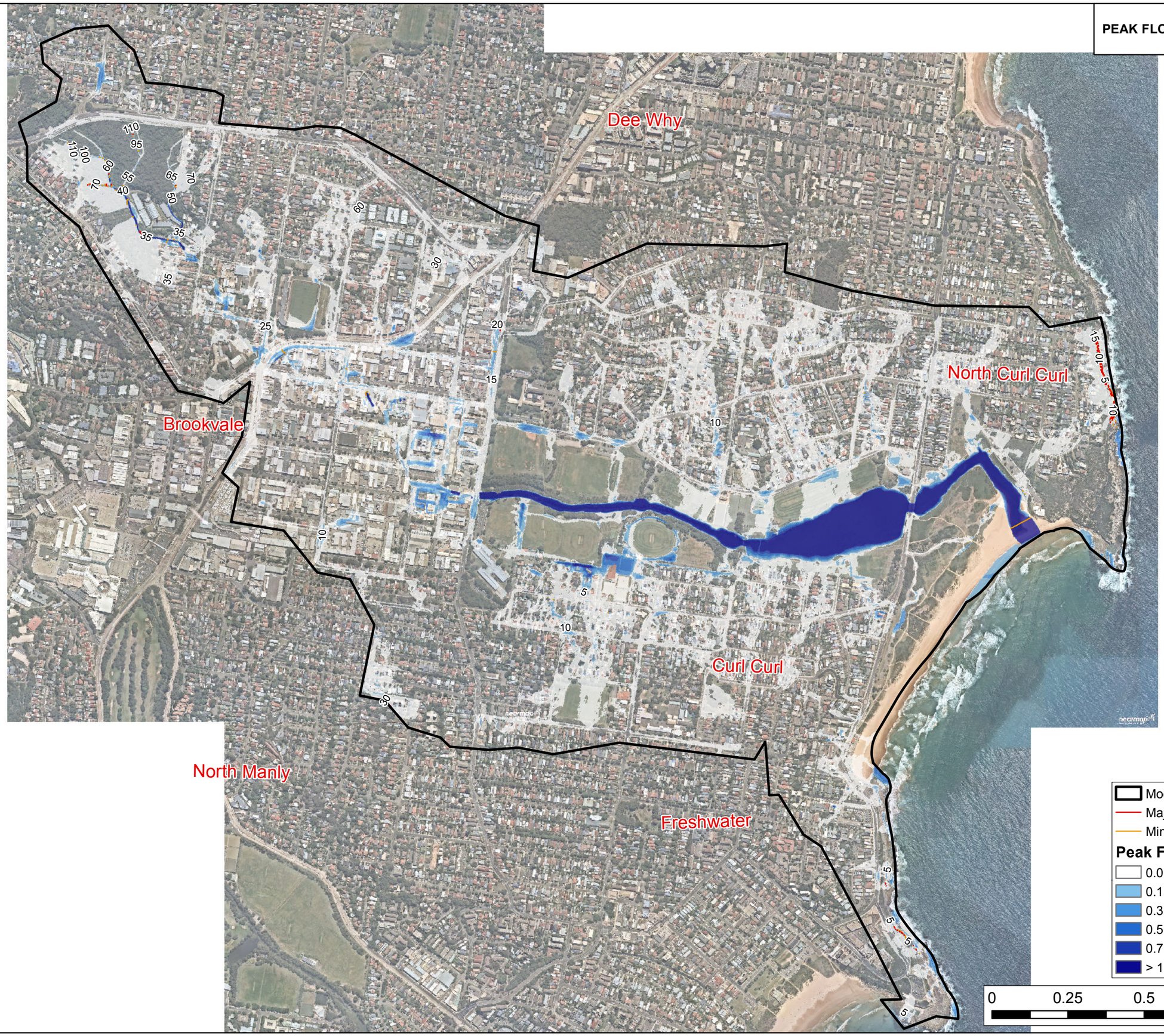
Peak Flood Depth (m)
0.00 to 0.15
0.15 to 0.30
0.30 to 0.50
0.50 to 0.75
0.75 to 1.00
> 1.00

N

0 0.25 0.5 1 km

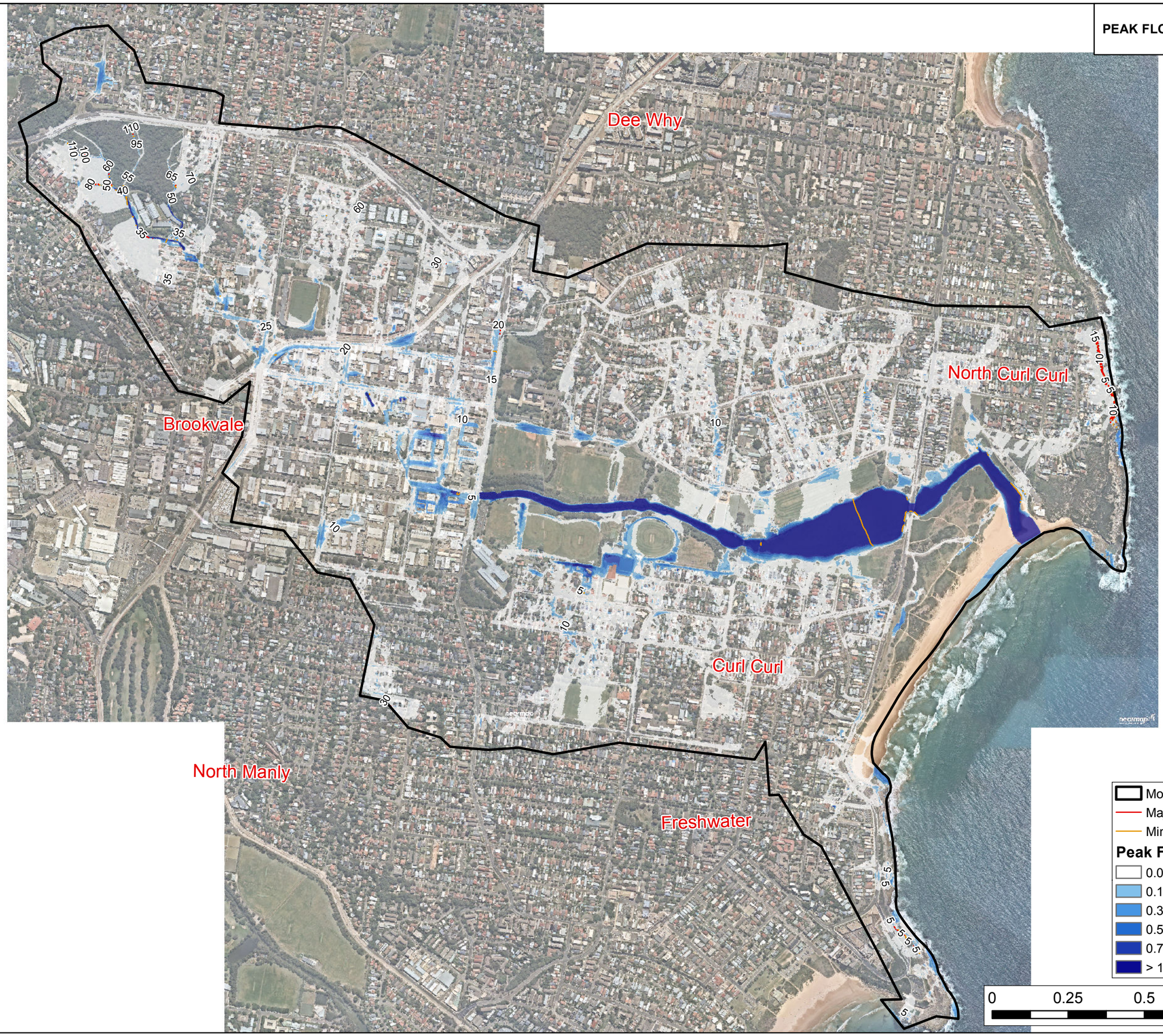
J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD01_PeakFloodDepthsandLevels_50%_AEP_Event.mxd

FIGURE D2
PEAK FLOOD DEPTHS AND LEVELS
20% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD02_PeakFloodDepthsandLevels_20%_AEP_Event.mxd

FIGURE D3
PEAK FLOOD DEPTHS AND LEVELS
10% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD03_PeakFloodDepthsandLevels_10%_AEP_Event.mxd

