Regional Floodplain Database:

2014 Model Maintenance Report - Bribie Island (BRI)

Moreton Bay
Regional Council

Moreton Bay Regional Council
PO Box 159
CABOOLTURE QLD 4510
Email: mbrc@moretonbay.qld.gov.au
Phone: (07) 3205 0555

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2014 Model Maintenance Report – Bribie Island (BRI)

Moreton Bay Regional Council

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Document prepared by:

Aurecon Australasia Pty Ltd

ABN 54 005 139 873

Level 14, 32 Turbot Street
Brisbane QLD 4000

Locked Bag 331
Brisbane QLD 4001
Australia

T +61 7 3173 8000
F +61 7 3173 8001
E brisbane@aurecongroup.com
W aurecongroup.com

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Author signature		Approver signature	
Name	Brian Sexton	Name	Talia Guest
Title	Senior Civil Engineer	Title	Associate

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1 Introduction

Aurecon has been commissioned by Moreton Bay Regional Council (MBRC) to upgrade the Bribie Island (BRI) hydrologic and hydraulic models as part of the Regional Floodplain Database (RFD) 2014 Maintenance Project.

Aurecon previously developed the RFD model for Bribie in 2012. A subsequent update was also carried out early last year which focused on updating/incorporating trunk drainage in a number of locations.

The key aspects of the RFD 2014 Maintenance Project updating process involved:

- Amendments to the sub-catchment parameterisation and discretisation in the WBNM hydrologic model based on latest LiDAR survey
- Testing of various rainfall loss permutations within the WBNM model to identify a preferred loss value going forward
- Incorporation of latest LiDAR survey within the 2D domain of the TUFLOW model
- Incorporation of latest bathymetric survey in the TUFLOW models at the canals
- Updating of TUFLOW material roughness layers in line with Councils current requirements
- Inclusion of break-lines to define channels where necessary in the TUFLOW domain
- Inclusion of Dux Creek within the TUFLOW model domain (ie as opposed to its routing being calculated in the WBNM model)
- Incorporation of latest structure data within TUFLOW model pertaining to recent development areas in the TUFLOW domain
- Incorporation of underground trunk drainage within the TUFLOW 1D model domain at specific 'investigation areas'
- Generating outputs in multiple formats as per Council's requests, and using latest TUFLOW version for all simulations
- Running updated storm tide and sensitivity modelling scenarios as per Council's requirements

These updates are described in further detail in the following sections of this report.

2 2014 model maintenance details

2.1 WBNM model

The existing WBNM model was provided to Aurecon by MBRC. This was reviewed and amended in agreement with Council. The principal alterations that were made are described in the following bullet points.

- Investigation of the behaviour of Dux Creek was requested by Council. Initially the Dux Creek sub-catchments were modelled with a detention component in order to reduce flows. However, following a review of the sub-catchment discretisation and the topography Aurecon recommended that these catchments be incorporated directly into the TUFLOW model domain, thereby not relying on the routing of the hydrograph on Dux Creek to be computed solely by the WBNM model. It was found that using TUFLOW to route the 'local' inflow hydrographs, as well as allowing water to leave the model by providing a boundary condition on the eastern edge of the floodplain, generated more realistic discharges at the Dux Creek catchment outlet

- Multiple initial and continuing loss permutations were tested within the WBNM model to represent the effects of the sandy soil that is present on Bribie Island. Council then reviewed the results of the various tests and nominated the following loss combinations to be used for all design runs within the WBNM model:
  - Initial loss: 25 mm for all events
  - Continuing loss: 2.5 mm/hr for all events
- The 2014 LiDAR data was used to cross-check sub-catchment discretisation throughout the model. This led to changes in the sub-catchment discretisation in a small number of areas, most notably where development had obviously since taken place when compared against the previous LiDAR dataset
- Aurecon also incorporated amendments as provided by Council to the fraction impervious percentages of the WBNM sub-catchments
- Where previous modelling had not accounted for certain event magnitudes these were generated in accordance with Council and industry requirements (ie 0.02% and 0.01% AEP events)
- Quality checks against the previous WBNM modelling was carried out to ensure consistency across both model outputs, notwithstanding any differences that were owing to the aforementioned changes that were made to the model set-up/parametrisation

2.2 TUFLOW model

In conjunction with Council, Aurecon made a number of changes to the BRI TUFLOW model. These modifications are outlined in the following bullet points. Refer also to Figure 2-1:

- The TUFLOW 2013-12-AD-iSP-w64 executable was used for all simulations. This TUFLOW version includes Councils hazard categories as a default output
- All TUFLOW model files were named as per Council's RFD naming convention (Run ID: 002c)
- Results were generated in multiple formats as per Council's requests – this includes XMDF, FLT and WRB outputs types. In summary the outputs coding is as follows:
  - For rivers/creeks:
    - Map Output Format == XMDF | FLT | WRB
    - WRB Map Output Data Types == h d v
    - XMDF Map Output Data Types == h v d ZMBRC Z0 ZQRA SP
    - FLT Map Output Data Types == h v d ZMBRC Z0 ZQRA
  - For storm tide:
    - Map Output Format == XMDF | FLT |
    - XMDF Map Output Data Types == h v d ZMBRC Z0 ZQRA SP Z9
    - FLT Map Output Data Types == h v d ZMBRC Z0 ZQRA Z9
- Incorporation of 2014 LiDAR survey within the 2D domain of the TUFLOW model
- Incorporation of 2014 bathymetric survey in the TUFLOW model at the canals
- Updating of TUFLOW material roughness layer in line with Councils current requirements – this includes use of the most up to date waterbody layer, and also accounts for a number of specific areas of development within the 2D domain

- Inclusion of break-lines to define channels where necessary in the TUFLOW domain – this was undertaken as per Council's standard methodology using 'z-shape' gully lines based on streamline data provided
- Inclusion of Dux Creek within the TUFLOW model domain (ie as opposed to its routing being calculated in the WBNM model) – refer to Section 2.1 where this is further discussed
- Incorporation of latest structure data within TUFLOW model pertaining to recent development areas in the TUFLOW domain. These locations were outlined in the project brief and data pertaining to each was provided by Council – this comprised design drawings, onsite survey, photographs, etc. Over the course of the project, and following Aurecon's ongoing review of the model, a small number of additional structures were also added
- Incorporation of underground trunk drainage within the TUFLOW 1D model domain at specific 'investigation areas'. These investigation areas were outlined in the project brief, of which there were 20 discrete locations in total. The data was typically obtained from Council's stormwater GIS layer which was also provided as part of this project. '2d SA pits' were used to control the application of the flow within the 2d domain such that it would be subsequently conveyed by the underground network, yet could still surcharge and show overland flooding where the pipe network capacity was exceeded
- A review of the modelling of buildings was also conducted to ensure the BRI model met with current industry practices
- A z-line was also added at the top of the canal retaining walls
- PO lines were reviewed and amended where necessary
- Storm tide and sensitivity modelling scenarios were simulated as per Council's brief requirements

