Appendix D
Modelling Quality Report

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Project: Regional Floodplain Database

Model Quality Report
Brisbane Coastal Creeks (BCC)

Reference: 222767

Prepared for: Moreton Bay Regional Council

Revision: 1

10 October 2012

Document Control Record

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Document control							aurecon
Report Title		Model Quality Report Brisbane Coastal Creeks (BCC)					
Document ID			**Project Number**		222767		
File Path		222767 BCC Quality Report Final.docx					
Client		Moreton Bay Regional Council	**Client Contact**		Hester van Zijl		
Rev	**Date**	**Revision Details/Status**	**Prepared by**	**Author**	**Verifier**	**Approver**	
0	9 October 2012	Final	C Smyth	T Campbell	T Graham	C Russell	
1	10 October 2012	Final incorporating comments	C Smyth	T Campbell	T Graham	C Russell	
Current Revision		1					

Approval			
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1 Introduction

1.1 Study objective

Moreton Bay Regional Council (MBRC) is delivering a Regional Floodplain Database (RFD) in support of their flood risk management, considering emergency response, development control, strategic land use and infrastructure planning. MBRC is responsible for the areas of Caboolture, Pine Rivers, Redcliffe and Bribie Island. The RFD project focuses on the northern sector of the Council area as a key growth area for South-east Queensland.

The project is being funded by MBRC, Emergency Management Queensland (EMQ) and Emergency Management Australia (EMA) as part of the Natural Disaster Resilience Program and will provide:

- A comprehensive and consistent description of flood behaviour across the region
- Strategies for management of any identified flooding problems
- A system/process to store and manage this information and keep it up-to-date

Stage 1 of the project was completed in July 2010 and involved a number of sub-projects. These projects delivered consistent processes and protocols for the detailed hydrologic and hydraulic model development. A key sub-project involved the development of broadscale hydrodynamic models for each minor basin to provide general understanding of flooding mechanisms and allow prioritisation of data capture.

Stage 2 of the project involves the development of detailed hydrologic and hydraulic models for each minor basin and is currently nearing completion.

Stage 3 includes development of a further two detailed models (currently underway). Stage 3 will then build on the detailed models and “add value” through assessment of flood damages and community resilience measures.

1.2 Objective of model quality report

This report describes the model setup process adopted for the detailed 5 m grid TUFLOW model of the Brisbane Coastal Creeks (BCC) minor basin. It also describes the model quality and model issues for the hydrologic and hydraulic models.

2 TUFLOW model setup process

2.1 Code boundary

The code boundary was modified as per the following:

- The code boundary was extended downstream past Osborne Road and Old Northern Road to prevent model results at the stream gauge locations from being affected the downstream boundary conditions
- The code boundary was widened wherever flows were being constrained by the code boundary

In Figure 1 below, the red line shows the adopted code boundary and the blue line shows the broadscale model code boundary.

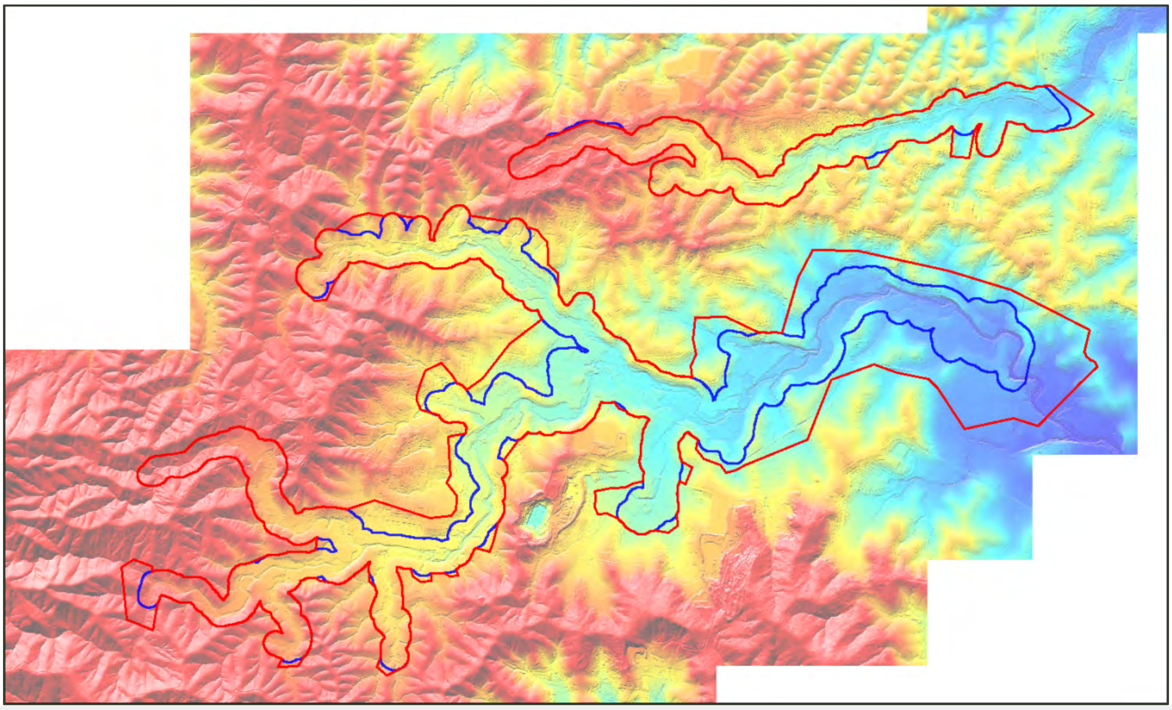


Figure 1 | Code boundary

2.2 Inflows and SA boundaries

SA boundaries were adopted based upon the final hydrography minor catchments layer provided to Aurecon on 24 February 2011. The following changes were made to this layer:

- At structures the SA boundaries were modified so they crossed the top of the structure and inflows were then applied upstream of the structure

Figure 2 below shows an example of how the SA boundaries were modified at structures. The black line represents the adopted SA boundary and the grey line represents the minor catchment definition. In this image, flow is from the left of the page towards the right of the page.

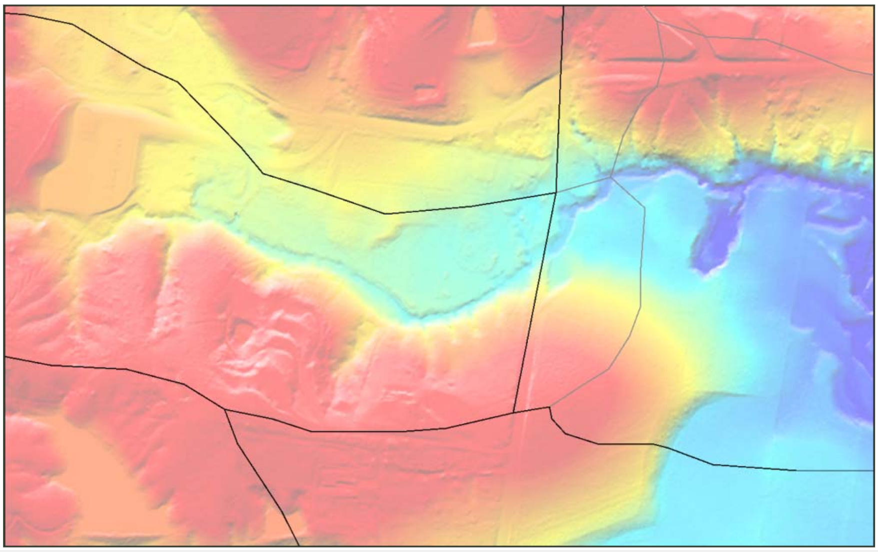


Figure 2 | SA Boundaries

2.2.1 Downstream boundaries

The locations of the downstream boundaries were modified to match the code boundary. Water level-discharge boundaries were applied at these two locations as well as a third location at the extreme event breakout.

The following slopes were adopted:

- 0.5% at Cabbage Tree Creek
- 0.1% at Kedron Brook
- 0.1% at the additional boundary for extreme events

2.2.2 Survey, topography and Zpoints

The Zpoints provided by WorleyParsons were used as the base Zpoints for the model. The following changes were made to the Zpoints:

- In locations where the lowest point within a SA boundary was a culvert inlet, a Zc upstream of the culvert was lowered such that this would become the initial location for SA inflow application
- Where required for model stability, Zlines and Zshapes have been used to lower the cells in the vicinity of culvert inlets and outlets

- The Woolshed Grove Development occurred after the LiDAR was captured in 2009. Design information for this development was provided by MBRC and used to update the Zpoints in this area

2.3 Materials

Materials files provided by MBRC at the outset of the project were reviewed and extended to cover the entire model area, including the Brisbane City Council regional area.

The Manning's n values associated with the materials files were also updated. The new values were those adopted during the model calibration process undertaken for a number of the other catchments within the MBRC region.

2.4 Structures

Hydraulic structures, including bridges, footbridges and culverts, were incorporated into the model. Appendix A presents details of all modelled structures and all other structures identified in the Data Assessment Report. Comments regarding specific structures are included in this table.

3 Quality assessment process

3.1 Hydrologic model quality

The hydrologic model quality was reviewed using the following process:

- For the 100yr 1hr and EDS runs, the peak outflow volumes and discharges and the time of peak discharge were mapped across the catchment. A visual inspection of these values was undertaken to ensure that peaks were sensible as flows moved through the system
- For the 100yr 1hr and EDS runs, a graphical review of the hydrographs throughout the system was undertaken to check that timing and volume was sensible as flows moved through the system
- It was assumed that if the 100yr 1hr and EDS runs were sensible, then the model would perform adequately for the remainder of the runs

3.2 Hydraulic model quality

The model quality was assessed using the following process:

- Review of model log to determine:
  - Whether the run was completed or unstable
  - Number of negative depths in the run
  - Whether final and peak cumulative mass error values were less than 1%
- Review of culvert discharges to determine:
  - Whether culverts were stable during the peak of the run
  - Extent of instabilities in low flows
  - Whether run duration was long enough to capture the peak at all structures
- Review of water levels to determine:
  - Whether instabilities were evident (ie whether any “blow ups” existed)
  - Whether the water surface gradients were sensible throughout the system
- Where required, modifications to the models were made to reduce instabilities and the above process was repeated
  - For the culverts, it was not possible to get all culverts stable for all runs, therefore the focus was upon obtaining stability in the peak of the critical events

4 Quality assessment results

4.1 Hydrologic model quality

The hydrologic model was found to be performing well. The following Error! Reference source not found. and Error! Reference source not found. show examples of the model hydrographs within the Cabbage Tree Creek part of the model. These figures show that:

- Between branch KED_04_04260 and KED_04_00000 there is a significant change in shape and volume which is expected as a result of the side tributary inflows
- As expected, discharges in KED_01_03019 are approximately equal to the addition of discharges from branches KED_04_00000 and KED_01_06019, with a slight change in timing resulting from routing along the reach
- Between branches KED_01_03019 and KED_01_00000, the hydrograph shape stays the same, with the timing extended and the volume only slightly increased. This is the expected model response as there are no large tributaries entering the system between these two locations