FIGURE D4
PEAK FLOOD DEPTHS AND LEVELS
5% AEP EVENT

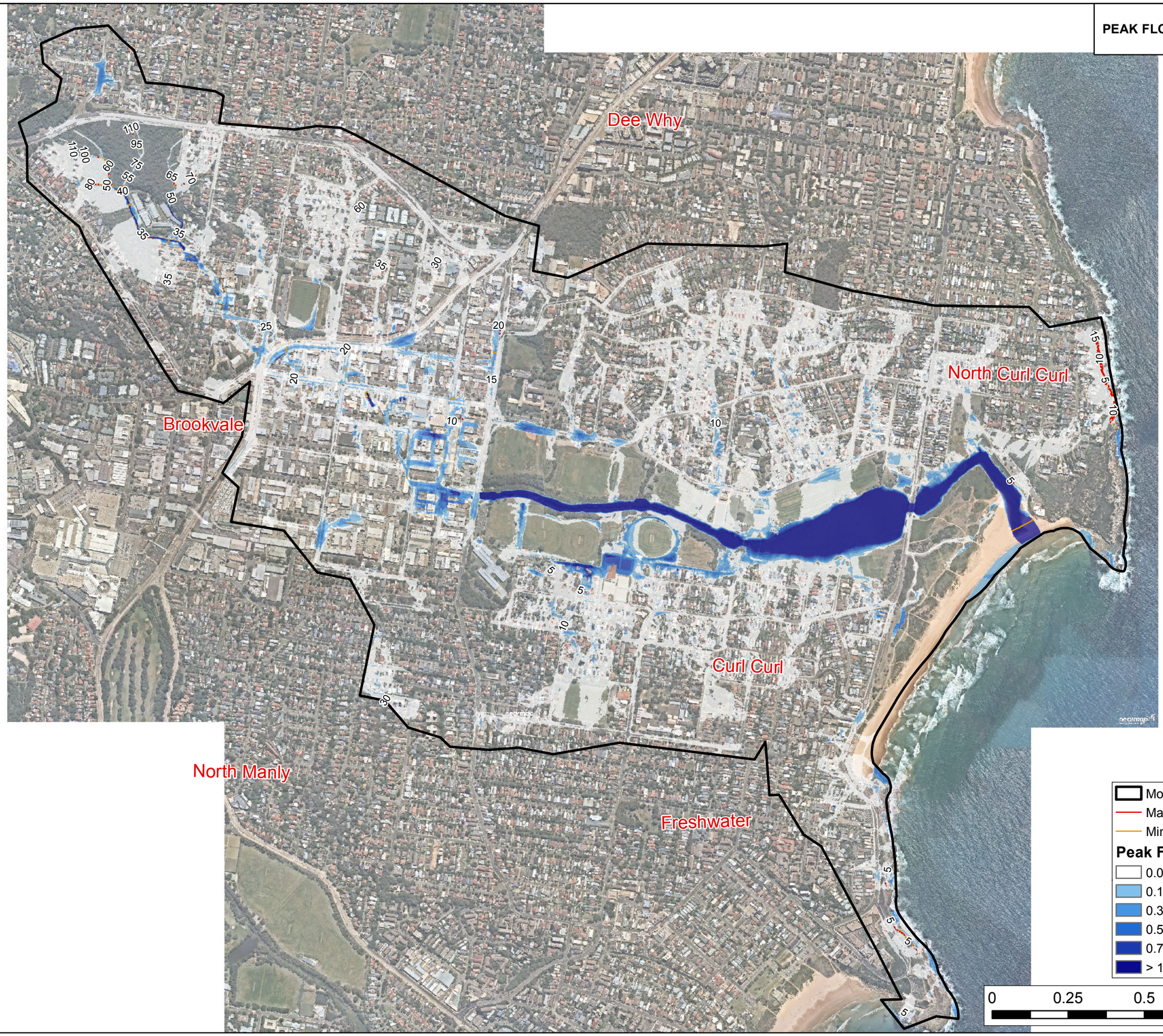


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FIGURE D5
PEAK FLOOD DEPTHS AND LEVELS
2% AEP EVENT

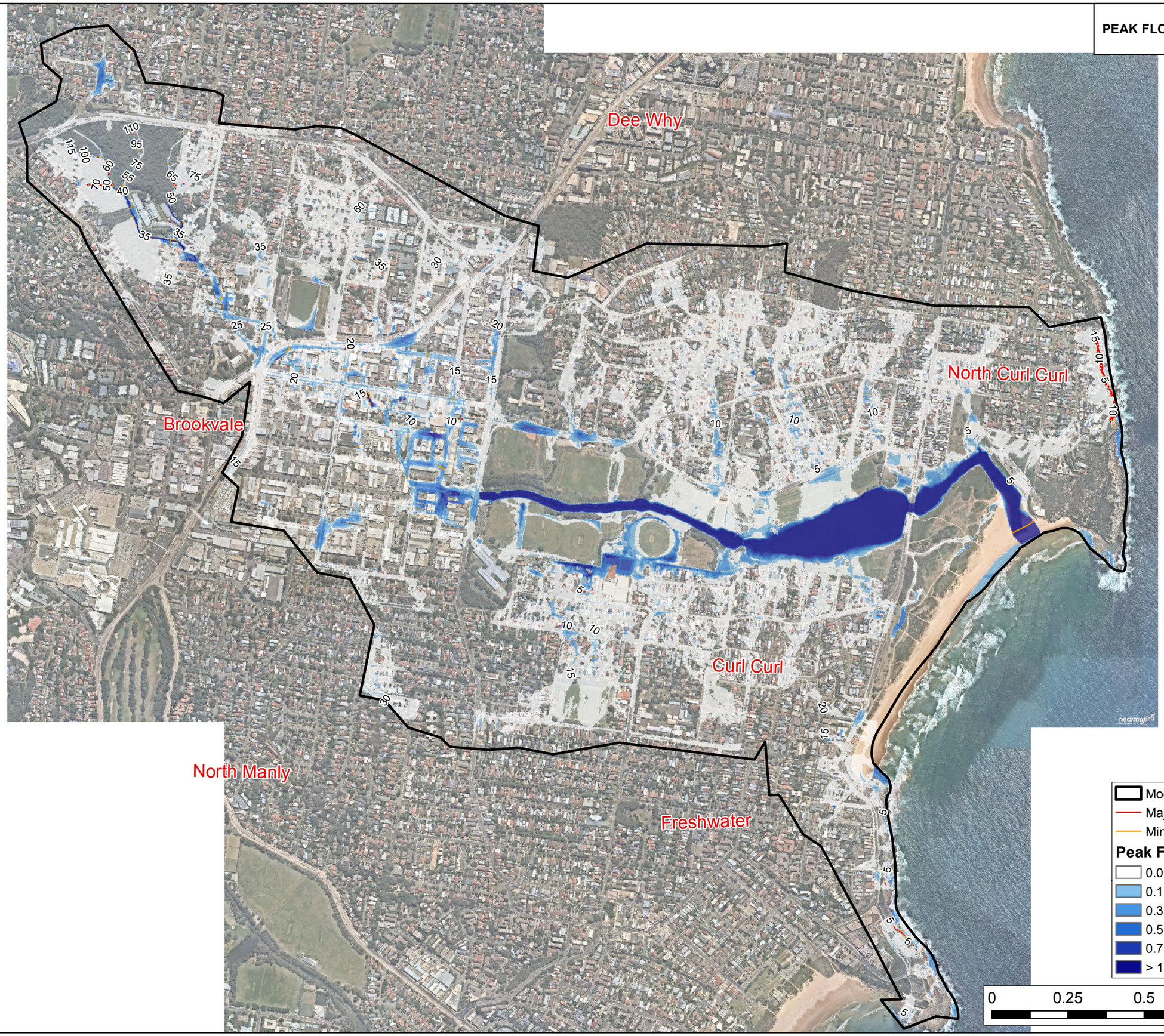

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FIGURE D6
PEAK FLOOD DEPTHS AND LEVELS
1% AEP EVENT

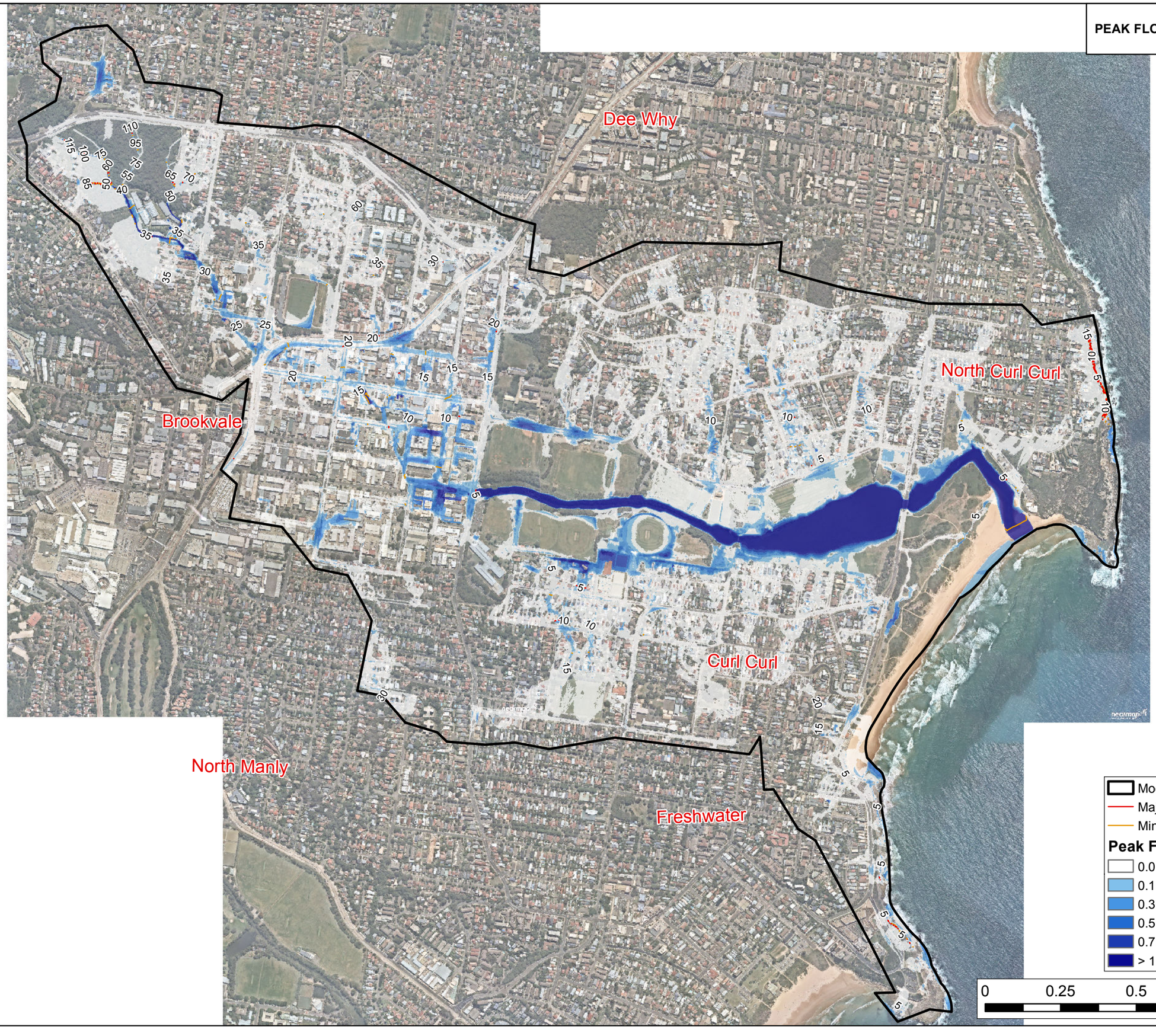

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FIGURE D7
PEAK FLOOD DEPTHS AND LEVELS
0.5% AEP EVENT

Dee Why
North Curl Curl
Brookvale
Curl Curl
North Manly
Freshwater

N

Model Boundary
Major Contour (5m Intervals)
Minor Contour (2.5m Intervals)

Peak Flood Depth (m)

