APPENDIX D

APPENDIX D

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Phone: (07) 3205 0555

DISCLAIMER

APPENDIX D: MODELLING QUALITY REPORT

BMT WBM

Technical Note

From:	Anne Kolega	To:	Moreton Bay Regional Council
Date:	9 April 2013	CC:	
Subject:	Modelling Quality Report; Lower Pine River		

1 Background

As part of Moreton Bay Regional Council's (Council) Regional Floodplain Database (RFD) project, a detailed TUFLOW model of the Lower Pine River catchment has been developed. This technical note has been prepared to demonstrate that the Lower Pine River model has been reviewed, and that the model performance is suitable for the intended use and that the sensibility of the results has been checked. This report also documents areas of uncertainty, suggestions for future upgrades and local instability.

The extended model run times of approximately 6 days per run (for the 5m model) limited the number of iterations that could practicably be undertaken per event during model development. This particularly large model, and the long model run time, is due to the model extent and grid cell of 5m and 10m, which was chosen by MBRC. The main reason for the small grid size is for consistency within the RFD.

2 Model Development Process

The following procedure has been implemented in the development of the model:

1 A site visit was undertaken prior to commencing development of the model to gain an appreciation for the catchment;

2 An infrastructure assessment was undertaken. A report was produced from this assessment and submitted to MBRC for their consideration on structure data requirements. This approach ensured that sufficient data was captured for the level of accuracy required from the model;

3 The catchment delineation used in the hydrology was reviewed. This review indicated that the catchment delineation was suitable;

4 A draft TUFLOW model was developed, focussing on the January 2011 flood event, and submitted to MBRC for review (in October 2012);

5 MBRC provided feedback from their review of the TUFLOW model. Alterations following this review are discussed later in this note;

6 A final model was developed and used to simulate all the design and sensitivity events; and

7 Further checking was undertaken to ensure that the model was suitable for simulating the full range of flood events.

Throughout model development, model stability, warnings messages and mass errors were monitored to ensure that the model performance was acceptable.

3 Model Amendments

Various enhancements were recommended by BMT WBM during the model development. The following changes were implemented:

1 During calibration of the model it was found that the method used to apply form loss coefficients at the bridges was incorrect. The bridge layers were therefore corrected by analysing the bridge widths and

assigning the form loss coefficients as absolute values when the bridges were relatively narrow and as per meter width when the bridges were relatively wide (i.e. a bridge widths of 7.5m was chosen for the 5m model and 15m model was chosen for the 10m model).

2 A correction was made to the AJ Wylie Bridge (at Gympie Road), whereby the eastern and westerns crossings had been digitised the wrong way around in the original dataset. This bridge was severely damaged during the January 2011 event and is currently being rebuilt. The new AJ Wylie Bridge was also digitised and included in the model based on drawings provided by MBRC for the design event model.

3 MBRC supplied additional bathymetry data on the North Pine River to resolve discrepancies in modelled results versus recorded flood levels identified during calibration. This bathymetry data was converted to GIS format. Breaklines were drawn to generate a TUFLOW readable TIN (see Figure 3-1).

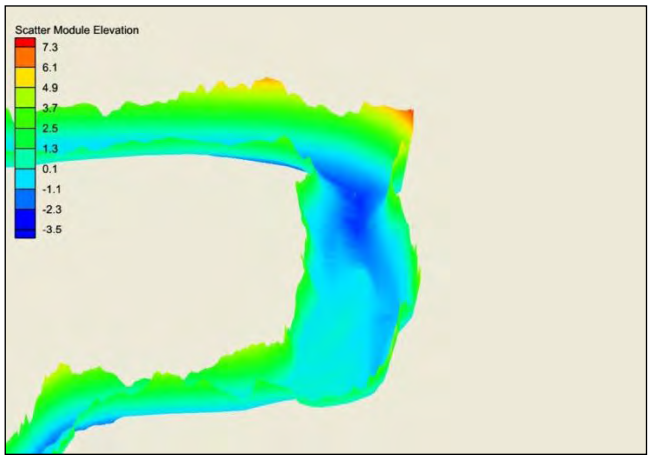


Figure 3-1: Additional Bathymetry Data for the North Pine River included in the TUFLOW Model

Following MBRC's review of the draft model, the following additional structures were incorporated/amended:

i. Plans were provided for the following three road crossings: BER_01_02037a, BER_01_02235a and BER_010331a.

ii. A plan was provided by MBRC for the channel under the Strathpine Courthouse (COU_01_02189a). This was included by developing a TIN from the survey marked on the plan (see Figure 3-2).

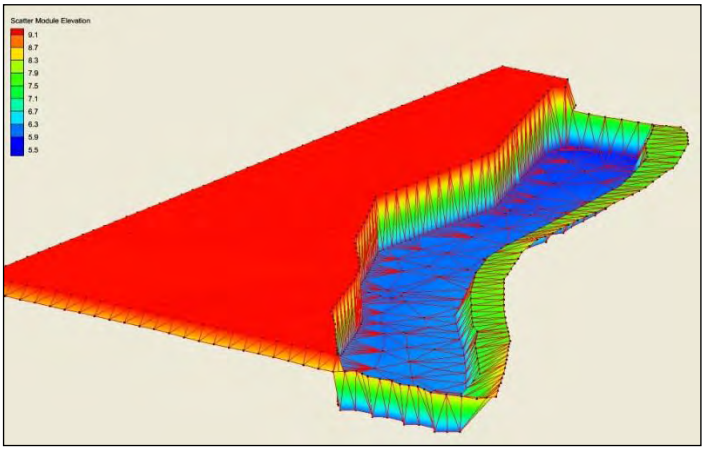


Figure 3-2: Channel Underneath the Strathpine Courthouse

iii. Plans of a culvert for new development next to Centre Link in Strathpine (SPR_43_00953a) were provided.

iv. A plan of an open channel drain at a new development in Petrie (NPR_49_00829a) was provided. The details of the drain were added to the model by developing a TIN.

v. A sound barrier adjacent to a railway line was incorporated using a GIS file that had been provided.

vi. The Railway Bridge on Four Mile Creek was amended. It appeared that the invert level of the creek for the western span had not been captured in the survey.

4 Additional Amendments

Additional amendments were necessary for simulating the extreme events. The extent of the active 2D domain was further extended to ensure that the PMF flows were fully captured.

5 Model Performance

The following model performance checks have been undertaken:

- Stability of flow through key structures, represented in 2D, e.g. the Railway Bridge upstream of the Gympie Road at North Pine River (ID: NPR_01_06664) was checked during model development, refer to Figure 5-1.
- Stability of flow through key structures, represented in 1D, e.g. Anzac Avenue Culvert at Yebri Creek (ID: 01_02234) were checked during model development, refer to Figure 5-2.The arrangement of SX connections, structures and embankments has been edited to ensure that stable peak flows have been achieved where necessary.
- Stability of overland flow hydrographs were checked at several locations in the floodplain; e.g. downstream and to the north of Linkfield Road, ID: SPR_01_07887, refer to Figure 5-3.
- TUFLOW warning messages have been reviewed. Although some events include a large number of negative depth warning messages, these are spread over the model extent and are limited to small specific areas. This is discussed further in Section 6.
- Mass balance errors have been minimised. Mass balance errors range from -0.1% to 0.1% for most events up to the 1000 Year RI event. High mass balance errors occur in the PMF event with up to 1.6% for the 3 hours and 12 hours storm duration and 2.7% for the 24 hours storm duration.

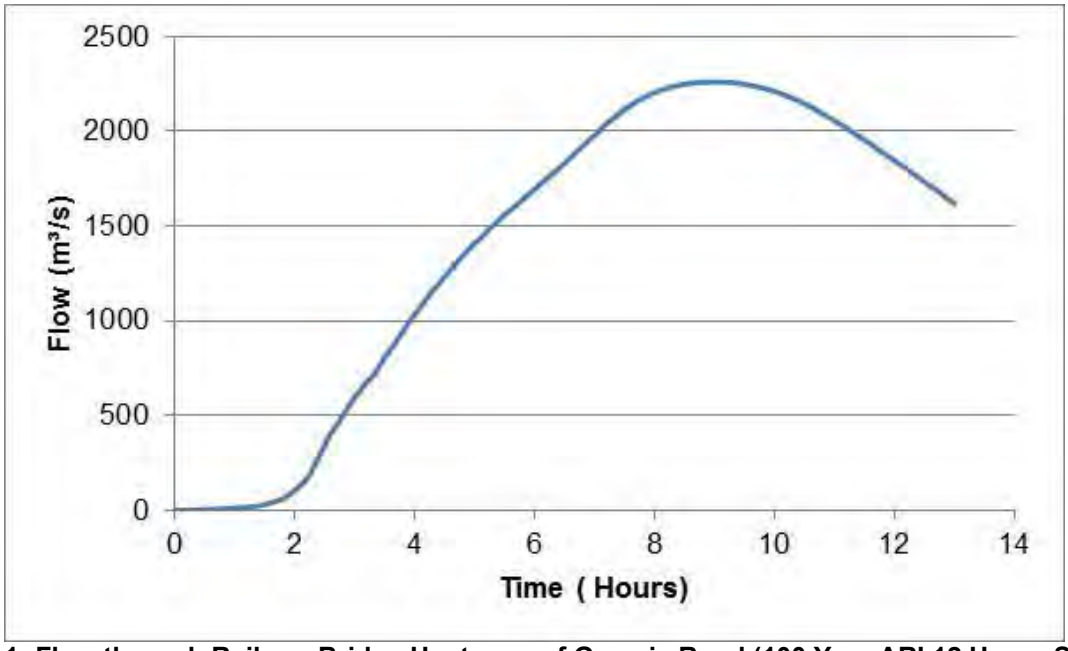


Figure 5-1: Flow through Railway Bridge Upstream of Gympie Road (100 Year ARI 12 Hours Storm Duration)

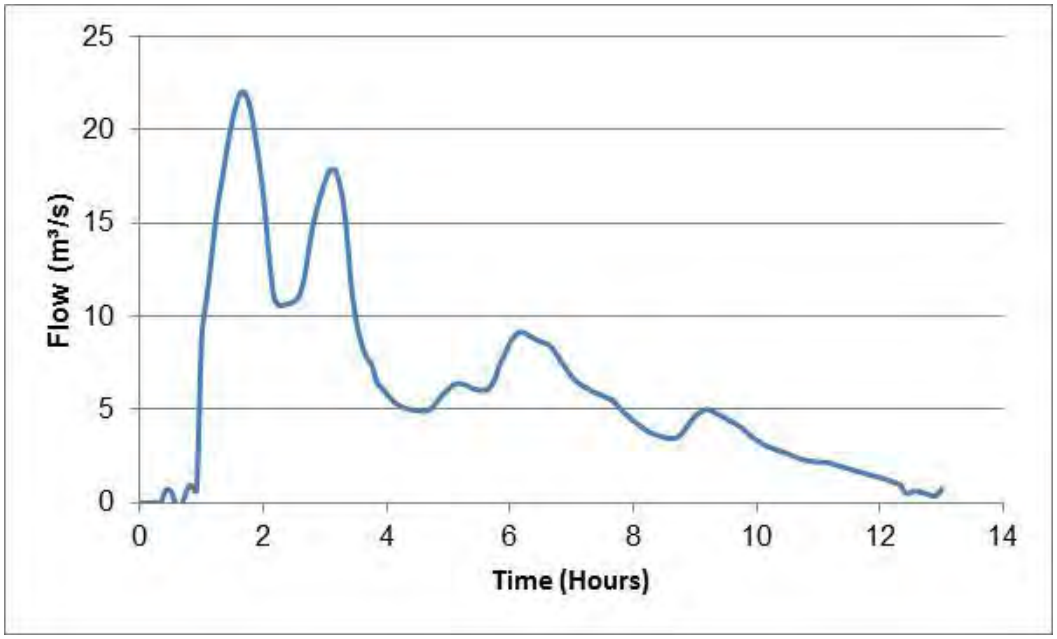


Figure 5-2: Flow through Railway Bridge Upstream of Gympie Road (100 Year ARI 12 Hours Storm Duration)