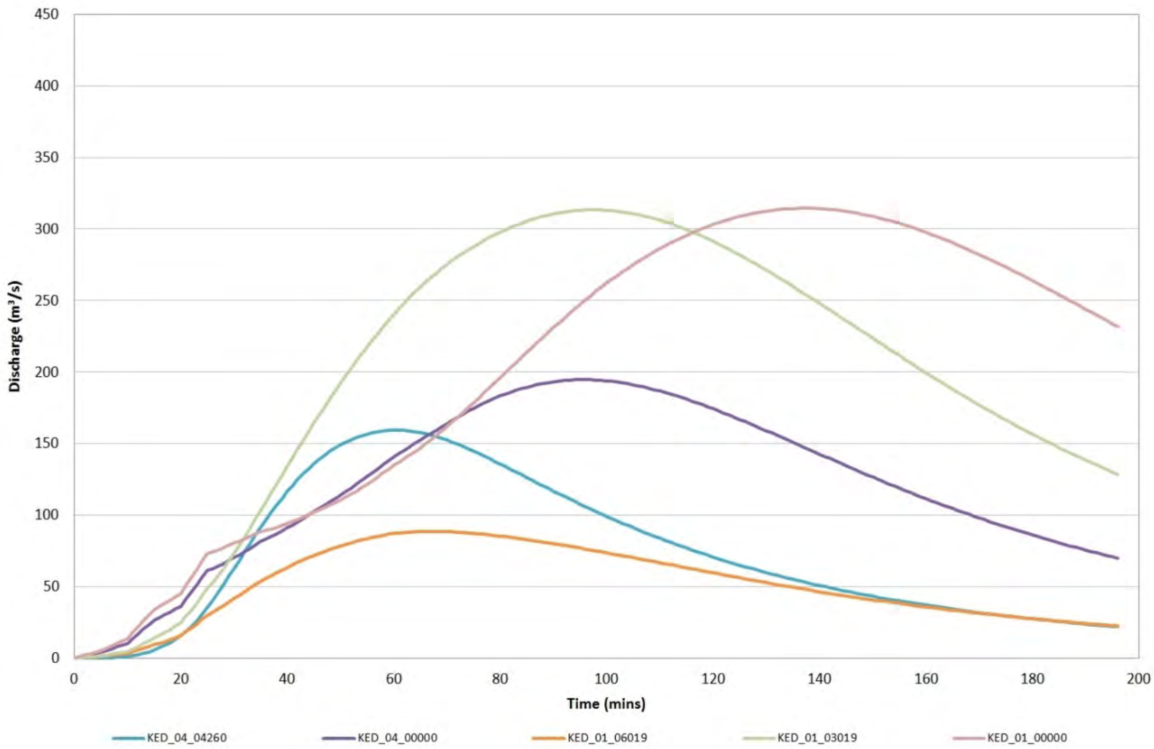


Figure 3 | WBNM 0060m Event Discharges – Kedron Brook

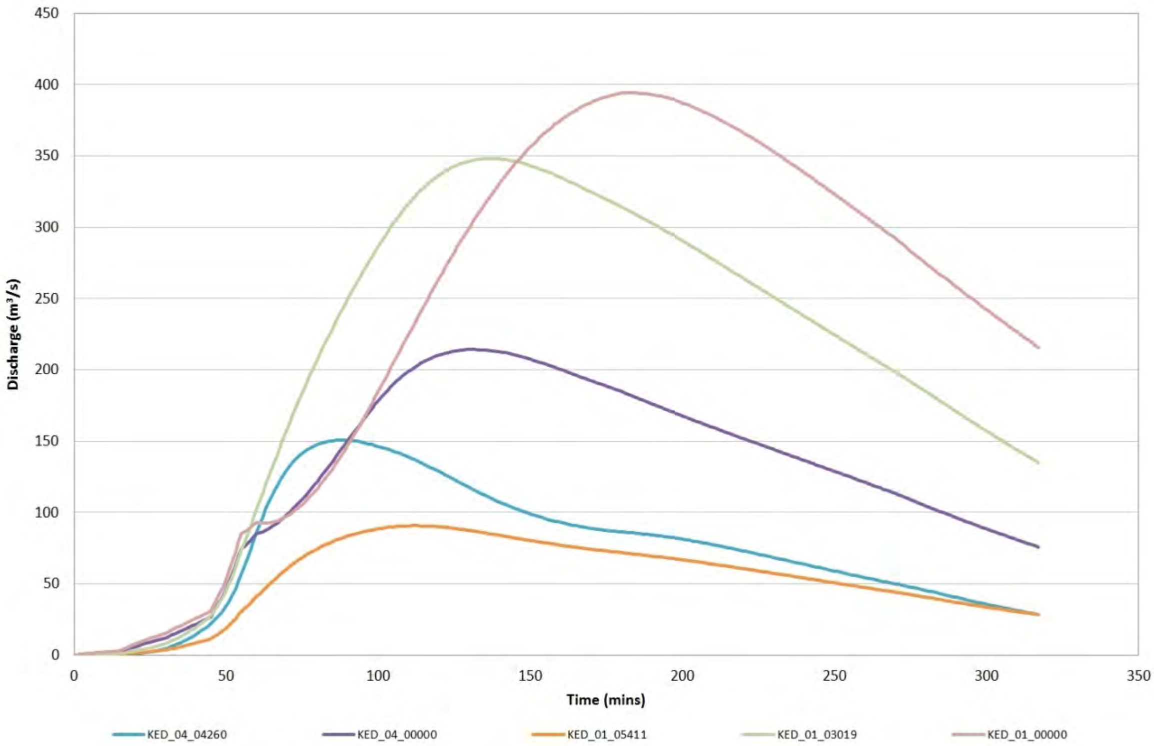


Figure 4 | WBNM EDS Event Discharges – Kedron Brook

A similar process to that described in this report for Cabbage Tree Creek was undertaken across the entire model area and for more frequent locations within each creek. No significant issues were found with model consistency, therefore the WBNM models were considered to be performing well.

4.2 Hydraulic model quality

As discussed below, there are a number of issues with the overall model quality; however there are no specific locations of concern within the model.

4.2.1 Overall stability

The parameters which were used to assess the overall stability results are provided in the table in Appendix B. These results show that:

- No 1D negative depths occur in any of the runs
- Typically there are less than 20 2D negative depths occurring, with a few exceptions in the larger events where up to 120 negative depths occur. There is one sensitivity run with nearly 30,000 2D negative depths which nearly all occur downstream of culvert CTC_02_00075.
- Volume error is within ±1.5%
- Final cumulative mass error is within ±1.5%
- Peak cumulative mass error is high in the initial startup period within the model then reduces and is within ±1.6%

Acceptable mass errors are in the order of ±1.0% and the results obtained for most runs are within or close to this range, indicating that the model is generally performing well. The exception to this is the PMF events in which mass errors of up to ±1.6% are obtained. Whilst these are outside normal acceptable ranges, it was not considered critical that the models be rerun to fix this issue for the extreme event.

4.2.2 Structure data

Many of the Brisbane City Council structures and a number of the MBRC structures within this model are represented using data measured on site. In these cases, the invert levels and/or bridge elevations are based upon reference to the LiDAR data. In comparison to surveyed data, the reliability of this approach is low. It is not expected that representing these structures accurately would significantly impact upon the results; however if a specific area of interest is in close proximity to one or more of these structures consideration should be given to obtaining better information for them.

4.2.3 Structure stability

Stability of model structures was problematic and many configurations of inlet/outlet boundaries and topography were tested. The adopted configuration proved to be the most stable. There are a number of culverts in which stability was not able to be achieved for all runs and for the entire duration of the run. Through this process, the single most unstable 1D structure was converted to a 2D structure to improve stability.

The culvert discharge results for the EDS run are presented in Appendix C. A summary of the culvert results is as follows:

- Stability is generally increased with increased discharge, ie stability issues tend to occur with low flows
- There are a number of culverts which are unstable in low flow conditions but which perform stably throughout the peak of the event
- Generally the culvert discharge and velocity instabilities have very little impact upon water levels both upstream and downstream of the culvert

5 Conclusions

The Brisbane Coastal Creeks detailed modelling has upgraded the broadscale model to a 5 m grid detailed model. This model upgrade has followed the general model setup of the Burpengary Creek (BUR) detailed model.

Changes to the model include:

- Revision of boundary conditions and their locations
- Inclusion of new Zpoints and some minor modifications to these
- Inclusion of materials layers and some minor modifications to these
- Inclusion of structures and associated boundary conditions

The model quality has been assessed through review of the model results for both the hydrologic and hydraulic model. Key findings of the quality assessment are:

- The hydrologic model is performing well
- The hydraulic model is generally performing well, with the following issues being of note
  - Model errors in a number of the PMF events are slightly outside the acceptable norm
  - A number of structures are modelled based upon measurements made on site and referenced to the LiDAR data elevations, the accuracy of these structures could be improved with additional survey but should not significantly affect the model results
  - Structure stability – the stability of the structures has been problematic and whilst stability has been significantly improved, minor instabilities are still occurring at some structures, particularly in low flow conditions

Appendices

Appendix A
Modelled Structures

Structure ID	Waterway ID	Structure Type	Crossing Name	Priority*	Is Structure Modelled?	Data Availability/Source and Comments
KED_01_01913	KED_01_01913	Bridge	Dawson Parade	A	Yes	Brisbane City Council plans
KED_01_01913	KED_01_01913	Bridge	Pedestrian (Jane St)	A	Yes	Brisbane City Council plans
KED_04_00000	KED_04_00000	Bridge	Samford Road	A	Yes	TMR plans
KED_04_00000	KED_04_00000	Bridge	Tramway Street	A	Yes	Site visit and culvert inspection
KED_04_00000	KED_04_00000	Bridge	Ferny Grove Rail Line	A	Yes	QR plans
KED_04_02038	KED_04_02038	Bridge	Upper Kedron Road	A	Yes	Site visit and culvert inspection
KED_04_02038	KED_04_02038	Bridge	Pedestrian	A	Yes	Site visit and culvert inspection
KED_04_03281	KED_04_03281	Bridge	Canvey Road	A	Yes	Site visit and culvert inspection
KED_10_00000	KED_10_00000	Bridge	Hogart Road	A	Yes	Site visit and culvert inspection
KED_16_00000	KED_16_00000	Bridge	Ross Road	A	Yes	Site visit and culvert inspection
KED_28_00000	KED_28_00000	Bridge	Samford Road	A	Yes	TMR plans
KED_28_00000	KED_28_00000	Bridge	Ferny Grove Rail Line	A	Yes	QR plans
KED_99_00515	KED_99_00515	Bridge	Osborne Road	B	Yes	Brisbane City Council plans
KED_99_00786	KED_99_00786	Bridge	Ferny Grove Rail Line	B	Yes	MBRC plans
CTC_01_00000	CTC_01_00000	Culvert	Old Northern Road	A	Yes	TMR plans
CTC_01_01288	CTC_01_01288	Culvert	Collins Road	A	Yes	Site visit and culvert inspection, Irregular culvert
CTC_01_01385	CTC_01_01385	Culvert	Collins Road	A	Yes	Site visit and culvert inspection
CTC_01_01813	CTC_01_01813	Culvert	John Street	A	Yes	Site visit and culvert inspection
CTC_01_02688	CTC_01_02688	Culvert	Francis Road	A	Yes	MBRC RTK GPS
CTC_01_03455	CTC_01_03455	Culvert	Bunya Road	A	Yes	Site visit and culvert inspection

Structure ID	Waterway ID	Structure Type	Crossing Name	Priority*	Is Structure Modelled?	Data Availability/Source and Comments
CTC_01_04319	CTC_01_04319	Culvert	View Crescent	A	Yes	Site visit and culvert inspection
CTC_01_05671	CTC_01_05671	Culvert	Woodhill Road	A	Yes	Site visit and culvert inspection, Irregular culvert
CTC_01_06388	CTC_01_06388	Culvert	Linkwood Drive	A	Yes	Site visit and culvert inspection
CTC_01_06685	CTC_01_06685	Culvert	Woodtop Court	A	Yes	MBRC RTK GPS
CTC_01_07207	CTC_01_07207	Culvert	Ridgewood Court	A	Yes	Site visit and culvert inspection
CTC_02_00075	CTC_02_00075	Culvert	Yingally Drive	A	Yes	Site visit and culvert inspection
CTC_02_00461	CTC_02_00461	Culvert	Woodhill Road	A	Yes	Site visit and culvert inspection
CTC_04_00304	CTC_04_00304	Culvert	Bennetts Road	A	Yes	Site visit and culvert inspection
KED_01_00975	KED_01_00975	Culvert	Pedestrian	A	Yes	Site visit and culvert inspection
KED_01_06019	KED_01_06019	Culvert	Samford Road	A	Yes	Site visit and culvert inspection
KED_01_06294	KED_01_06294	Culvert	Samford Road	A	Yes	TMR plans
KED_01_06294	KED_01_06294	Culvert	Samford Road	A	Yes	Site visit and culvert inspection
	KED_01_07110	Culvert	Samford Road	B	No	
	KED_01_08231	Culvert	Samford Road	B	No	
	KED_01_09303	Culvert	Lanita Road	B	No	
	KED_03_00076	Culvert	Samford Road	B	No	
KED_04_00000	KED_04_00000	Culvert	Samford Road	A	Yes	TMR plans
KED_04_00000	KED_04_00000	Culvert	Samford Road	A	Yes	TMR plans
KED_04_00000	KED_04_00000	Culvert	Samford Road	A	Yes	TMR plans
KED_04_00000	KED_04_00000	Culvert	Samford Road	A	Yes	Site visit and culvert inspection

Structure ID	Waterway ID	Structure Type	Crossing Name	Priority*	Is Structure Modelled?	Data Availability/Source and Comments
KED_04_00000	KED_04_00000	Culvert	Ferny Grove Rail Line	A	Yes	QR plans
KED_04_00000	KED_04_00000	Culvert	Ferny Grove Rail Line	A	Yes	QR plans
KED_04_05168	KED_04_05168	Culvert	Millwood Place	A	Yes	Site visit and culvert inspection
	KED_05_00166	Culvert	Samford Road	B	No	
	KED_07_00155	Culvert	Samford Road	B	No	
KED_08_00000	KED_08_00000	Culvert	Canvey Road	A	Yes	Site visit and culvert inspection
	KED_08_00000	Culvert	Cedar Creek Road	B	No	
KED_09_00000	KED_09_00000	Culvert	Woolshed Street	A	Yes	Site visit and culvert inspection
KED_09_00227	KED_09_00227	Culvert	Samford Road	A	Yes	Site visit and culvert inspection
KED_10_00000	KED_10_00000	Culvert	McAlroy Road	A	Yes	Site visit and culvert inspection
	KED_10_00404	Culvert	Selkirk Crescent	B	No	
KED_11_00059	KED_11_00059	Culvert	Samford Road	A	Yes	TMR plans
KED_12_00000	KED_12_00000	Culvert	Selkirk Crescent	A	Yes	Site visit and culvert inspection
	KED_12_00000	Culvert	McGinn Road	B	No	
KED_14_00000	KED_14_00000	Culvert	Ross Road	A	Yes	Site visit and culvert inspection
KED_28_00000	KED_28_00000	Culvert	Avington Street	A	Yes	Site visit and culvert inspection
KED_28_01009	KED_28_01009	Culvert	Glengarry Road	A	Yes	Site visit and culvert inspection
KED_32_00000	KED_32_00000	Culvert	Duggan Street	A	Yes	Site visit and culvert inspection

