Regional Floodplain Database:

Hydrologic and Hydraulic Modelling - Sideling Creek (SID)

Moreton Bay Regional Council

Emergency Management EMQ Queensland

Australian Government
Attorney-General's Department
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Queensland Government

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MORETON BAY REGIONAL COUNCIL

Regional Floodplain Database

Hydrologic and Hydraulic Modelling Report: Sideling Creek (SID)

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SYNOPSIS

This flood study report has been prepared by WorleyParsons for Moreton Bay Regional Council for the purposes of documenting the methodology, approach and outcomes associated with the comprehensive flood assessment works undertaken for the Sideling Creek (SID) minor basin as part of the MBRC Regional Floodplain Database (RFD) Stage 2 project. The study has included detailed hydrologic and hydraulic modelling to assess the flood behaviour of SID for a range of design storm events from the 1 year Average Recurrence Interval (ARI) event to the Probable Maximum Flood (PMF).

Modelling software packages used in this flood study are the WBNM (Watershed Bounded Network Model) as the hydrologic modelling software and TUFLOW as the hydraulic modelling software.

The flood assessment undertaken for the SID minor basin as documented in this report has been successful in addressing the overall objectives of the study. It is considered that the associated model outputs can be adopted by MBRC for the Regional Floodplain Database to deliver seamless information about flood behaviour across the entire Moreton Bay Regional Council area.

PROJECT 301001-01156 - REGIONAL FLOODPLAIN DATABASE

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
0	Issue for use	L Cheung	K Hegerty	M Shaw	30 Jul 2012		

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1 INTRODUCTION

WorleyParsons Services Pty Ltd has been commissioned by Moreton Bay Regional Council (MBRC) to carry out detailed surface water flood modelling over six (6) regional minor basins located within the MBRC Local Government Area (LGA). The six minor basins are Upper Pine River (UPR), Sideling Creek (SID), Stanley River (STA), Neurum Creek (NEU), Mary River (MAR) and Byron Creek (BYR). This flood modelling study has been carried out as part of Stage 2 of the Regional Floodplain Database (RFD) Project. Stage 1 of the RFD Project involved a pilot study and various sub-projects that have provided the basis for the overall project methodology.

UPR and SID make up ‘Package 1’ and STA, NEU, MAR and BYR make up ‘Package 5’ of MBRC’s Stage 2 RFD Project.

This report details the project methodology, results and outcomes associated with the SID minor basin investigation.

1.1 Scope

The scope of this flood modelling investigation was to carry out detailed hydrologic and hydraulic modelling over the Sideling Creek minor basin. The results from the detailed modelling of Sideling Creek will provide Council with an enhanced understanding of the flood behaviour in the minor basin for a large range of flood events from the 1 year Average Recurrence Interval (ARI) event to the Probable Maximum Flood (PMF).

1.2 Objectives

The objectives of this study are:

- Development of computer based hydrologic and hydraulic modelling suite for the Sideling Creek minor basin based on standardised modelling procedures and modelling input parameters specific for the RFD study minor basins.
- Use of the developed models to predict where and how flooding may occur in the Sideling Creek minor basin.

The associated model outputs are to be included in the RFD for delivering seamless information about flood behaviour across the entire MBRC LGA.

1.3 General Approach

The detailed hydrologic and hydraulic modelling undertaking for the SID minor basin has involved the following tasks:

- Refine the broadscale WBNM2010 hydrologic model established for SID minor basin in Stage 1 RFD project;
- Establish a detailed 1D/2D coupled TUFLOW model with a grid resolution of 5m cell size for the SID minor basin utilising the topographic information, roughness values, inflow and other boundary condition information determined in previous sub-projects as detailed in Table 1-1;
- Undertake separate critical duration assessments for simulation of a range of storm durations for the 10 and 100 year ARI design events and the Probable Maximum Flood (PMF) event;
- Select three (3) critical durations for each design event from the above separate critical duration assessments as follows:
  - 1 to 10 year ARI events, determined by the 10 year ARI critical duration assessment;
  - 20 to 100 year ARI events, determined by the 100 year ARI critical duration assessment; and
  - 200 year ARI to PMF events, determined by the PMF critical duration assessment;
- Simulate 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000 year ARI and PMF events for the three (3) selected critical durations for each design event;
- Simulate the 100 year ARI 15 minutes Burst in 270 minutes envelope Embedded Design Storm (EDS);
- Assess model sensitivity to Manning's 'n' and blockage of culverts;
- Assess climate change scenario by 20% increase of rainfall intensity over the SID minor basin;
- Assess future landuse scenario by increased vegetation coverage on the floodplain; and
- Provide a concise report describing the adopted methodology, study data, model results and findings.