0.00 to 0.15
0.15 to 0.30
0.30 to 0.50
0.50 to 0.75
0.75 to 1.00
> 1.00

0 0.25 0.5 1 km

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FIGURE D8
PEAK FLOOD DEPTHS AND LEVELS
0.2% AEP EVENT

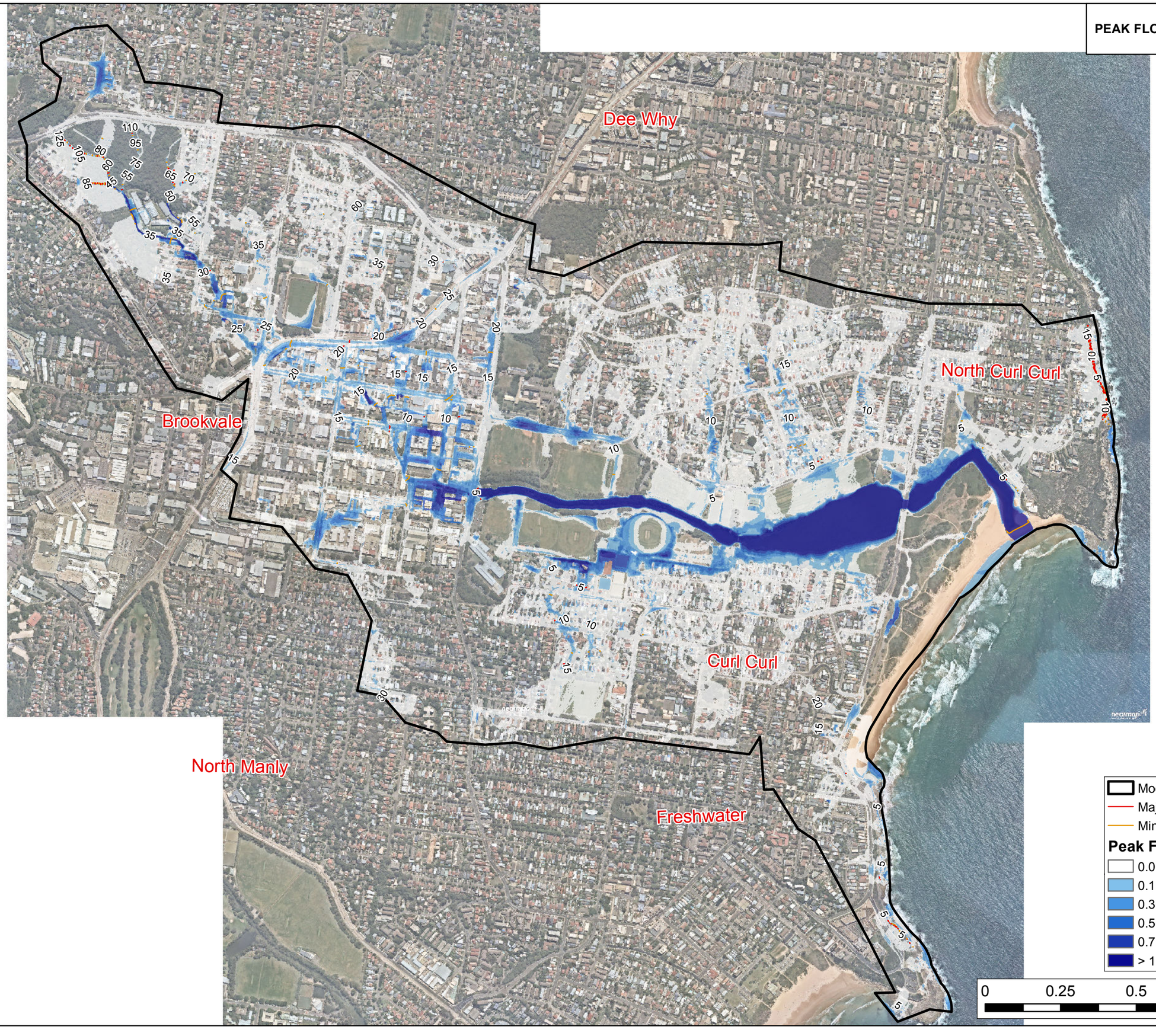

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FIGURE D9
PEAK FLOOD DEPTHS AND LEVELS
PMF EVENT

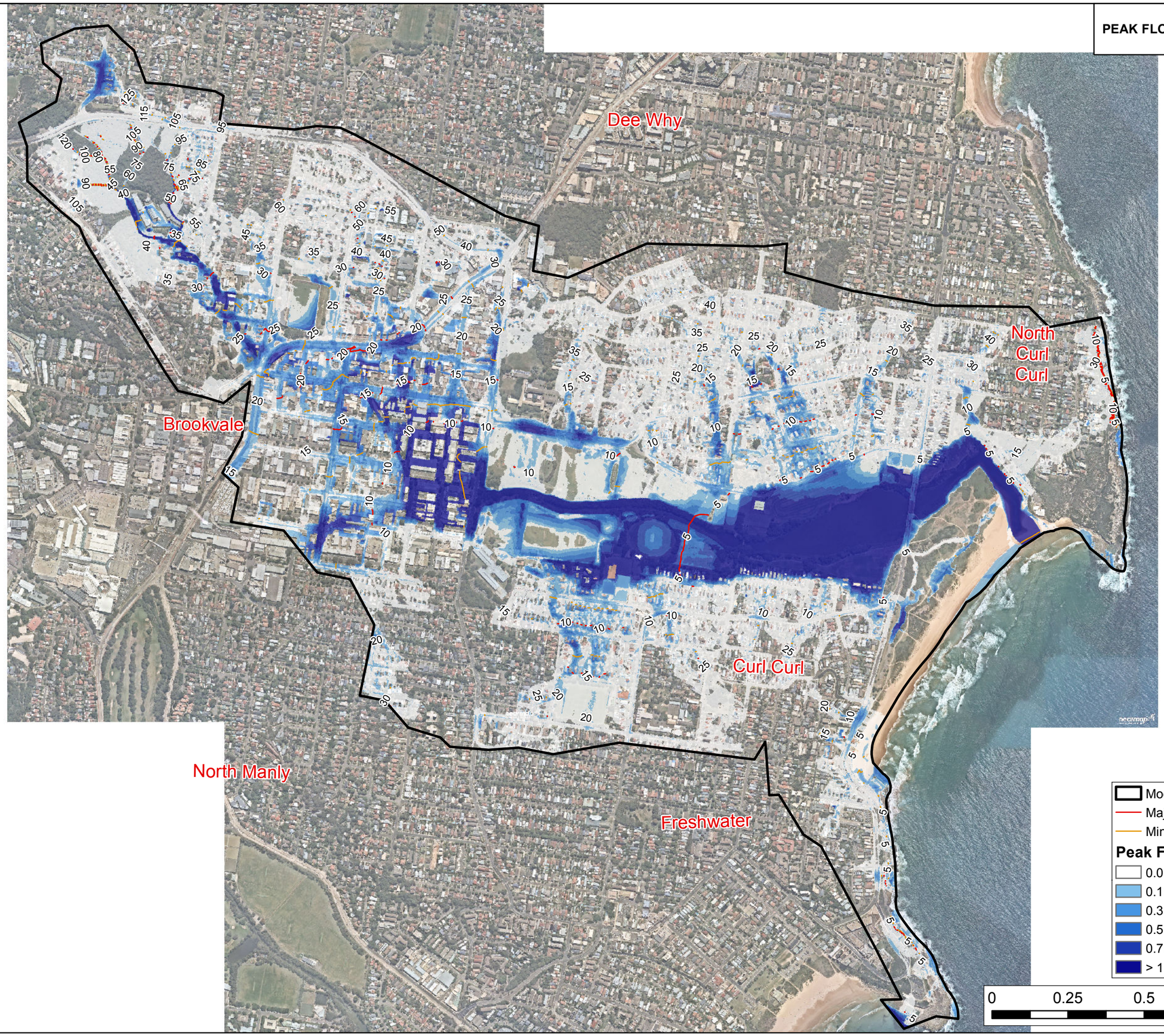

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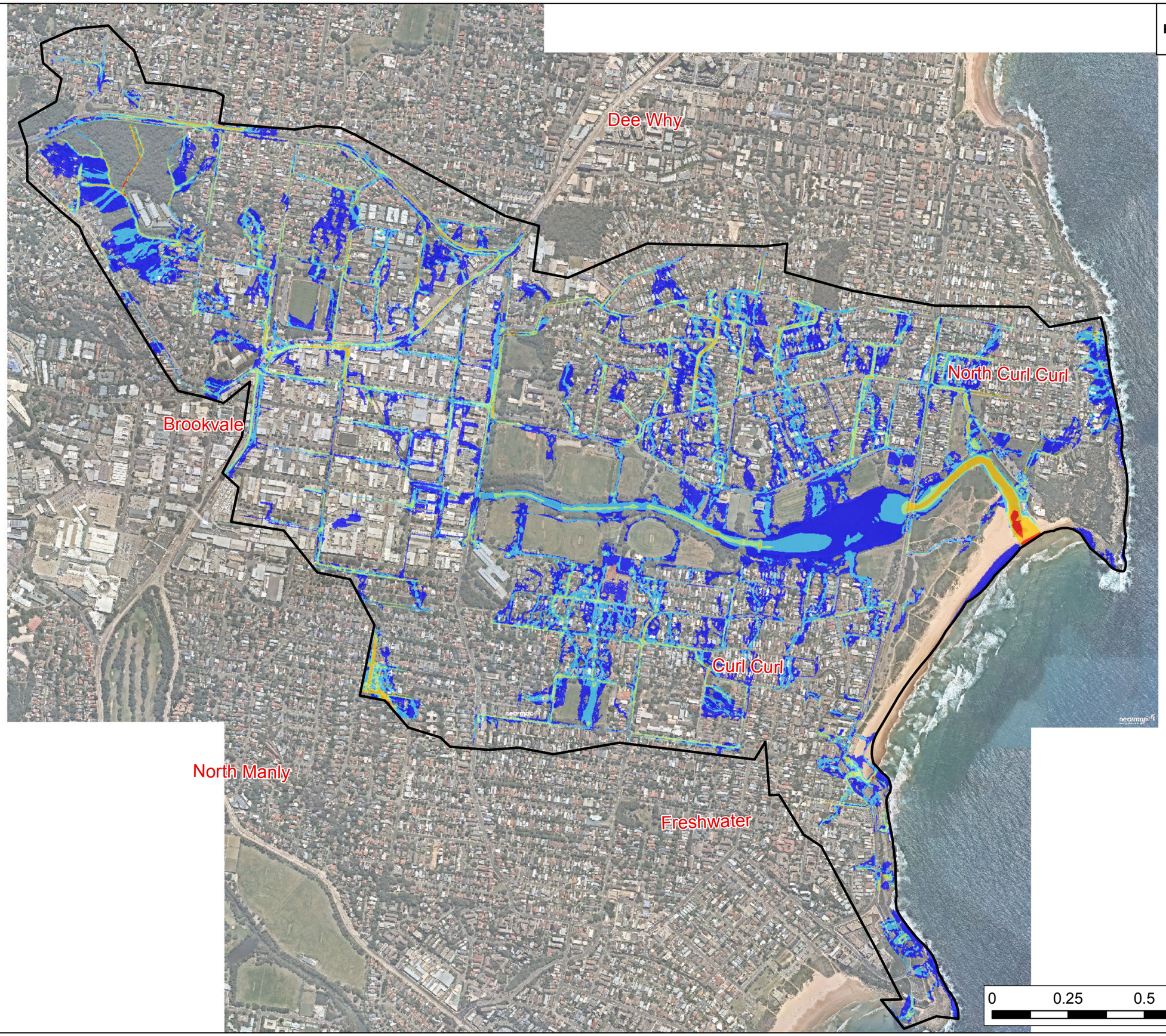
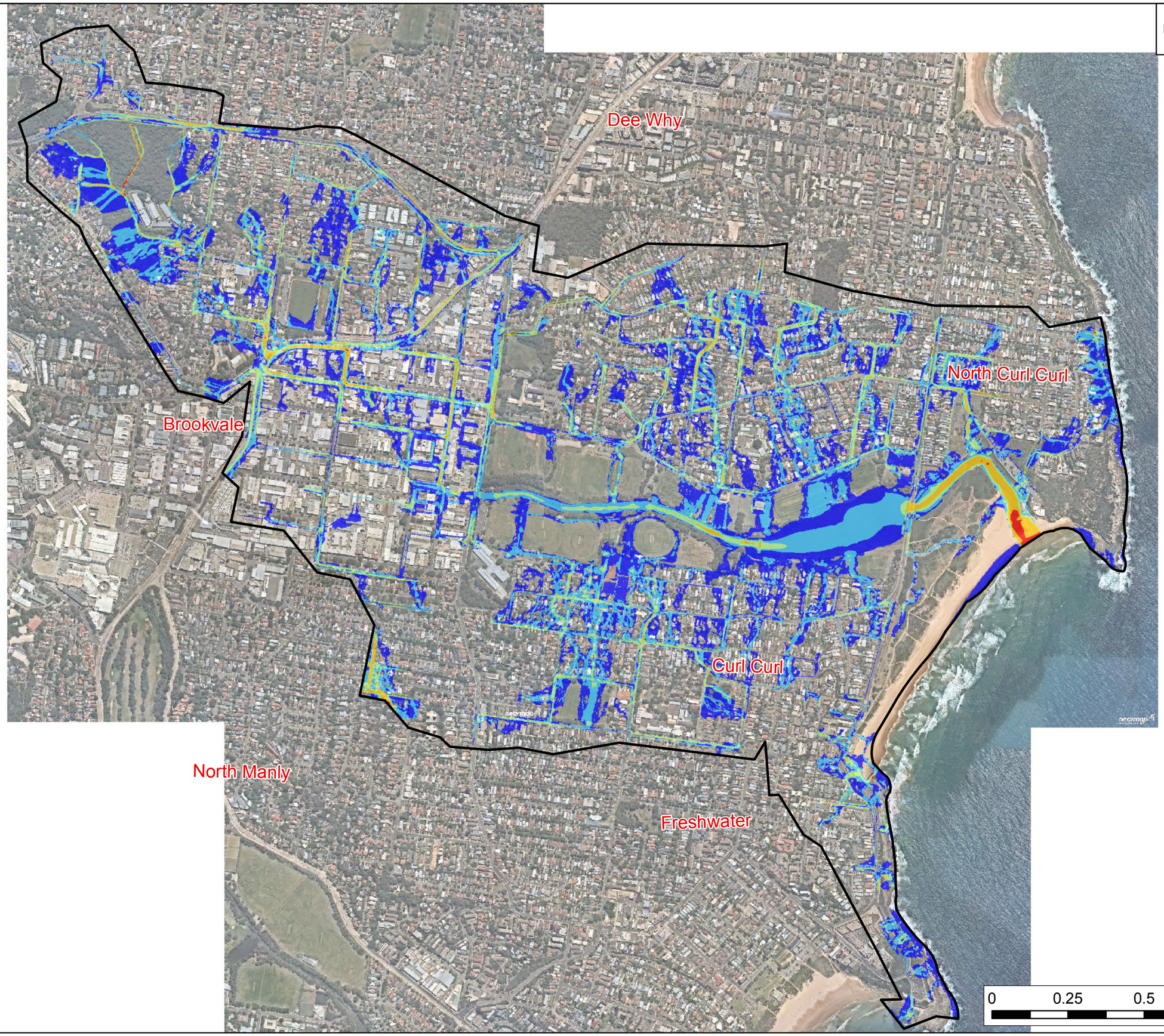
FIGURE D10
PEAK FLOOD VELOCITIES
50% AEP EVENT



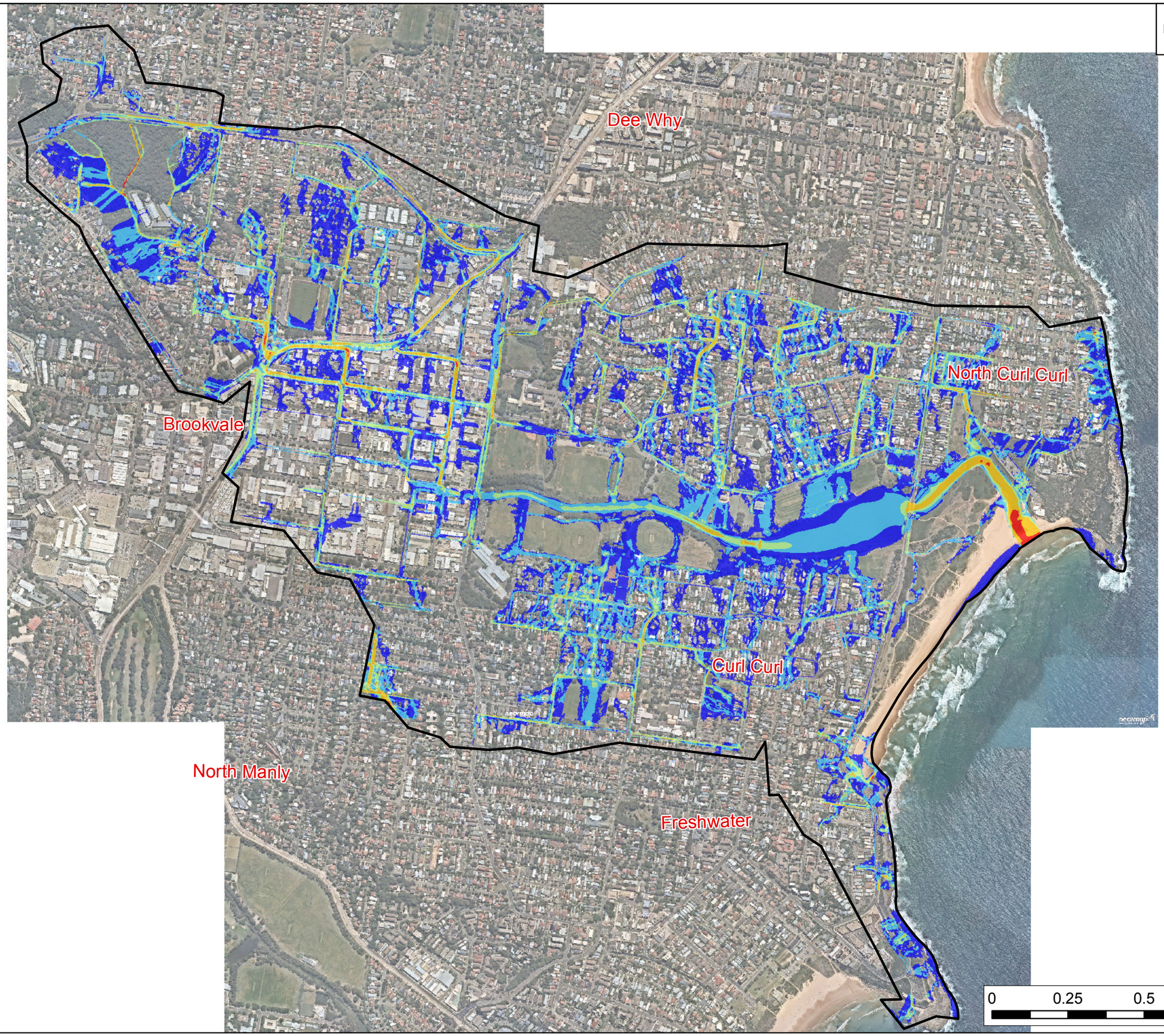
J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD10_PeakFloodVelocities_50%_AEP_Event.mxd

FIGURE D11
PEAK FLOOD VELOCITIES
20% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD11_PeakFloodVelocities_20%_AEP_Event.mxd

FIGURE D12
PEAK FLOOD VELOCITIES
10% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD12_PeakFloodVelocities_10%_AEP_Event.mxd

FIGURE D13
PEAK FLOOD VELOCITIES
5% AEP EVENT

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

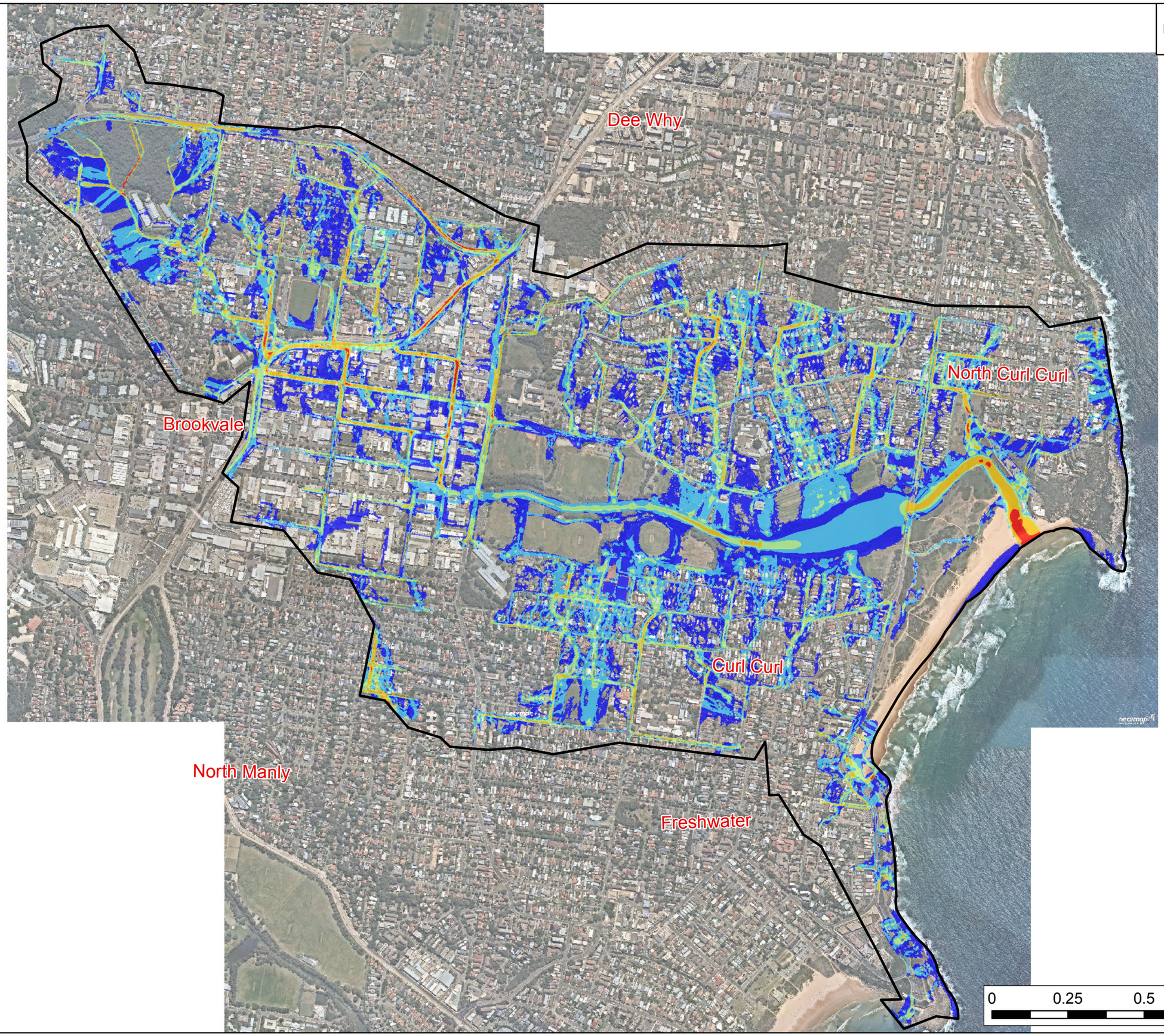
N

Model Boundary
Velocity (m/s)
0 to 0.2
0.2 to 0.5
0.5 to 1.0
1.0 to 2.0
> 2.0

0 0.25 0.5 1 km

J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD13_PeakFloodVelocities_5%_AEP_Event.mxd

FIGURE D14
PEAK FLOOD VELOCITIES
2% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD14_PeakFloodVelocities_2%_AEP_Event.mxd