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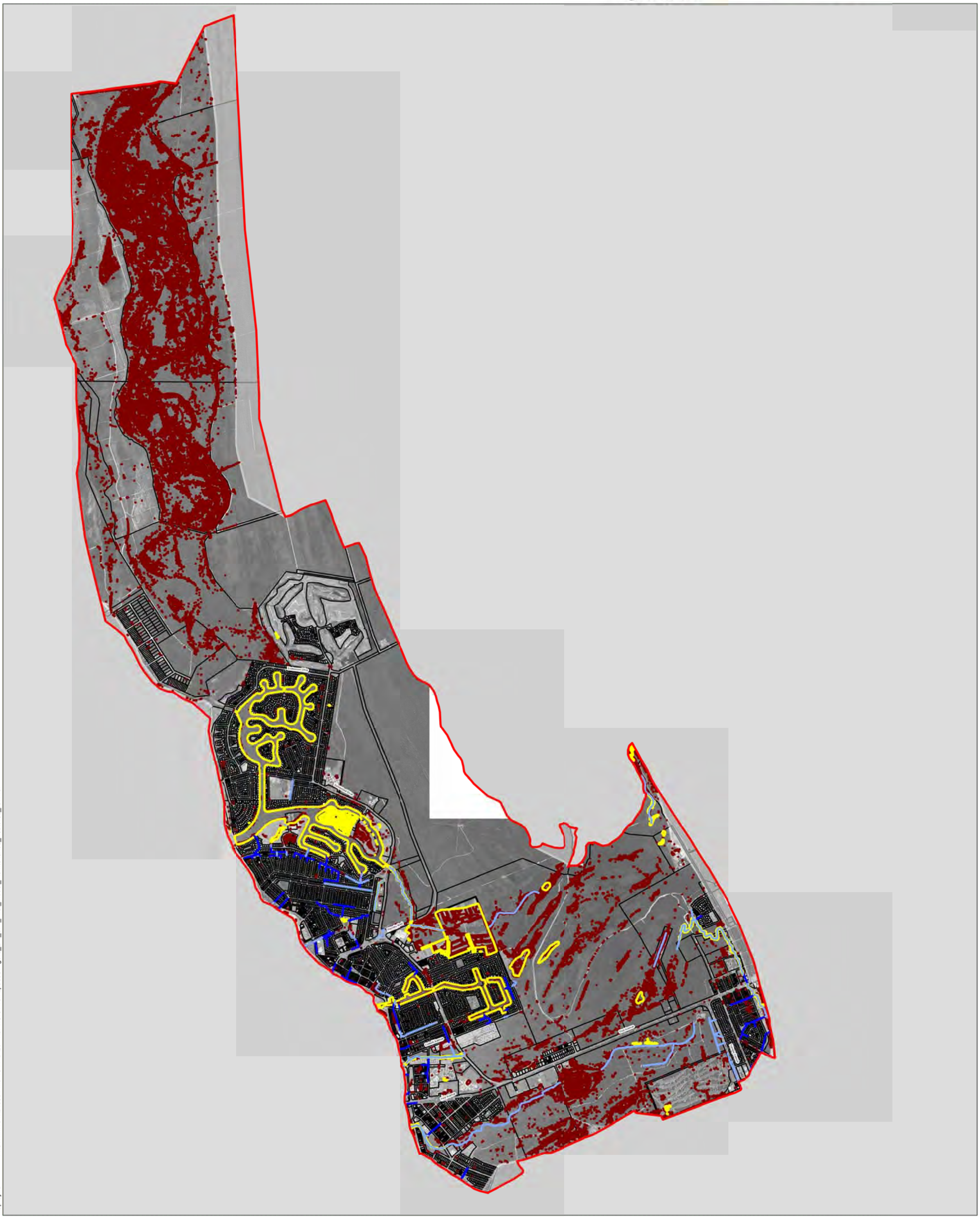

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Legend

Bribie Catchment Boundary

Hydraulic Model Boundary

Cadastral Bondaries

Additional Features

Change in Landuse Roughness

Change in Topography/Bathymetry

Open Drain/Channel

Underground Drainage

Notes:

A3 scale 1:50,000

0   1250 m   2,500 m

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Projection: MGA Zone 56

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Figure 2-1: Hydraulic Model Maintenance Features

3 Model simulations

3.1 Verification

Verification against recorded rainfall and surveyed flood marks was not undertaken for the BRI model due to lack of historical event data.

3.2 Design flood events

This section describes the design storm conditions used in the hydrodynamic modelling tasks. Design storm events are synthesised events used to estimate design flood conditions. They are based on a probability of occurrence, usually specified using the Average Exceedance Probability (AEP) nomenclature. For events less than the 50% AEP, the terminology Exceedances per Year (EY) is used (eg 0.5EY for the 2yr ARI event).

3.2.1 River and creek critical duration assessment

For the RFD 2014 Maintenance Project the Critical Duration Analysis (CDA) undertaken utilised the 1% AEP and 0.1% AEP events. Results from the CDA are shown in Figure 3-1 to Figure 3-2.

Critical durations selected from the 1% AEP event CDA were applied to all events ranging from the 1EY to the 1% AEP. Critical durations selected from the 0.1% AEP event CDA were applied to all events ranging from the 0.5% AEP to the PMF event.

The critical durations selected from the CDA is shown in Table 3-1

Table 3-1 Critical duration assessment

Assessment event	Durations	Selected durations	Adopted event(s)
1% AEP	½, 1, 1½, 2, 3, 4½, 6, 9, 12, and 24 hour storm	1, 2 and 6 hour storm	1EY, 0.5EY, 20%, 10%, 5%, 2% and 1% AEP
0.1% AEP	½, 1, 1½, 2, 3, 4, 5, 6, 12, and 24 hour storm	1½, 2 and 6 hour storm	0.5%, 0.2%, 0.1%, 0.05%, 0.02%, 0.01% AEP and PMF

To determine the critical storm durations, the following methodology was adopted:

1. Hydrologic and hydraulic modelling for the range of storm durations as listed in Table 3-1
2. Mapping of the peak flood levels for the “maximum envelope” of all the storm durations
3. Mapping of the peak flood levels for the “maximum envelope” of the selected storm durations as listed in Table 1
4. Difference comparison between the mapped peak flood levels for the selected storm durations (iii) and the mapped peak flood levels from all storm durations (ii)
5. Selection of the critical storm durations was based on the storm durations generating the highest flood levels across the most of the minor basin area

The difference comparison for the 1% and 0.1% AEP peak flood levels determined from above methodology is shown in Figure 3-3 and Figure 3-4. These figures illustrate that the selected critical durations (see Table 3-1) generally represents the peak flood levels throughout the minor basin.