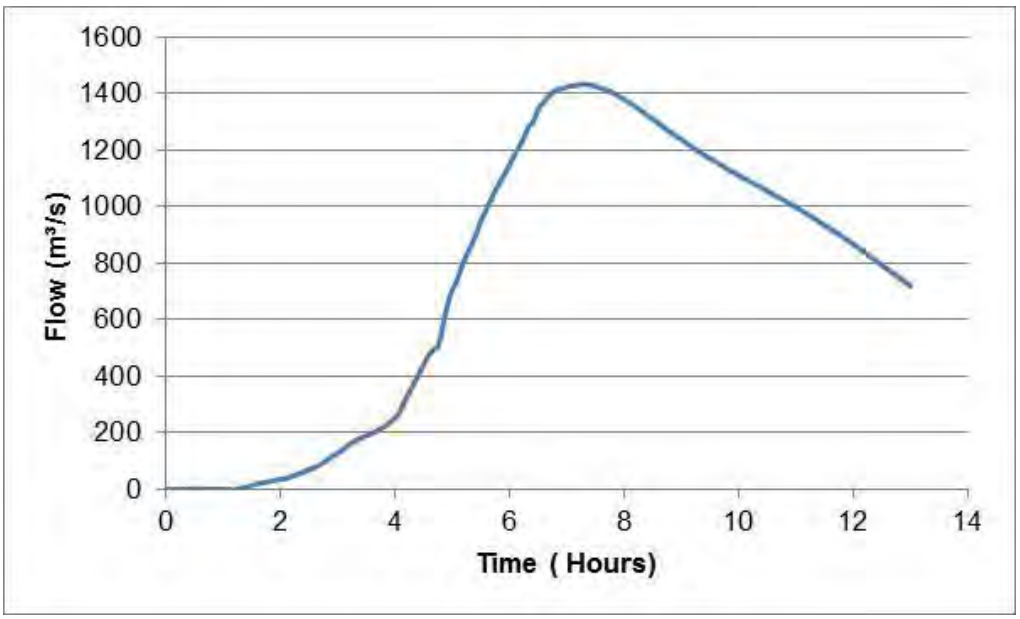


Figure 5-3: Flow South Pine River Floodplain Upstream of Linkfield Road (100 Year ARI 12 Hours Storm Duration)

6 Localised Instabilities

The Lower Pine River TUFLOW model includes a high number of warning messages for most design events as a result of localised instabilities. The locations of these messages vary significantly for various ARI events and storm durations.

For example, the 100 year 12 hours storm duration event has 1500 messages during the simulation. Most of these messages (1300) are located between the railway line and Railway Avenue at the inlet of the Strathpine Courthouse culvert. These warning messages are a result of model instability at this location for this particular event. This does not occur for events smaller than the 100 year ARI events, as the area where the instability occurs is not inundated in smaller events.
Similarly, there are different locations with localised instabilities for other design events. It is recommended that consideration is given to the warning messages and potential instability when interpreting the model

results. Furthermore, it is recommended that these instabilities be resolved as required, if the model is used for other analyses.

7 Model Run Times and Specification

A 5m and 10m model were developed for the Lower Pine River catchment, as adopted by MBRC. These models cover a catchment area of approximately 300km², which result in large model run times and specific requirements for the simulation, as listed in **Table 7-1**:

Table 7-1: Model Run Times and Specification

	5m Model	**10m Model**
RAM Requirement	10.3 GB (10315 MB)	2.5GB (2598 MB)
Number of Active Cells	6,800,000 cells	1,700,000 cells
Approximate Model Run Time	144 Hours (6 days)	15 Hours

8 Bathymetry Data

The model uses bathymetry data collected in 2005. The model calibration has shown that it is likely that the bathymetry has changed in some areas following the January 2011 flood event.

BMT WBM and MBRC recommend that the bathymetry survey is updated and possibly additional bathymetry data collected within the next 2 years.

The bathymetry data seems to have been poorly processed in some places. The Zpts and DEM (including the processed bathymetry data) for the LPR TUFLOW model were provided by WorleyParsons. One location is shown in Figure 8-1, where the provided DEM includes a 2m high weir feature within the South Pine River channel; presumably due to interpolation between the left and right bank.

The comparison between aerial photography and the DEM identified another two locations, where aerial photography showed high land, which was not represented in the DEM, as shown in Figure 8-2.

Figure 8-1: Anomaly in DEM Upstream of Gympie Road

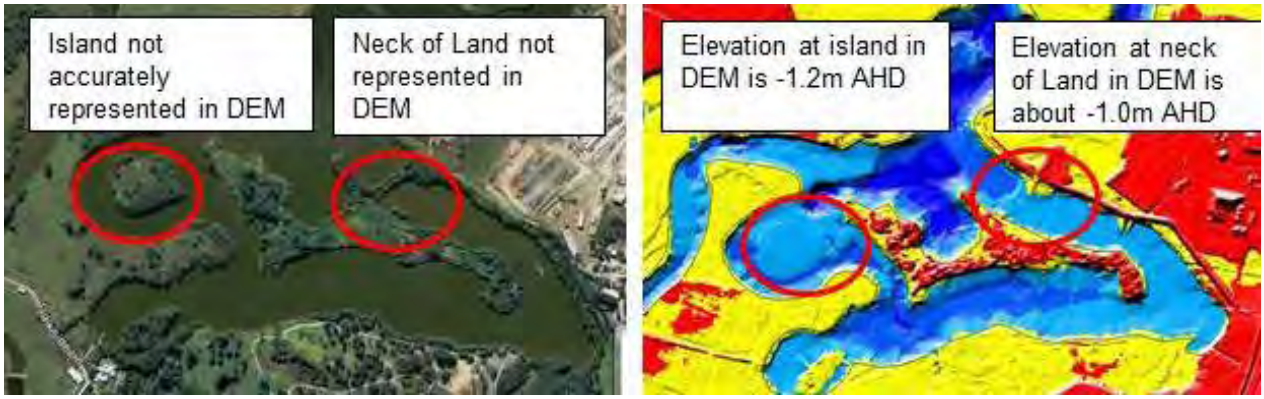


Figure 8-2: Anomaly in DEM in South Pine River Floodplain, East of Strathpine

A sensitivity test was undertaken using a DEM of the bathymetry for a portion of the South Pine River which had been interpolated more accurately by BMT WBM. This amended DEM extended from the railway line crossing to the Bruce Highway. The 100 year 6 hours storm duration (10m model) was used for the sensitivity test.

The results show that the adopted model over predicts peak flood levels by up to 0.12m in the area between Linkfield Road and approximately 350m downstream of Gympie Road on the South Pine River. This area is shown in dark blue with a black outline in Figure 8-3. For events smaller than the 100 Year ARI event, it is expected that the adopted DEM will further over predict peak flood levels. The light blue areas (shown in Figure 8-3) demonstrate that the adopted model over predicts by less than 0.1m.

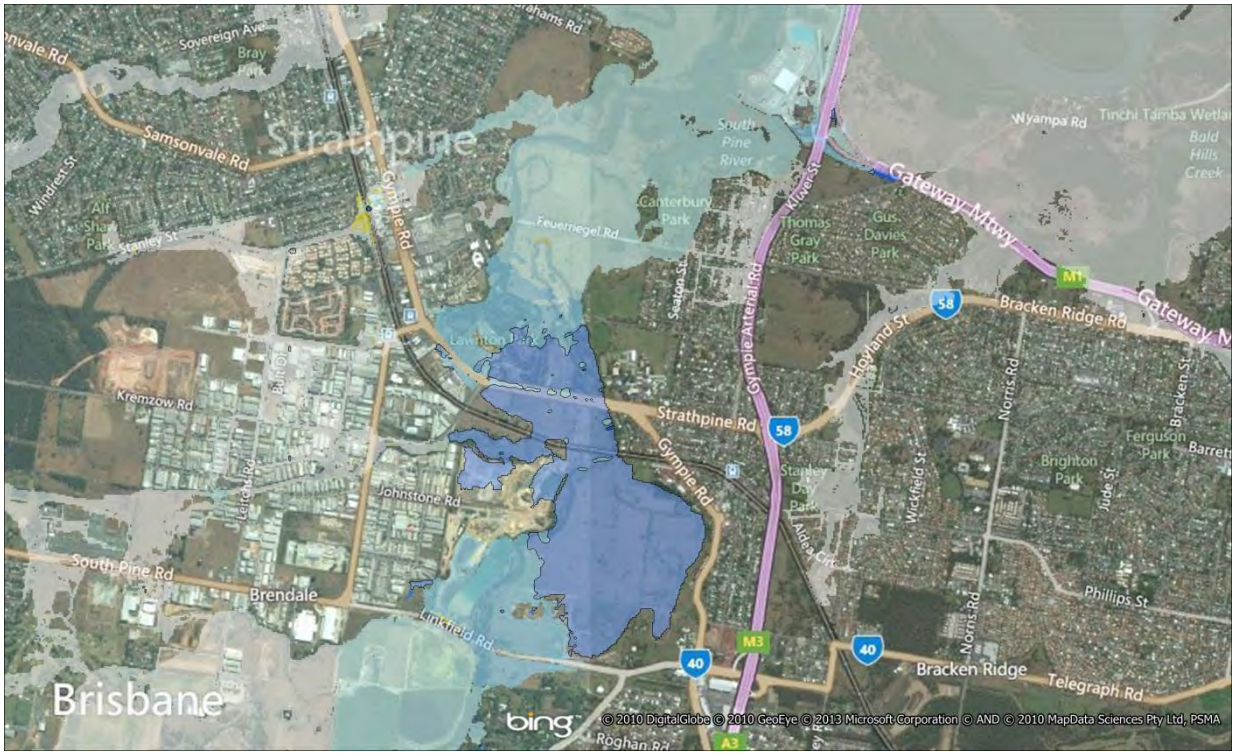


Figure 8-3: Results from Amended Bathymetry Data in South Pine River Floodplain (100 Year ARI 6 Hours Storm Duration)

Note: The dark blue area indicates that the adopted model over predicts peak flood levels by up to approximately 0.12m. The light blue areas show the adopted model over predicts by less than 0.1m.

9 Flood Depth Model Results

The 5m model includes approximately 10 grid cells (concentrated around four locations) that have an elevation lower than -50m AHD due to the corresponding Zpts erroneously attributed an elevation of -9999).