1.4 Related Sub-Projects (RFD Stage 1 & Stage 2 Pilot)

Table 1-1 summarises the previous related sub-projects (as part of the RFD Stage 1) for the purposes of providing input data and or methodologies to this RFD Stage 2 project:

Table 1-1 Related Previous Sub-Projects

Sub-Project	Origin	Scope
1D – Hydrologic and Hydraulic modelling (Broadscale)	BMT WBM (2010)	To define model naming conventions and model protocols to be used in the RFD project
1E – Floodplain Topography (2009 LiDAR)	WorleyParsons (2010a)	To provide the topographic information, such as model z-pts layer and digital elevation models (DEM) utilising a DEM tool developed specifically for the RFD
1G – Hydrography	MBRC	To supply the sub-catchment delineation of Burpengary minor basin including a stream line and junctions (used in the WBNM model)
1H – Floodplain Landuse	SKM (2010a)	To deliver the current percentage impervious cover (utilised in the hydrologic model) and the roughness Manning's 'n' values (utilised in the hydraulic model)
1I – Rainfall and Stream Gauges Information Summary	MBRC	To summarise available rainfall and stream gauge information for the study area
2B – Detailed modelling of the Burpengary Creek minor basin	BMT WBM (2010)	The pilot study for the RFD Stage 2. One of the key outputs of this sub project was to develop a general modelling methodology and structure as an overall guideline for all detailed modelling being undertaken in Stage 2 of the RFD
2C – Floodplain Structures (Culverts)	Aurecon (2010)	To supply a GIS layer of the culverts to be included in the hydraulic model for the RFD project
2D - Floodplain Structures (Bridges)	Aurecon (2010)	To provide a GIS layer of the major road bridges and foot bridges to be included in the hydraulic model for the RFD project
2F – Floodplain Structures (Trunk Underground Drainage)	Aurecon (2010)	To provide trunk underground drainage information for the RFD project
2G - Floodplain Structures (Basins)	Aurecon (2010)	To consolidate and survey the existing basin information for the RFD project

Sub-Project	Origin	Scope
2I - Floodplain Structures (Channels)	Aurecon (2010)	To identify channels within the minor basins
2J – Floodplain Landuse (Historic and Future)	SKM (2010a)	To define the historic and future percentage impervious cover (utilised in the hydrologic model) and the roughness (Manning's 'n') values representing landuse for the February 1999 event (utilised in the hydraulic model)
2K – Flood Information Historic Flooding	GHD (2010)	To locate and survey flood levels for the May 2009 and February 1999 historic flood events
2L – Design Rainfall and Infiltration Loss	WorleyParsons (2010b)	To develop the hydrologic models for the Burpengary Creek minor basin and provide the design rainfall hydrographs for the TUFLOW models
2M – Boundary Conditions, Joint Probability and Climate Risk Scenarios	SKM (2012b)	To define the boundary conditions and provide recommendations in regards to joint probability (i.e. occurrence of storm surge in combination with river flooding events, or river flooding in combination with local tributary flooding). This project also recommended certain sea level rise and rainfall intensity values to assess Climate Risk Scenarios
2N – Floodplain Parameterisation	SKM (2012c)	To provide recommendations of the floodplain parameters, such as a range of values for various impervious percentages for various landuse types (i.e. residential or rural landuse, dense vegetation), a range of values for various roughness types (i.e. long grass, dense vegetation) and structure losses

2 AVAILABLE DATA

The following list summarises the data available for the study:

- Floodplain Topography - DEM Tool to create 2.5m DEM and model Z-pts (model topography) The topography is based on LiDAR (Light Detection And Ranging) data collected in 2009 and provided by Department of Environment and Resource Management (DERM);
- Hydrography - hydrography dataset (sub-minor basin delineation) supplied by MBRC;
- Floodplain Landuse – polygons for nine (9) different landuse categories provided by MBRC and developed by SKM (2010a) as part of RFD Stage 1;
- Floodplain Structures – DTMR and QT structures prepared by Aurecon (2010) and provided by MBRC in TUFLOW readable format. Other structure provided by MBRC in the form of as constructed drawings and detail survey;
- Design Rainfall – amendment of WBNM models, development of design simulations and provision of design rainfall hydrographs;
- Boundary Conditions, Joint Probability and Climate Risk Scenarios – report with recommendations for boundary conditions, joint probability and climate change scenarios; and
- Floodplain Parameterisation – recommendations for impervious percentages for various landuse types, roughness types and structure losses.

2.1 Qualification to Report Findings

It is important to appreciate that the accuracy of the information presented in this report is entirely dependent on the accuracy of these available data. Therefore, the interpretation of information presented in this report should be done so with an understanding of any limitations in their accuracy.