** As identified in the Data Assessment Report*

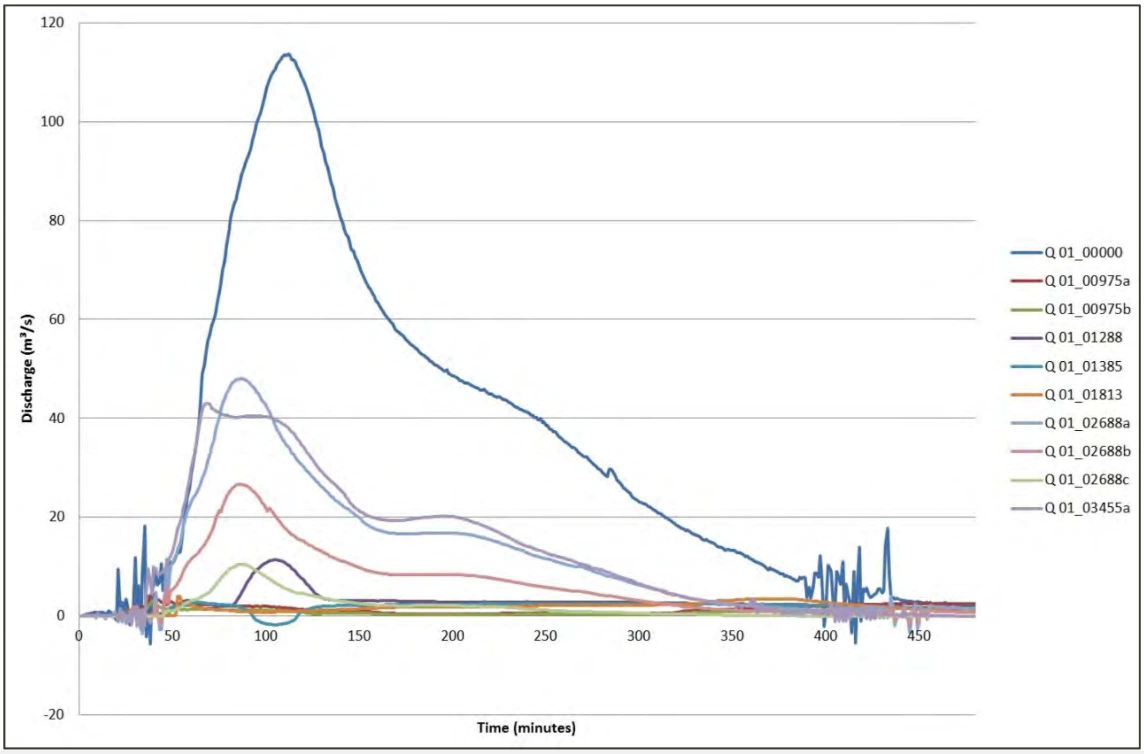
Appendix B
Overall Stability Results

Simulation	Total 1D Negative Depths	Total 2D Negative Depths	WARNINGs prior to simulation	WARNINGs during simulation	Volume Error (m3)	Final Cumulative ME	Peak Cumulative ME when Qi+Qo > 5%
00001Y_0060m	0	0	14	0	19865 or 0.9%	0.89%	0.89% at 6.00h
00001Y_0120m	0	1	14	1	25993 or 0.9%	0.92%	0.92% at 6.00h
00001Y_0180m	0	1	14	1	31279 or 0.9%	0.94%	0.94% at 8.00h
00002Y_0060m	0	0	14	0	26720 or 0.9%	0.88%	0.88% at 6.00h
00002Y_0120m	0	5	14	5	31466 or 0.8%	0.82%	0.82% at 6.00h
00002Y_0180m	0	0	14	0	35855 or 0.8%	0.80%	0.79% at 7.74h
00005Y_0060m	0	1	14	1	36631 or 0.9%	0.87%	0.87% at 5.88h
00005Y_0120m	0	4	14	4	50733 or 1.0%	0.95%	0.95% at 5.97h
00005Y_0180m	0	1	14	1	59318 or 1.0%	0.96%	0.95% at 7.47h
00010Y_0010m	0	0	14	0	12697 or 0.7%	0.75%	0.71% at 5.24h
00010Y_0015m	0	0	14	0	19013 or 0.8%	0.85%	0.81% at 5.15h
00010Y_0030m	0	2	14	2	28095 or 0.8%	0.82%	0.79% at 5.31h
00010Y_0045m	0	1	14	1	37240 or 0.9%	0.87%	0.86% at 5.70h
00010Y_0060m	0	12	14	12	46567 or 0.9%	0.94%	0.94% at 5.74h
00010Y_0090m	0	3	14	3	58220 or 1.0%	1.02%	1.02% at 5.86h
00010Y_0120m	0	1	14	1	70025 or 1.1%	1.12%	1.12% at 6.00h
00010Y_0180m	0	10	14	10	81791 or 1.1%	1.12%	1.11% at 7.22h
00010Y_0270m	0	1	14	1	85547 or 1.1%	1.06%	1.06% at 8.00h
00010Y_0360m	0	3	14	3	92172 or 1.0%	1.03%	1.02% at 9.79h
00010Y_0540m	0	15	14	15	79874 or 0.8%	0.81%	0.79% at 11.80h
00010Y_0720m	0	11	14	11	91991 or 0.9%	0.87%	0.85% at 11.53h
00010Y_1080m	0	8	14	8	178950 or 0.9%	0.85%	0.87% at 7.94h
00010Y_1440m	0	0	14	0	202106 or 0.9%	0.88%	0.94% at 9.66h
00010Y_1800m	0	1	14	1	249537 or 1.0%	1.02%	1.11% at 16.10h
00010Y_2160m	0	11	14	11	128153 or 0.9%	0.87%	0.95% at 12.06h
00010Y_2880m	0	5	14	5	143356 or 0.9%	0.94%	0.95% at 45.45h
00010Y_4320m	0	11	14	11	133785 or 0.8%	0.80%	0.94% at 9.83h
00020Y_0060m	0	3	14	3	67283 or 1.1%	1.14%	1.13% at 5.60h
00020Y_0120m	0	17	14	17	79852 or 1.1%	1.07%	1.07% at 6.00h
00020Y_0180m	0	5	14	5	93229 or 1.1%	1.07%	1.06% at 7.23h
00050Y_0060m	0	35	14	35	70662 or 1.0%	0.97%	0.97% at 5.68h
00050Y_0120m	0	10	14	10	82083 or 0.9%	0.90%	0.90% at 6.00h
00020Y_0180m	0	3	14	3	97615 or 0.9%	0.92%	0.91% at 7.29h

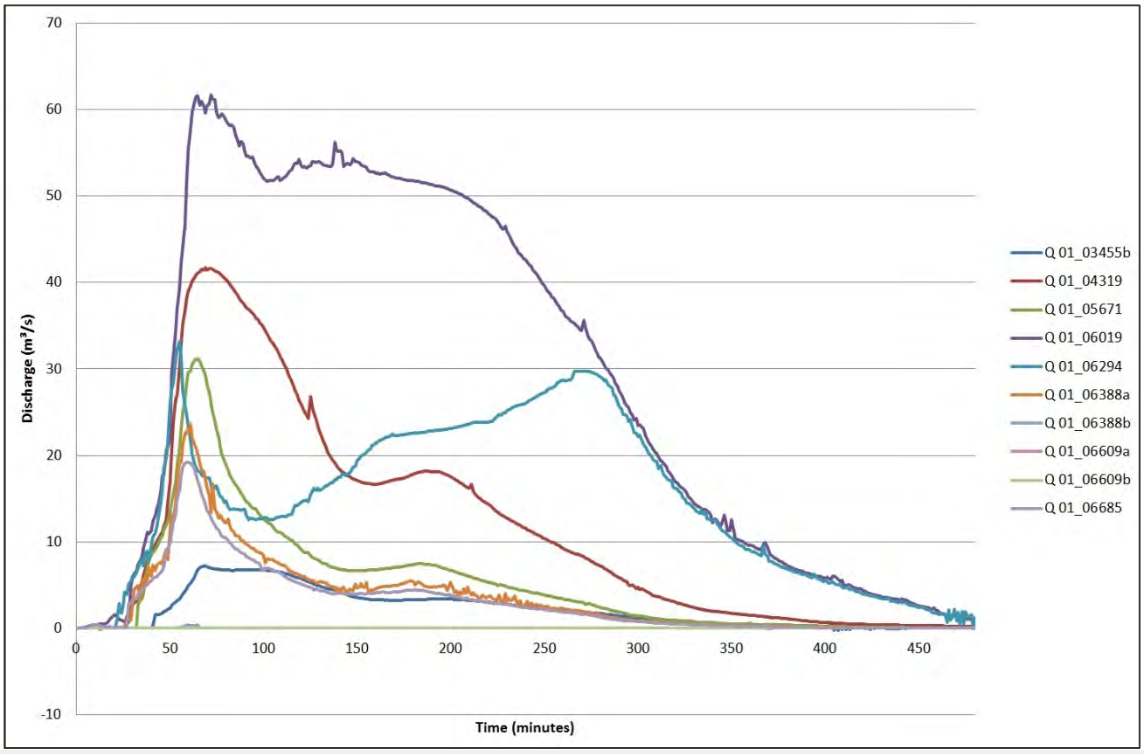
Simulation	Total 1D Negative Depths	Total 2D Negative Depths	WARNINGs prior to simulation	WARNINGs during simulation	Volume Error (m3)	Final Cumulative ME	Peak Cumulative ME when Qi+Qo > 5%
00100Y_0010m	0	6	14	6	24517 or 0.9%	0.86%	0.82% at 4.78h
00100Y_0015m	0	16	14	16	29592 or 0.8%	0.79%	0.76% at 4.91h
00100Y_0030m	0	11	14	11	59991 or 1.1%	1.05%	1.04% at 5.20h
00100Y_0045m	0	45	14	45	69764 or 1.0%	0.98%	0.97% at 5.35h
00100Y_0060m	0	20	14	20	73954 or 0.9%	0.89%	0.88% at 5.46h
00100Y_0090m	0	10	14	10	81386 or 0.9%	0.85%	0.85% at 5.85h
00100Y_0120m	0	17	14	17	83870 or 0.8%	0.80%	0.80% at 6.00h
00100Y_0180m	0	13	14	13	98983 or 0.8%	0.82%	0.81% at 7.28h
00100Y_0270m	0	16	14	16	118269 or 0.9%	0.87%	0.87% at 8.00h
00100Y_0360m	0	5	14	5	137991 or 0.9%	0.92%	0.92% at 9.83h
00100Y_0540m	0	6	14	6	187463 or 1.1%	1.12%	1.11% at 11.79h
00100Y_0720m	0	6	14	6	179253 or 1.0%	0.99%	0.97% at 14.27h
00100Y_1080m	0	8	14	8	178950 or 0.9%	0.85%	0.87% at 7.94h
00100Y_1440m	0	0	14	0	202106 or 0.9%	0.88%	0.94% at 9.66h
00100Y_1800m	0	1	14	1	249537 or 1.0%	1.02%	1.11% at 16.10h
00100Y_2160m	0	15	14	15	257369 or 1.0%	0.99%	1.03% at 10.32h
00100Y_2880m	0	9	14	9	258163 or 0.9%	0.93%	1.04% at 11.15h
00100Y_4320m	0	6	14	6	24517 or 0.9%	0.86%	0.82% at 4.78h
00200Y_0030m	0	57	14	57	67438 or 1.0%	1.03%	1.01% at 5.01h
00200Y_0090m	0	10	14	10	84921 or 0.7%	0.67%	0.67% at 5.87h
00200Y_0180m	0	7	14	7	106156 or 0.8%	0.75%	0.75% at 7.34h
00500Y_0030m	0	32	14	32	71124 or 0.9%	0.92%	0.90% at 4.98h
00500Y_0090m	0	118	14	118	164346 or 1.1%	1.09%	1.09% at 5.71h
00500Y_0180m	0	34	14	34	196163 or 1.2%	1.17%	1.16% at 7.15h
01000Y_0030m	0	0	14	0	38900 or 0.5%	0.45%	0.42% at 4.81h
01000Y_0090m	0	0	14	0	34924 or 0.2%	0.21%	0.20% at 5.63h
01000Y_0180m	0	3	14	3	43341 or 0.2%	0.23%	0.22% at 7.05h
02000Y_0030m	0	1	14	1	39566 or 0.4%	0.41%	0.37% at 4.77h
02000Y_0090m	0	2	14	2	37920 or 0.2%	0.21%	0.19% at 5.56h
02000Y_0180m	0	1	14	1	42663 or 0.2%	0.21%	0.19% at 7.01h
PMF_0015m	0	41	14	41	33822 or 0.2%	0.21%	0.15% at 4.19h
PMF_0030m	0	29	14	29	59983 or 0.3%	0.27%	0.22% at 4.43h
PMF_0045m	0	44	14	44	154610 or 0.4%	0.44%	0.44% at 6.00h

Simulation	Total 1D Negative Depths	Total 2D Negative Depths	WARNINGs prior to simulation	WARNINGs during simulation	Volume Error (m3)	Final Cumulative ME	Peak Cumulative ME when Qi+Qo > 5%
PMF_0060m	0	71	14	74	175423 or 0.4%	0.43%	0.43% at 6.00h
PMF_0090m	0	84	14	84	504018 or 0.9%	0.94%	0.94% at 3.07h
PMF_0120m	0	120	14	120	842354 or 1.3%	1.31%	1.41% at 3.48h
PMF_0150m	0	109	14	109	1029291 or 1.4%	1.36%	1.47% at 3.80h
PMF_0180m	0	47	14	47	1213716 or 1.4%	1.44%	1.56% at 4.15h
PMF_0240m	0	18	14	18	1377364 or 1.5%	1.47%	1.60% at 4.74h
PMF_0300m	0	5	14	5	1553738 or 1.5%	1.49%	1.64% at 5.27h
PMF_0360m	0	5	14	5	1403291 or 1.3%	1.31%	1.47% at 5.60h
PMF_0720m_ GSDM	0	29	14	29	521290 or 0.5%	0.46%	0.46% at 17.00h
PMF_1440m	0	1	14	1	203543 or 0.2%	0.22%	0.22% at 4.50h
PMF_2160m	0	0	14	0	312159 or 0.3%	0.28%	0.37% at 20.06h
PMF_2880m	0	6	14	6	358267 or 0.3%	0.27%	0.37% at 16.80h
PMF_4320m	0	5	14	5	476832 or 0.3%	0.29%	0.28% at 72.79h
00100Y_EDS	0	9	14	9	110471 or 0.8%	0.81%	0.81% at 7.77h
00100Y_EDS_S2	0	29174	14	29174	64069 or 0.5%	0.47%	0.47% at 8.00h
00100Y_EDS_S3	0	180	14	180	139796 or 1.0%	1.03%	1.03% at 7.85h
00100Y_EDS_S4	0	11	14	11	122289 or 0.8%	0.80%	0.79% at 7.88h
00100Y_EDS_S5	0	13	14	13	60417 or 0.4%	0.42%	0.48% at 0.00h
00100Y_EDS_S6	0	10	14	10	65504 or 0.4%	0.40%	0.48% at 0.00h
00100Y_EDS_S7							
00100Y_EDS_S8							
00100Y_EDS_S9							
00100Y_EDS_ S10	0	34	14	34	59971 or 0.4%	0.45%	0.45% at 8.00h
00100Y_EDS_ S11	0	8	14	8	110844 or 0.8%	0.81%	0.81% at 7.75h
00100Y_EDS_ S12	0	31	14	31	60235 or 0.4%	0.45%	0.45% at 8.00h