Two of these locations are located outside the flood extent and should be ignored (i.e. represented as dry areas). The other two locations are within the flood extent thus resulting in very high depths (and high depth x velocity product values) within 4 grid cells; these values should be ignored. This has occurred due to holes in the provided DEM; numerous holes in the DEM were identified and covered using Z shapes, but these few grid cells were missed. These remaining small holes in the DEM should be amended in future model upgrades.

10 Conclusion

The Lower Pine River model has been developed with due consideration given to ensuring the quality of the model; within the context of the size, large number of structures and practicality of running this large model. The Lower Pine River model has extended model run times and specific modelling requirements, as outlined in Section 7.

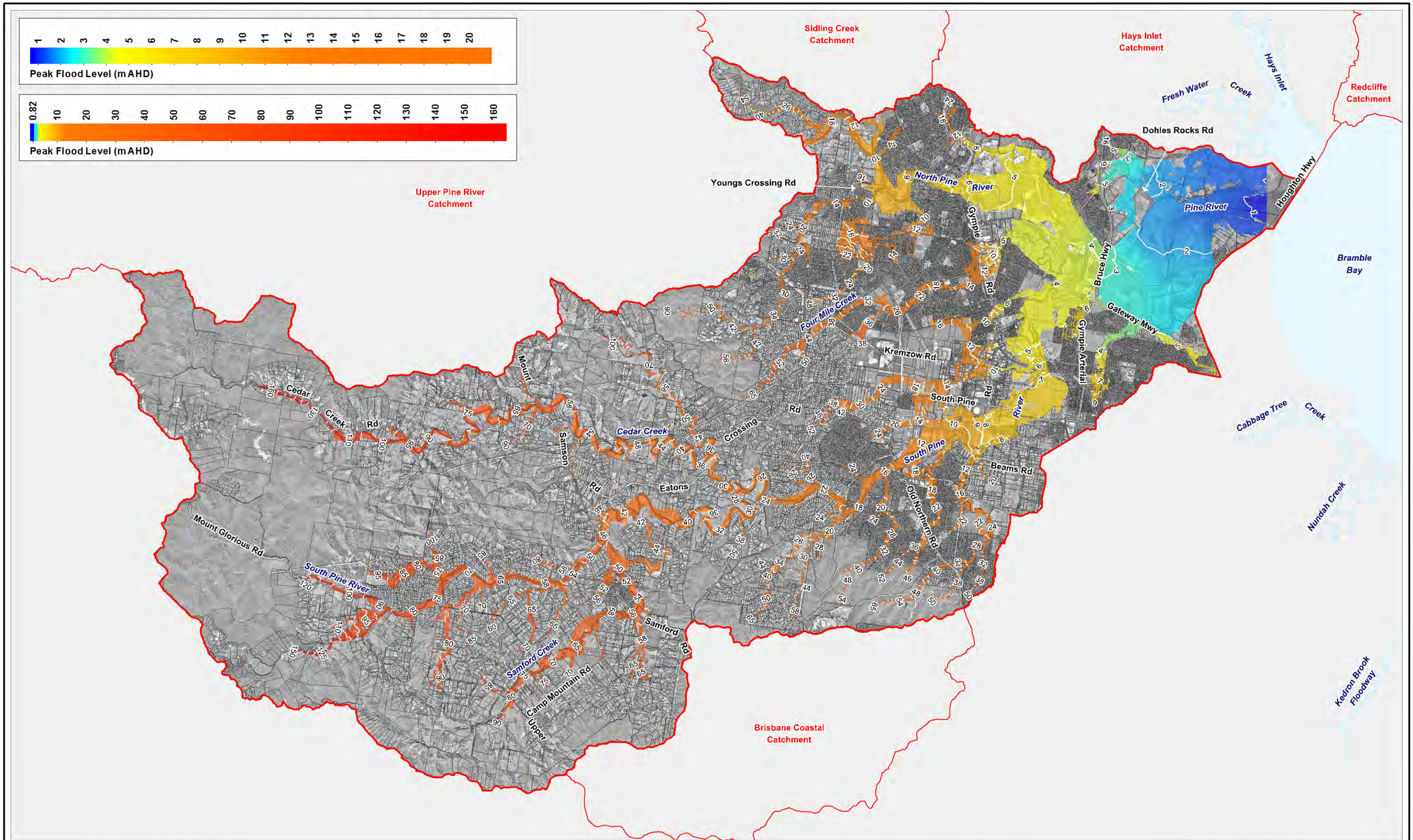
The model has been reviewed internally and externally by MBRC. Amendments have been made in light of these reviews. Some residual small errors were found subsequent to the reviews, which have been discussed in this report (Section 8 and Section 9). Also, isolated model instabilities exist (see Section 6). Despite these residual errors and instability, the overall model performance is suitable for the current intended use of the model.

For future use of the model, it is recommended that the following is considered:

1. Correction of the -9999 grid elevation errors;
2. Resolution of isolated model instabilities;
3. Resurveying of bathymetry data and extending the coverage of bathymetry data;
4. Improvement of the process used to interpolate the bathymetry data; and
5. Changes in the catchment, such as new development, that may have occurred subsequent to the model development.

APPENDIX E

APPENDIX E: FLOOD MAPS – 100 YEAR ARI



LEGEND

Lower Pine River Catchment Boundary

Contour Lines [Labelled with 100 Year ARI Peak Flood Level (m AHD)]

Cadastral Boundaries

Title:

Peak Flood Level Map - 100 Year ARI

Figure: **E-1**

Rev: **A**

N

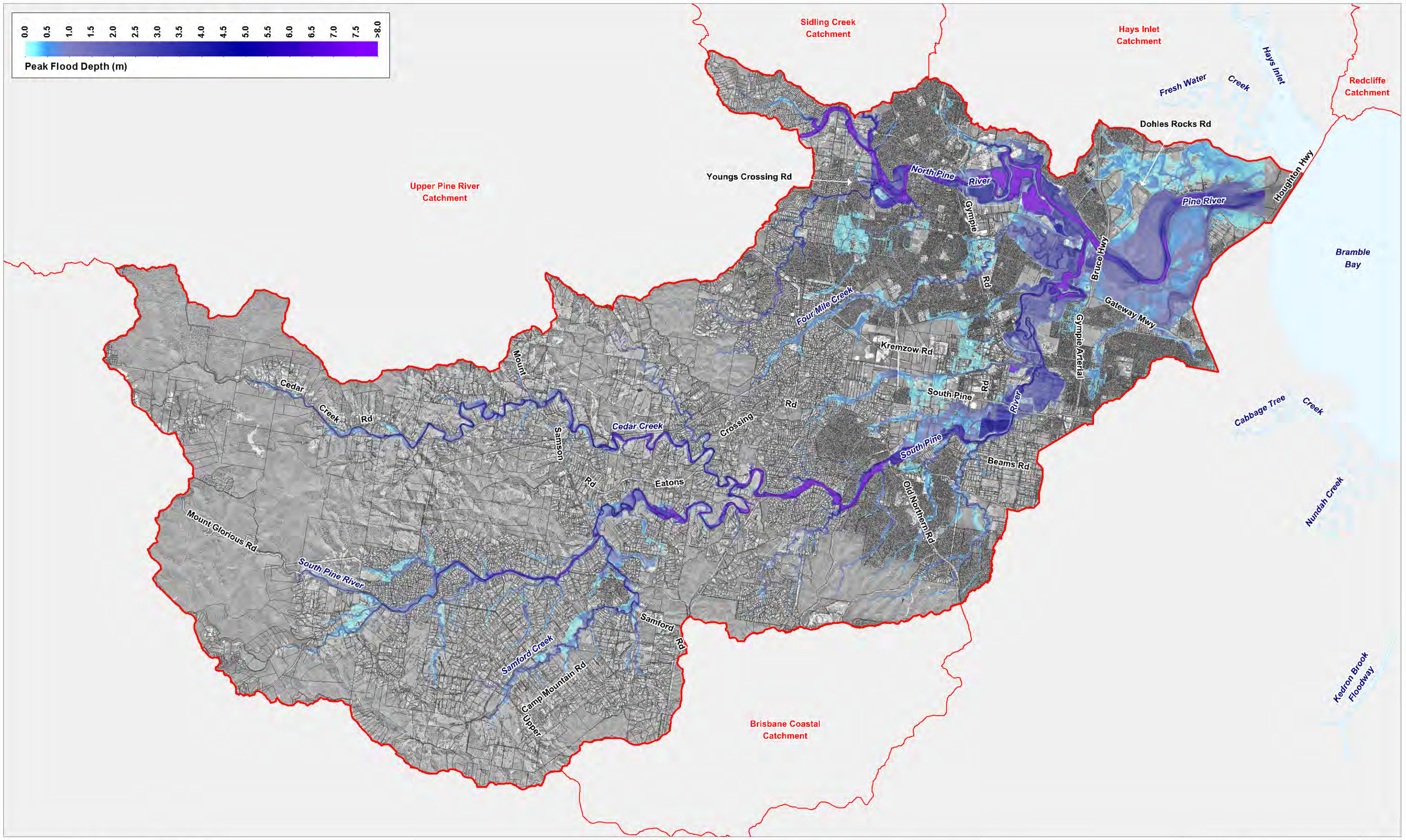
0km 2 4

Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_006_130118_100Y Peak Flood Level.WOR



LEGEND

Lower Pine River Catchment Boundary

Cadastral Boundaries

Title:

Peak Flood Depth Map - 100 Year ARI

Figure: **E-2**

Rev: **A**

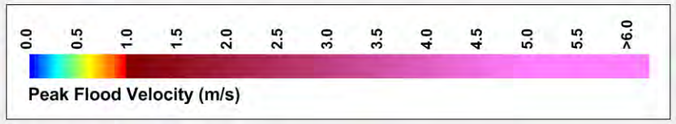
N

0km 2 4

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_007_130121_100Y Peak Flood Depth.WOR



Sidling Creek Catchment

Hays Inlet Catchment

Redcliffe Catchment

Upper Pine River Catchment

Brisbane Coastal Catchment

Fresh Water Creek

Hays Inlet

Bramble Bay

Cabbage Tree Creek

Nundah Creek

Kedron Brook Floodway

Dohles Rocks Rd

Youngs Crossing Rd

North Pine River

Pine River

Houghton Hwy

Gympie Rd

Bruce Hwy

Gateway Mwy

Four Mile Creek

Kremzow Rd

Gympie Arterial

South Pine River

Beams Rd

Old Northern Rd

Mount Samson Rd

Cedar Creek Rd

Cedar Creek

Crossing Rd

Eatons Hill

Mount Glorious Rd

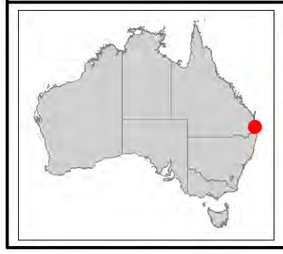
South Pine River

Samford Rd

Samford Creek

Camp Mountain Rd

Upper



LEGEND

Lower Pine River Catchment Boundary

Cadastral Boundaries

Title:

Peak Flood Velocity Map - 100 Year ARI

Figure: **E-3**

Rev: **A**

N

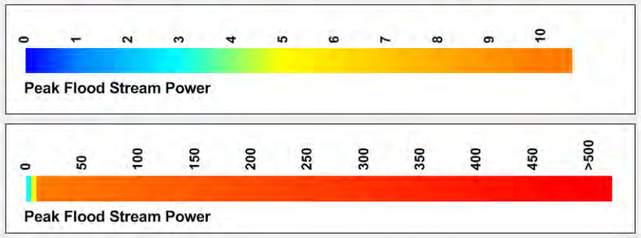
0km 2 4

Approx. Scale

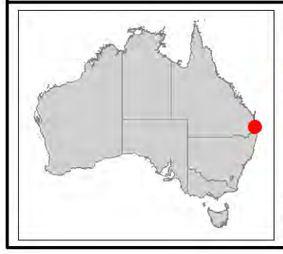
BMT WBM

www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_008_130121_100Y Peak Flood Velocity.WOR



Sidling Creek Catchment
Hays Inlet Catchment
Redcliffe Catchment
Upper Pine River Catchment
Brisbane Coastal Catchment
Hays Inlet
Fresh Water Creek
Dohles Rocks Rd
Youngs Crossing Rd
North Pine River
Pine River
Houghton Hwy
Bramble Bay
Gympie Rd
Bruce Hwy
Four Mile Creek
Gateway Mwy
Kremzow Rd
Gympie Arterial
South Pine River
Cedar Creek Rd
Mount Samson Rd
Cedar Creek
Crossing Rd
South Pine Rd
Beams Rd
Eatons Hill
Old Northern Rd
Cabbage Tree Creek
Nundah Creek
Mount Glorious Rd
South Pine River
Samford Rd
Samford Creek
Camp Mountain Rd
Upper Kedron Brook Floodway



LEGEND

Lower Pine River Catchment Boundary

Cadastral Boundaries

Note:
Stream power is a function of velocity and bed shear stress.

Title:
Peak Flood Stream Power Map - 100 Year ARI

Figure: **E-4**

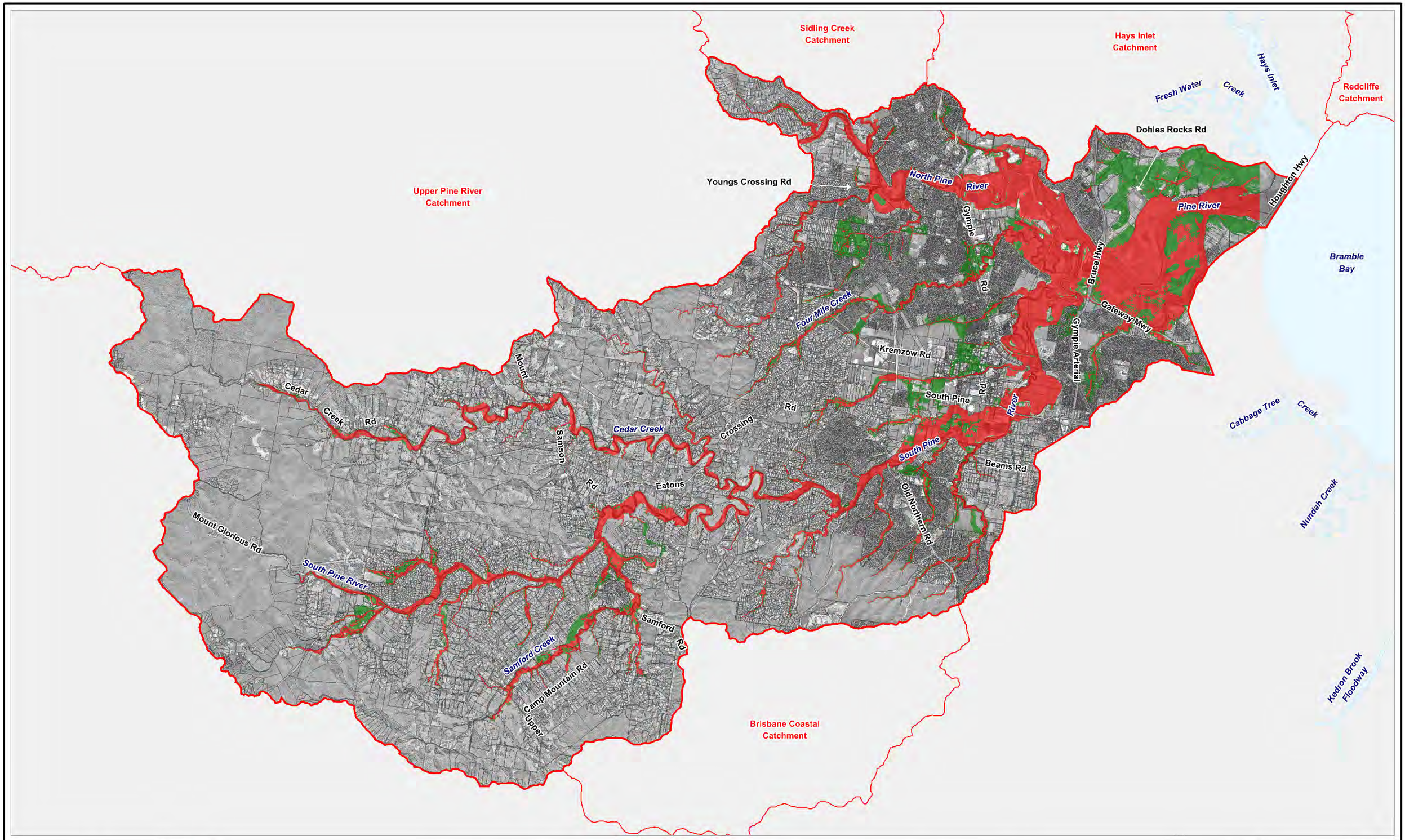
Rev: **A**

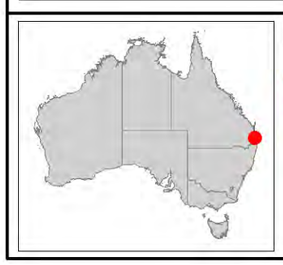
N

0km 2 4
Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_009_130121_100Y Peak Flood Stream Power.WOR





LEGEND

Lower Pine River Catchment Boundary

Cadastral Boundaries

NSW Floodplain Development Manual
Flood Hazard Category
100 Year ARI Event

Low Hazard
High Hazard

Title:

Peak Flood Hazard Map - 100 Year ARI

Figure: **E-5**

Rev: **A**

N

0km 2 4

Approx. Scale

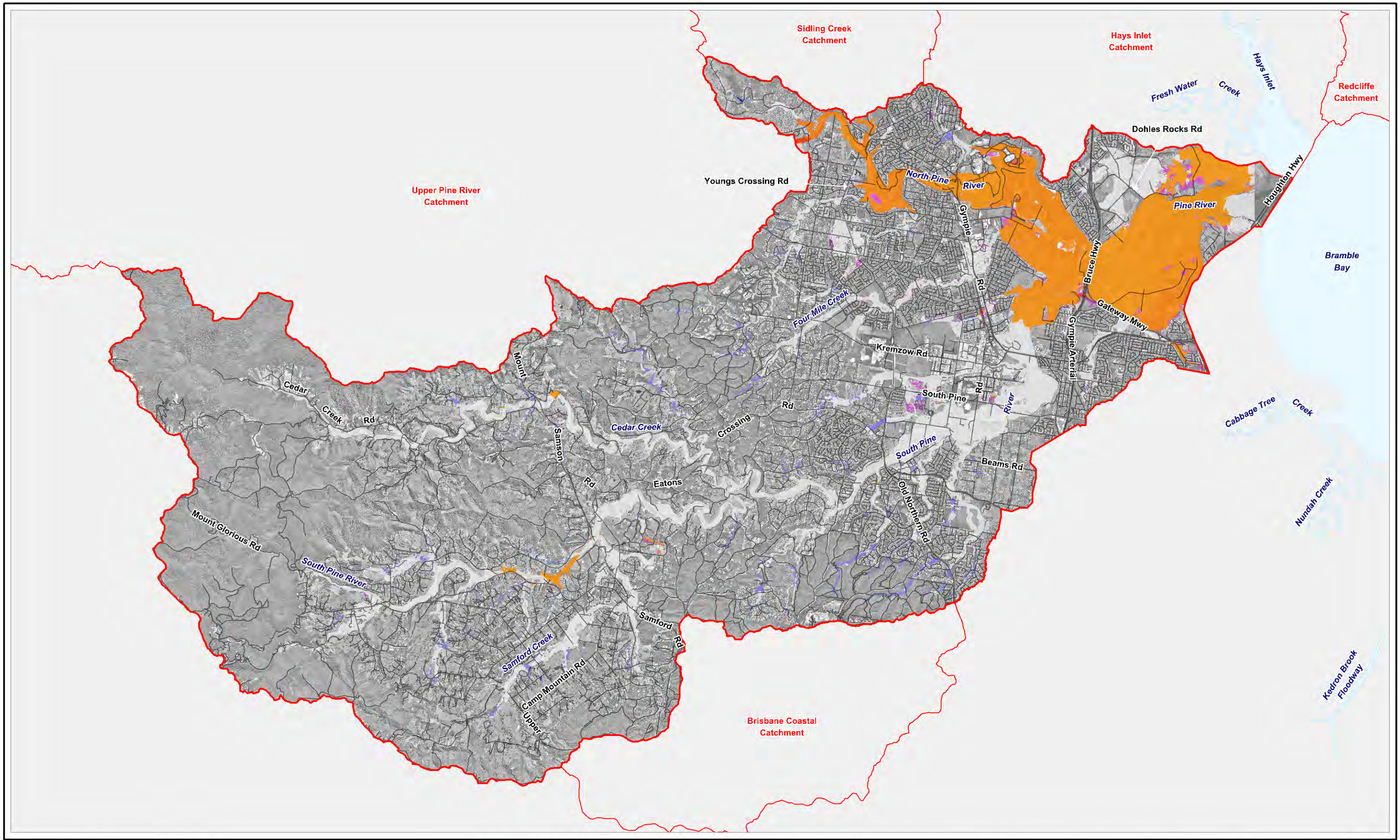
BMT WBM
www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_010_130121_100Y Peak Flood Hazard.WOR