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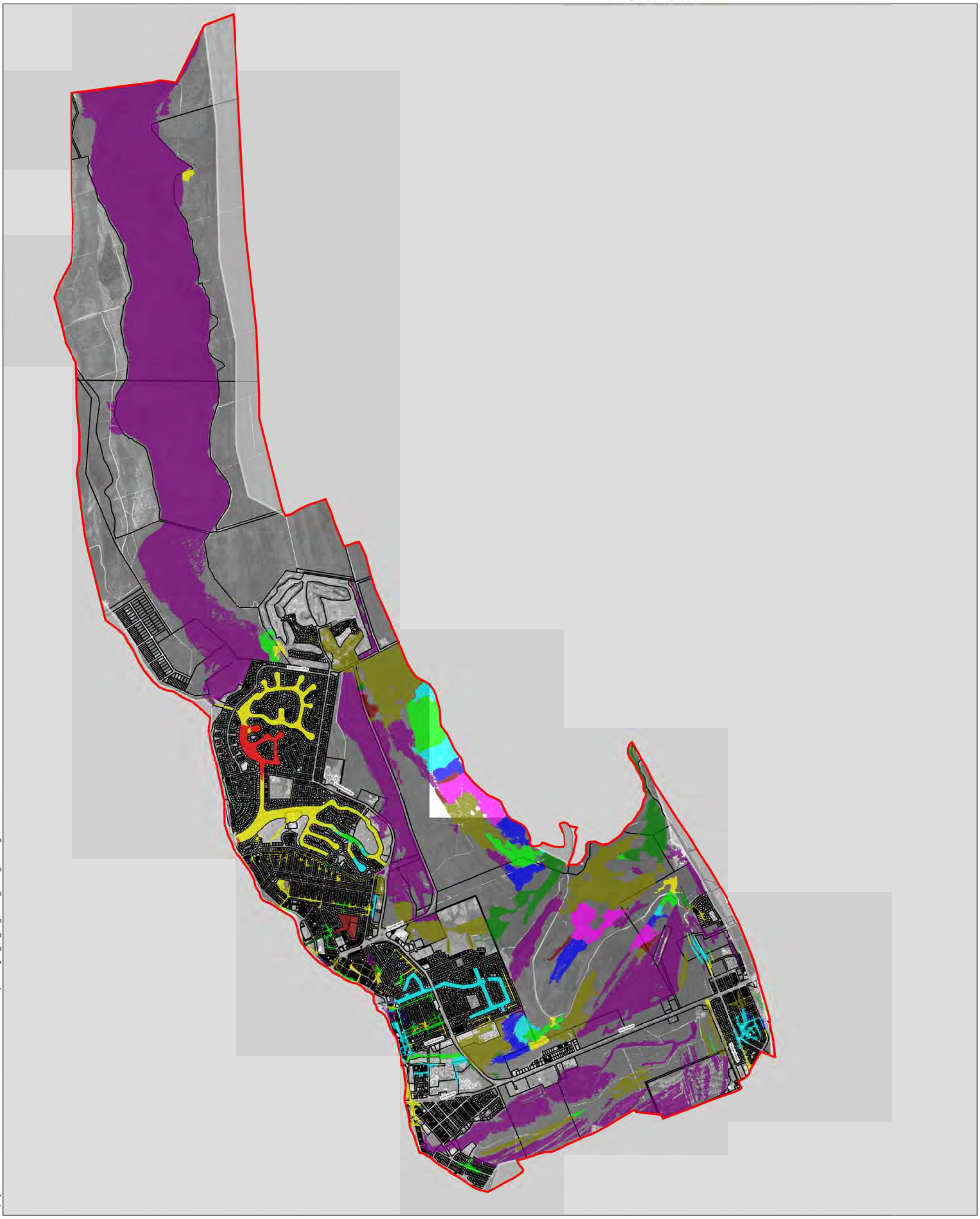

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Map by: DF

Legend

Bribie Catchment Boundary

Hydraulic Model Boundary

Cadastral Bondaries

Critical Durations

30m	180m	720m
60m	270m	1440m
90m	360m	
120m	540m	

Notes:

A3 scale 1:50,000

0 1250 m 2,500 m

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Projection: MGA Zone 56

2014 Model Maintenance Report - Bribie (BRI)

Figure 3-1: Critical Duration Assessment - 1% AEP

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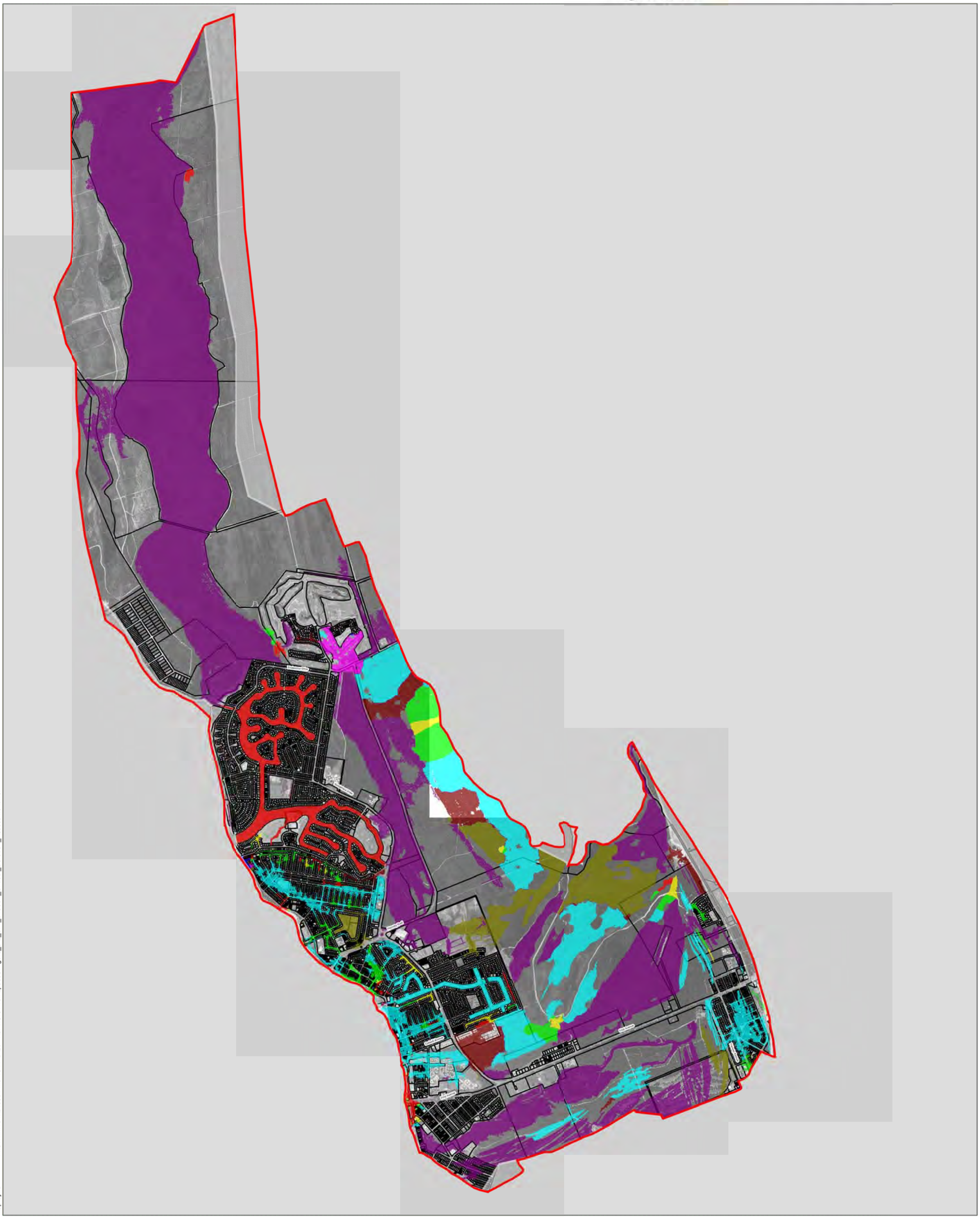