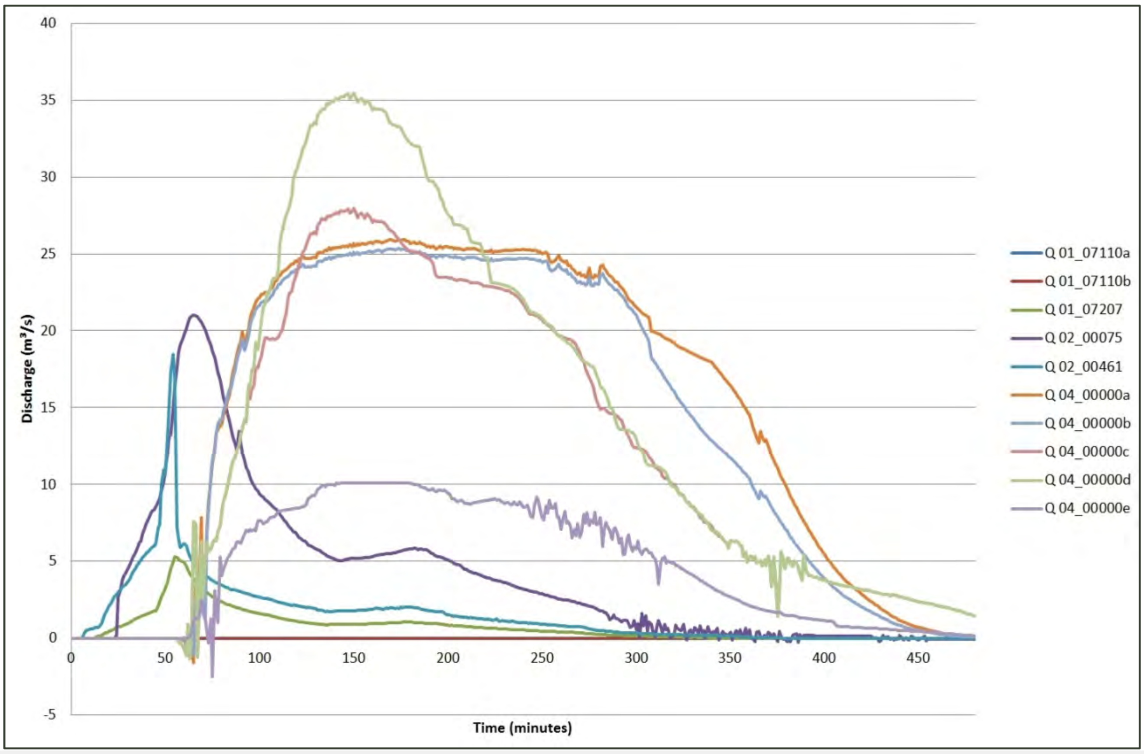
Appendix C
EDS Culvert Discharge Graphs



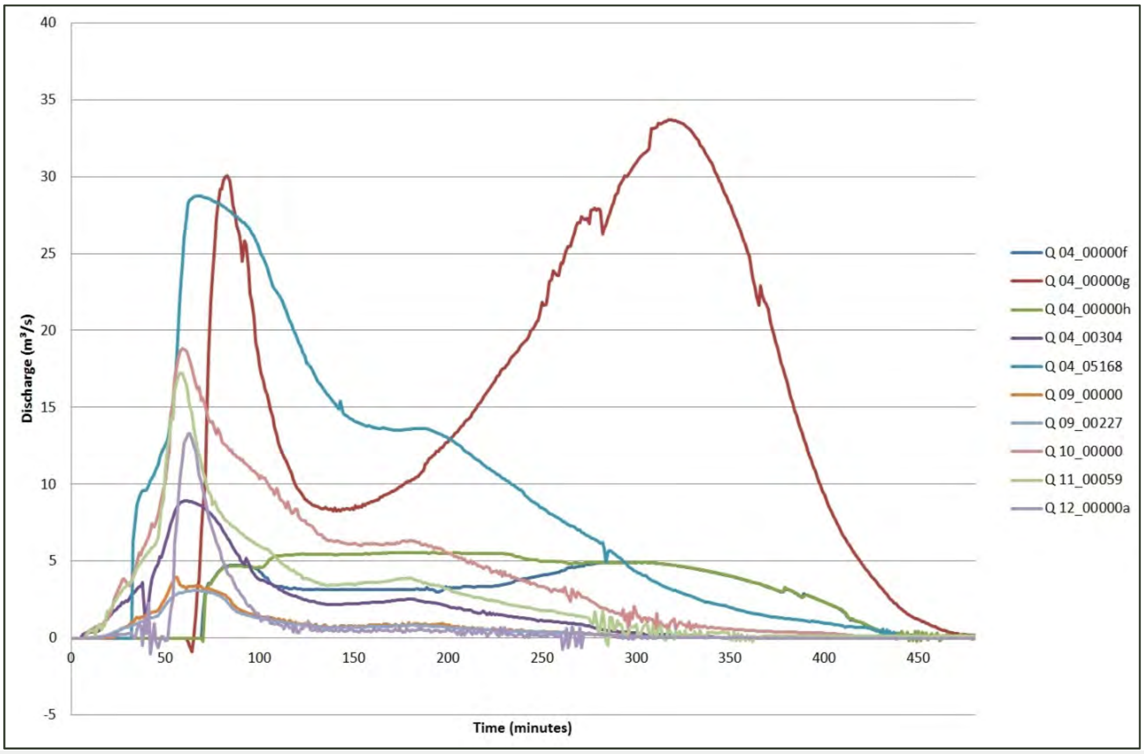
BCC Culvert Discharge Results - Chart 1



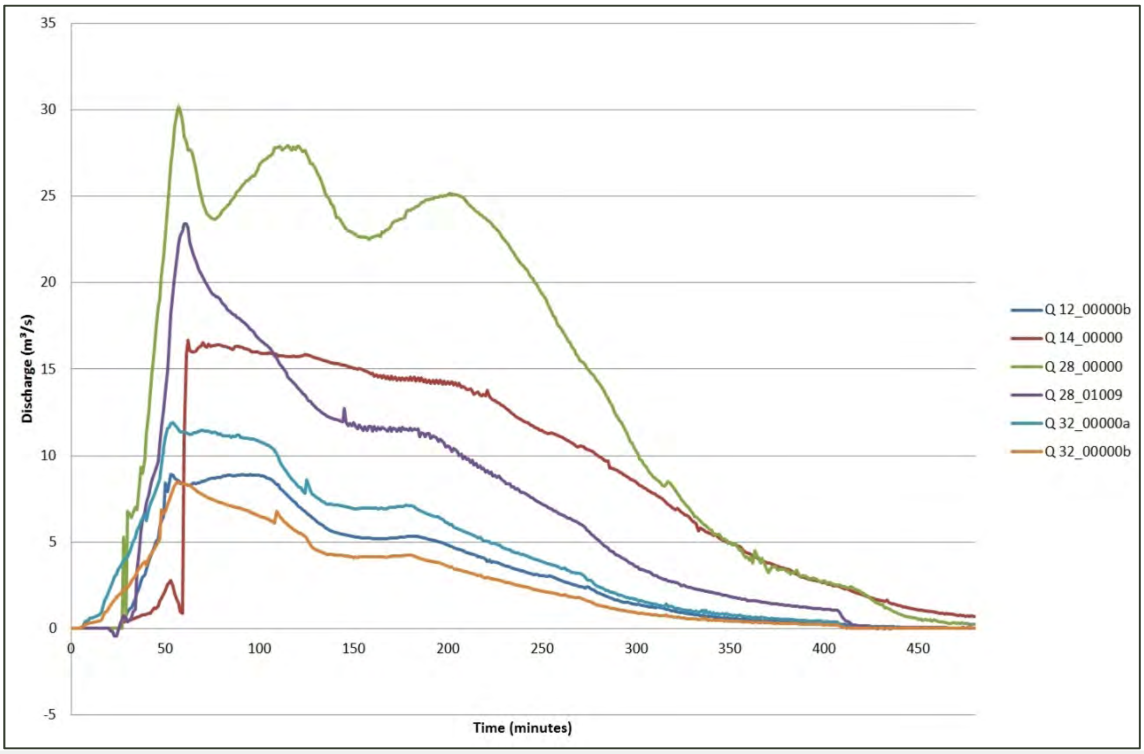
BCC Culvert Discharge Results – Chart 2



BCC Culvert Discharge Results – Chart 3



BCC Culvert Discharge Results – Chart 4



BCC Culvert Discharge Results – Chart 5

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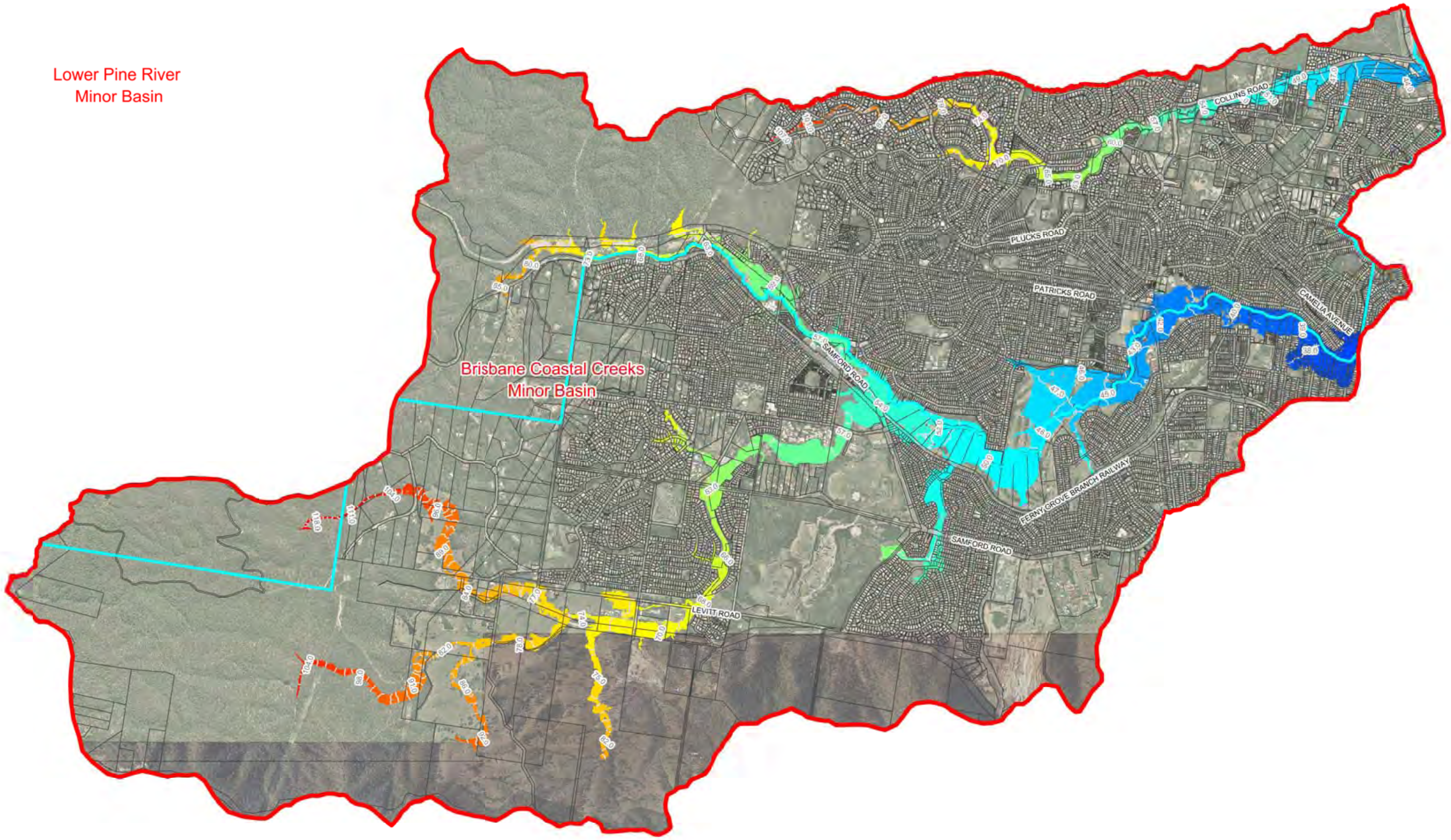
Appendix E
Flood Maps – 100 Year ARI

Appendix E
Flood Maps – 100 Year ARI



aurecon

Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary
- Contour Line (m AHD)

100 Year ARI Peak Flood level (m AHD)

>110.0
90.0
70.0
50.0
30.0

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

Map by: DJF P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_E1_WSL_100Y.wor