APPENDIX F

APPENDIX F

APPENDIX F: MODEL SENSITIVITY ANALYSIS MAPS



LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

100 Year EDS Minus 100 Year ARI 3 Hours, 6 Hours and 12 Hours Storm (S1)

Figure: F-1

Rev: A

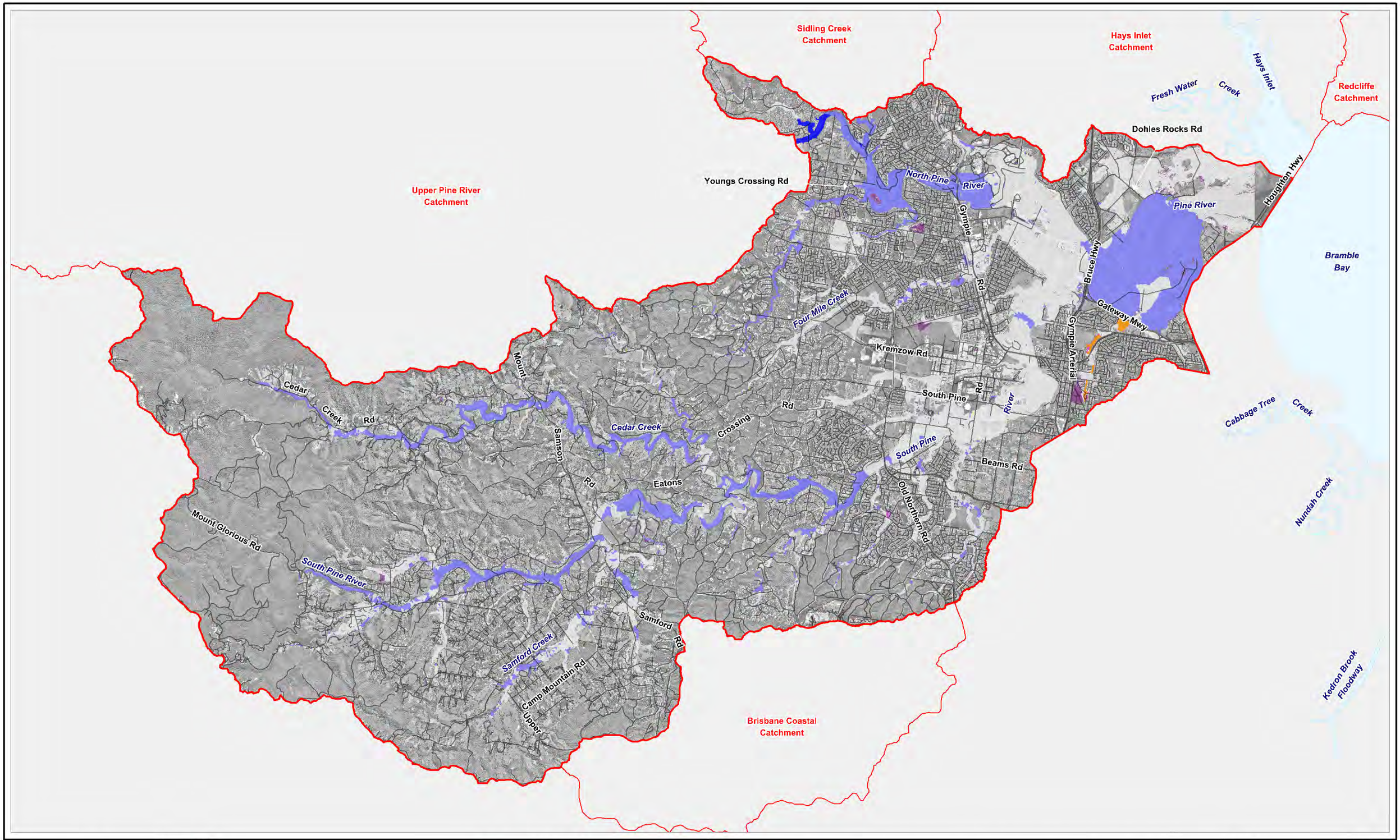
N

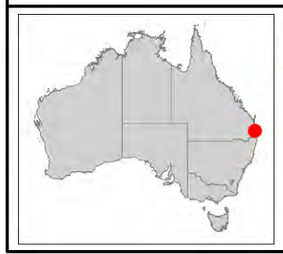
0km 2 4

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_011_130201_Sensitivity_S1.WOR





LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Increased Roughness Scenario (S2) Minus 100 Year EDS

Figure: F-2

Rev: A

N

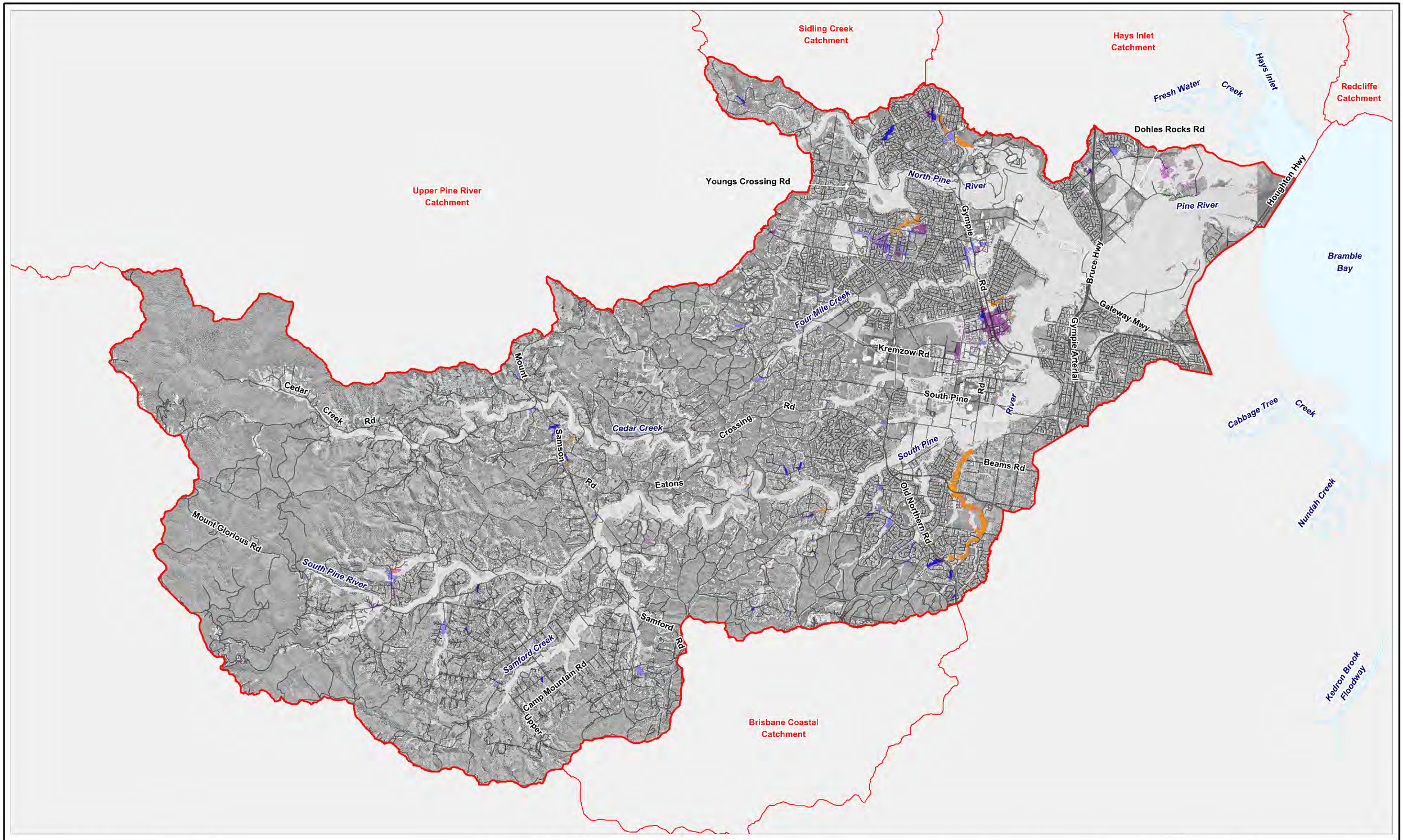
0km 2 4

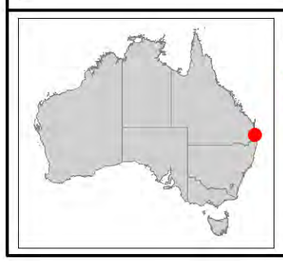
Approx. Scale

BMT WBM

www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_012_130201_Sensitivity_S2.WOR





LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Structure Blockage Scenario (S3) Minus 100 Year EDS

Figure: **F-3**

Rev: **A**

N

0km 2 4

Approx. Scale

BMT WBM
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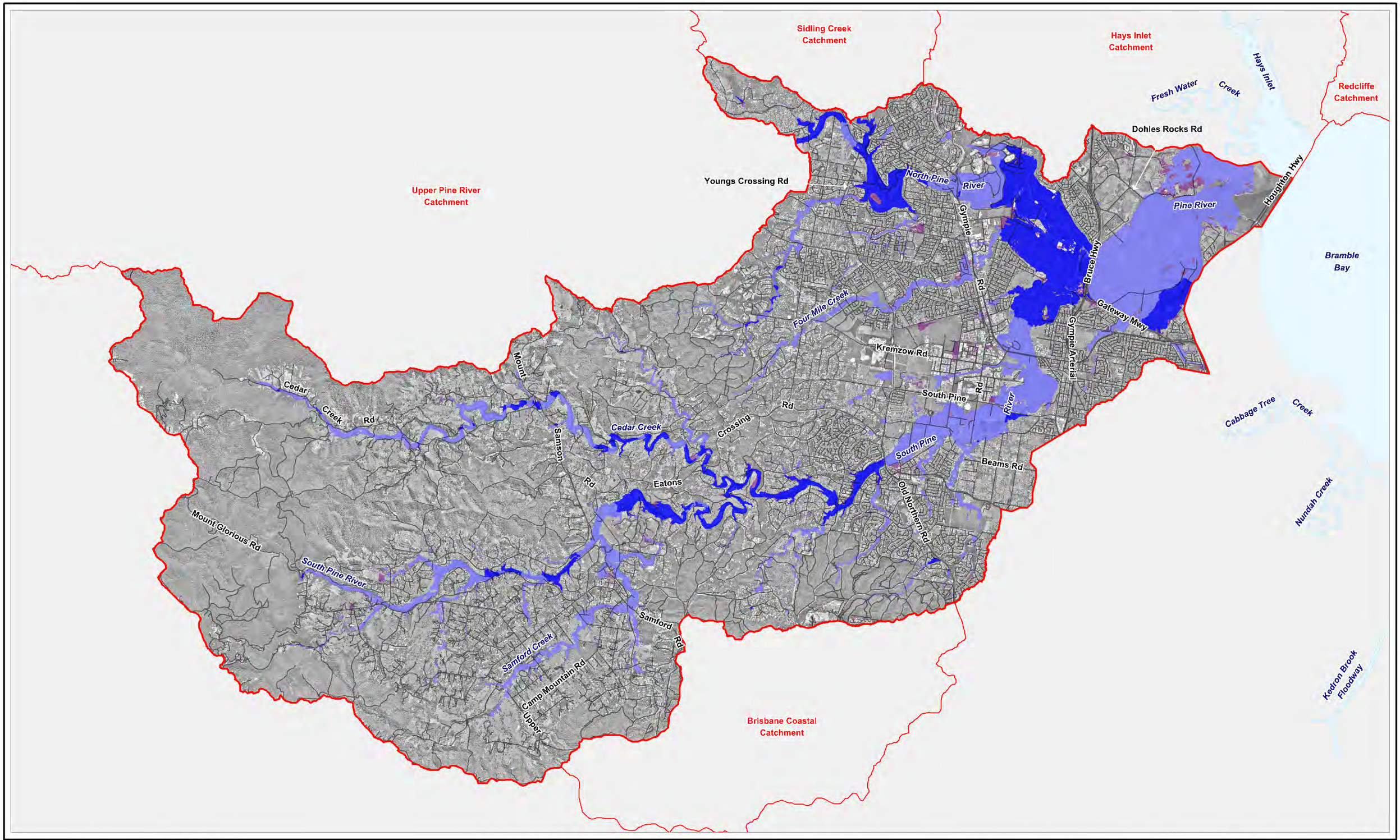
Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_013_130201_Sensitivity_S3.WOR



LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Increased Rainfall Scenario (S4) Minus 100 Year EDS

Figure: F-4

Rev: A

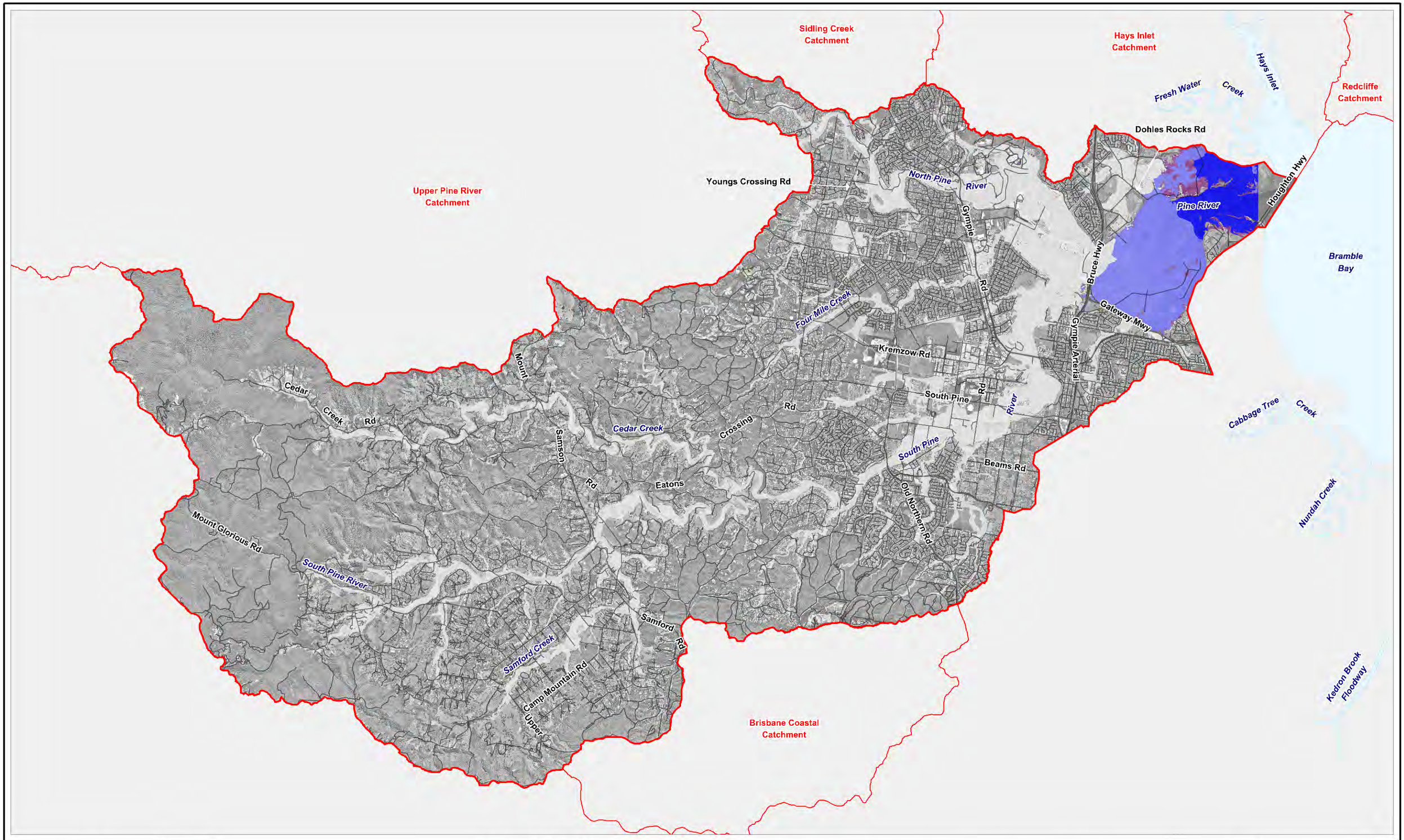
N

0km 2 4

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_014_130201_Sensitivity_S4.WOR



LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Increased Downstream Boundary Scenario (S5) Minus 100 Year EDS

Figure: F-5

Rev: A

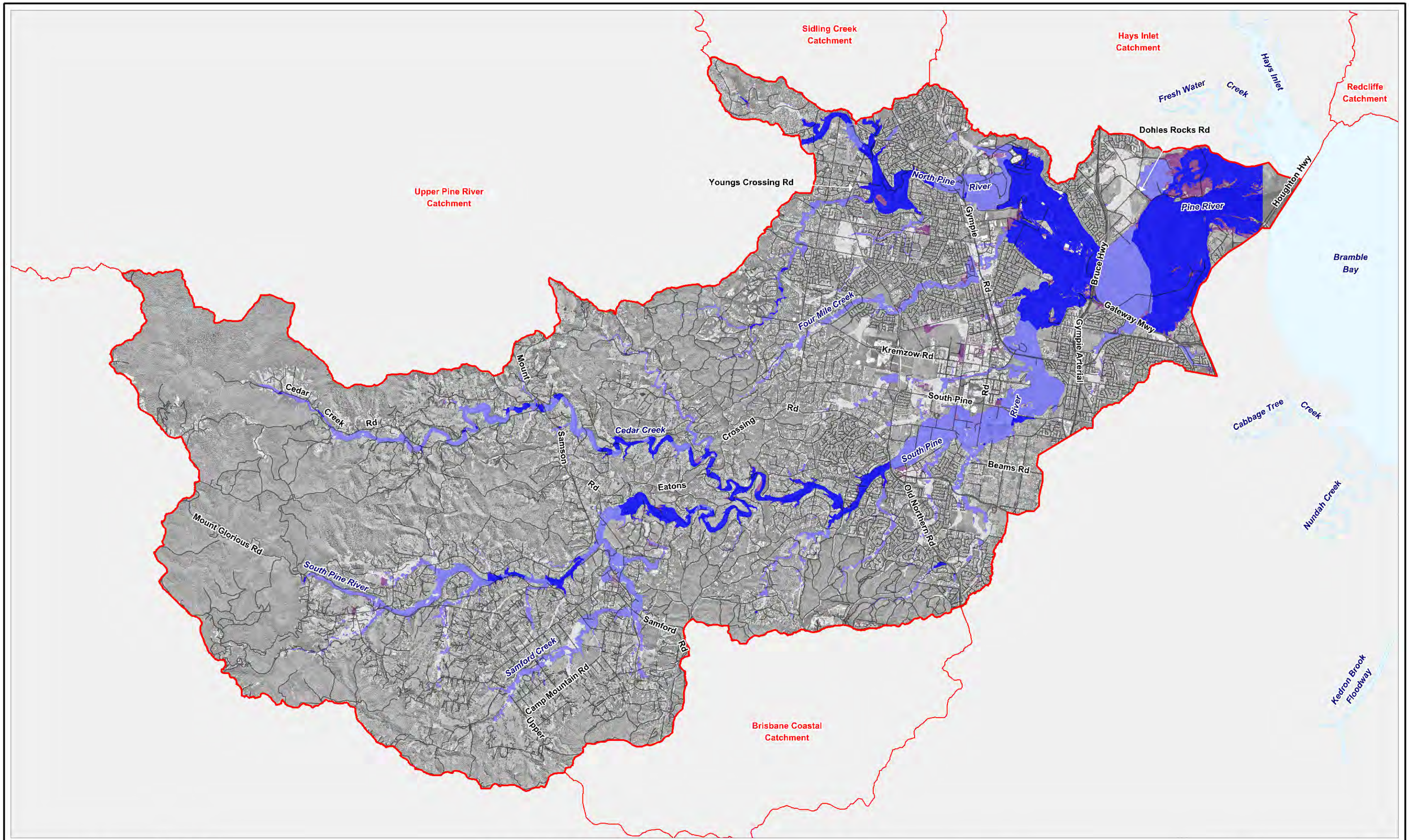
N

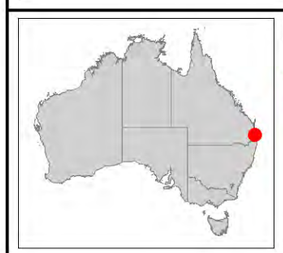
0km 2 4

Approx. Scale

BMT WBM
www.bmtwbm.com.au

Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_015_130201_Sensitivity_S5.WOR





LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Increased and Downstream Boundary and Rainfall Scenario (S6) Minus 100 Year EDS

Figure: F-6

Rev: A

N

0km 2 4

Approx. Scale

BMT WBM

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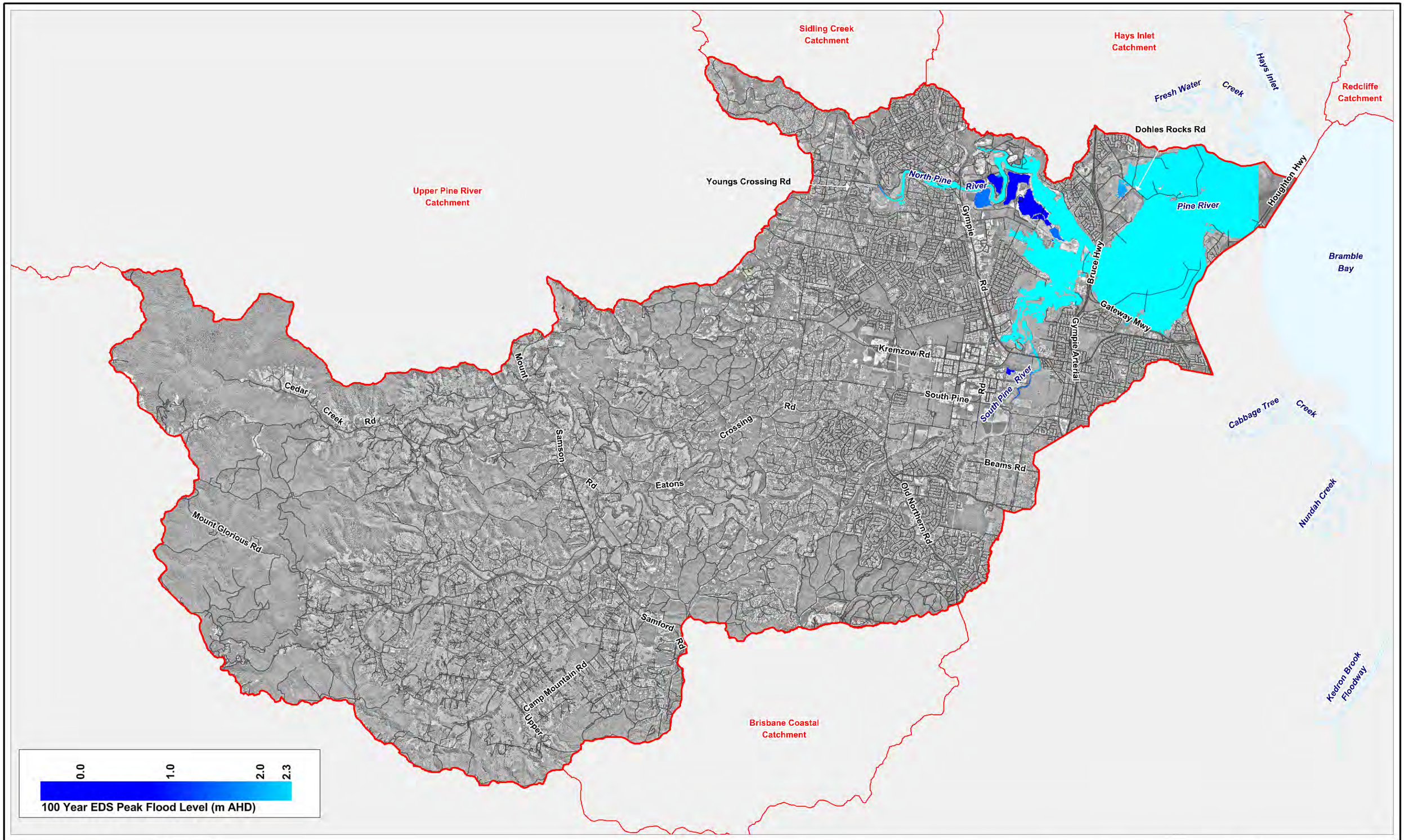
Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_016_130201_Sensitivity_S6.WOR



LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Title:

Dynamic Storm Tide Peak Flood Level - 100 Year EDS (S7)

Figure: F-7

Rev: A

N

0km 2 4

Approx. Scale

BMT WBM

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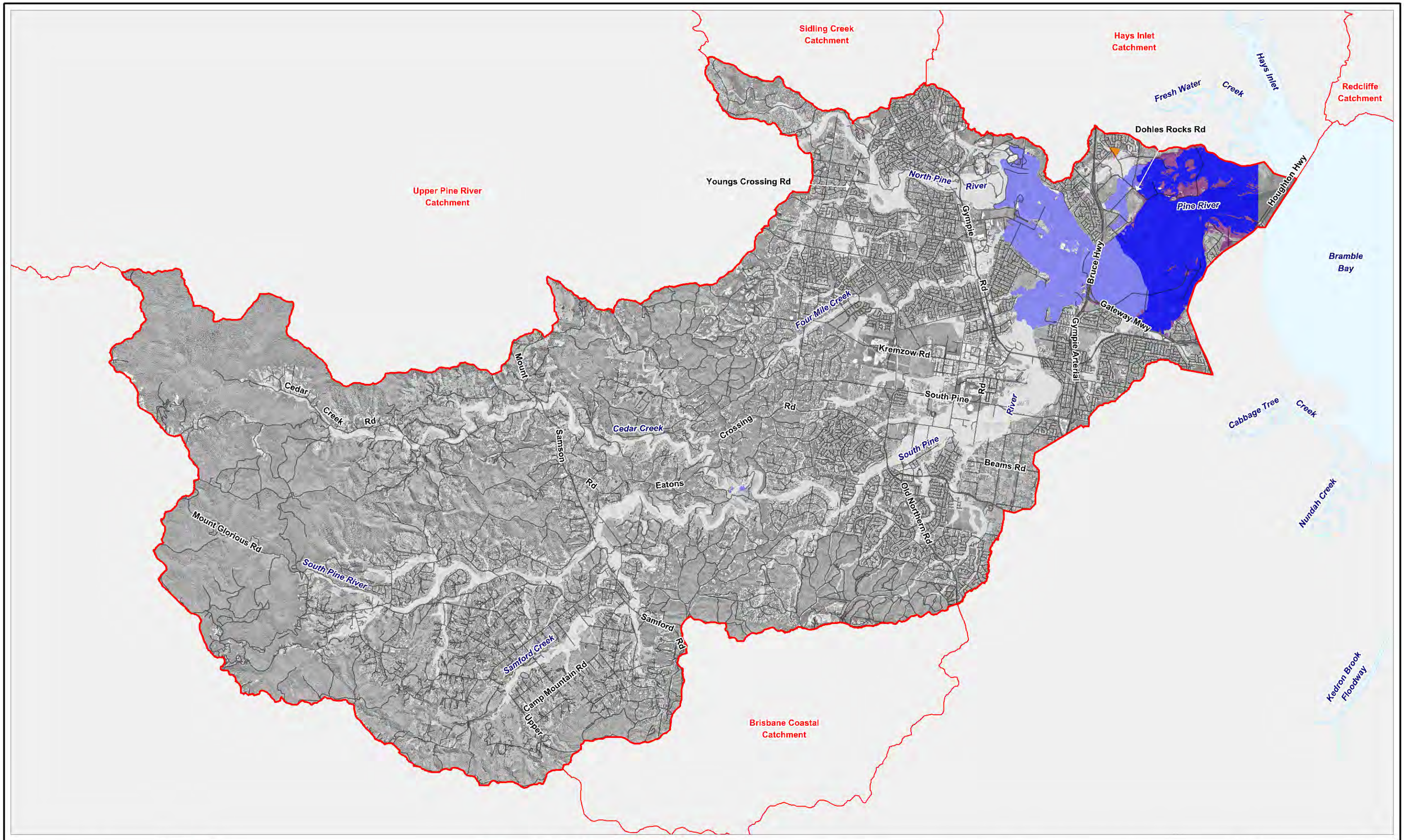
Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_017_130201_Sensitivity_S7.WOR



LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Static Storm Tide Scenario (S8) Minus 100 Year EDS

Figure: F-8

Rev: A

N

0km 2 4

Approx. Scale

BMT WBM
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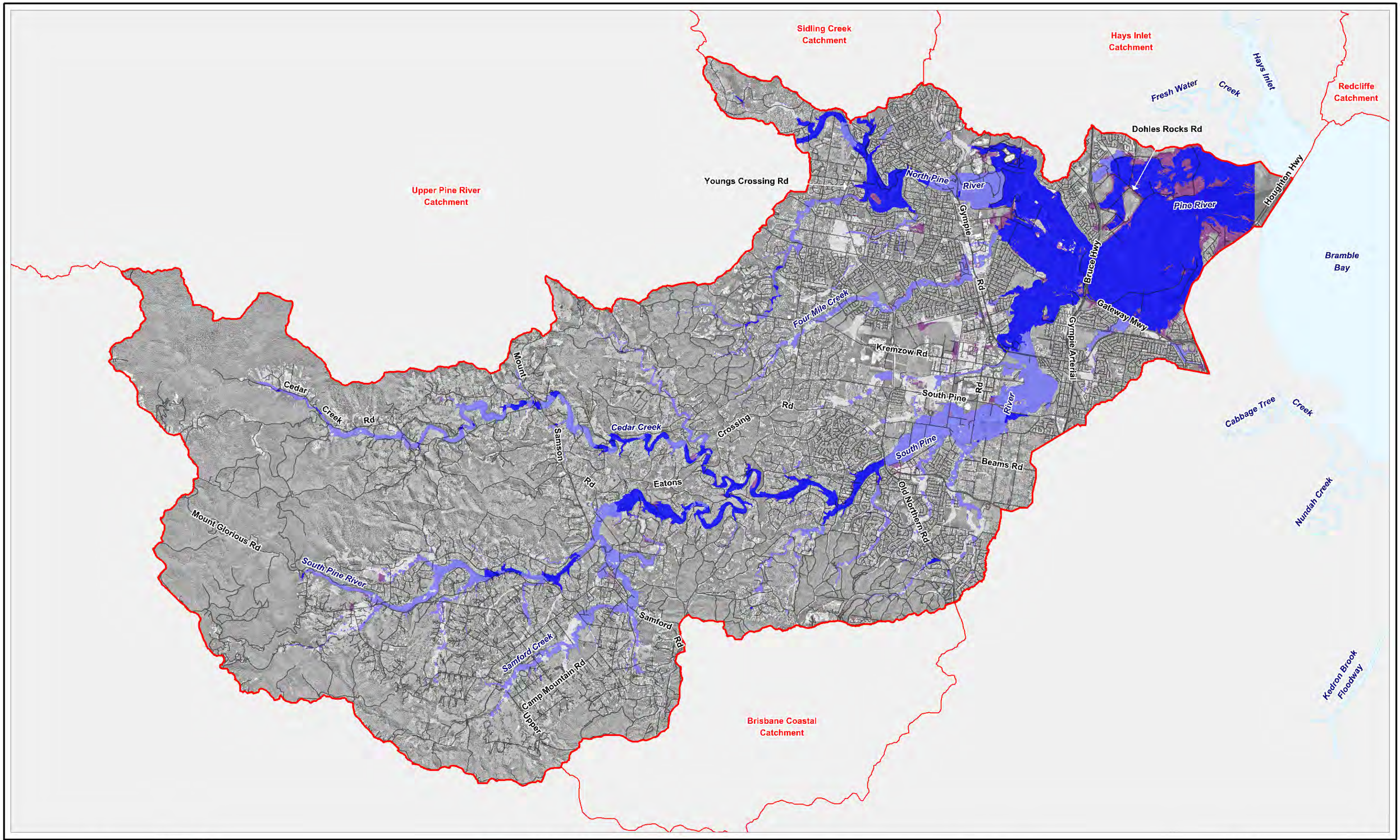
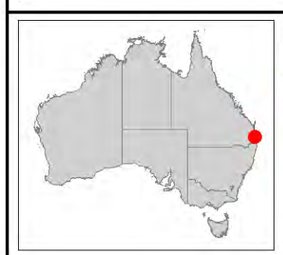
Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_018_130201_Sensitivity_S8.WOR





LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Static Storm Tide, Increased Rainfall and Sea Level Rise Scenario (S9) Minus 100 Year EDS