Factors for consideration:

- All data listed above have been provided by Moreton Bay Regional Council for the purpose of developing this model. WorleyParsons have assumed the accuracy of this data and suitability of use for this study, and have not critically reviewed this information. In particular, topographic information has been provided by MBRC, and the flood assessment predictions are based on the accuracy of this data;
- Due to unavailability of suitable historical data there has not been the opportunity to undertake calibration of model results. Therefore, models have been derived based on regionally verified parameters;

- Recognition that no two floods behave in exactly the same manner and the data provided for use cannot represent conditions for all possible flood scenarios. Therefore, the results presented may not exactly replicate the flooding behaviour of an actual flood event;
- Design floods are considered a best estimate of an "average" flood for their probability of occurrence. It is assumed that these data provide the best estimate of the average;
- Over time further information may become available that could impact on the outcomes of the study as presented in this report. Council should be mindful of new information that may impact the outcomes as presented in this study and consider appropriate actions to address possible changes to findings;
- Flood study analysis relies on the requirement to have a freeboard between the predicted average recurrence interval flood event and land levels used for development purposes. The freeboard accounts for variation in modelling assumptions and impacts not accounted in the analysis such as wave action. Accordingly flood levels from this study will need to be used with freeboard allowances contained in the applicable MBRC Town Planning Scheme; and
- This analysis has been carried out using industry standard software and methods considered industry best practice at the time of the study.

3 METHODOLOGY

3.1 Data Review

3.1.1 Infrastructure Data Assessment

WorleyParsons completed a report entitled "*Infrastructure Data Assessment Report Package 1*" in October 2010. The purpose of the report was to review, identify and prioritise any additional floodplain infrastructures as well as the existing data for both Upper Pine River (UPR) and Sideling Creek (SID) minor basins that is necessary to complete the detailed modelling for the Stage 2 RFD project. The infrastructures assessed within the minor basins included:

- Structure junctions
- Hydraulic structures
- Basins and dams
- Buildings in the floodplains

A copy of the "*Infrastructure Data Assessment Report Package 1*" is included in Appendix A.

3.1.2 Calibration and Validation

WorleyParsons completed a report entitled "*Calibration and Validation Feasibility Report Package 1*" in November 2010. The purpose of the report was to assess the feasibility of carrying out historical event model calibration and validation for the Upper Pine River (UPR) and Sideling Creek (SID) minor basins as part of the Stage 2 RFD project. The report identified five (5) river gauges in the vicinity of Package 1 minor basins with potential historical data and two (2) possible events for the purpose of model calibration/validation.

A copy of the "*Calibration and Validation Feasibility Report Package 1*" is included in Appendix C.

It should be noted however that, MBRC has subsequently decided not to carry out model calibration/validation for SID model due to insufficient reliable historical flow data. Selection of key modelling parameters for the SID model is discussed further in Section 3.4.

3.1.3 Hydrography

WorleyParsons completed a report entitled "*Hydrography Review Report Package 1*" in November 2010. The purpose of the report was to review the supplied hydrography data against other data provided for the Stage 2 RFD project including aerial imagery and a 2.5m grid aerial LiDAR digital elevation model and identify issues in the supplied data as well as make recommendations to improve the suitability of the hydrography for use in the Stage 2 RFD project. Most of the recommendations in the report have been adopted by MBRC and the sub-catchment delineation for Sideling Creek minor basin was updated and re-issued.

A copy of the "*Hydrography Review Report Package 1*" is included in Appendix B of this report.

3.2 Hydrologic Model

The WBNM (Watershed Bounded Network Model) software was nominated by MBRC as the hydrologic software package to be used for the RFD to calculate inflow hydrographs for the hydraulic model described in Section 3.3 of this report.

WBNM is an event based hydrologic model that was developed at the University of Woolongong and is widely used throughout Australia. The model calculates flood flow hydrographs from storm rainfall hyetographs and can simulate the behaviour of hydraulic structures including weirs, culverts and diversion works. The model routes runoff from upstream sub-areas through the current sub-area and adds the routed flow to the excess rainfall that is routed separately through the sub-area. The model can be used for natural, partly urban and fully urbanized minor basin using different lag factors for pervious and impervious areas.

Detailed hydrologic model parameters, such as adopted losses, design gauge locations and Intensity Frequency Duration (IFD) data are described in the Regional Floodplain Database Design Rainfall - Burpengary Pilot Project Report (WorleyParsons, 2010b). Other model input data, such as landuse and minor basin delineation, was provided through other sub-projects outlined in Section 1.4 of this report. Table 3-1 below summarises the ultimate rainfall loss and model lag parameters adopted for the current SID WBNM model.

Table 3-1 Rainfall Loss and Model Lag Parameters

Loss Parameters		Sub-area Lag Parameter
Initial	Continuing	
0mm	2.5mm/hour	1.6

3.3 Hydraulic Model

3.3.1 Model Selection

Because of the complex nature of floodplain flow patterns in urban and rural minor basins, MBRC has adopted TUFLOW, a dynamically-linked 2D/1D hydrodynamic numerical model, to predict the flood behaviour of a minor basin. TUFLOW has the ability to:

- Accurately represent overland flow paths, including flow diversion and breakouts (2D modelling);
- Model the waterway structures of the entire minor basin with a relatively high level of accuracy (1D or 2D modelling);
- Dynamically link components of the 1D models (i.e. culverts) to any point in the 2D model area; and
- Produce high quality flood map output (i.e. flood extent, flood levels, depths, velocities, hazard and stream power), which are fully compatible with Geographic Information Systems (GIS).