FIGURE D15
PEAK FLOOD VELOCITIES
1% AEP EVENT

Dee Why
North Curl Curl
Brookvale
Curl Curl
North Manly
Freshwater

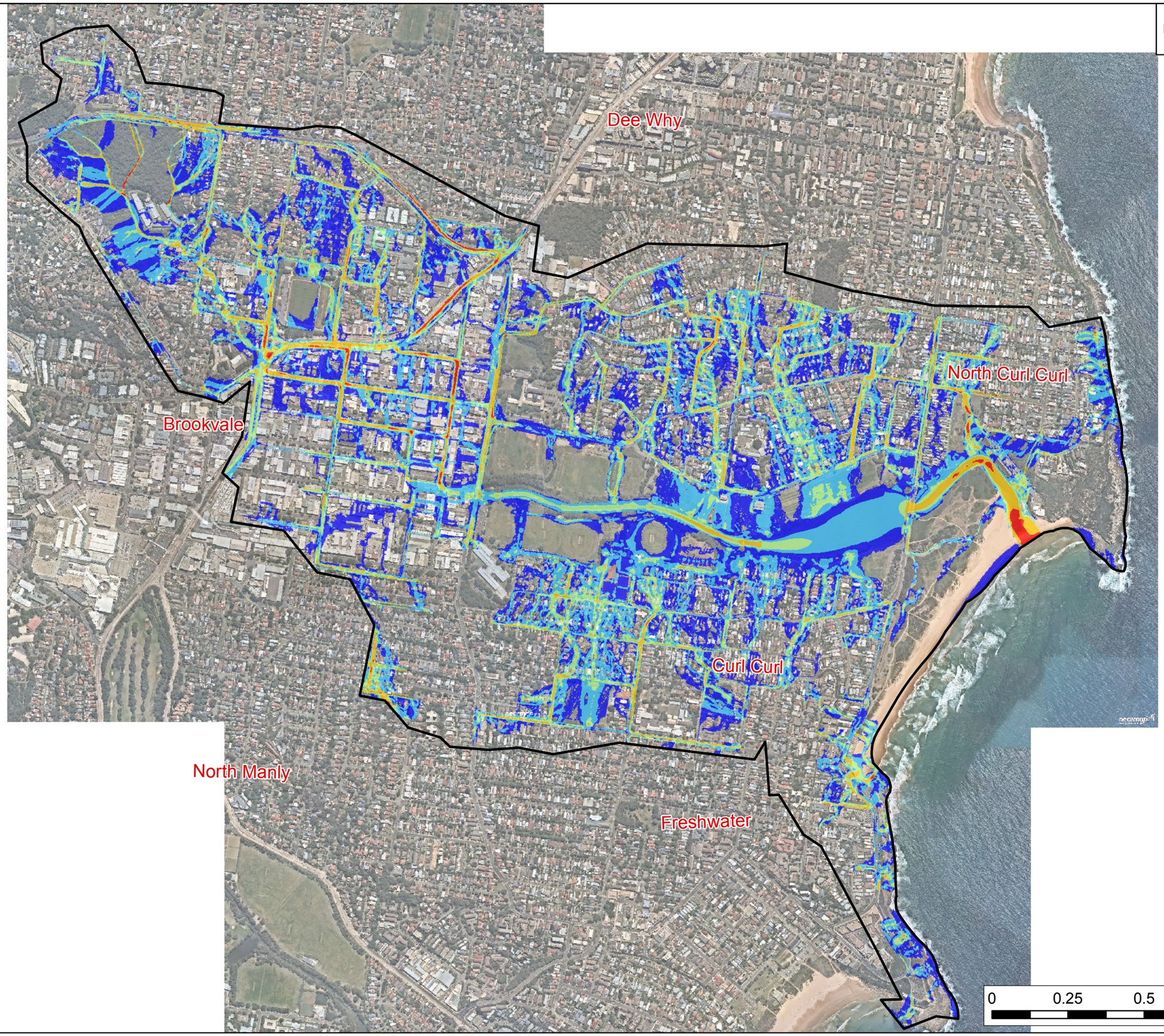
N

Model Boundary
Velocity (m/s)
0 to 0.2
0.2 to 0.5
0.5 to 1.0
1.0 to 2.0
> 2.0

0 0.25 0.5 1 km

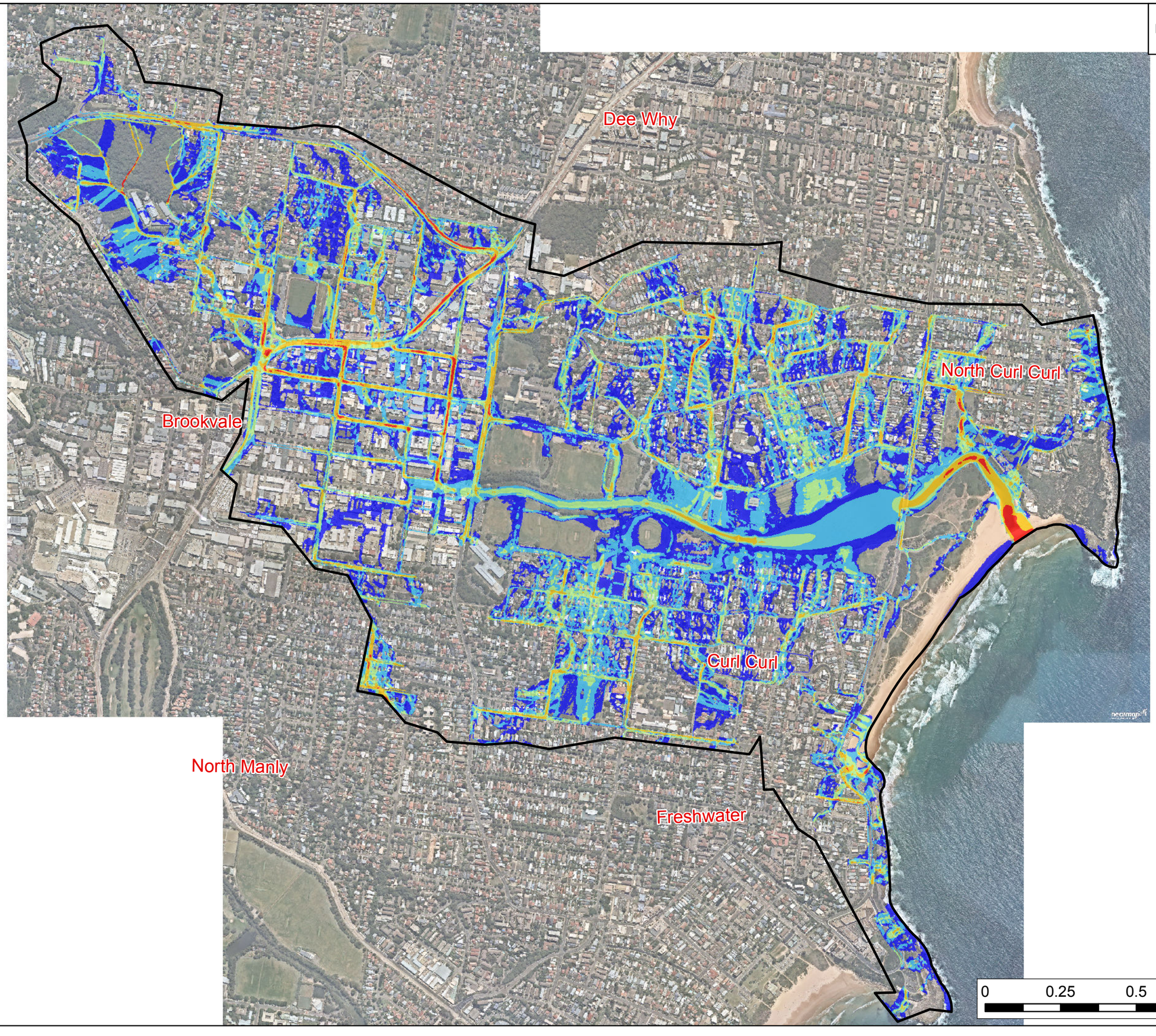
J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD15_PeakFloodVelocities_1%_AEP_Event.mxd

FIGURE D16
PEAK FLOOD VELOCITIES
0.5% AEP EVENT



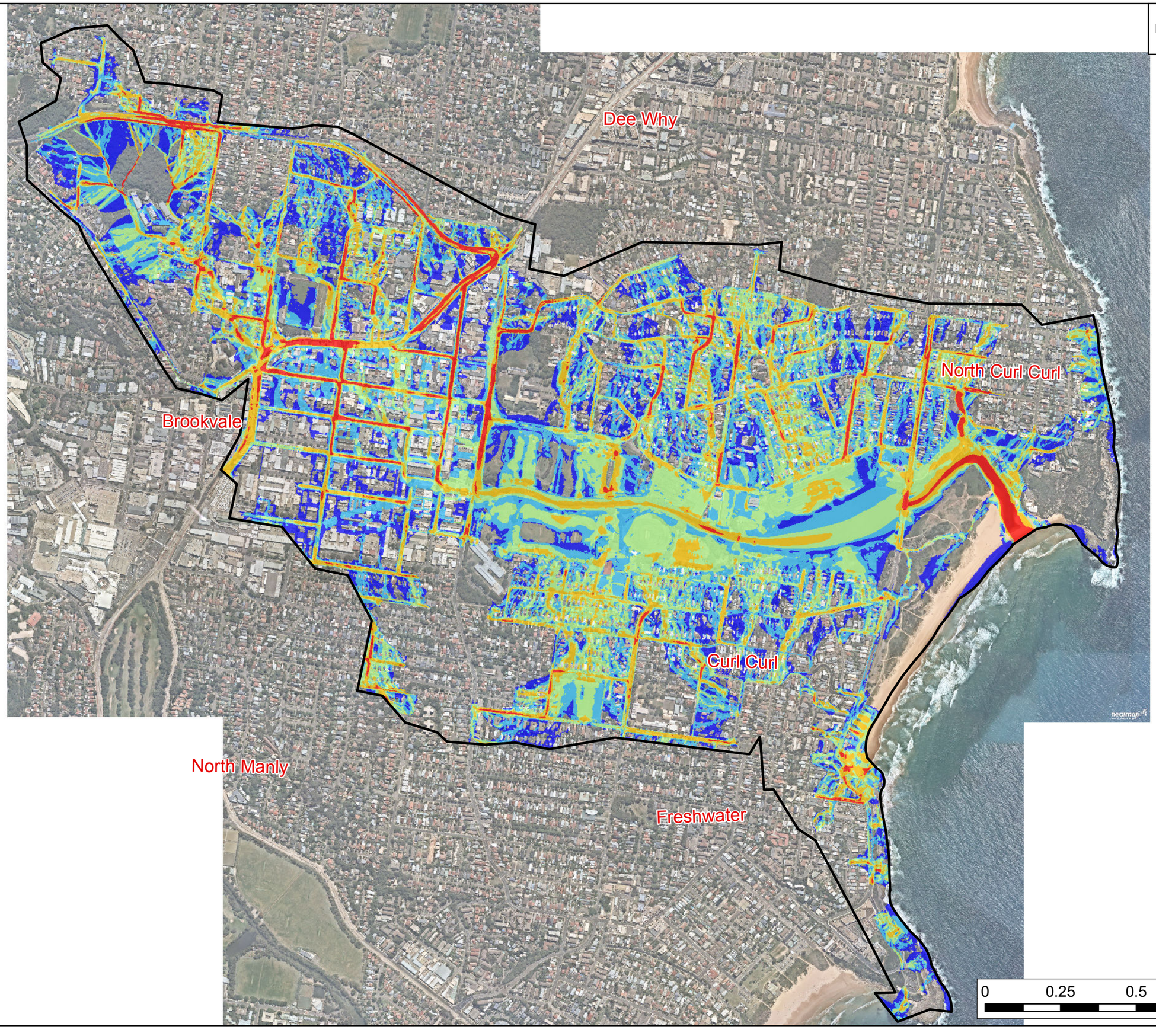
J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD16_PeakFloodVelocities_0.5%_AEP_Event.mxd

FIGURE D17
PEAK FLOOD VELOCITIES
0.2% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD17_PeakFloodVelocities_0.2%_AEP_Event.mxd

FIGURE D18
PEAK FLOOD VELOCITIES
PMF EVENT

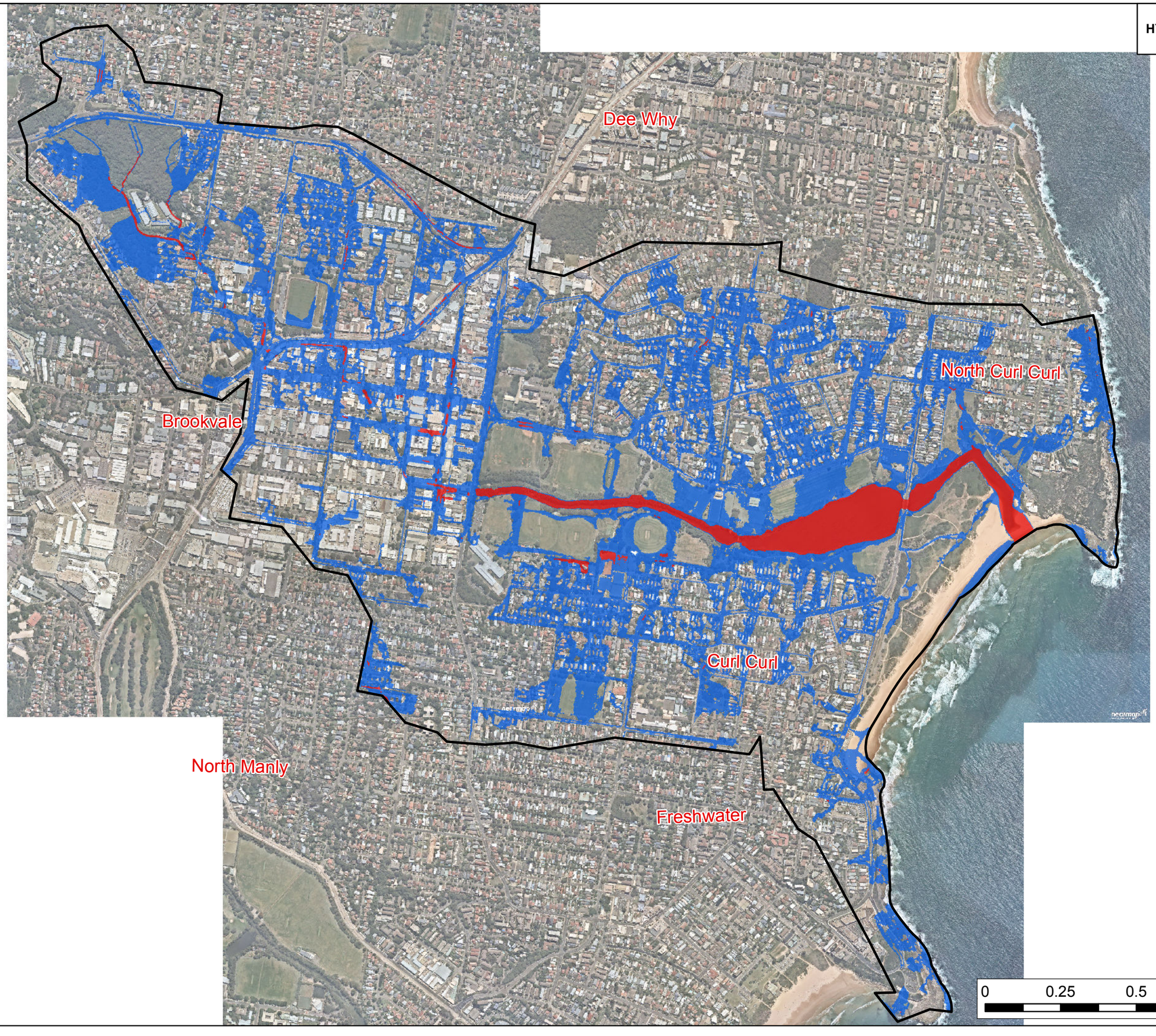


J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_D\FigureD18_PeakFloodVelocities_PMF_Event.mxd

APPENDIX E. Hydraulic Hazard and Flood Function

Appendix E

FIGURE E1
HYDRAULIC HAZARD (FDM)
5% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE01_HydraulicHazard_FDM_5%_AEP_Event.mxd

FIGURE E2
HYDRAULIC HAZARD (FDM)
1% AEP EVENT

Dee Why
North Curl Curl
Brookvale
Curl Curl
North Manly
Freshwater

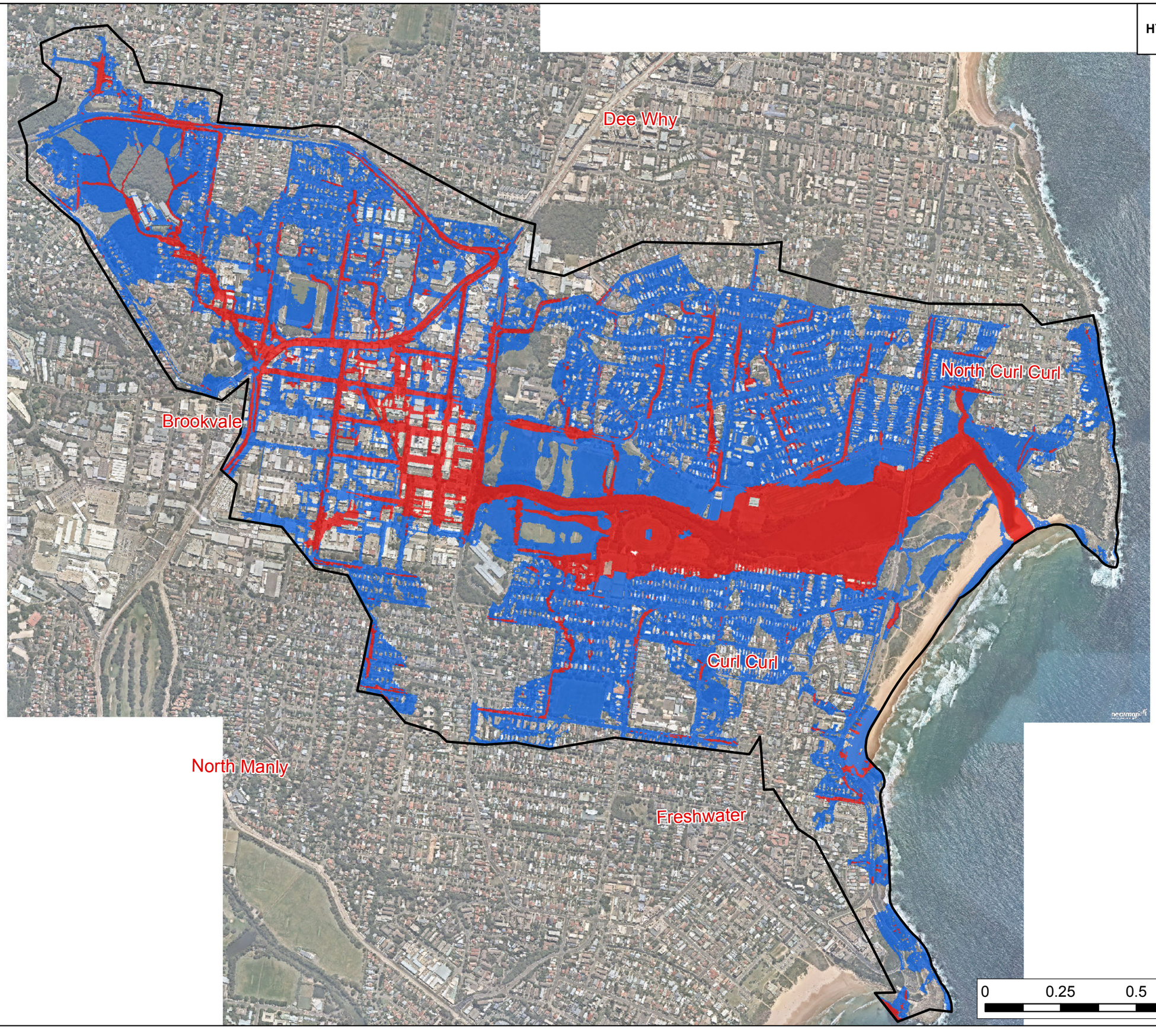
N

Model Boundary
Hydraulic Hazard
Low Hazard
High Hazard

0 0.25 0.5 1 km

J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE02_HydraulicHazard_FDM_1%_AEP_Event.mxd