A3 scale 1:40,000

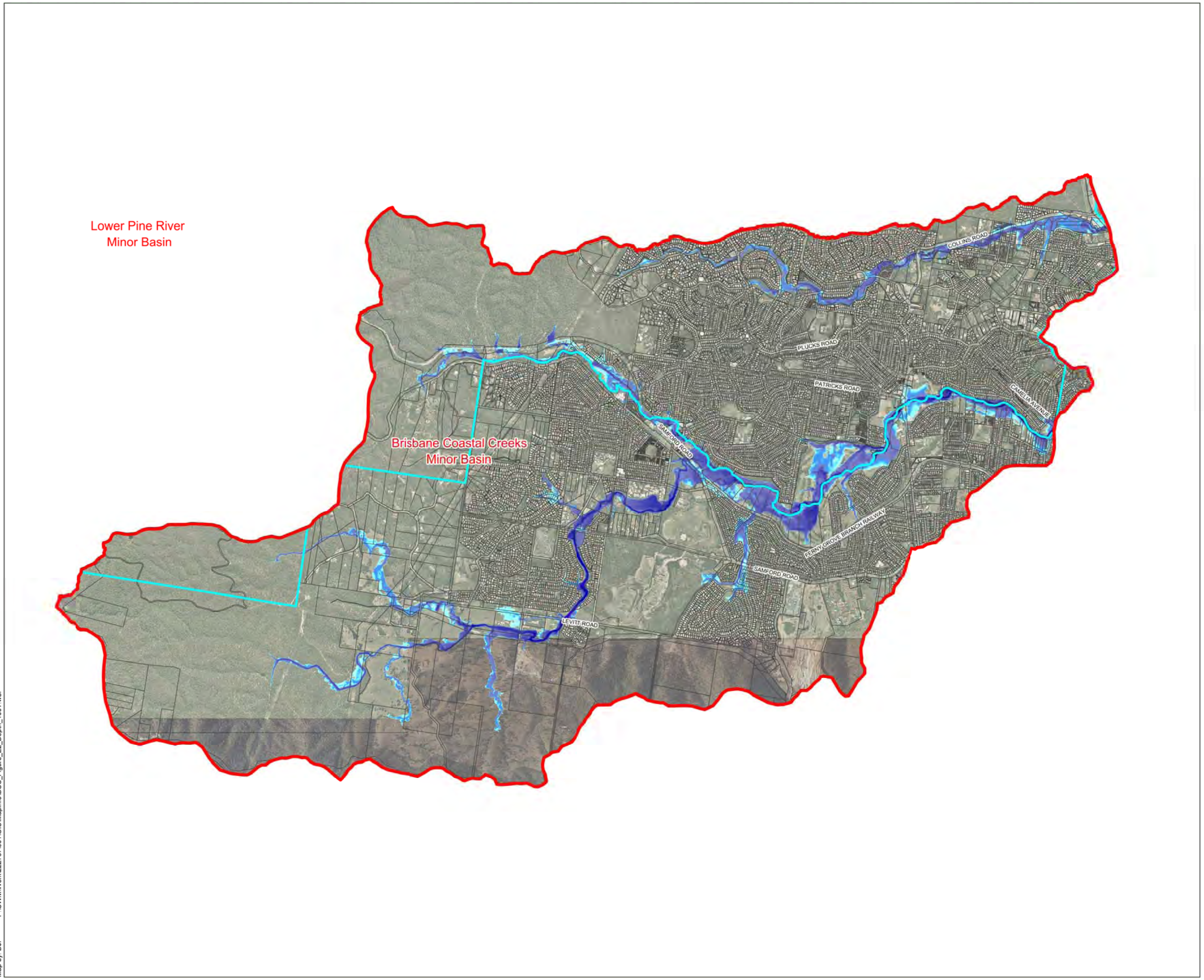
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure E1: Peak Flood Level Map - 100 Year ARI



aurecon

Legend

Cadastre

Minor Basin Boundaries

MBRC/BCC Boundary

100 Year ARI Peak Flood Depth (m)

>4.0

3.0

2.0

1.0

0.0

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

Map by: DJF   P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_E2_Depth_100Y.wor

A3 scale 1:40,000

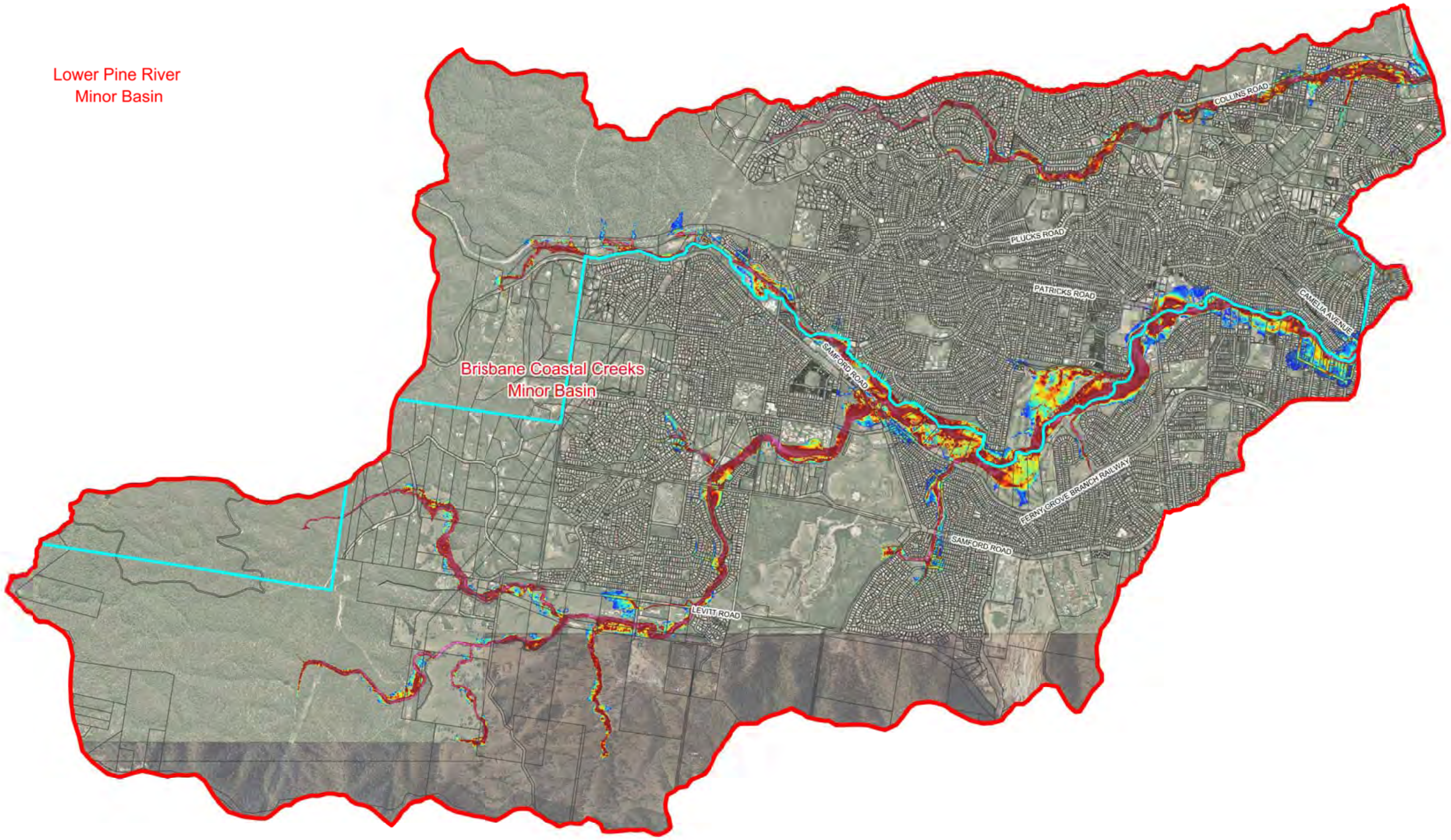
0   1000 m   2,000 m

Date: 12/10/2012   Version: 0   Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure E2: Peak Flood Depth Map - 100 Year ARI



Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

100 Year ARI Peak Flood Velocity (m/s)

>6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

Map by: DJF P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_E3_Velcoity_100Y_rev0.wor

A3 scale 1:40,000

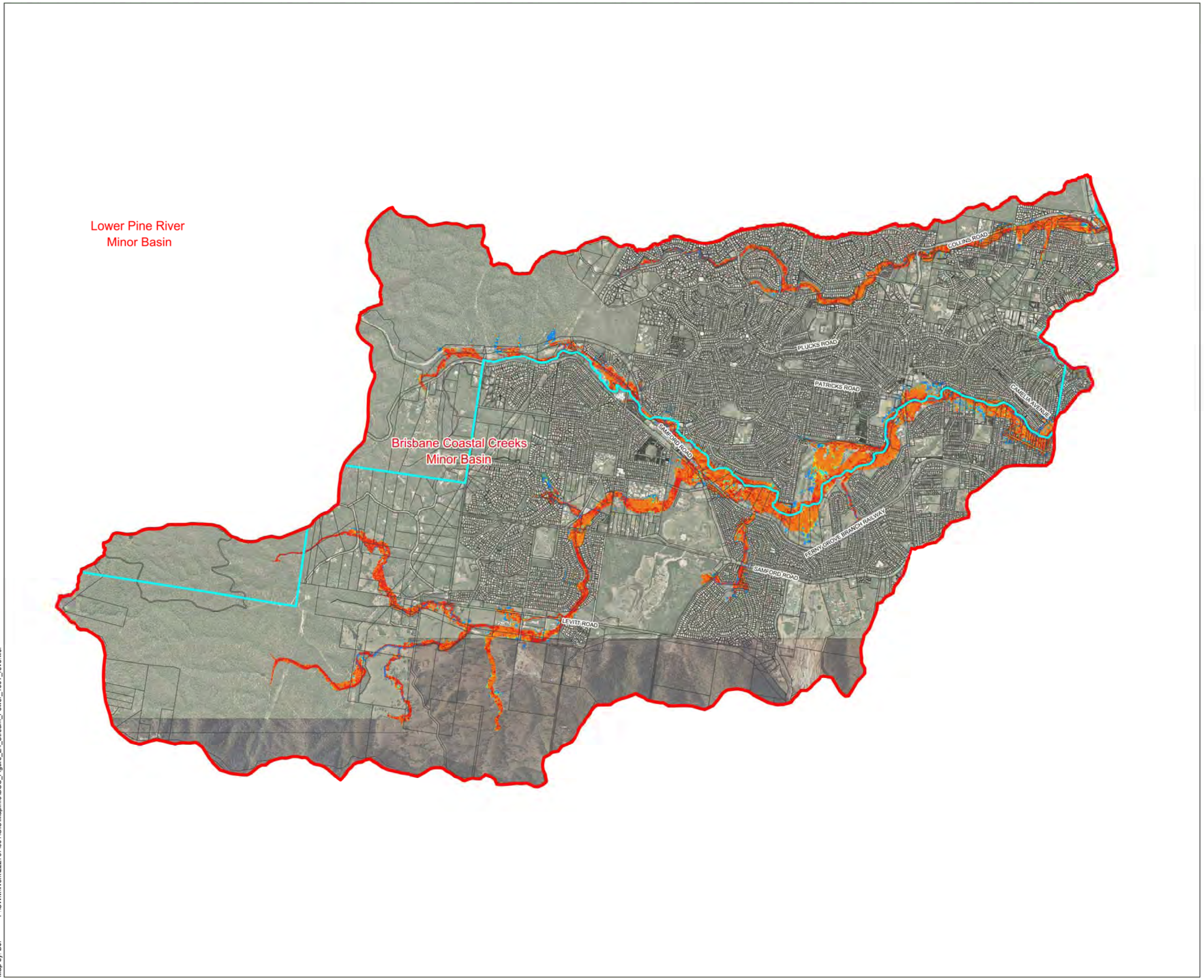
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure E3: Peak Flood Velocity Map - 100 Year ARI



Map by: DJF P:\SWMIWork\222767\001\GIS\MapInfo\BCC_Figure_E4_Stream_Power_100Y_rev0.wor

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Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

100 Year ARI Peak Stream Power

>500
10
5
3
0

Notes:

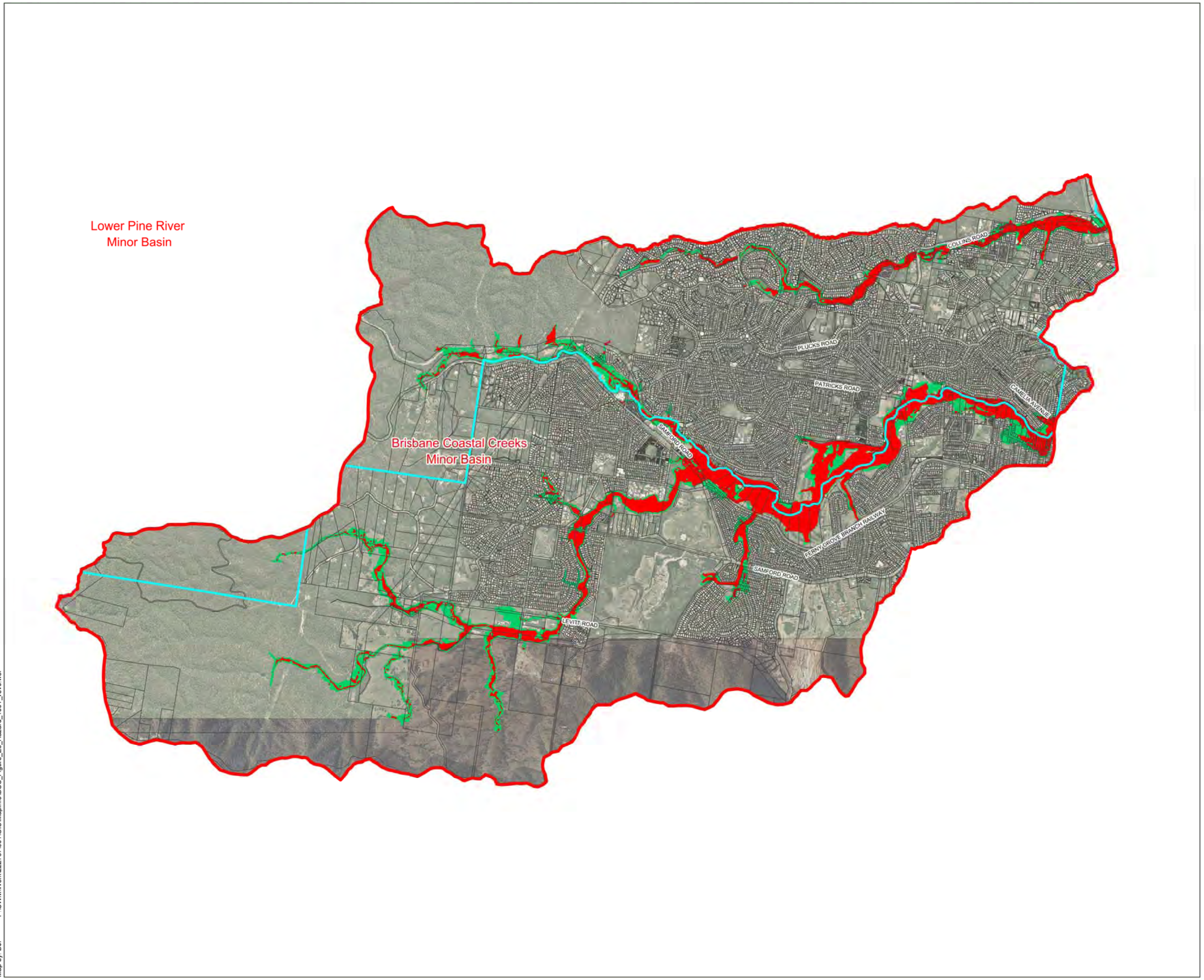
This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