A brief description of TUFLOW is provided in the following sections.

3.3.2 Model Geometry

Sideling Creek is a major tributary of the North Pine River, which enters the North Pine River at Young's Crossing approximately 1km downstream from the North Pine Dam. Lake Kurwongbah behind Sideling Creek Dam is a major urban water supply storage that was constructed in 1957. The dam embankment level was later raised in 1969 to create a present day storage of approximately 16GL in Lake Kurwongbah. The total minor basin area of Sideling Creek including Lake Kurwongbah is approximately 53 km^2.

A TUFLOW model was developed for the SID minor basin, including Lake Kurwongbah and Sideling Creek Dam with the model resolution pre-defined by MBRC at 5m cell size across the entire 2D model domain with a horizontal grid orientation (zero rotation). The horizontal grid orientation approach was selected as part of the development of the RFD to ensure consistency of model parameters across the entire RFD study area.

The model topography was derived from the DEM tool (WorleyParsons, 2010) including the DEM modifiers utilising the 2009 ALS data developed for the RFD project. During Stage 1 RFD studies, stream and road modifiers were used in the DEM tool to 'carve out' streams and define road embankments in the Z-pts layer. However, in the current RFD Stage 2 studies, the DEM tool has been updated so that roads are modified after the streams, avoiding the need to further modify the topography in TUFLOW.

The combination of the above features has allowed for the development of catchment-wide flood models, providing detailed flood information across the entire SID minor basin. Figure 3-1 illustrates the SID model layout.

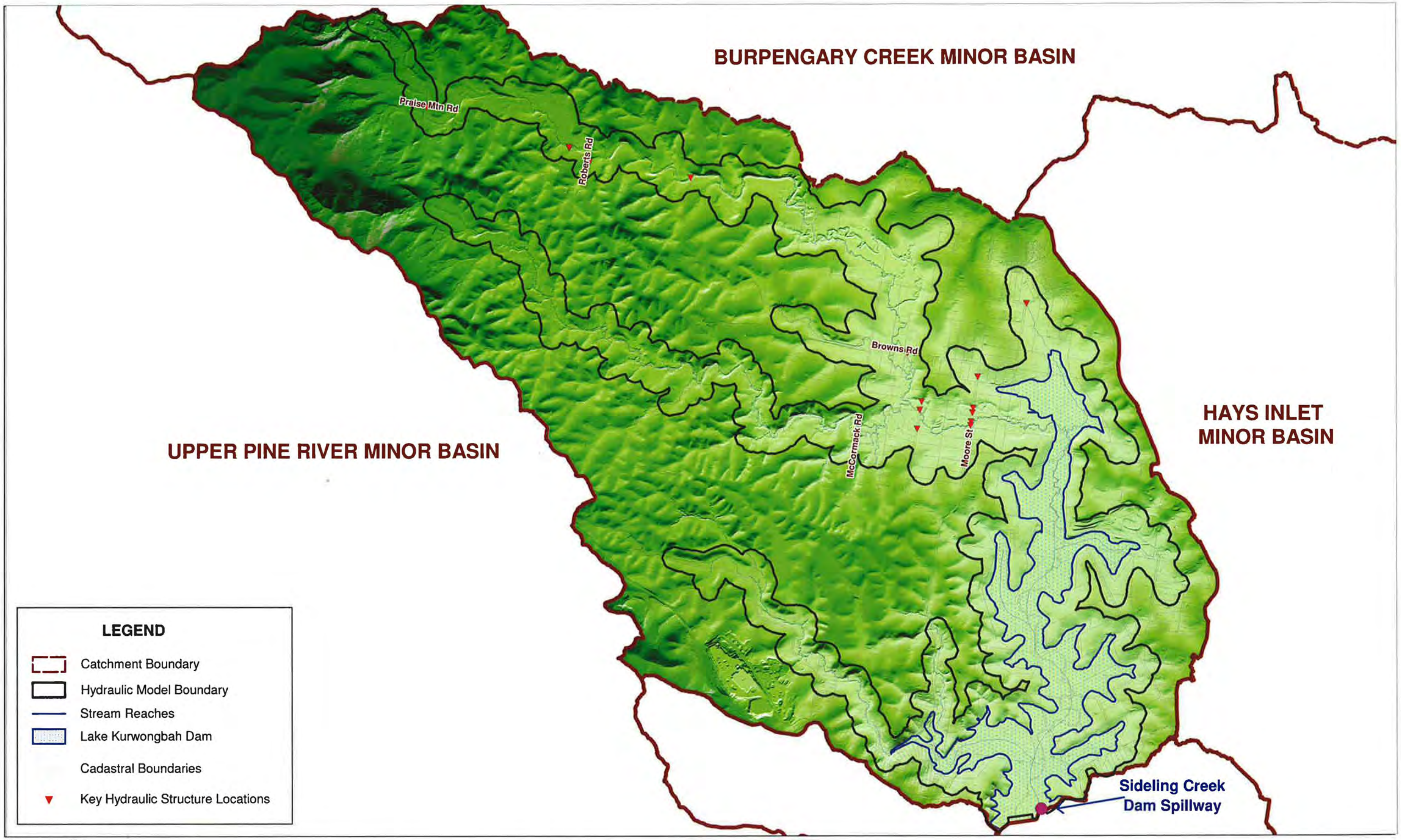

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FIGURE 3.1 - HYDRAULIC MODEL LAYOUT