FIGURE E3
HYDRAULIC HAZARD (FDM)
PMF EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE03_HydraulicHazard_FDM_PMF_Event.mxd

FIGURE E4
HYDRAULIC HAZARD (ADR)
5% AEP EVENT

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

N

Model Boundary

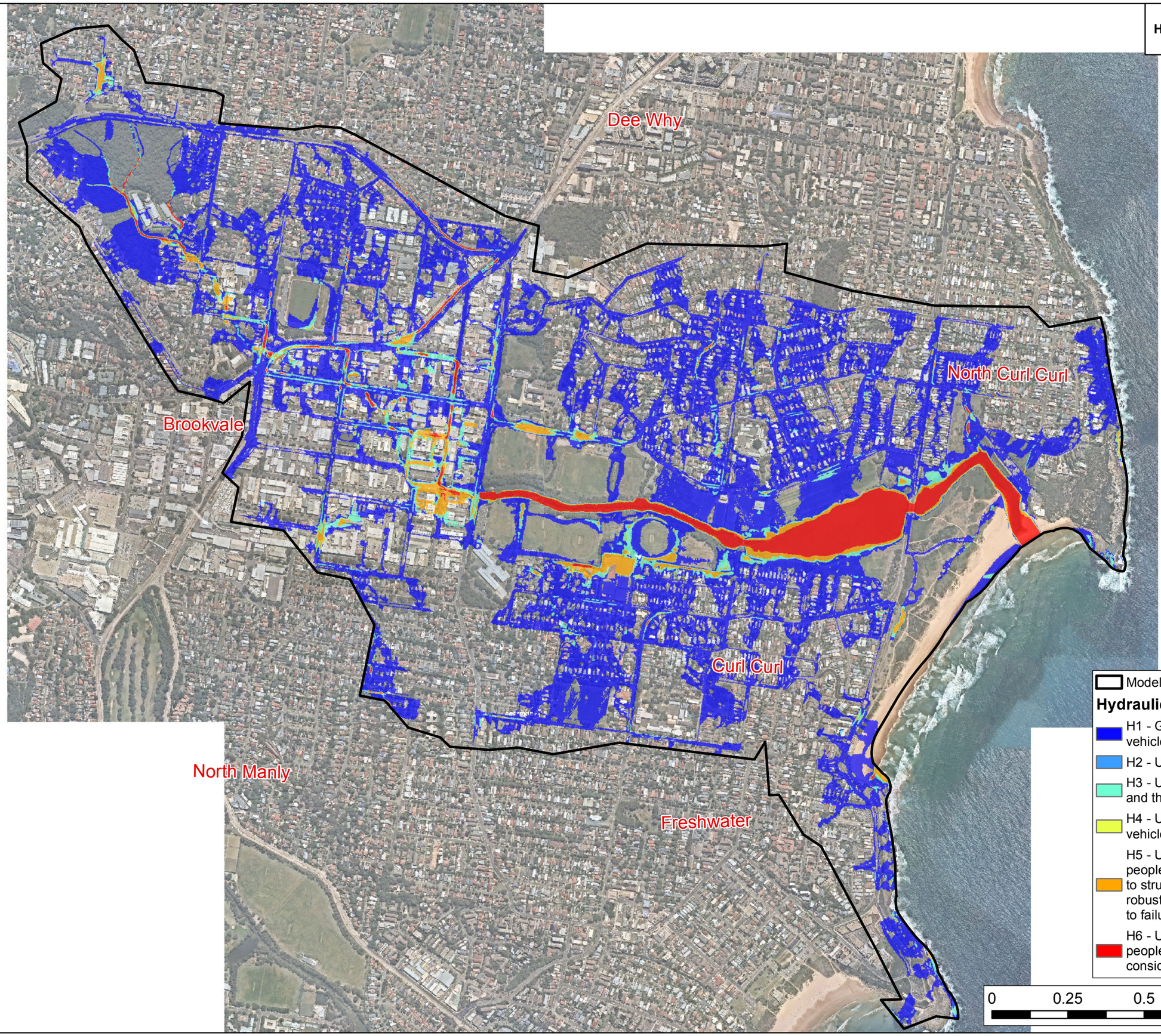
Hydraulic Hazard

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure

0 0.25 0.5 1 km

J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE04_HydraulicHazard_ADR_5%_AEP_Event.mxd

FIGURE E5
HYDRAULIC HAZARD (ADR)
1% AEP EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE05_HydraulicHazard_ADR_1%_AEP_Event.mxd

FIGURE E6
HYDRAULIC HAZARD (ADR)
PMF EVENT

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

N

Model Boundary

Hydraulic Hazard

- H1 - Generally safe for people, vehicles and buildings
- H2 - Unsafe for small
- H3 - Unsafe for vehicles, children and the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure

0 0.25 0.5 1 km

J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE06_HydraulicHazard_ADR_PMF_Event.mxd

FIGURE E7
HYDRAULIC CATEGORIES
5% AEP EVENT

Dee Why
North Curl Curl
Brookvale
Curl Curl
North Manly
Freshwater

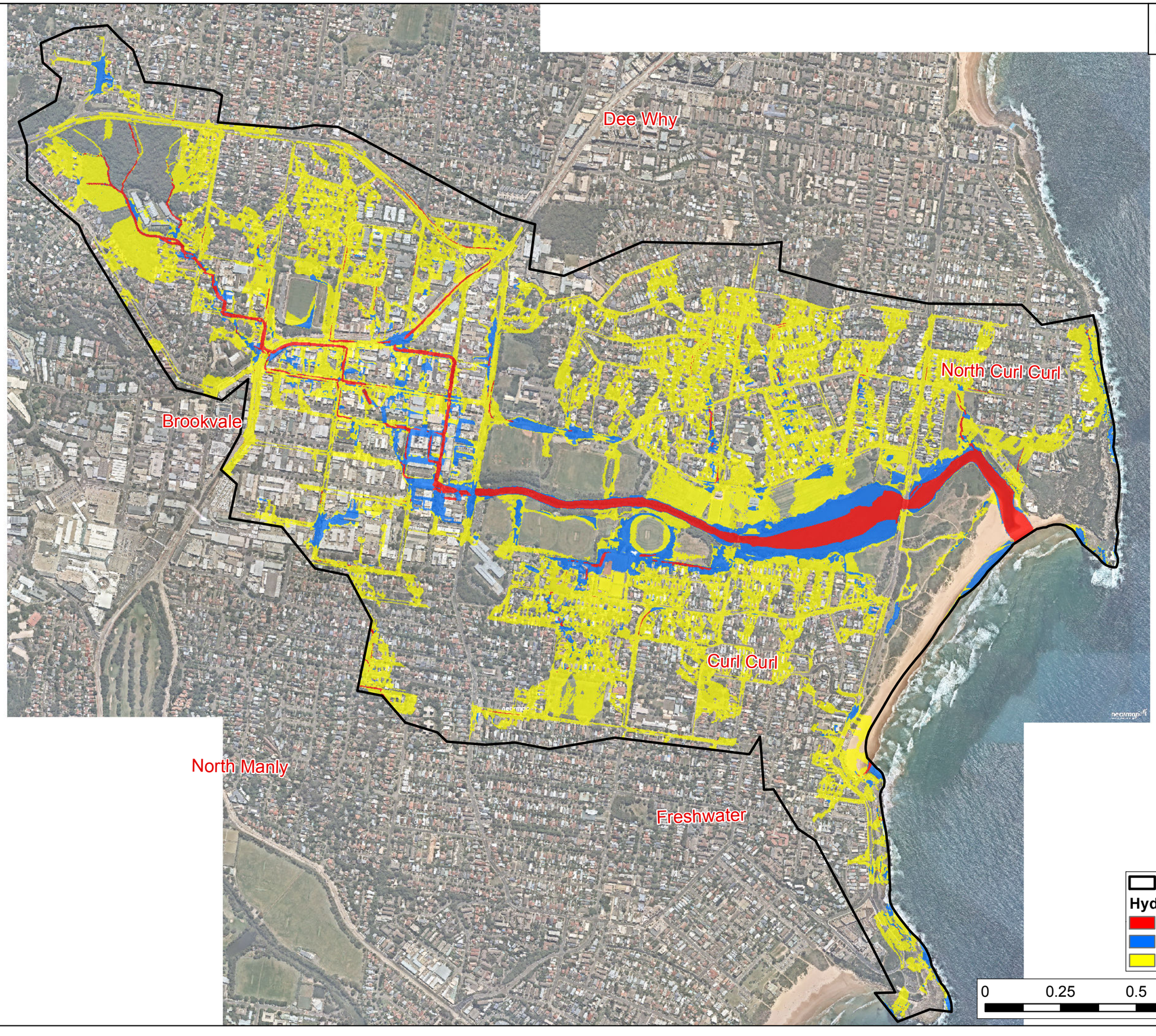
N

Model Boundary
Hydraulic Categorisation
Floodway
Flood Storage
Flood Fringe

0 0.25 0.5 1 km

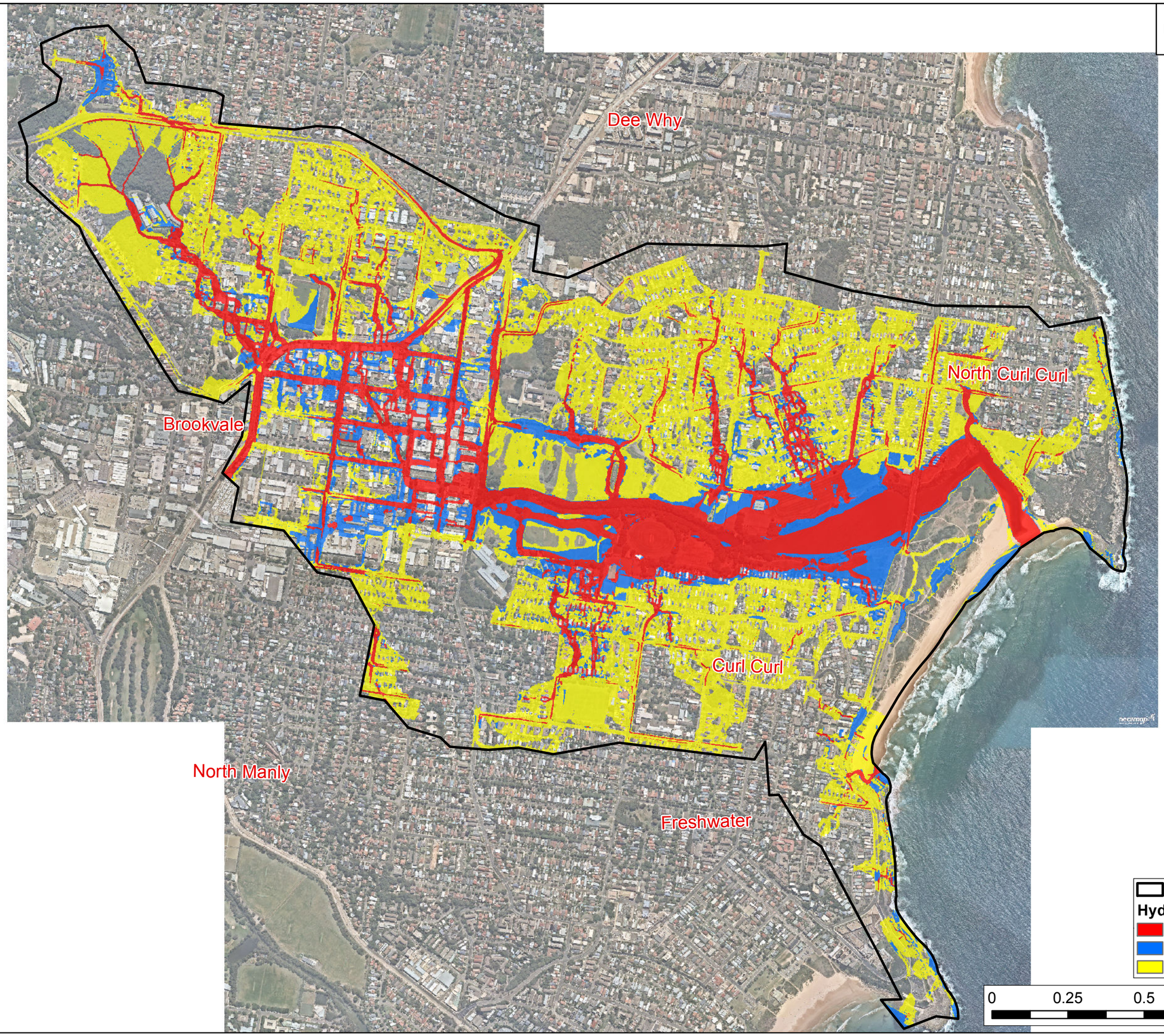
J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE07_HydraulicCategories_5%_AEP_Event.mxd

FIGURE E8
HYDRAULIC CATEGORIES
1% AEP EVENT



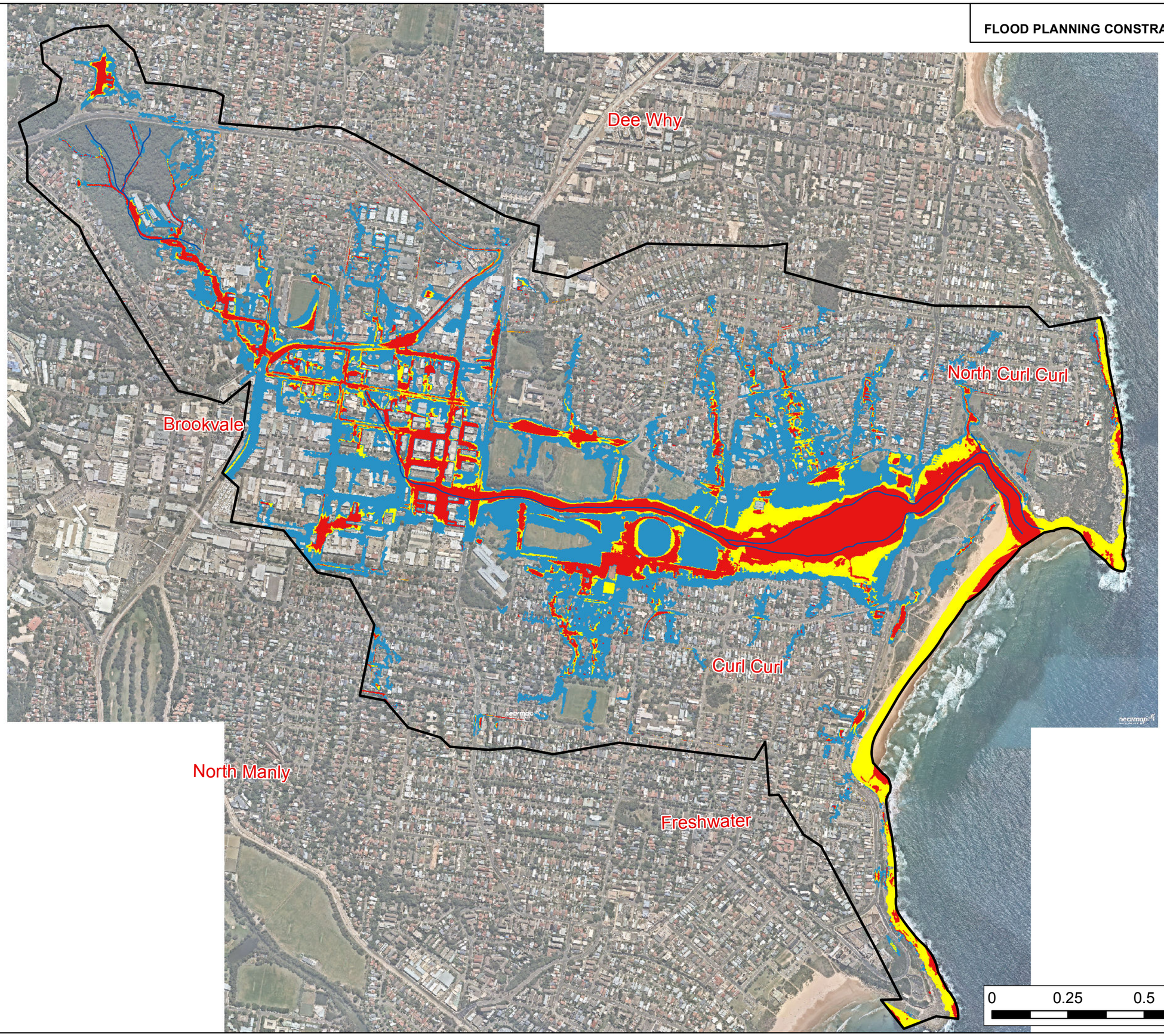
J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE08_HydraulicCategories_1%_AEP_Event.mxd