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Legend

Bribie Catchment Boundary

Hydraulic Model Boundary

Cadastral Bondaries

Critical Durations

30m	180m	720m
60m	270m	1440m
90m	300m	
120m	360m	

Notes:

A3 scale 1:50,000

0 1250 m 2,500 m

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Figure 3-2: Critical Duration Assessment - 0.1% AEP

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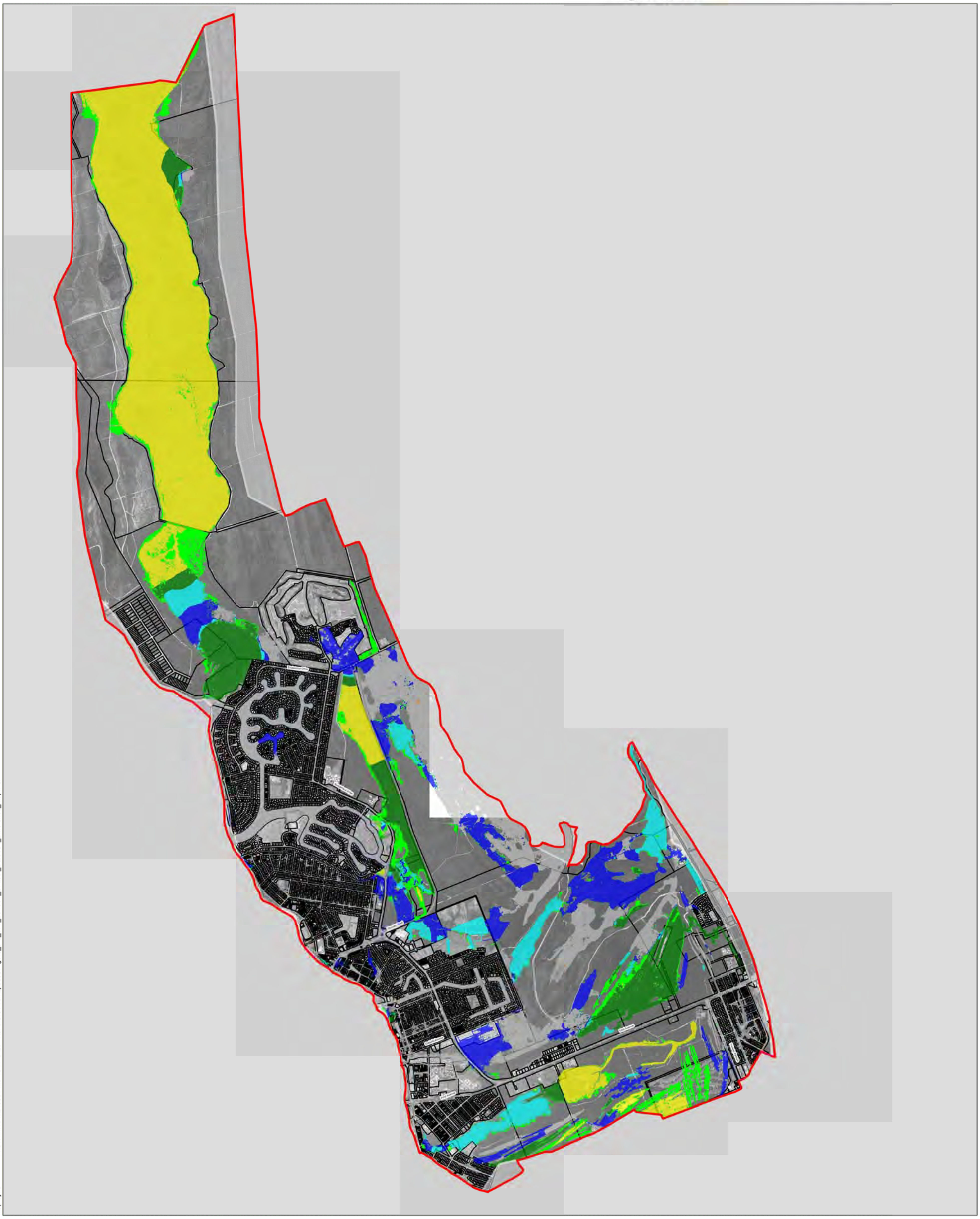

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Legend

Bribie Catchment Boundary

Hydraulic Model Boundary

Cadastral Bondaries

Peak Flood Level Difference (m)

- <-1.00
- -1.00 to -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- No Change

Difference in Flood Extent

- Decrease in Innundation Extent
- Increase in Innundation Extent

Notes:

A3 scale 1:50,000

0 1250 m 2,500 m

Date: 26/06/2015 Version: 0 Job No: 243304

Projection: MGA Zone 56

2014 Model Maintenance Report - Bribie (BRI)

Figure 3-3: Critical Duration Assessment
Peak Flood Level Difference - 1% AEP

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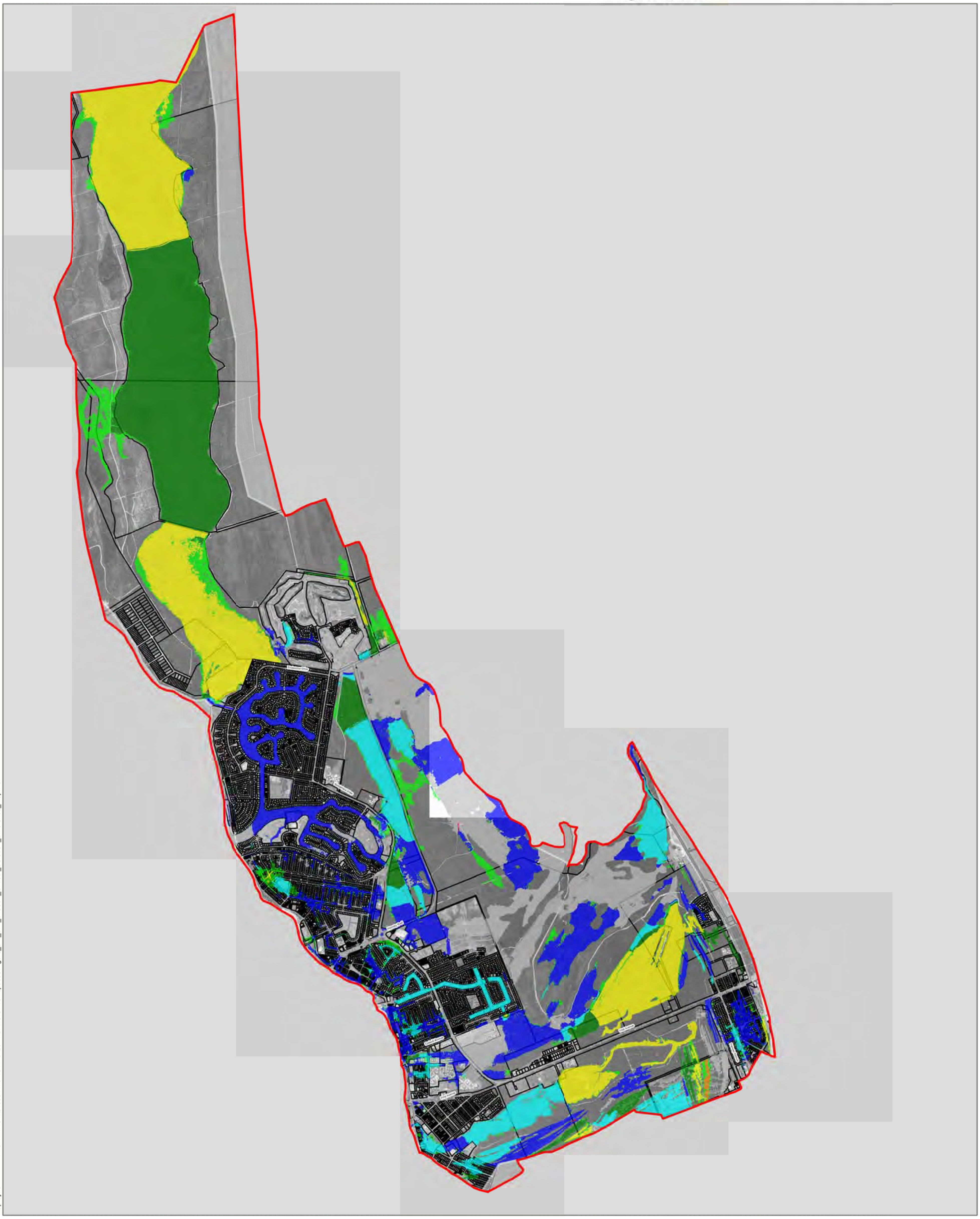

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Legend

Notes:

Bribie Catchment Boundary

Hydraulic Model Boundary

Cadastral Bondaries

Peak Flood Level Difference (m)

- <-1.00
- -1.00 to -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- No Change

Differnce in Flood Extent

- Decrease in Innundation Extent
- Increase in Innundation Extent

A3 scale 1:50,000

0 1250 m 2,500 m

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2014 Model Maintenance Report - Bribie (BRI)

Figure 3-4: Critical Duration Assessment
Peak Flood Level Difference - 0.1% AEP

3.2.2 River and creek design event simulations

The BRI model was simulated for a range of AEPs and storm durations as detailed in Section 3.2.1, as well as the MBRC Design Storm (MDS). Councils adopted design storm (ie the MDS) is a 1% AEP 15 minute event embedded within a 270 minute design storm. The MDS is useful for general investigations into changes in model parameters and catchment characteristics, as it reduces the number of model runs required (ie one run instead of multiple storm durations).

The BRI model was simulated for the following design events:

- The 1EY, 0.5EY, 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2%, 0.1%, 0.05%, 0.02%, 0.01% AEP events and the PMF event for the three selected critical durations
- The Moreton Bay Design Storm – 1% AEP 15 minute in 270 minute embedded design storm

3.2.3 Storm tide design event simulations

The coastal (downstream) boundary was modified for the storm tide runs to allow for accurate modelling of the inundation propagation/extents.

Note that this event utilises a dynamic (temporally varying) downstream boundary condition without any rainfall over the catchment. The downstream boundary condition was generated using MBRC's Storm Tide Hydrograph Tool as supplied by Council ('20140620 Storm Tide Hydrograph Tool.xlsx').

In total there were nine (9) storm tide reference points that were used to develop the storm tide dynamic profile. They included MBC_038, MBC_042, MBC_053, MBC_054, MBC_055, MBC_056, MBC_058, MBC_059, and MBC_060.

Table 3-2 outlines the various storm tide runs that were undertaken as part of the BRI RFD 2014 Maintenance Project.

Table 3-2 Summary of storm tide events

ID	Description
BRI_S_002c_E_00020Y	No rainfall, dynamic Storm Tide (5% AEP current)
BRI_S_002c_E_00100Y	No rainfall, dynamic Storm Tide (1% AEP current)
BRI_S_002c_E_01000Y	No rainfall, dynamic Storm Tide (0.1% AEP current)
BRI_S_002c_E_10000Y	No rainfall, dynamic Storm Tide (0.01% AEP current)
BRI_S_002c_F_00100Y	No rainfall, dynamic Storm Tide (1% AEP future incl. Climate Change + 0.8m SLR)

3.3 Sensitivity analysis

The BRI model was used to assess a total of ten (10) sensitivity simulations in order to evaluate the response of the model to changes in key parameters. Each scenario test is outlined in Table 3-3.

Note that each test was undertaken using the 1% AEP MDS storm.

Table 3-3 Sensitivity analysis summary

ID	Scenario Test	Section
R01	Roughness	3.3.1
R02	Blockage	3.3.2
R03	Climate Change – Rainfall	3.3.3
R04	Climate Change – Sea level rise	3.3.3
R05	Climate Change – Rainfall and sea level rise	3.3.3
R06	Storm tide – current storm tide with current rainfall	3.3.3
R07	Storm tide – future storm tide with future rainfall and sea level rise	3.3.3
R08	Vegetated floodplain	3.3.4
R09	Future catchment development	3.3.4
R10	Vegetated floodplain and future catchment development	3.3.4

3.3.1 Hydraulic roughness analysis

All Manning's 'n' values in the TUFLOW models 2D domain were increased by 20%.

3.3.2 Structure blockage analysis

For the blockage scenario a blockage factor was only applied to all culverts in the BRI model (noting that this does not apply to underground pipe networks).

For culverts the blockage scenario was adopted from the SKM *Floodplain Parameterisation* report (2012b), and includes:

- A full blockage is applied if the culvert diagonal is less than 2.4 m
- A 15% blockage is applied if the culvert diagonal is greater than 2.4 m

3.3.3 Climate change and downstream boundary conditions analysis

Simulations R03 to R07 involved the testing of the models sensitivity to climate change. This involved investigation of effects associated with increased rainfall, sea-level rise and storm tide activity. The following five (5) scenarios were assessed:

- R03: Investigation of the impact of an increase in rainfall intensity of 20% (as per SKM (2012a) *Boundary Conditions, Joint Probability and Climate Change Report*)
- R04: Investigation of the impact of an increased tailwater level of 0.8 m due to predicted sea level rise
- R05: Investigation of the impact of a 20% increase in rainfall intensity and an increased tailwater level of 0.8 m due to predicted sea level rise. This test combines scenarios R03 and R04
- R06: Investigation of the impact of a 1% AEP current static storm tide level with concurrent 1% AEP MDS rainfall event
- R07: Investigation of the impact of a 20% increase in rainfall intensity and an increase in sea level rise (ie a static storm tide level (1% AEP GHG) + 0.8 m)

3.3.4 Future land-use analysis

Three future landuse scenarios were assessed using the 1% AEP MDS. These tests did not incorporate any changes to rainfall intensity or tailwater conditions from those assumed in the design runs. Instead they focused on altering the fraction impervious within the sub-catchment domain, as well as modifying the vegetative cover within the floodplain.