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3.3.3 Model Structures

The entire SID minor basin including Lake Kurwongbah has been established in the 2D domain in the SID hydraulic model. The downstream boundary, located at the Sideling Creek Dam spillway has been specified as a 1D downstream boundary condition in the 1D domain and the initial water level of the Sideling Creek Dam has been assumed to be at Full Supply Level (FSL) at 20.34mAHD for all design event runs. The SEQWater spillway rating curve for the Sideling Creek Dam has been applied to the 1D downstream boundary. Details of the SEQWater spillway rating curve is discussed further in Section 3.3.5 of this report.

Culvert crossings were typically modelled as 1D elements. A total of 16 culverts have been included in the SID TUFLOW model. Flow over structures was modelled within the 2D domain. Bridges and footbridges were represented in the 2D domain. Structure details were provided by MBRC in the form of as constructed drawings and detail survey.

The adopted exit and entry loss coefficients, applied to the hydraulic structures, have been based on recommendations from Sub-project 2N (SKM, 2012c).

3.3.4 Landuse Mapping

Landuse mapping was used to define the spatially varying hydraulic roughness within the hydraulic model. In total, nine (9) different types of landuse based on recommendations from Sub-project 2N (SKM, 2012c) were mapped across SID minor basin, together with associated Manning's 'n' values as presented in Table 3-2 and Figure 3-2.

Table 3-2 Hydraulic Model Roughness and Landuse Categorisation

Landuse Type	Manning's 'n' Roughness Coefficient
Dense vegetation	Depth varying Mannings 'n'
Medium dense vegetation	Depth varying Mannings 'n'
Low Grass/Grazing	Depth varying Mannings 'n'
Reeds	0.080
Crops	0.040
Roads/Footpaths	0.015
Buildings	1.000
Waterbodies	0.030
Urban Block	0.300

Footpaths within open space areas were excluded from the model, as these features are typically finer than the model grid resolution. In some locations where there were sudden changes in roughness across one or a few cells (e.g. narrow roads crossing dense vegetation), roughness was locally modified to resolve associated modelling instabilities.

In highly developed blocks larger than 2000m², the urban block category was used (Manning's 'n' of 0.3). In addition, an individual buildings layer (building footprint) was used for areas outside the high residential development (Manning's 'n' of 1.0 i.e. total blockage at buildings).

Based on the results from the calibration runs for other adjacent models, MBRC has adopted a depth varying Manning's 'n' approach (Sub-project 2N, SKM 2012c) to globally represent the hydraulic roughness for the dense, medium dense and low grass grazing vegetation landuse profiles.

The change in roughness factors with increasing depth of water represents the increased obstruction to flow caused by branches and foliage of trees, compared to individual tree trunks at lower depths and the reduction in vegetation retardance due to flattening of grasses with increasing depth of flow.

The depth varying Manning's 'n' relationships for the above vegetation profiles are summarised in Table 3-3.

Table 3-3 Depth Varying Manning's 'n'

Depth y(m)	Manning's 'n'			Depth y(m)	Manning's 'n'
	Dense Vegetation	Medium Dense Vegetation			Low Grass Grazing
0	0.090	0.075		0	0.250
1.5	0.090	0.075		0.2	0.060
3.5	0.180	0.150		0.4	0.045
99.0	0.180	0.150		0.8	0.035
				2.0	0.025
				99.0	0.025