FIGURE E9
HYDRAULIC CATEGORIES
PMF EVENT



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE09_HydraulicCategories_PMF_Event.mxd

FIGURE E10
FLOOD PLANNING CONSTRAINT CATEGORY MAPPING



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_E\FigureE10_FPCCMapping.mxd

APPENDIX F. Road Overtopping Information

Appendix F

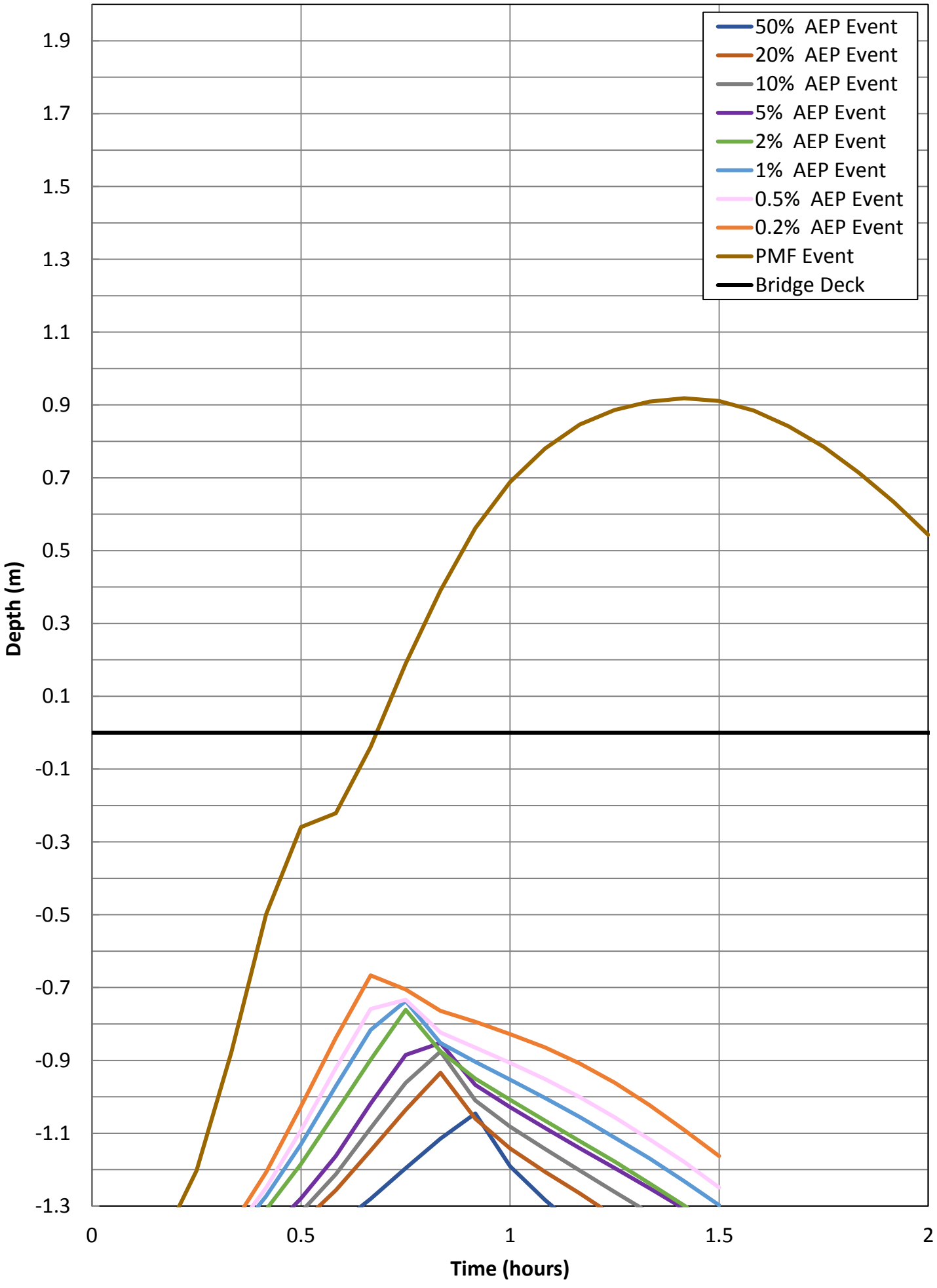
FIGURE F1
SES REPORTING LOCATIONS

Figure F10
SES9
McKillop Rd
Lee R
Warringah Rd
Dee Why
Figure F9
SES8
Federal Parade
Quirk St
Figure F8
SES7
Consul Rd
Gulliver St
Pine Ave
Headland Rd
Figure F7
SES6
Pittwater Rd
North Curl Curl
Robertson Rd
Winbourne Rd
Pitt Rd
Playfair Rd
Figure F6
SES5
Brookvale
Mitchell Rd
Sydenham Rd
Figure F3
SES2
Abbott Rd
Figure F2
SES1
Griffin Rd
Powells Rd
Ethel Ave
Harbord Rd
Figure F4
SES3
Wattle Rd
Amourin St
Figure F5
SES4
Bennett St
Brighton St
Adams St
Oliver St
Curl Curl
Carrington Parade
Wyadra Ave
North Manly
N
SES Reporting Locations
Model Boundary
0 0.25 0.5 1 km

J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_F\FigureF01_SES_Reporting_Locations.mxd

FIGURE F2

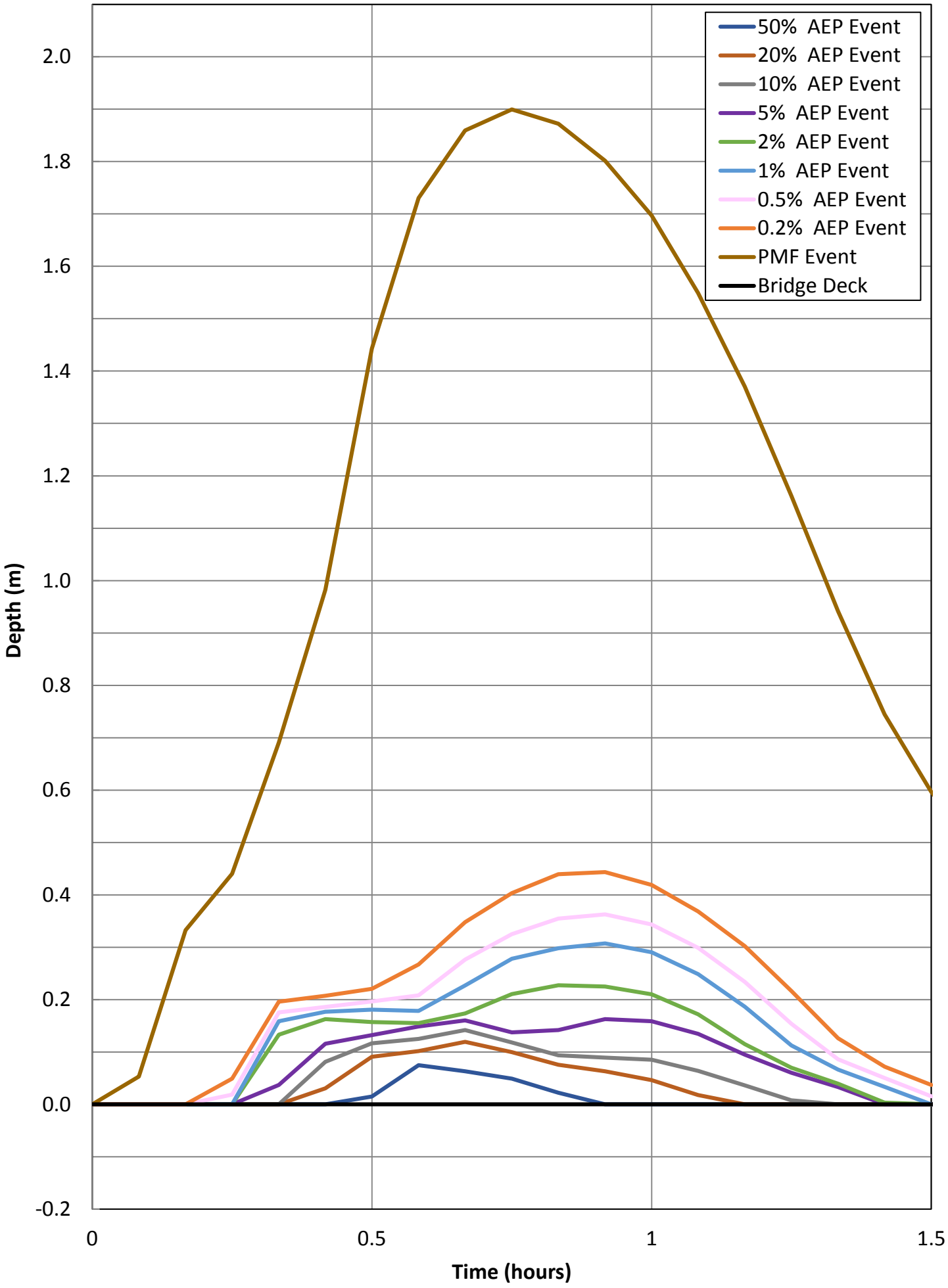
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES1 - GRIFFIN ROAD BRIDGE



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F3

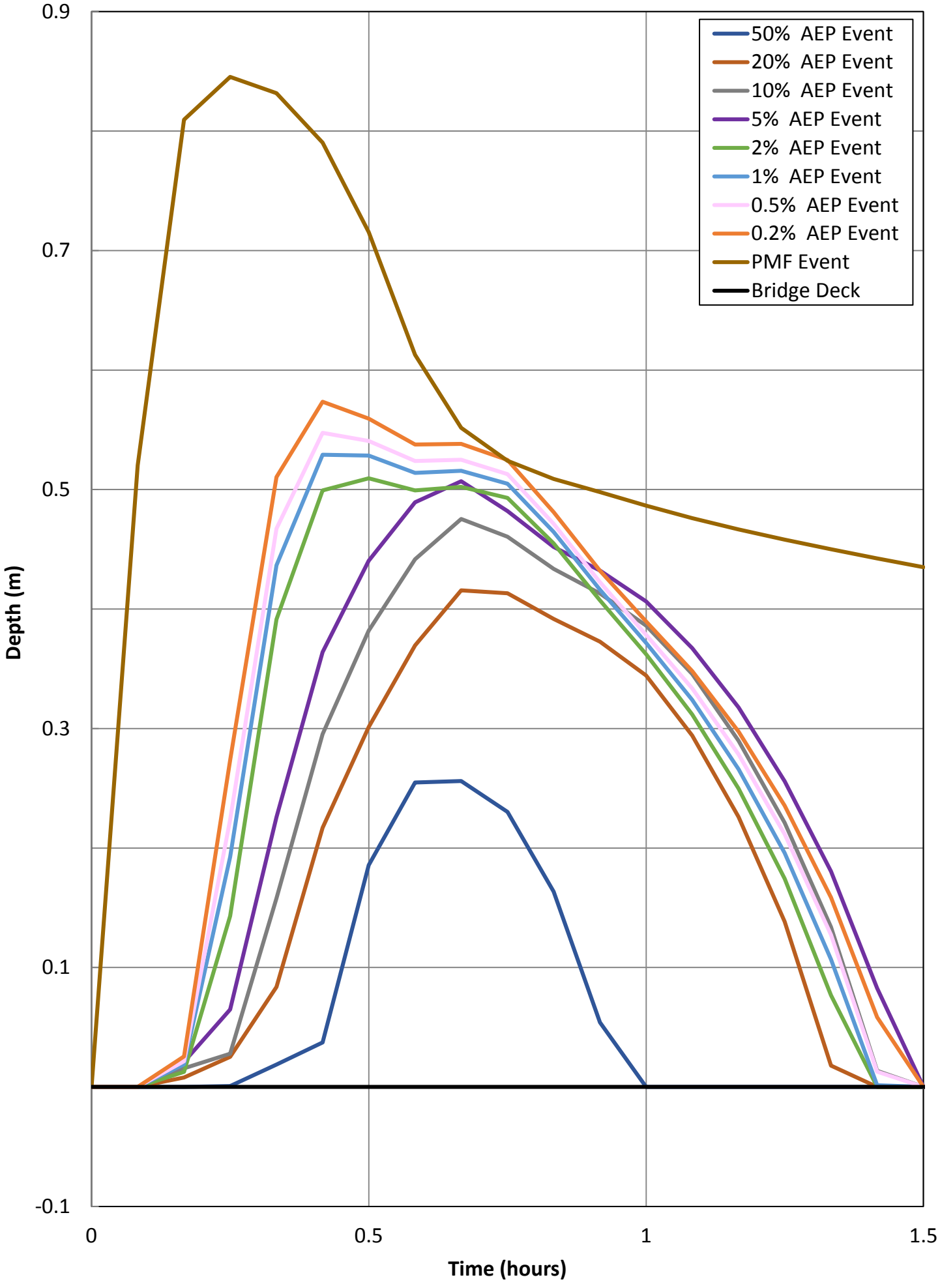
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES2 - HARBORD ROAD