In line with anticipated future catchment development the WBNM hydrologic model was modified to reflect an increase in the fraction impervious within each subcatchment. This leads to increased run-off and higher peak discharges. These discharges were in turn incorporated into the TUFLOW model as inflow boundary conditions.

The floodplain vegetation was altered in line with the brief requirements. This was done by developing specific TUFLOW material layers to increase the roughness within the 1% AEP floodplain.

The following three (3) scenarios were assessed:

- R08: Investigation of the impact of increased vegetation in the floodplain. This involved changing the 'medium dense vegetation' material class to a 'high dense vegetation' class and changing the 'low grass/grazing' material class to a 'medium dense vegetation' class
- R09: Investigation of the impact of increased residential development. The WBNM model was updated to reflect an increase in the fraction impervious within each subcatchment. The increased discharges were then incorporated into the TUFLOW model as inflow boundary conditions
- R10: Investigated the impact of increased residential development and increased vegetation in the floodplain. This test combines scenarios R08 and R09

4 Model results and outcomes

4.1 2014 model maintenance

Figures 4-1 and 4-2 show the difference between the 2012 BRI model and the updated 2014 BRI model for the 5% and 1% AEP events respectively. The storm durations used in creating a combined envelope for the two models and events are shown in Table 4-1.

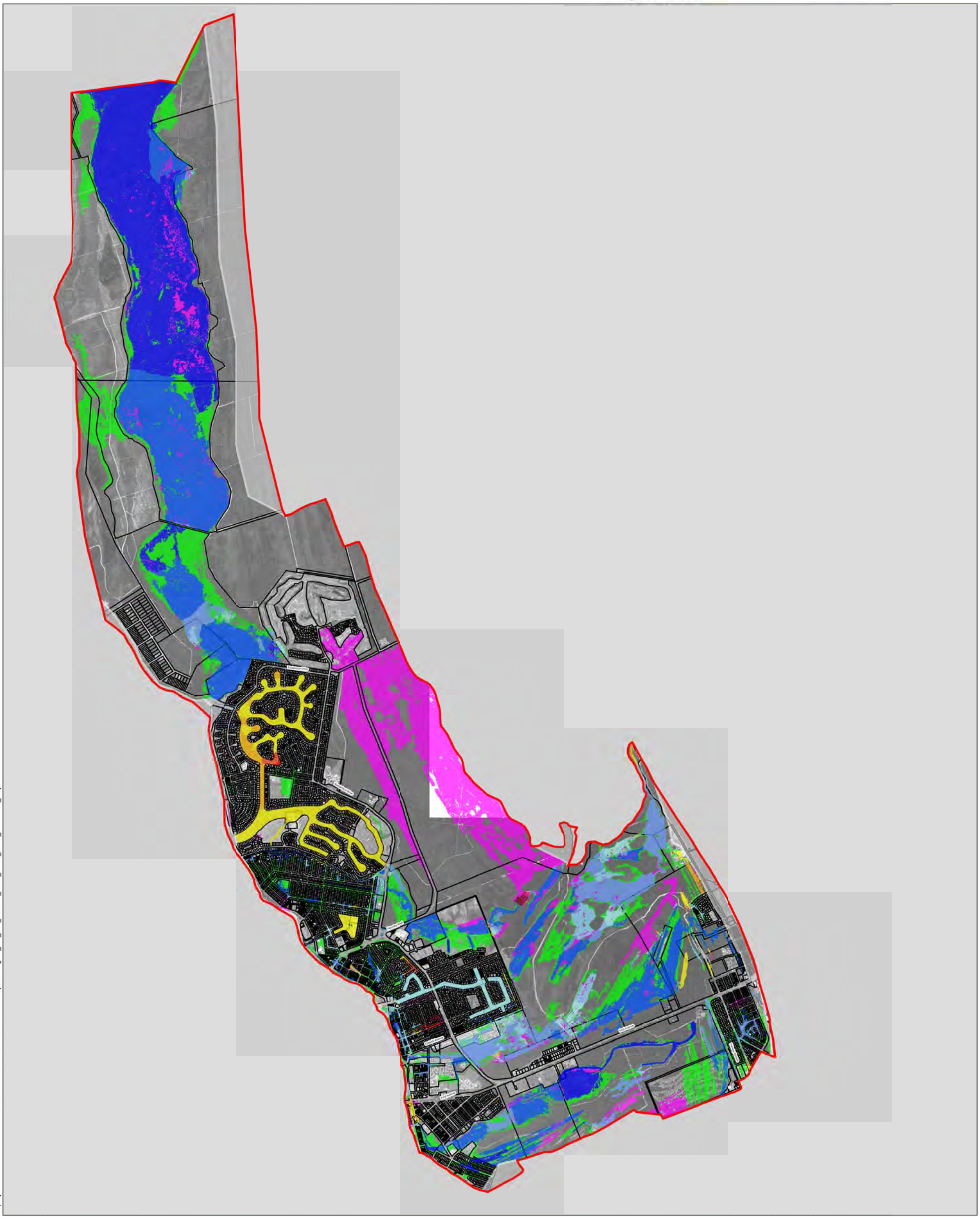
Table 4-1 Storm duration comparison for 5% and 1% AEP events

Event	Storm durations for 2012 model	Storm durations for 2014 model
5% AEP	3 and 24 hour	1, 2 and 6 hour
1% AEP	10, 15, 30, 45 minutes, 1, 1½, 2, 3, 4½, 6, 9, 12, 18, 24, 36, 48 and 72 hour	½, 1, 1½, 2, 3, 4½, 6, 9, 12, and 24 hour

Negative values in Figures 4-1 and 4-2 show where the 2014 BRI model flood levels are lower than those of the 2012 BRI model results and vice versa. These differences were investigated and satisfactorily understood. Aspects contributing to the differences included updated topography, alterations in the hydrologic model outputs that act as inflow boundary conditions to the TUFLOW model, and changes to local drainage infrastructure (eg new pipes, embankments, earthworks, etc).

4.2 Verification

Verification against recorded rainfall and surveyed flood marks was not undertaken for the BRI model due to lack of historical event data.