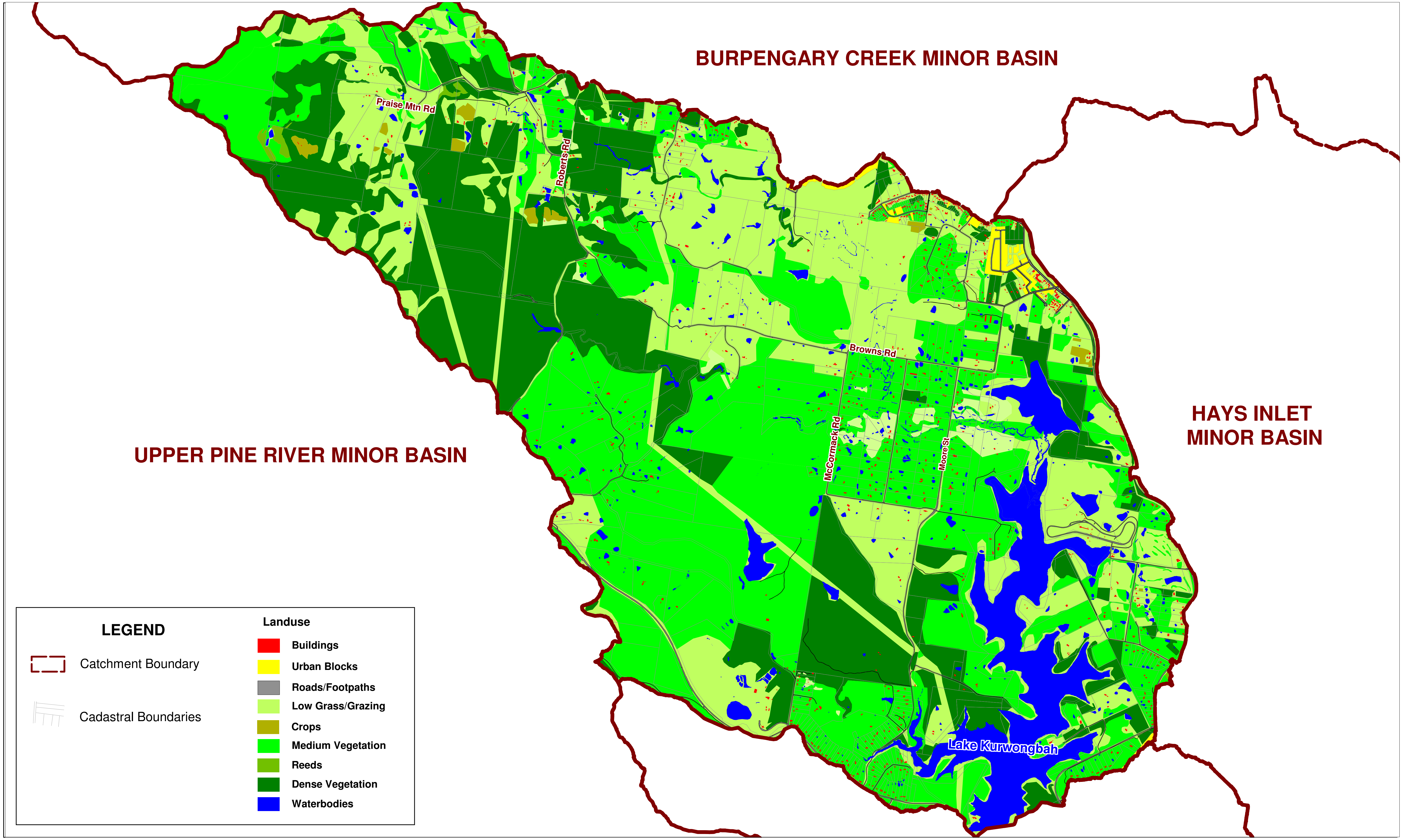

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FIGURE 3.2 - LANDUSE MAPPING - EXISTING CONDITIONS

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3.3.5 Model Boundaries

The results of the WBNM hydrologic model were used to generate inflow hydrographs for the hydraulic model for all design events, as discussed in Section 3.1. The inflows were applied to the 2D domain using a flow-time source boundary for each sub-catchment. This technique applies the inflow at the lowest grid cell in a sub-catchment initially and then subsequently to all wet cells in that sub-catchment.

The SEQWater stage discharge relationship (H-Q) rating curve for Sideling Creek Dam spillway has been adopted by MBRC as the downstream boundary condition of the SID hydraulic model. The Sideling Creek Dam spillway rating curve is outlined in Table 3-4.

Table 3-4 SEQWater Sideling Creek Dam Spillway Rating Curve

Flow (m^3/s)	Level (mAHD)
0	20.34
26	20.50
67	20.75
109	21.00
189	21.25
282	21.50
381	21.75
492	22.00
614	22.25
688	22.50
756	22.75
797	23.00
839	23.25
872	23.50
906	23.75
939	24.00
1226	24.25
1528	24.50
1829	24.75
2130	25.00

3.4 Model Calibration and Verification

No model calibration has been specifically carried out for the SID hydraulic model. However, the key modelling parameters (such as landuse, floodplain roughness) adopted in the model have been validated through the model calibration and model verification processes undertaken for other adjacent minor basins modelled during Stage 2.

3.5 Design Flood Events

Design storm events are hypothetical events that are used to estimate design flood conditions. They are based on a probability of occurrence, frequently specified as an Average Recurrence Interval (ARI).

3.5.1 Critical Storm Duration Assessment

Critical storm durations were selected based on the hydraulic models results, rather than hydrologic model results. This means that the critical duration was selected based upon the maximum flood levels rather than flows. Separate assessments were undertaken for the minor events (1, 2, 5 and 10 year ARI event), moderate and major events (20, 50 and 100 year ARI), very large and extreme events (200, 500, 1000, 2000 year ARI and the probable maximum flood (PMF) event).