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F4

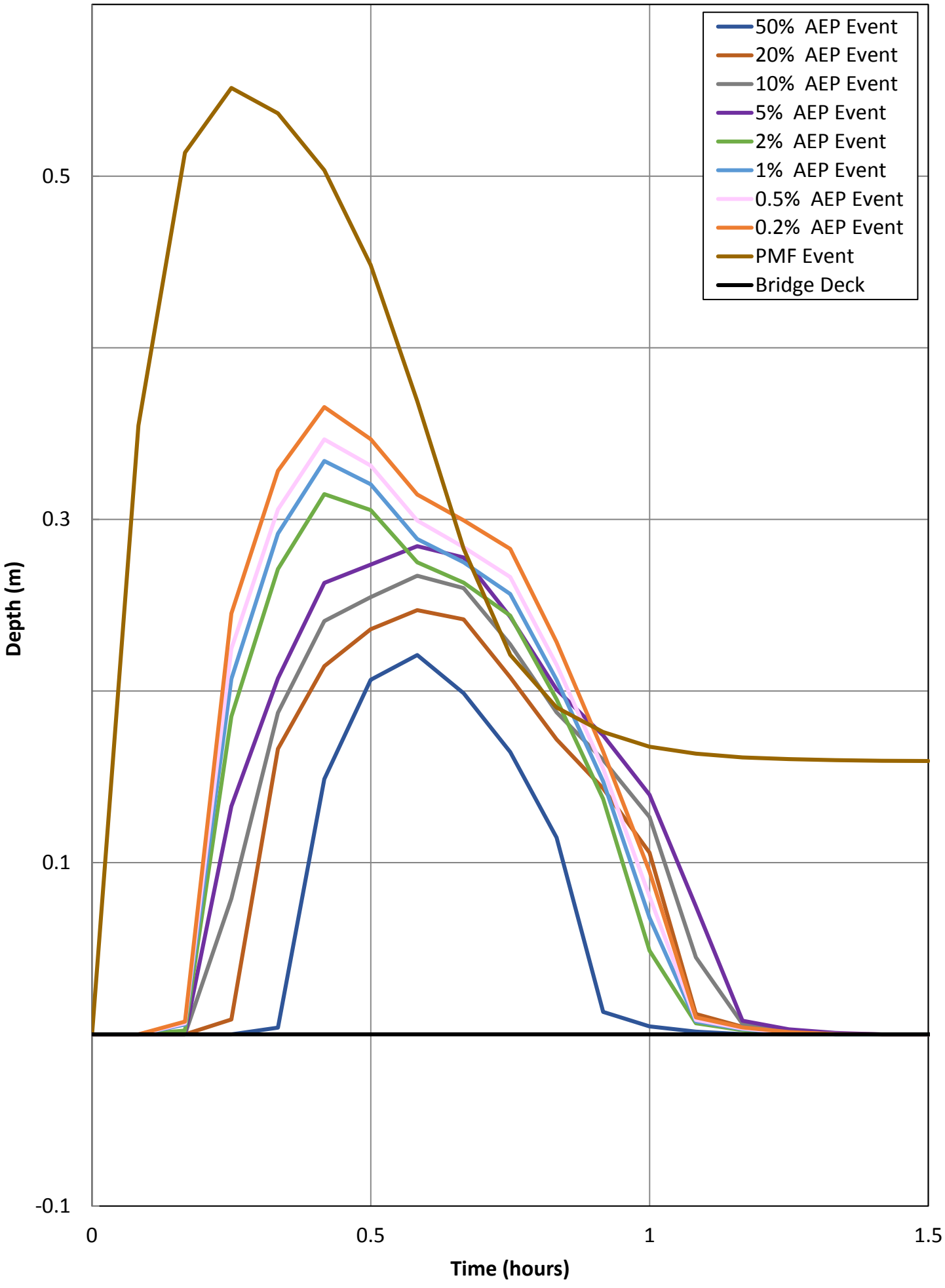
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES3 - MANUELA PLACE



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F5

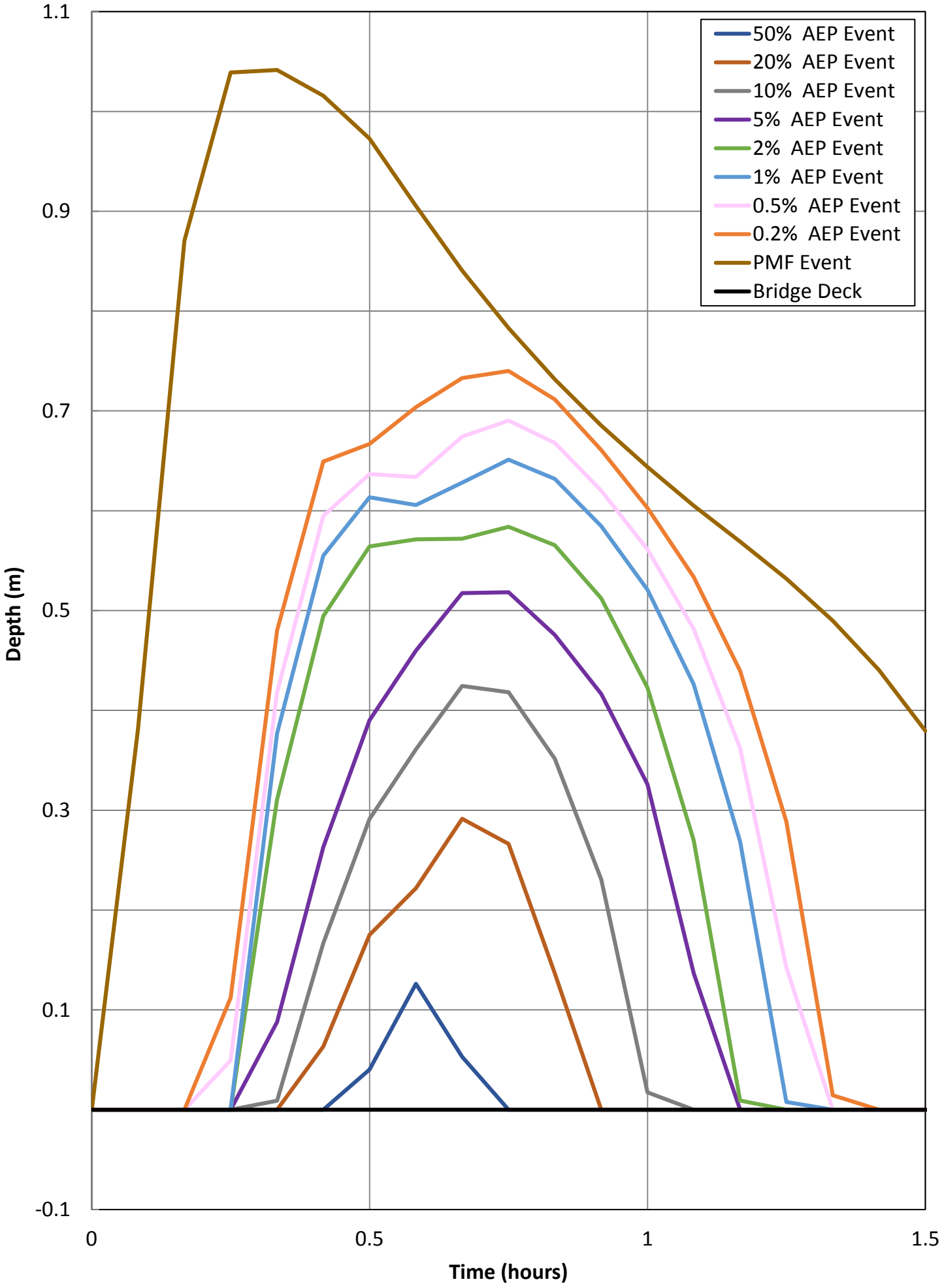
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES4 - BRIGHTON STREET



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F6

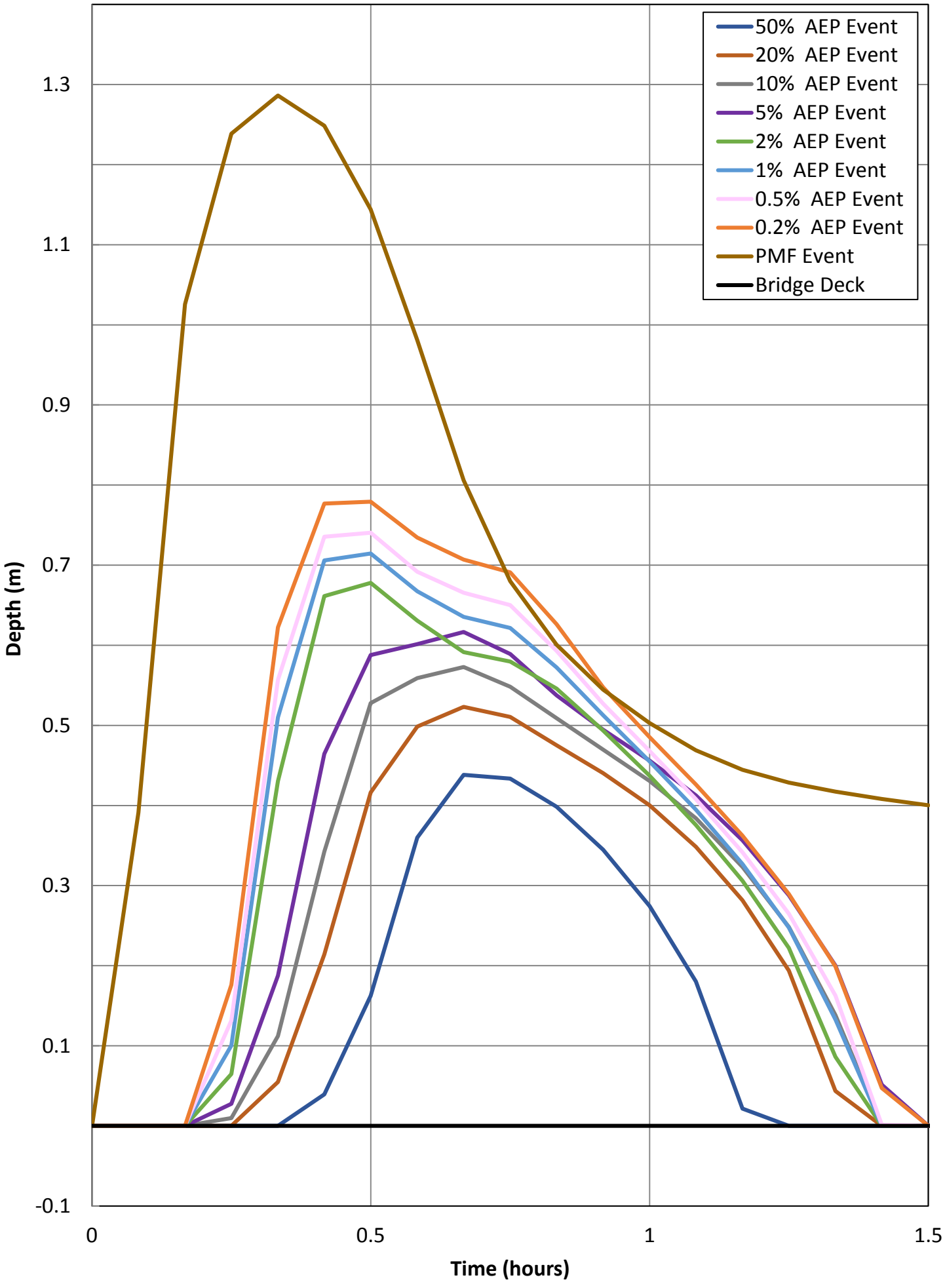
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES5 - ABBOTT ROAD



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F7

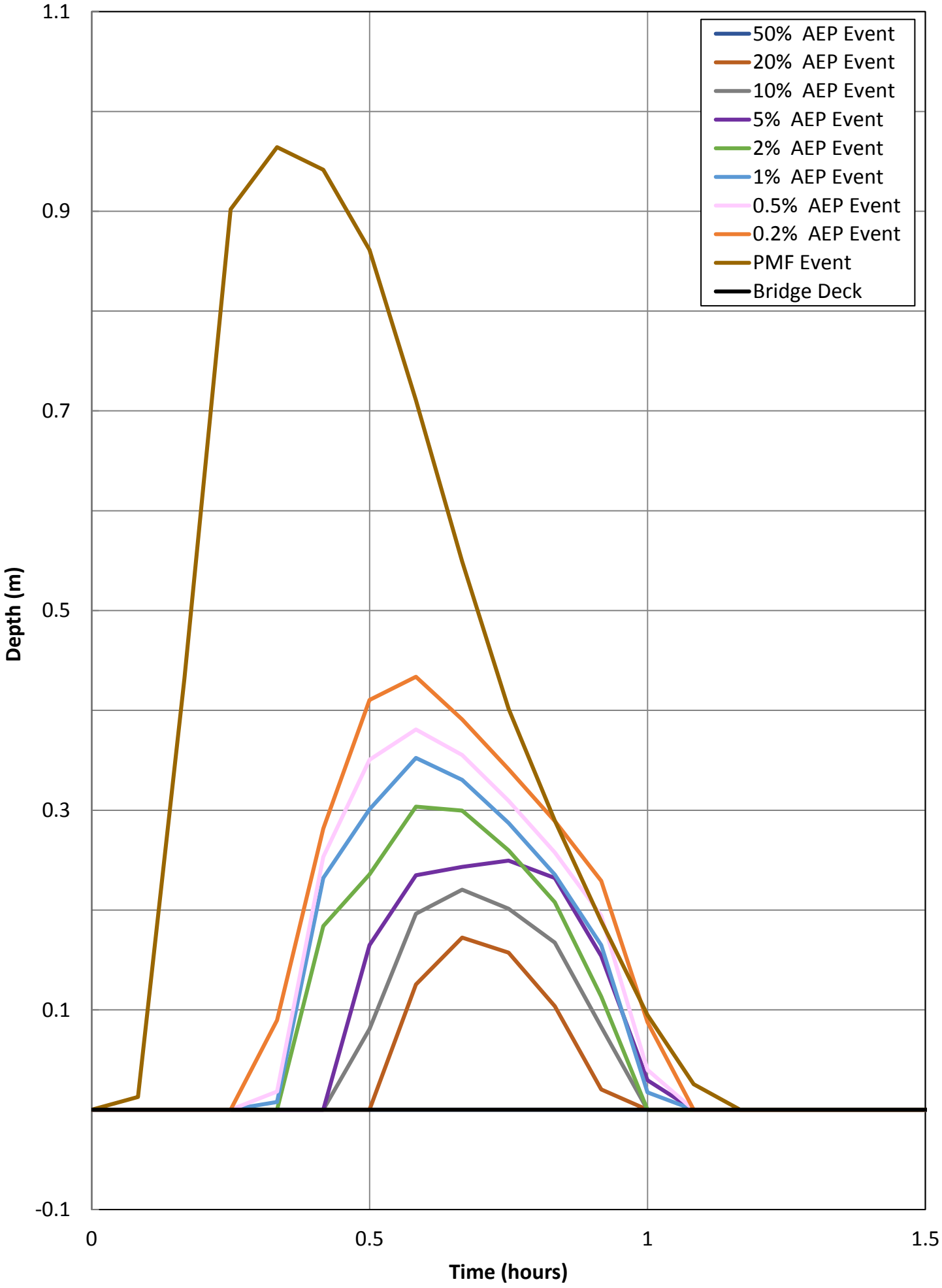
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES6 - PITTWATER ROAD



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F8

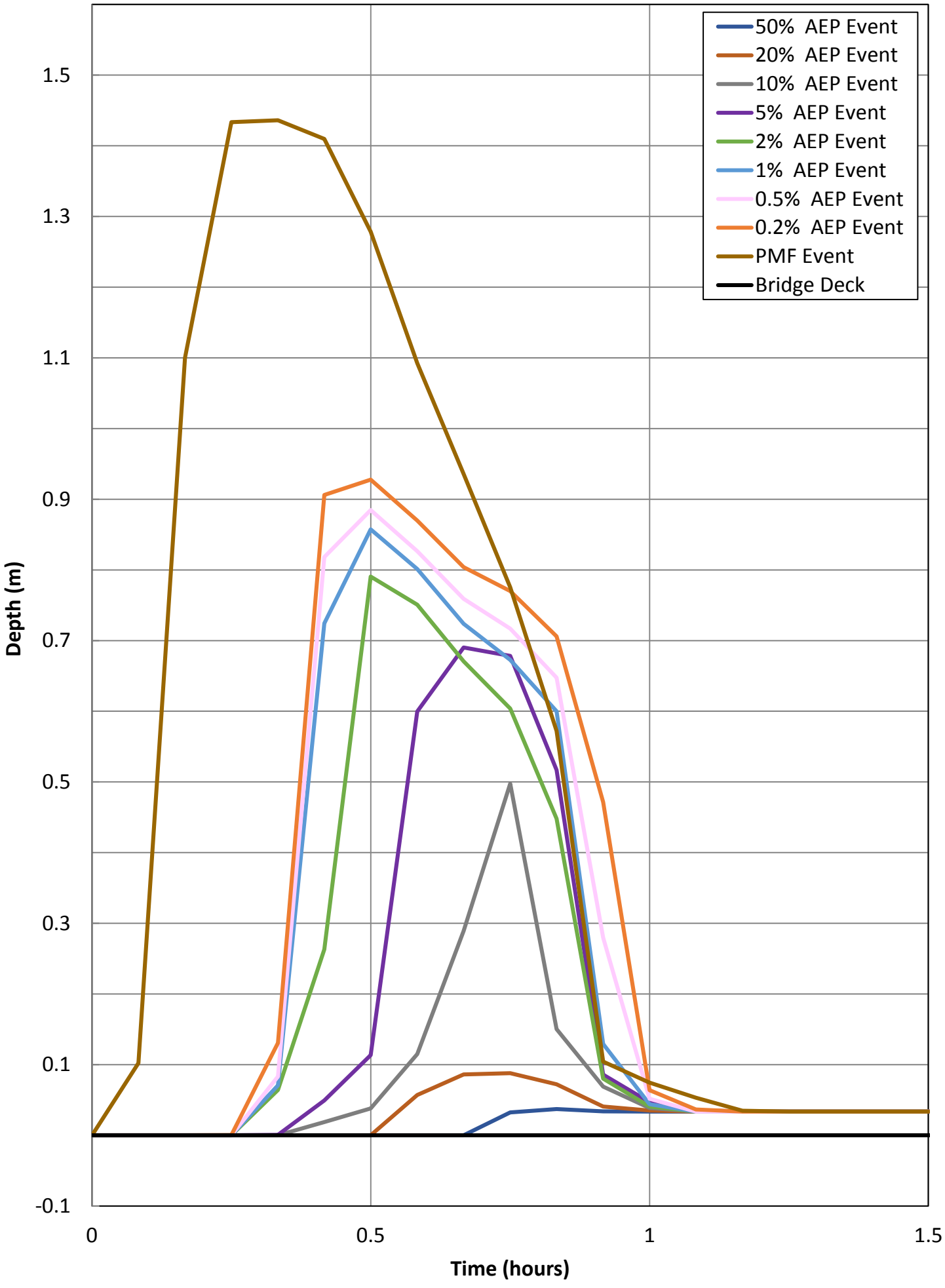
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES7 - GULLIVER STREET