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Legend

Bribie Catchment Boundary

Hydraulic Model Boundary

Cadastral Bondaries

Difference in Peak Flood Levels (m)

<-0.50
-0.50 to -0.20
-0.20 to -0.10
-0.10 to -0.05
-0.05 to -0.01
-0.01 to 0.01
0.01 to 0.05
0.05 to 0.10
0.10 to 0.20
0.20 to 0.50
>0.50

Difference in Flood Extent

Decrease in Innundation Extent
Increase in Innundation Extent

Notes:

A3 scale 1:50,000

0   1250 m   2,500 m

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Figure 4-1: 2014 BRI Model Versus 2012 BRI Model Peak Flood Level Difference - 5% AEP

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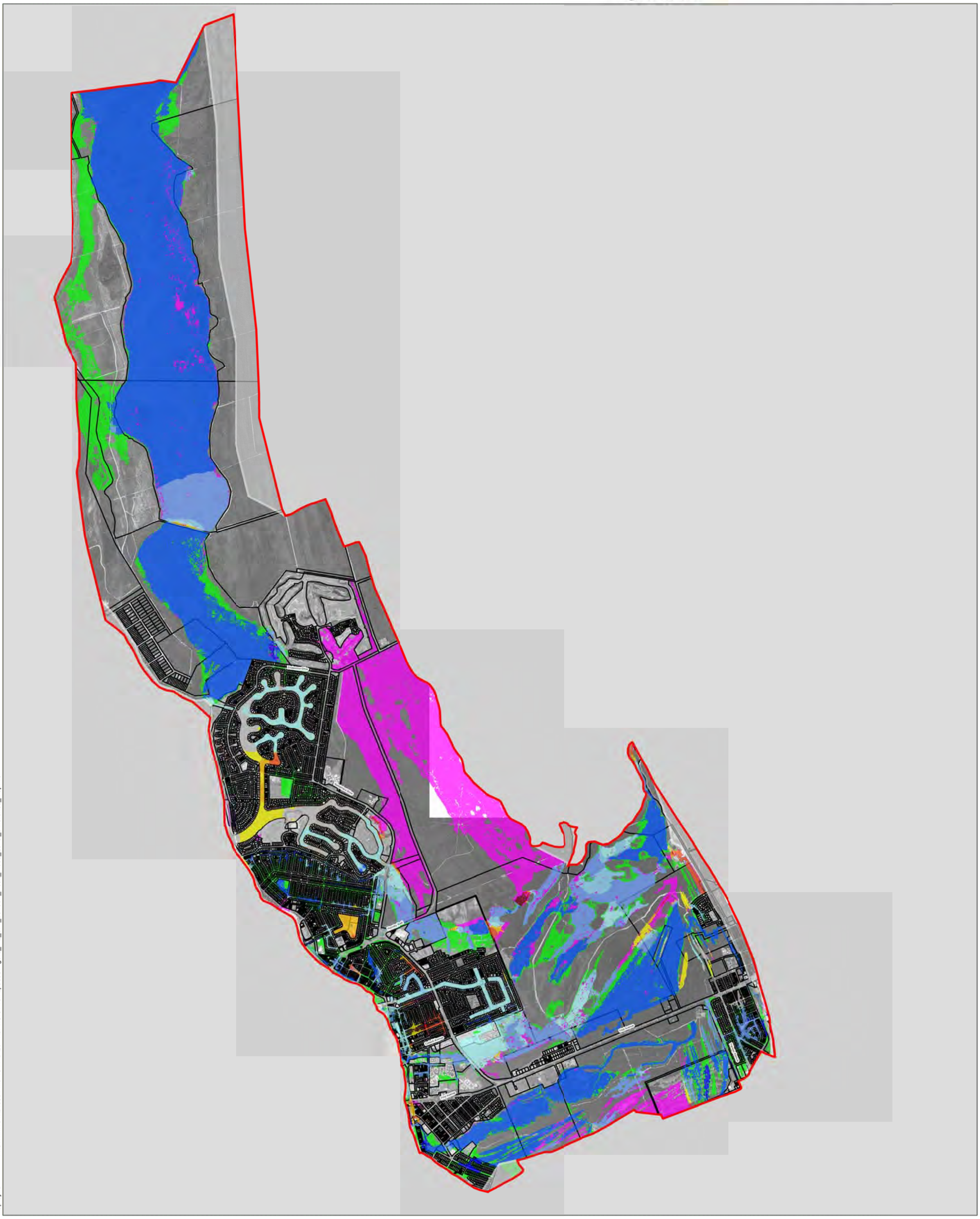

Map by: DF

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Legend

Notes:

Bribie Catchment Boundary

Hydraulic Model Boundary

Cadastral Bondaries

Difference in Peak Flood Levels (m)

<-0.50	-0.05 to -0.01	0.10 to 0.20
-0.50 to -0.20	-0.01 to 0.01	0.20 to 0.50
-0.20 to -0.10	0.01 to 0.05	>0.50
-0.10 to -0.05	0.05 to 0.10	

Difference in Flood Extent

Decrease in Inundation Extent

Increase in Inundation Extent

A3 scale 1:50,000

0 1250 m 2,500 m

Date: 26/06/2015 Version: 0 Job No: 243304

Projection: MGA Zone 56

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Figure 4-2: 2014 BRI Model Versus 2012 BRI Model Peak Flood Level Difference - 1% AEP

4.3 Design flood behaviour

Results were generated in multiple formats as per Council's requests – this includes XMDF, FLT and WRB outputs types. The following outputs were generated both on an interval basis (time varying) and peak value basis:

- Flood level (h)
- Flood depth (d)
- Flow velocity (v)
- Four Hazard Classifications (ZBMRC, Z0, ZQRA, Z9)
- Stream Power (SP)

4.3.1 River and creek

A max-max function was used to derive the envelope of all critical storm durations (Section 3.2.1) for each event and all the TUFLOW outputs listed in Section 4.3 above. Results for the 5%, 1% and 0.1% AEP events are available on Council's website (www.moretonbay.qld.gov.au/floodcheck) as PDF suburb maps or in the Flood Explorer interactive mapping tool.

In summary the output coding for all design fluvial flooding is as follows:

- Map Output Format == XMDF | FLT | WRB
- WRB Map Output Data Types == h d v
- XMDF Map Output Data Types == h v d ZMBRC Z0 ZQRA SP
- FLT Map Output Data Types == h v d ZMBRC Z0 ZQRA

4.3.2 Storm tide

Outputs were generated for each storm tide event (Section 3.2.3) and all the TUFLOW outputs listed in Section 4.3 above. The outputs for the 5%, 1% and 0.1% AEP events are available on Council's website (www.moretonbay.qld.gov.au/floodcheck) as PDF suburb maps or in the Flood Explorer interactive mapping tool.

In summary the output coding for all storm tide flooding is as follows:

- Map Output Format == XMDF | FLT |
- XMDF Map Output Data Types == h v d ZMBRC Z0 ZQRA SP Z9
- FLT Map Output Data Types == h v d ZMBRC Z0 ZQRA Z9

4.4 Sensitivity analysis results

The Moreton Bay Design Storm (MDS) was used in all the sensitivity analyses, avoiding the need to run multiple durations. The results of these analyses are summarised in Sections 4.4.1 to 4.4.4.

Note also that in comparing the 1% MDS against the 1% AEP design event (envelope of all durations) some discrepancies were observed in terms of peak flood level. In most areas this is predominantly due to the longer storm durations being critical (which is understandable considering the flat and slowly-propagating characteristics of the floodplain) – the greater volume of run-off associated with such events leads to increased flood levels. The 1% AEP event is approximately 200 mm higher in Wrights Creek for instance.