The following methodology was adopted to determine the critical storm durations for the SID model:

- WBNM hydrologic modelling of a range of 10, 100 year ARI and PMF standard storm durations (from 30 minutes to 72 hours) to calculate inflow hydrographs for the TUFLOW hydraulic model.
- TUFLOW hydraulic modelling of 10, 100 year ARI and PMF to calculate peak flood levels for all the studied storm durations.
- Mapping of the peak flood level results for the 'maximum envelope' of all the 10, 100 year ARI and PMF standard storm durations.
- Selection of three critical durations for each ARI storm event based on the storm durations generating the highest flood levels across the most widespread and developed areas.
- Mapping of the peak flood level results for the 'maximum envelope' of the selected three storm durations for each storm event.
- Difference comparison between the mapped peak flood levels for the three selected critical durations and the results accounting for all storm durations for each of the storm event.
- The critical duration storms resulting in the least difference, compared with the mapping of the full envelope of durations, were then adopted throughout the studied storm events ranging from 1 year to PMF events.

A summary of the three selected critical storm durations for SID model for all events assessed is outlined in Table 3-5. A comparison of the 10, 100 year ARI and PMF peak flood levels is illustrated in Figure 3-3 to Figure 3-5 respectively. The figures demonstrate that the three selected critical storm durations have dominated the 10, 100 year ARI and PMF peak flood levels across the study area.

Table 3-5 Critical Duration Selection

Assessment Event	Selected Critical Durations	Adopted Event
10 year ARI	1hr, 3hr and 6hr	1, 2, 5 and 10 year ARI
100 year ARI	1hr, 3hr and 6hr	20, 50 and 100 year ARI
PMF	2hr, 3hr and 5hr	200, 500, 1000, 2000 year ARI and PMF

3.5.2 Design Event Simulations

As discussed in the previous section, the SID model was simulated for a range of Average Recurrence Intervals (ARI) and storm durations which has included:

- Minor events – 1, 2, 5 and 10 year ARI events;
- Moderate and major events – 20, 50 and 100 year ARI events; and
- Very large and extreme events – 200, 500, 1000, 2000 year ARI and PMF events.