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F9

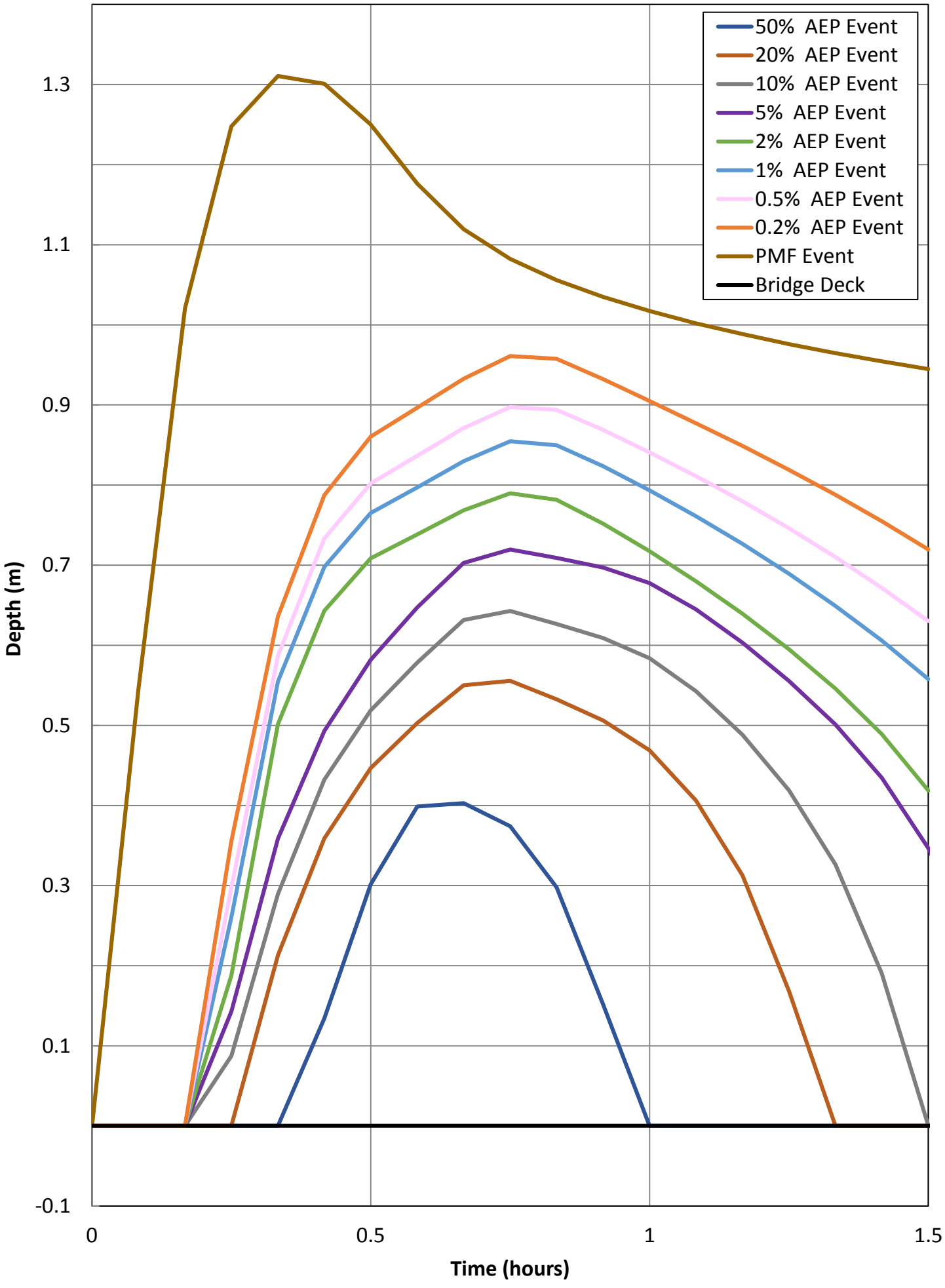
FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES8 - CONSUL ROAD



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

FIGURE F10

FLOOD DEPTH ABOVE ROAD HYDROGRAPH
LOCATION SES9 - MCKILLOP STREET



J:\Jobs\118094\Hydraulics\Results_Reporting\TUFLOW_Flood_Level_Hydrographs_v02.xlsm

APPENDIX G. Climate Change Impacts

Appendix G

FIGURE G1
CLIMATE CHANGE IMPACT
0.5% AEP VERSUS 1% AEP EVENT

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

N

Model Boundary
Change in Flood Level (m)
< -0.5
-0.5 to -0.2
-0.2 to -0.1
-0.1 to -0.01
-0.01 to 0.01
0.01 to 0.1
0.1 to 0.2
0.2 to 0.5
> 0.5
No Longer Flooded
Newly Flooded

0 0.25 0.5 1 km

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FIGURE G2
CLIMATE CHANGE IMPACT
0.2% AEP VERSUS 1% AEP EVENT

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

N

Model Boundary
Change in Flood Level (m)
< -0.5
-0.5 to -0.2
-0.2 to -0.1
-0.1 to -0.01
-0.01 to 0.01
0.01 to 0.1
0.1 to 0.2
0.2 to 0.5
> 0.5
No Longer Flooded
Newly Flooded

0 0.25 0.5 1 km

J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_G\FigureG01_ClimateChange_0p5pc_v1.mxd

FIGURE G3
CLIMATE CHANGE IMPACT
1% AEP EVENT WITH 0.4M SEA LEVEL RISE

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

N

Model Boundary
Change in Flood Level (m)
< -0.5
-0.5 to -0.2
-0.2 to -0.1
-0.1 to -0.01
-0.01 to 0.01
0.01 to 0.1
0.1 to 0.2
0.2 to 0.5
> 0.5
No Longer Flooded
Newly Flooded

0 0.25 0.5 1 km

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FIGURE G4
CLIMATE CHANGE IMPACT
1% AEP EVENT WITH 0.9M SEA LEVEL RISE

Dee Why
Brookvale
North Curl Curl
Curl Curl
North Manly
Freshwater

N

Model Boundary
Change in Flood Level (m)
< -0.5
-0.5 to -0.2
-0.2 to -0.1
-0.1 to -0.01
-0.01 to 0.01
0.01 to 0.1
0.1 to 0.2
0.2 to 0.5
> 0.5
No Longer Flooded
Newly Flooded

0 0.25 0.5 1 km

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FIGURE G5
CLIMATE CHANGE IMPACT
1% AEP EVENT WITH 10% INCREASE IN RAINFALL AND 0.4M SEA LEVEL RISE

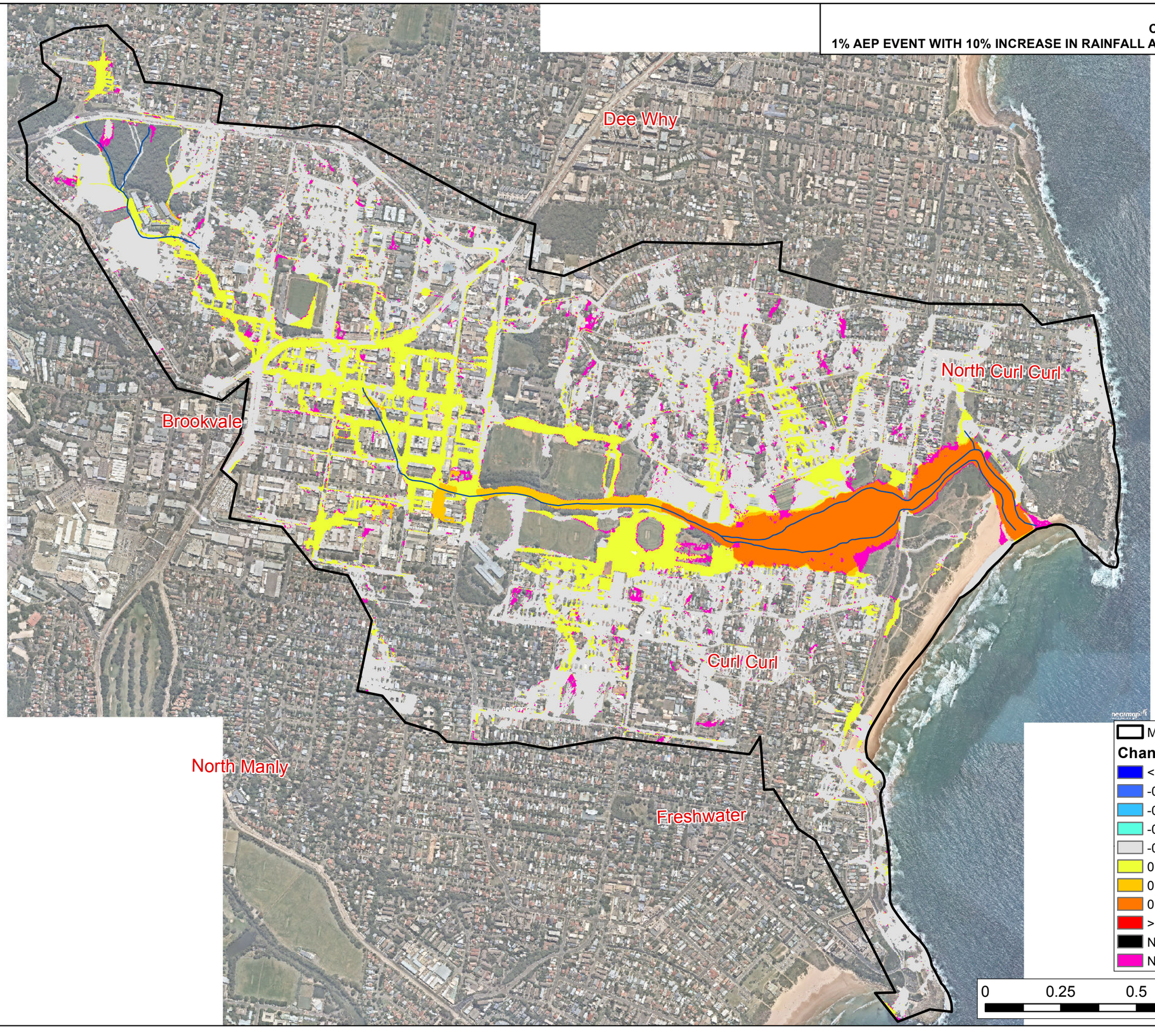

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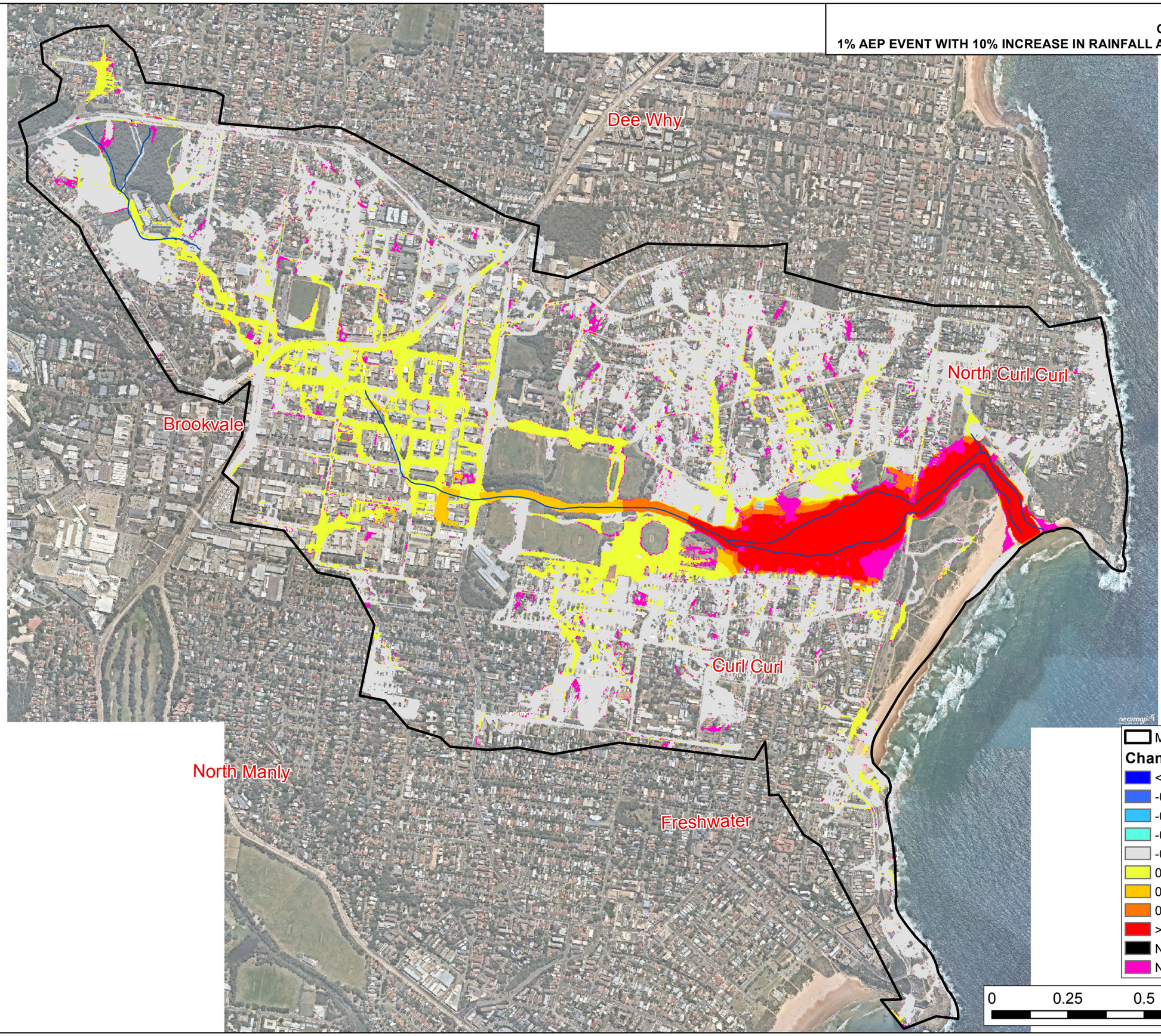
FIGURE G6
CLIMATE CHANGE IMPACT
1% AEP EVENT WITH 10% INCREASE IN RAINFALL AND 0.9M SEA LEVEL RISE



J:\Jobs\118094\ArcGIS\ArcMaps\Appendix_G\FigureG06_ClimateChange_1pc_RF10_0p9mSLR.mxd