A3 scale 1:40,000
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767
Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure E4: Stream Power Map - 100 Year ARI



Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

New South Wales Floodplain Development
Manual Flood Hazard Category
100 Year ARI Event

- Low Hazard
- High Hazard

Notes:

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Map by: DJF P:\SWMWork\222767\001\GIS\MapInfo\BCC_Figure_E5_Hazard_100Y_rev0.wor

A3 scale 1:40,000

0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure E5: Peak Flood Hazard Map - 100 Year ARI

Appendix F
Model Sensitivity Analysis Maps

Appendix F
Model Sensitivity Analysis Maps

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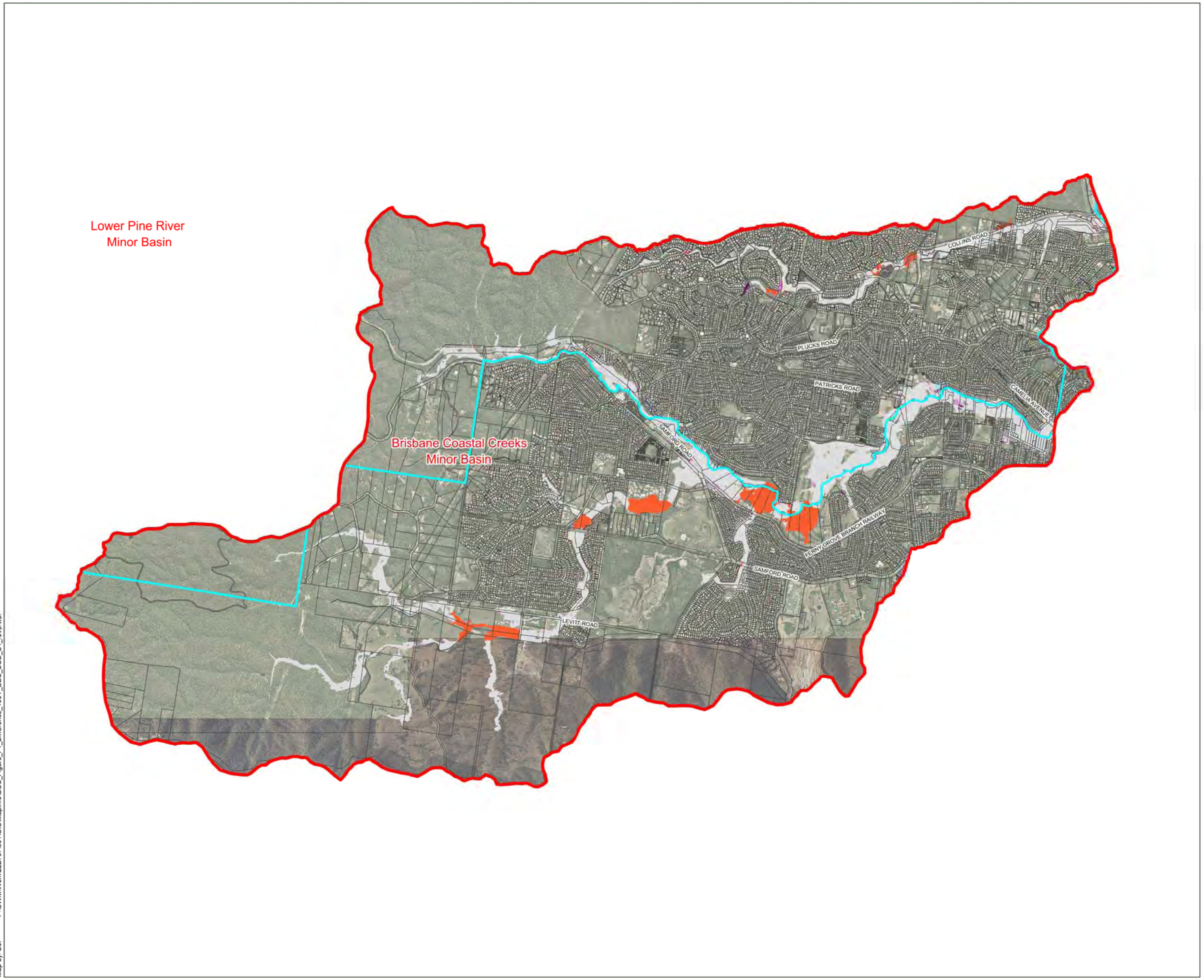


Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows selected critical durations peak water level minus EDS peak water level

Map by: DJF P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_F1_Difference_100Y_EDS_SCD_S1_rev0.wor

A3 scale 1:40,000

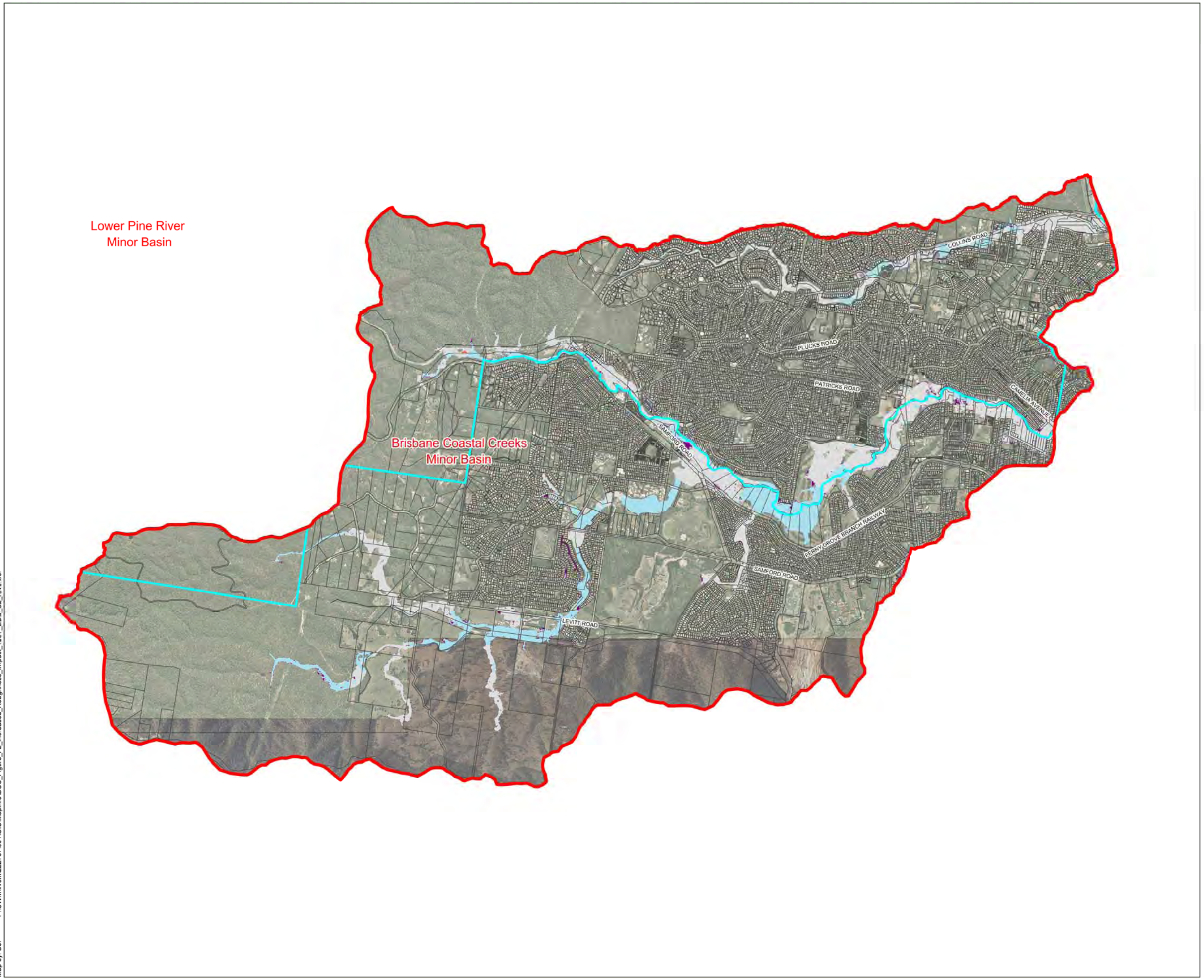
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F1: Peak Flood Level Difference between EDS and Selected Critical Storm Durations - 100 Year ARI (S1)



aurecon

Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in roughness peak water level minus EDS peak water level

Map by: DJF P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_F2_Increased_Roughness_Impact_100Y_EDS_S2_rev0.wor

A3 scale 1:40,000

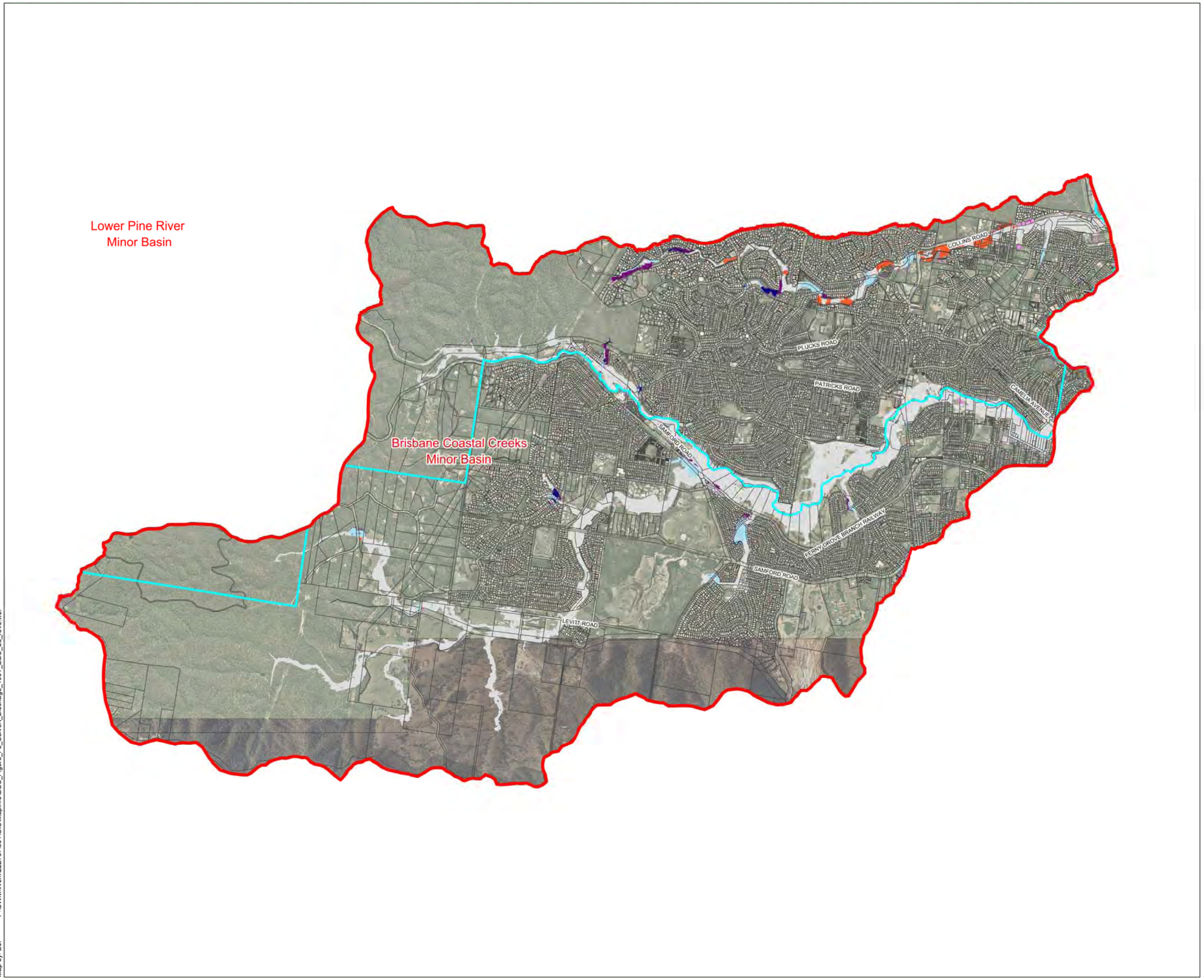
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F2: Increase in Roughness Flood Level Impact 100 Year ARI (S2)



aurecon

Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows structure blockage peak water level minus EDS peak water level

Map by: DJF P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_F3_Culvert_Blockage_100Y_EDS_S3_rev0.wor