In isolated locations the 1% MDS storm is observed to generate raised levels in comparison to the 1% AEP by up to 200 mm. This typically occurs in well defined, localised channels.

4.4.1 Hydraulic roughness analysis

A comparison of the results showed the increase in Mannings ‘n’ to only raise water levels by approximately 20 mm. This is due to the low-lying/flat nature of the topography. Isolated locations showed an increase in flood level of 50 mm.

4.4.2 Structure blockage analysis

Blockage of the structures in line with the details set out in Section 3.3.2 resulted in maximum increases in flood level of 300 mm immediately upstream of the structure. Decreases in peak flood levels of up to 20 mm were observed downstream of a number of blocked structures.

4.4.3 Climate change and downstream boundary conditions analysis

The climate changes analyses involved testing the response of the model to changes in rainfall intensity and sea-level rise (ie increased tailwater levels) both individually and in combination.

Investigation of the impact of an increase in rainfall intensity of 20% (R03)

An increase in rainfall intensity resulted in flood levels being raised by up to 60 mm on average throughout the catchment. Isolated increases of up to 180 mm were observed in certain areas. The corresponding increase in flood extent is minimal in most areas.

Investigation of the impact of an increased tailwater level of 0.8 m SLR (R04)

An increase in the downstream tailwater to simulate the effects of sea level rise increases the flood levels in the downstream model reaches by 800 mm in the canals and 350 mm just upstream – this corresponds to a relatively minimal increase in the extent of flooding. The increased tailwater level does not affect the flood levels in the model reaches 2 km upstream of the model outlet.

Investigation of increase in rainfall intensity of 20% and 0.8 m SLR (R05)

Combining the two previous scenarios, flood levels in the downstream reaches of the model (in close proximity to the downstream boundary) were observed to increase by up to 800 mm. The upper reaches which are beyond the influence of the tailwater did not show any significant differences when compared to the R03 results. However in the areas where the effects of both the higher tailwater and increased discharge are experienced, flood levels were observed to increase by up to 210 mm - generally speaking this corresponds to a relatively minimal increase in the extent of flooding.

Investigation of 1% AEP current static storm tide with concurrent 1% AEP MDS rainfall event (R06)

The impact of a 1% AEP storm tide principally affects only the lower model reaches near the Bribie Canals. Close to the models downstream boundary increases in flood level of up to 1350 mm are observed. Further upstream where the tailwater effect is still present but reduced in magnitude, increases of 150 mm are experienced. No increases are predicted to occur 3 km upstream of the outlet model boundary.

Investigation of increase in rainfall of 20% combined with a static storm tide level (1% AEP GHG) + 0.8 m sea level rise (R07)

The impact of a 1% AEP future storm tide combined with an increase in rainfall intensity and 0.8 m sea level rise has a significant impact on flood levels and extents in the catchment. This is essentially a ‘worst case’ scenario with three components being tested in combination. Flood levels in the downstream reaches of the model on both eastern and western sides of the island (in close proximity to the downstream boundary) were observed to increase by up to 2250 mm while in the upstream reaches increases of 800 mm to 1500 mm were observed. Generally speaking this corresponds to a large increase in the extent of flooding throughout the catchment.

4.4.4 Future landuse analysis

Investigation of increased vegetation in the floodplain (R08)

The increased roughness parameters that were applied to the floodplain vegetation was observed to only cause increases in flood levels of up to 20 mm generally speaking. It is not observed to significantly alter flood conditions when compared to the existing/base-case scenario.

Investigation of increased catchment development (R09)

Increased catchment development has no significant impact on peak flood levels throughout the model. Maximum increases of less than 10 mm were observed to occur at a small number of locations.

Investigation of increased vegetation in the floodplain and increased catchment development (R10)

Testing the combination of increased vegetation and increased catchment development has no significant effect compared to the individual testing carried out in Scenarios R08 and R09, reaching a maximum increase of up to 25 mm.

4.5 Model limitations and quality

The following model limitations apply to the BRI 2014 model upgrade:

- The 5 m grid resolution within the 2D domain may not be able to accurately represent localised channels/drains that have a total width of approximately 10 m or less. Typically TUFLOW recommends that at least 3-4 grid cells be used when modelling a channel as being fully 2D.
- The extent of the underground pipe network that is modelled is focused on trunk drainage infrastructure and does not contain the full network extent
- The application of inflow boundaries (SA polygons) may not fully represent the extent of localised overland flooding that can occur in each sub-catchment
- The accuracy of the various datasets provided for use in the model development cannot be verified by Aurecon. This applies to topographic data, underground network data, structural survey/dimensions, etc
- The model reflects the catchment conditions at a particular point in time. This is captured in the LiDAR survey and aerial imagery/catchment urbanisation. This is obviously subject to change due to additional catchment development, and changes in topography that may be either man-made (eg cutting/filling), or natural (eg bathymetric alterations to channel profiles following major flood events). Accordingly, periodic updates of the models are recommended to ensure they reflect any significant changes to the catchment and floodplain conditions

4.6 Model specification and run times

The BRI TUFLOW model has a total model domain area of 49 km^2. Table 4-2 provides details on runtimes and memory requirements for various design events and the MDS.

Table 4-2 Model specification and approximate run times for selected events

Event	Model grid size	Model duration (hours)	Model run time (CPU hours)	Model memory (RAM Gb)
1 EY (6 hours)	5m	15	27	4.4
10% AEP (6 hours)	5m	15	39	4.4
1% AEP (6 hours)	5m	15	40	4.4
0.1% AEP (6 hours)	5m	15	44	4.4
0.01% AEP (6 hours)	5m	15	41	4.4
PMF (6 hours)	5m	15	46	4.4
MDS	5m	12	31	4.4
1% AEP storm tide	5m	60	90	4.2
0.1% AEP storm tide	5m	60	102	4.2

5 Conclusion

The BRI hydrologic and hydraulic models have been updated successfully in line with Councils brief requirements for the RFD 2014 Maintenance Project. An assessment of the hydraulic model outputs shows the simulations to be both robust and stable across the spectrum of event magnitudes that were run. This spans from the 1EY event right through to the PMF.

The data management and modelling has been undertaken in line with Councils naming conventions and modelling approaches/techniques. Close liaison was maintained with Council personnel over the course of the project to ensure a successful outcome.

6 References

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Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 14, 32 Turbot Street
Brisbane QLD 4000
Locked Bag 331
Brisbane QLD 4001
Australia

T +61 7 3173 8000
F +61 7 3173 8001
E brisbane@aurecongroup.com
W aurecongroup.com

Aurecon offices are located in:
Angola, Australia, Botswana, Chile, China, Ethiopia, Ghana, Hong Kong, Indonesia, Lesotho, Libya, Malawi, Mozambique, Namibia, New Zealand, Nigeria, Philippines, Qatar, Singapore, South Africa, Swaziland, Tanzania, Thailand, Uganda, United Arab Emirates, Vietnam, Zimbabwe.