Figure: **F-9**

Rev: **A**

N

0km 2 4

Approx. Scale

BMT WBM
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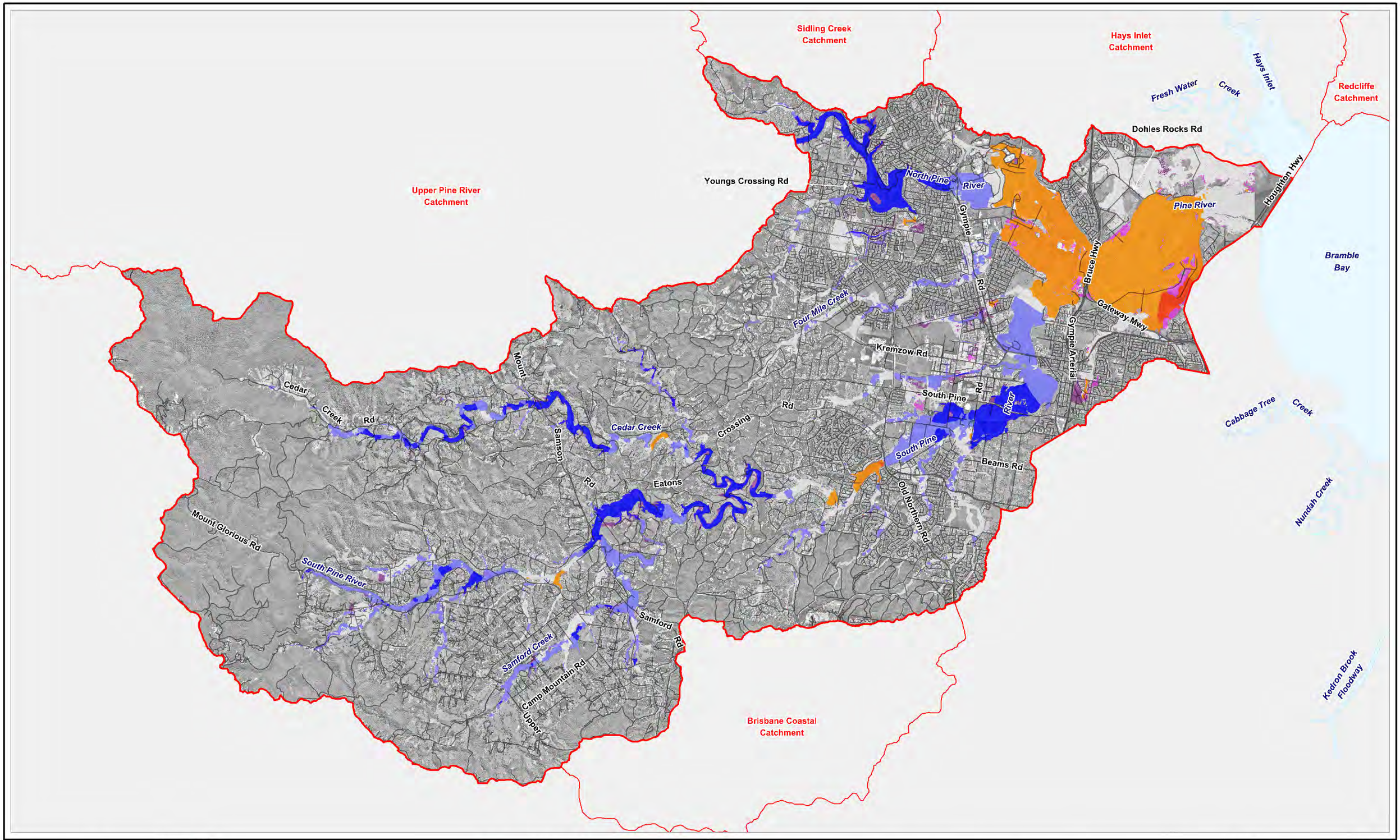
Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_019_130201_Sensitivity_S9.WOR



LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Increased Vegetation Scenario (S10) Minus 100 Year EDS

Figure: F-10

Rev: A

N

0km 2 4

Approx. Scale

BMT WBM
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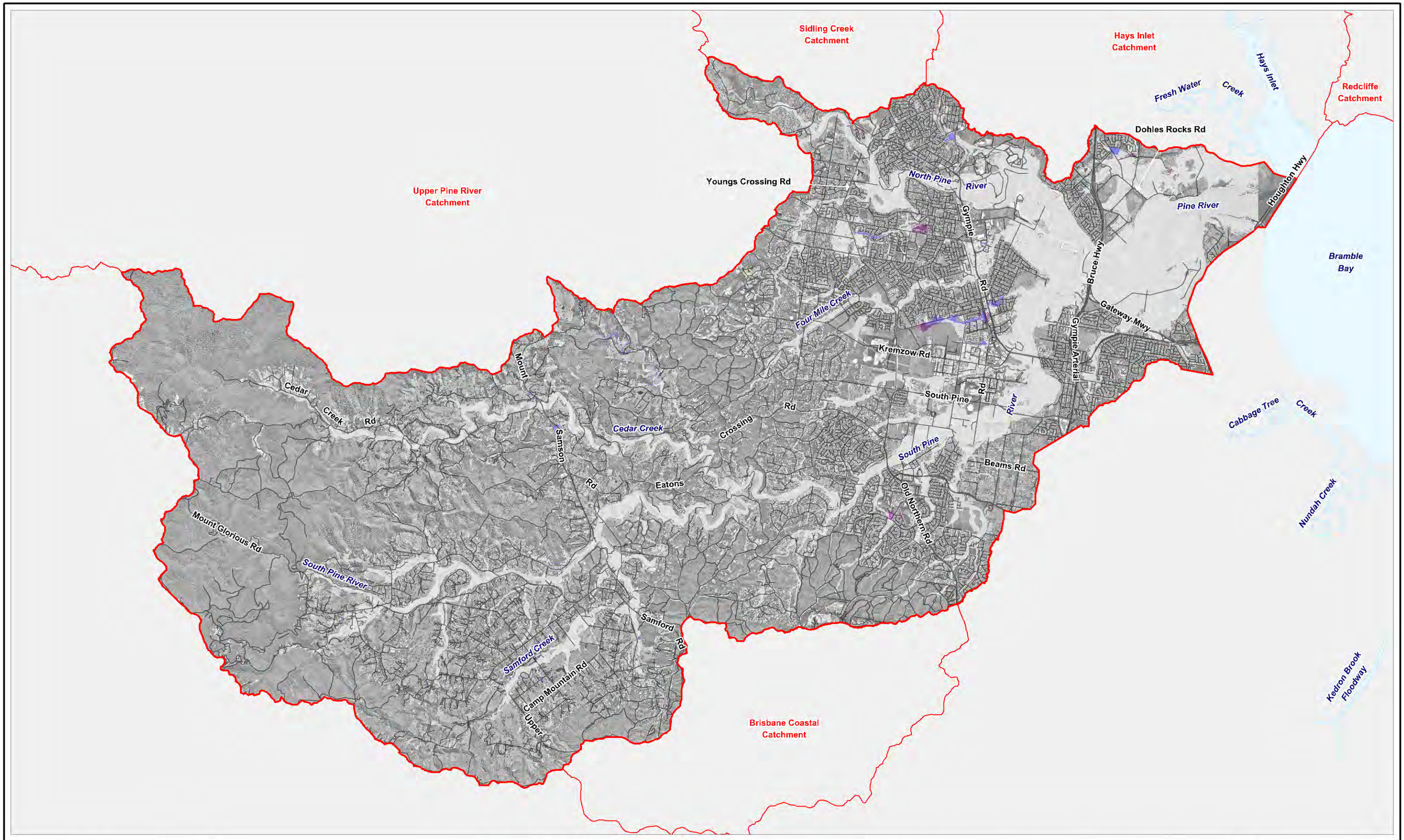
Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_020_130201_Sensitivity_S10.WOR



LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Increased Residential Development Scenario (S11) Minus 100 Year EDS)

Figure: F-11

Rev: A

N

0km 2 4

Approx. Scale

BMT WBM

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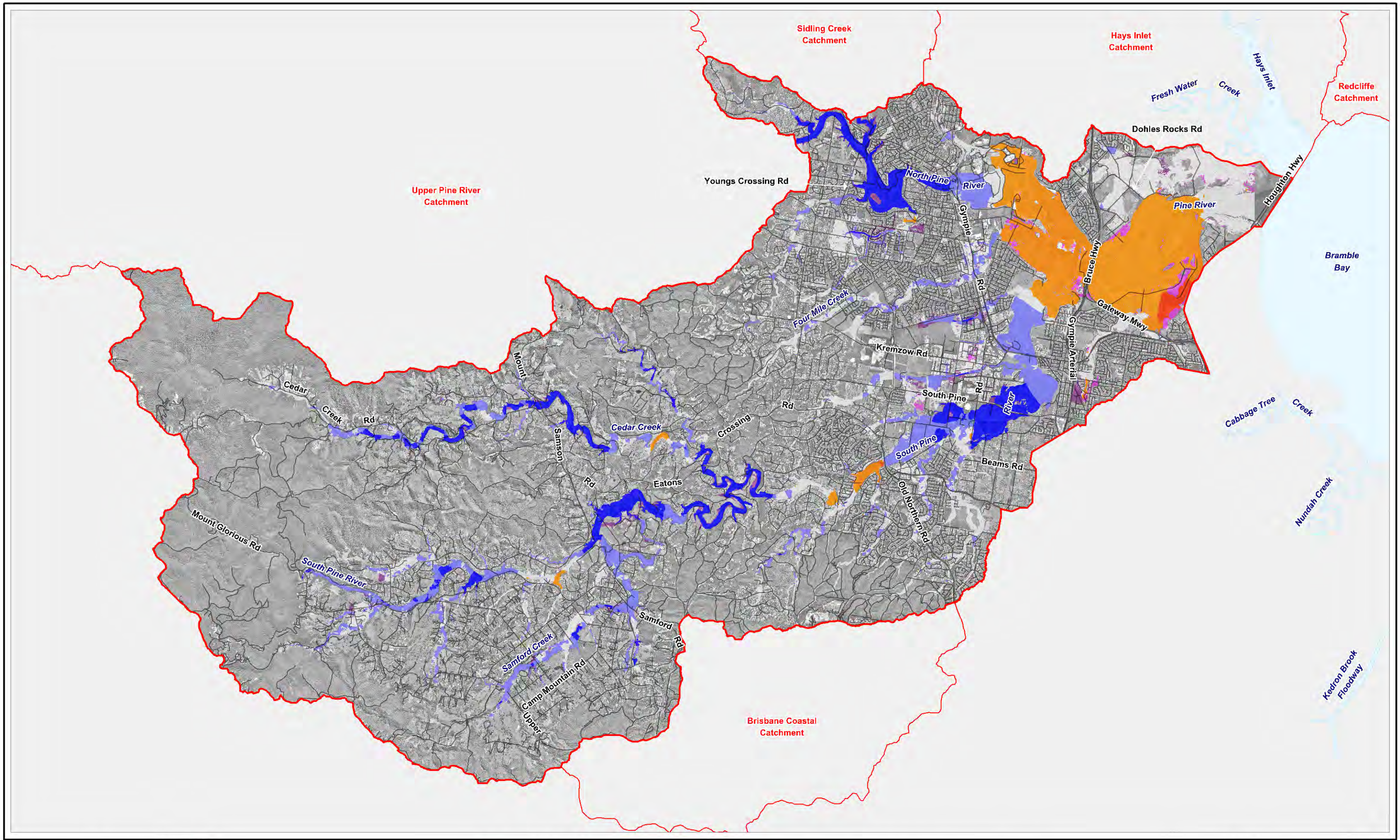
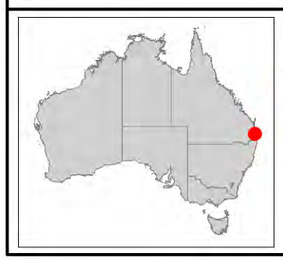
Filepath : I:\B18521_I_AK_MBRC_RFD_Stage_3\DRG\LPR_Report\FLD_021_130201_Sensitivity_S11.WOR





LEGEND

Lower Pine River Catchment Boundary

Physical Road Network

Difference in Peak Levels (m)

- < -0.5
- -0.5 to -0.1
- -0.1 to 0.1
- 0.1 to 0.5
- > 0.5
- Was dry now wet
- Was wet now dry

Title:

Increased Residential Development and Vegetation Scenario (S12) Minus 100 Year EDS

Figure: **F-12**

Rev: **A**

N

0km 2 4

Approx. Scale

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