A3 scale 1:40,000

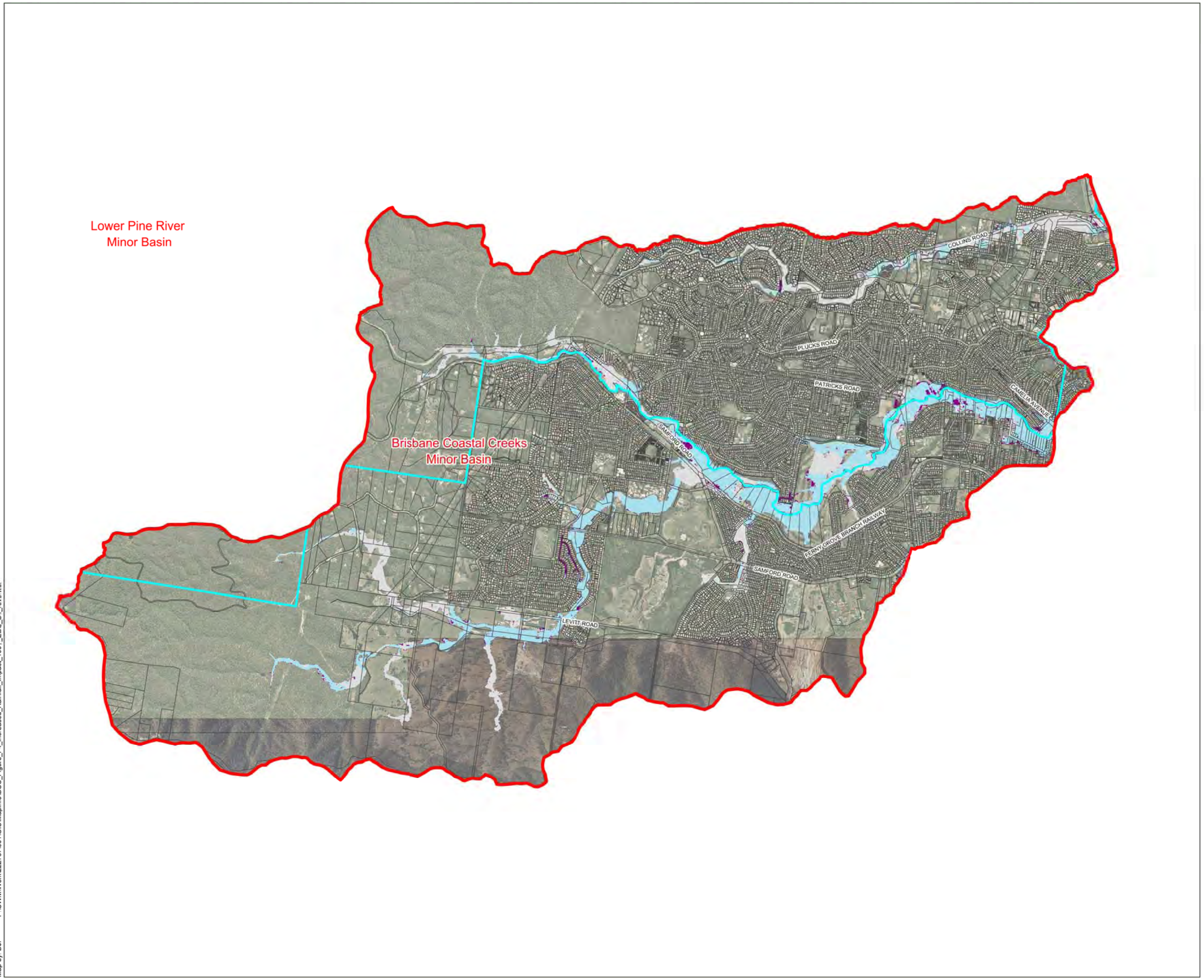
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F3: Structure Blockage Flood Level Impact 100 Year EDS (S3)



Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in rainfall peak water level minus EDS peak water level

Map by: DJF P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_F4_Increased_Rainfall_Impact_100Y_EDS_S4_rev0.wor

A3 scale 1:40,000

0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F4: Increase in Rainfall Flood Level Impact 100 Year EDS (S4)

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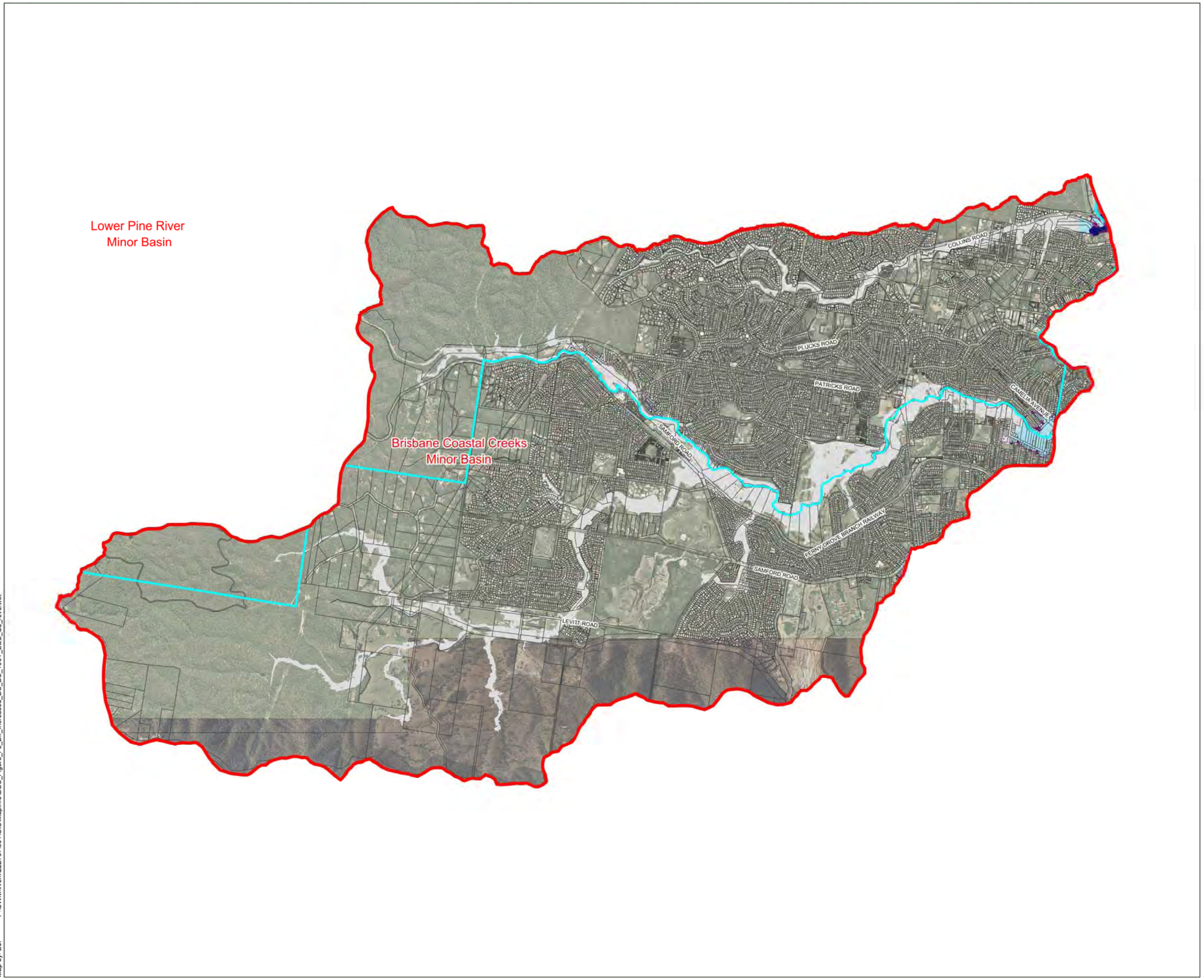


Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in downstream boundary peak water level minus EDS peak water level

Map by: DJF   P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_F5_Dif_Increased_DS_BC_100Y_EDS_S5_rev0.wor

A3 scale 1:40,000

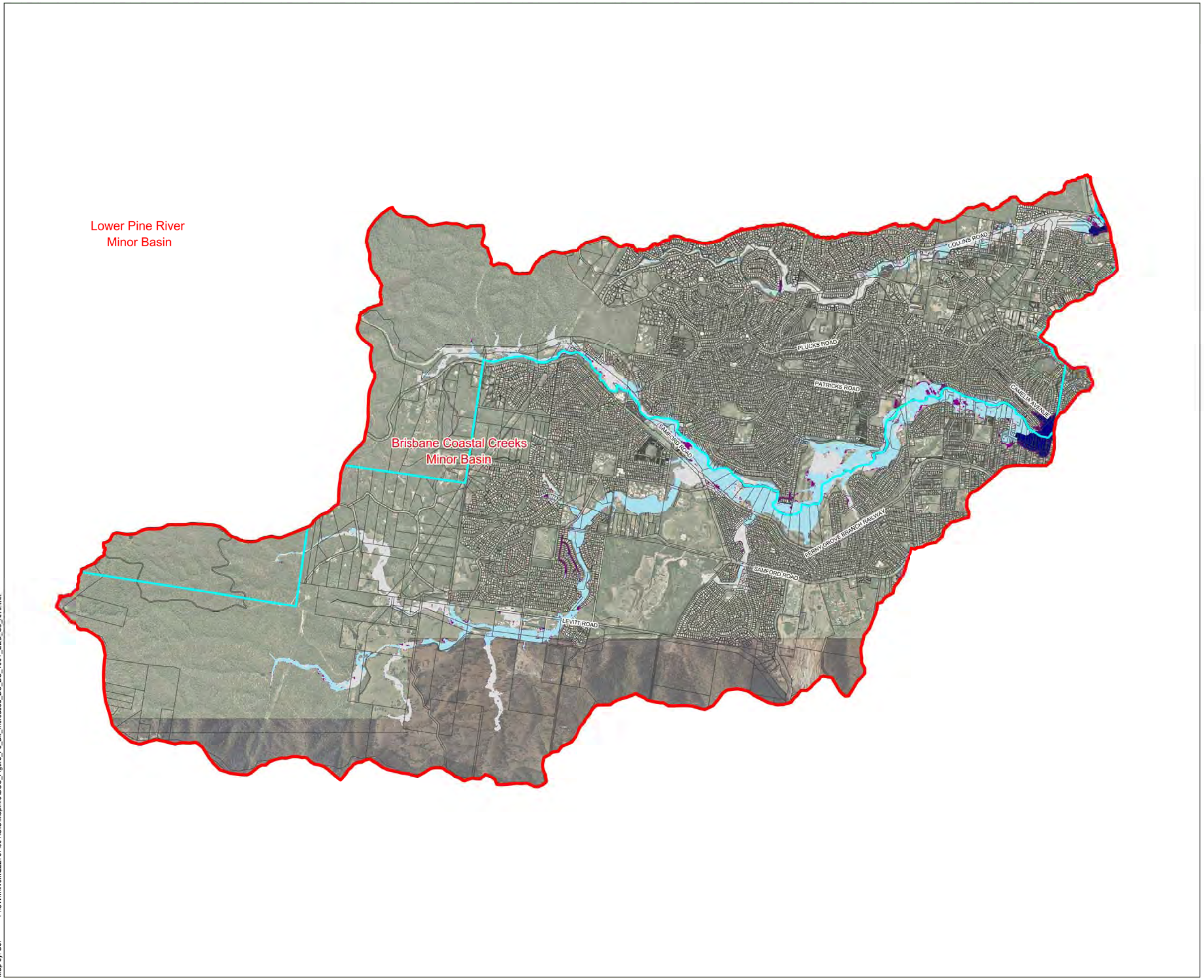
0   1000 m   2,000 m

Date: 12/10/2012   Version: 0   Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F5: Increase in Downstream Boundary Flood Level Impact 100 Year EDS (S5)



aurecon

Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in rainfall & downstream boundary peak water level minus EDS peak water level

Map by: DJF P:\SWMWork\222767\001\GIS\MapInfo\BCC_Figure_F6_Dif_Increased_DS_BC_100Y_EDS_S6_rev0.wor

A3 scale 1:40,000

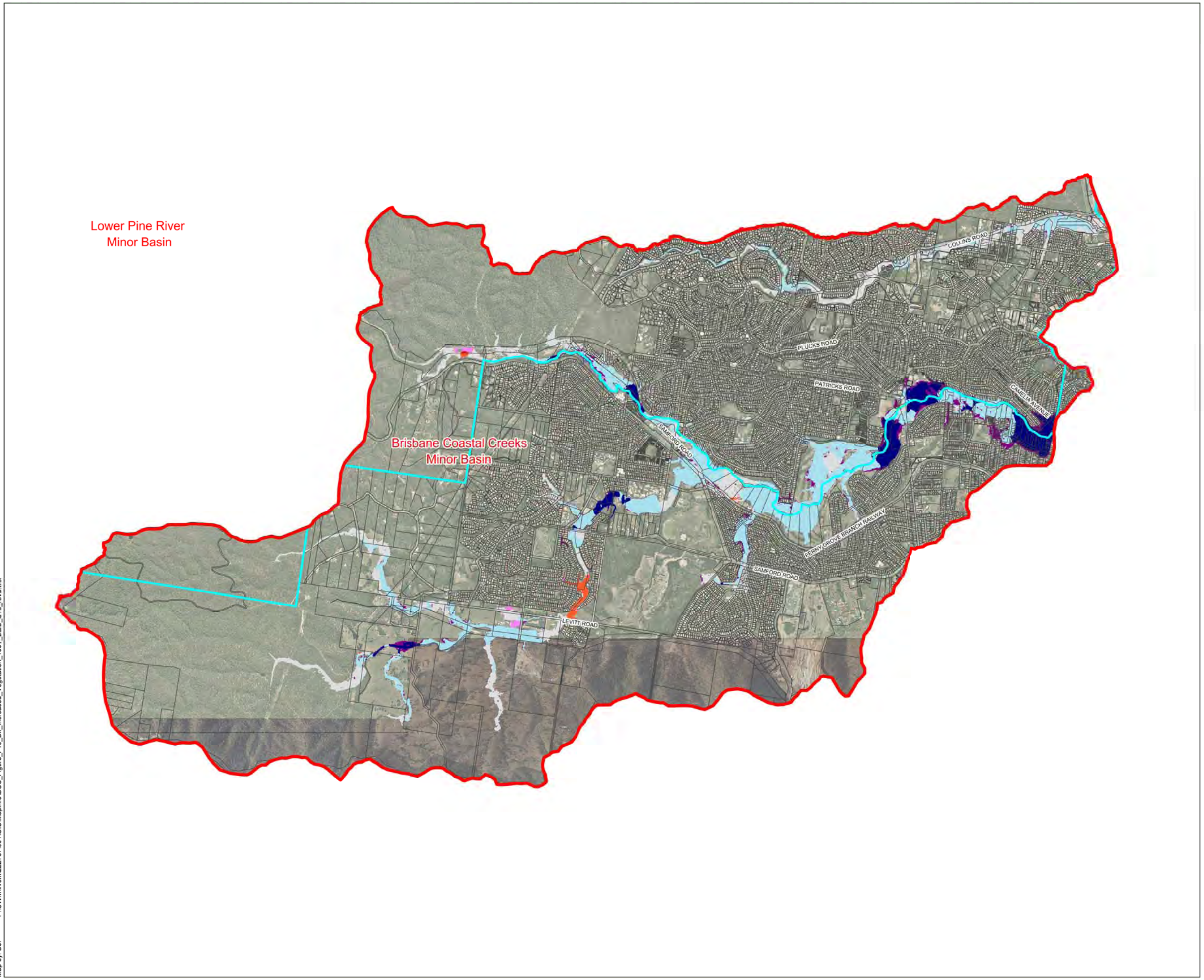
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F6: Increase in Rainfall & Downstream Boundary Flood Level Impact 100 Year EDS (S6)



aurecon

Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in vegetation peak water level minus EDS peak water level

Map by: DJF P:\SWMIWork\222767\001\GIS\MapInfo\BCC_Figure_F10_Dif_Increased_Vegetation_100Y_EDS_S10_rev0.wor

A3 scale 1:40,000

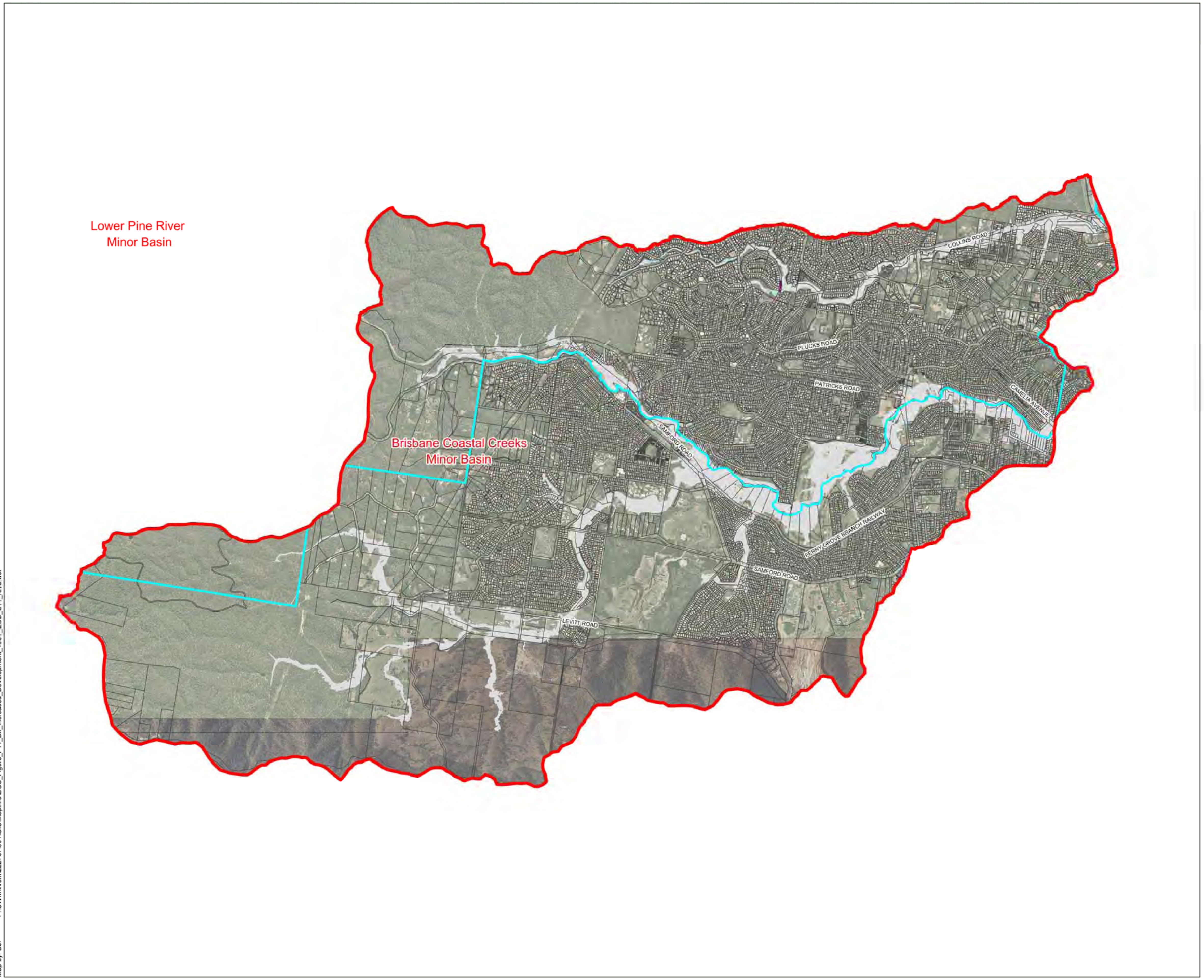
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F10: Increase in Vegetation Flood Level Impact 100 Year EDS (S10)



aurecon

Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in residential development peak water level minus EDS peak water level

Map by: DJF P:\SWMI\Work\222767\001\GIS\MapInfo\BCC_Figure_F11_Dif_Increased_Development_100Y_EDS_S11_rev0.wor

A3 scale 1:40,000

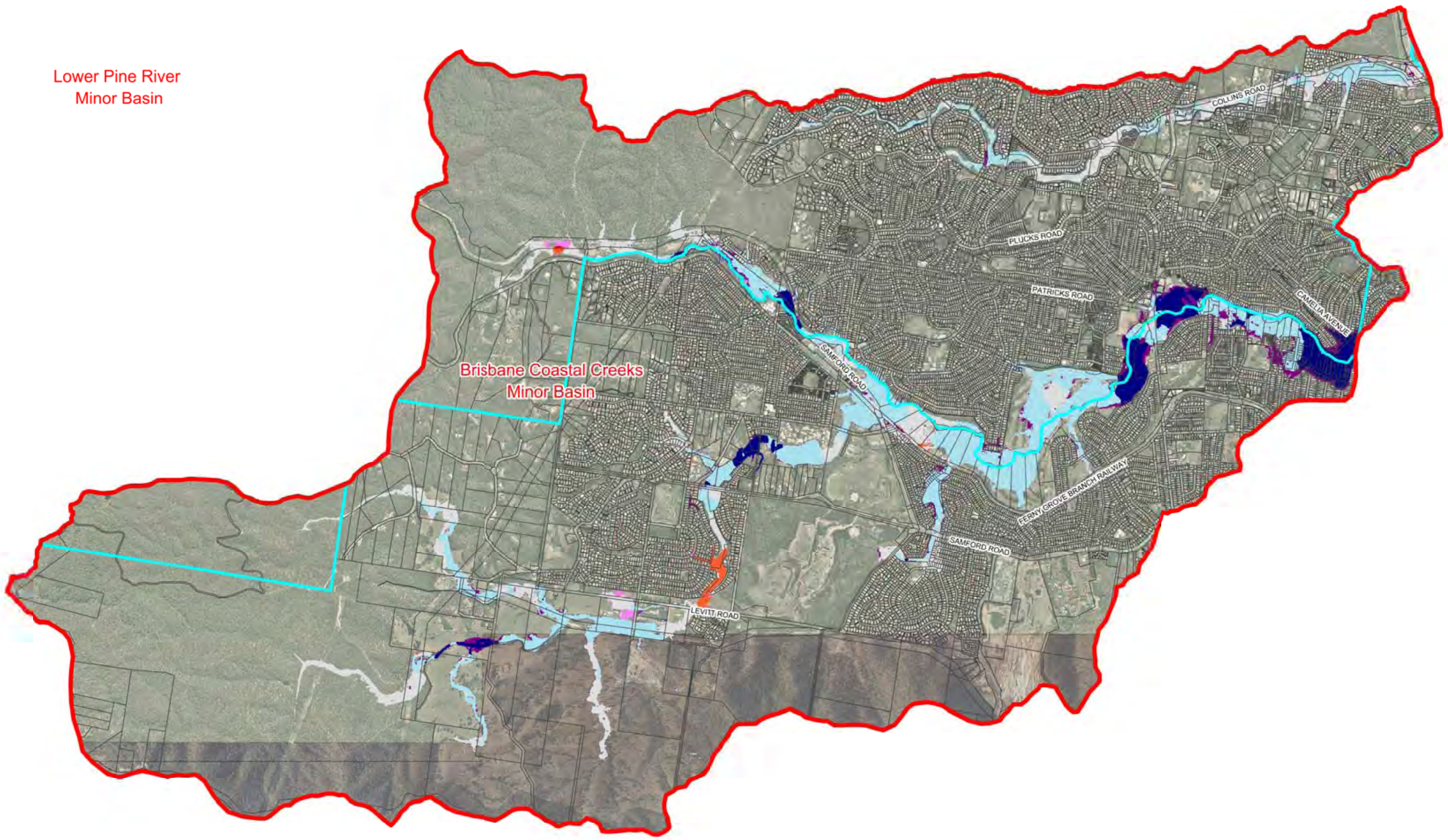
0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F11: Increase in Residential Development Flood Level Impact 100 Year EDS (S11)



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Legend

- Cadastre
- Minor Basin Boundaries
- MBRC/BCC Boundary

Peak Flood Level Difference (m)

- < -0.50
- -0.50 to -0.10
- -0.10 to 0.10
- 0.10 to 0.50
- >0.5
- Was Dry Now Wet
- Was Wet Now Dry

Notes:

This figure is based on information provided to Aurecon by Moreton Bay Regional Council (MBRC) and other parties. Although the provider of the information has not warranted the accuracy of the data and has waived liability in respect of its use, Aurecon's study was undertaken strictly on the basis that the information that has been provided is accurate, complete and adequate. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that MBRC may suffer resulting from any conclusions based on information provided to Aurecon, except to the extent that Aurecon expressly indicates in the associated report that it has verified the information to its satisfaction.

This figure shows increase in vegetation and residential development peak water level minus EDS peak water level

Map by: DJF

P:\SWM\Work\222767\001\GIS\MapInfo\BCC_Figure_F11_Dif_Increased_Development_100Y_EDS_S12_rev0.wor

A3 scale 1:40,000

0 1000 m 2,000 m

Date: 12/10/2012 Version: 0 Job No: 222767

Projection: MGA Zone 56

RFD Detailed Modelling (BCC)

Figure F12: Increase in Vegetation and Residential Development Flood Level Impact 100 Year EDS (S12)

Appendix G
Hydrologic Modelling Details

Appendix G
Hydrologic Modelling Details

A separate report for hydrologic model establishment was not created as part of the study; therefore this section has been included to describe the process undertaken in the hydrologic modelling.

Available data

The following data was made available for the hydrologic modelling:

- Base WBNM model supplied by MBRC. This model was supplied with notes that C-value = 1.6; ARF = 1.0 and IFD file location in all runfiles will need to be amended
- Design rain gauge locations were also supplied
- Guidance on how climate change modelling is to be undertaken ie IFD coefficients to be increased by 12% (as per email correspondence from Hester van Zijl on 10 April 2012)
- Future development impervious values as supplied by Hester van Zijl on 2 May 2012
- Guidance for rainfall data setup was provided in the Worley Parsons (2010) *Database Design Rainfall – Burpengary Pilot Project (Draft)* report

Methodology

Model version

WBNM version 2010_000 was used to undertake the analyses.

The TUFLOW convert_to_ts1 utility (v 2009-10-AB) was used to convert the results to TUFLOW format.

Design event modelling

A separate .wbn file was created for each duration for each event (ARI). This was done in order to create separate output files for each event, which could then be used as input to the TUFLOW hydraulic model.

Two (2) design event rain gauge locations were adopted for the BCC minor basin as per the IFD data supplied.

The model results were then converted to .ts1 files for input to TUFLOW. Zero flow values were added to the end of each hydrograph. This was done for all WBNM model results, including the extreme events, PMP events and climate change events. Only the .loc files were used as input to the TUFLOW models.

Extreme event modelling

CRC-Forge was used to provide rainfall intensities. These were calculated for each of the five rainfall gauge locations adopted for the design events. For the 0045, 0090 and 0120 minute durations, no values are provided by CRC-Forge, therefore these were linearly interpolated between the 0030, 0060 and 0180 intensities.

PMP temporal patterns were applied to the extreme events. For the 0015, 0030, 0045, 0060, 0090, 0120, 0180 and 0360 minute events the temporal pattern for the Generalised Short Duration Method (GSDM) (BoM, 2003) was adopted. For the 1440, 2160, 2880 and 4320 minute events the temporal patterns from the coastal_avm_100 storms were adopted (as per the Generalised Tropical Storm Method (GTSMR), BoM 2003).

For the 0720 minute duration, both the GSDM and GTSMR temporal patterns were analysed. For the GTSMR, the times applying to the 1440 minute duration pattern were halved to create a 0720 minute pattern.

PMP event modelling

For the PMP event, a single storm was used across the entire model extents. The temporal patterns used for the extreme events were also used for the PMP events.

The methods set out in the GSDM (BoM, 2003) were used to provide rainfall intensities for the 0015, 0030, 0045, 0060, 0120, 0150, 0180, 0240, 0300 and 0360 minute events. The GTSMR methods (BoM, 2003) were used to provide intensities for the 1440, 2160, 2880 and 4320 minute events. For the 0720 minute event, a line of best fit was applied between the short and long duration intensities and the rainfall intensity was calculated to provide the best R^2 value to this line.

Key parameters used in the PMP analysis are provided in Table G1.

Table G1 | Adopted PMP Parameters

Parameter/Method	Value
GSDM – initial depths	Rough surface for area = 1km2
GSDM – EAF	1 as topography is below 1500m AHD
GSDM – MAF	0.85 (as per design events)
GTSMR – initial depths	Coastal summer values for area = 1km^2
GTSMR – TAF	1.227 – median value from region inspection
GTSMR – DAF	0.979 – median value from region inspection
GTSMR – EPW	87.088 – median value from region inspection

Climate change event analysis

For the climate change scenario (S4), the IFD data adopted for the design events was increased by 12%. No other changes were made to the EDS model setup.

Future landuse scenario analysis

For the future landuse scenario (S11), the revised fraction impervious values provided by MBRC were incorporated into the .wbn file. No other changes were made to the model setup.

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