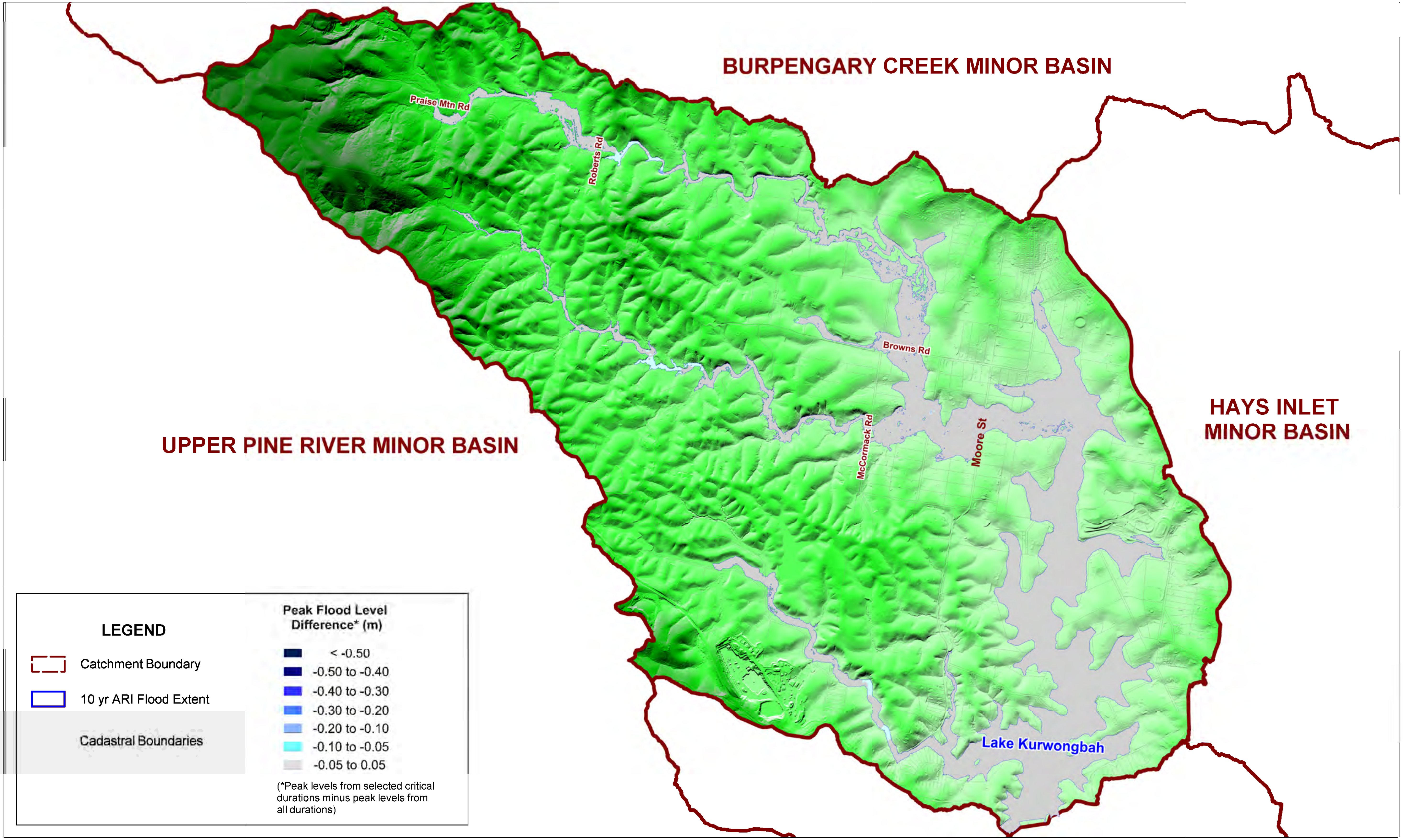

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FIGURE 3.3 - CRITICAL DURATION ASSESSMENT
PEAK FLOOD LEVEL DIFFERENCE - 10 YEAR ARI

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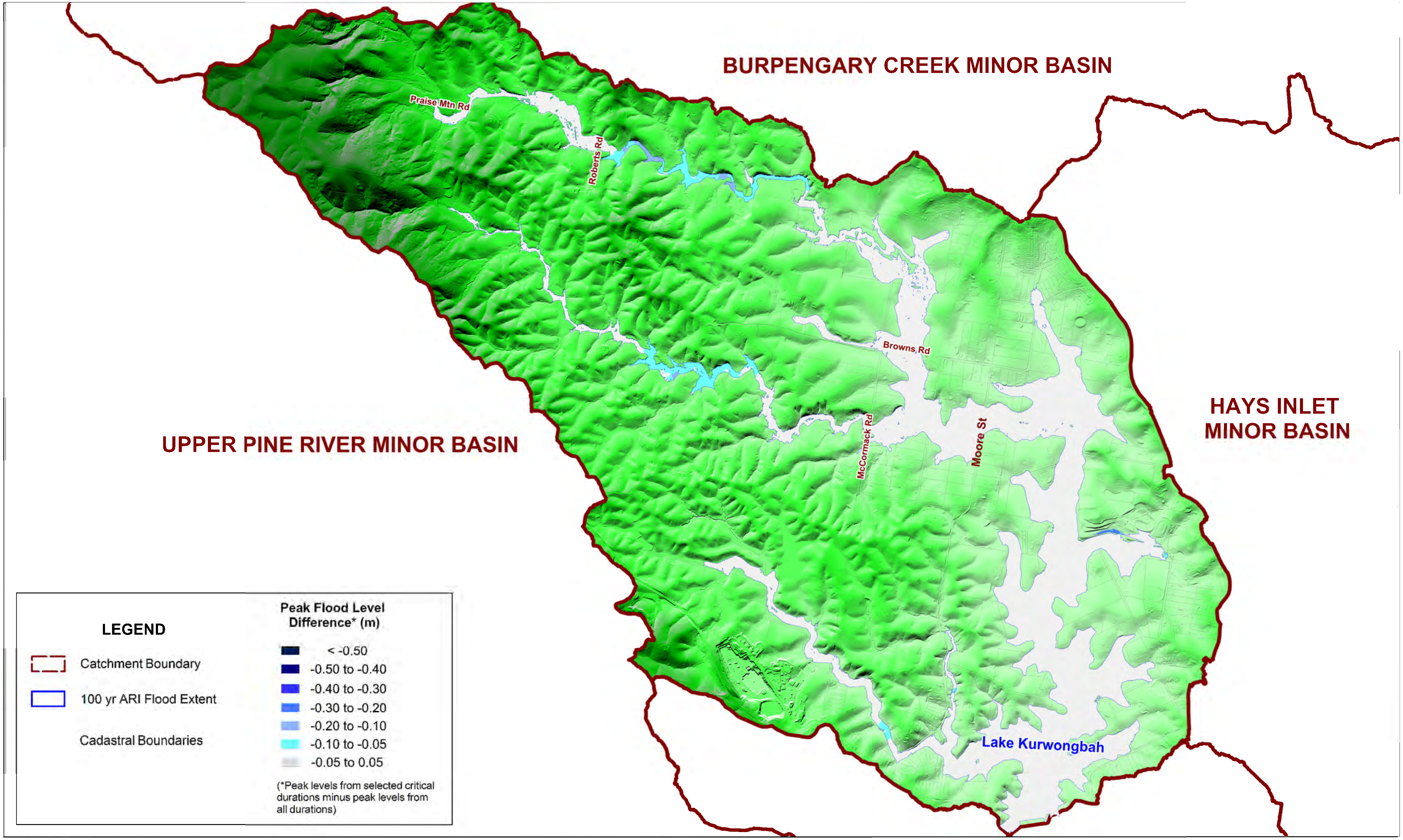

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FIGURE 3.4 - CRITICAL DURATION ASSESSMENT
PEAK FLOOD LEVEL DIFFERENCE - 100 YEAR ARI

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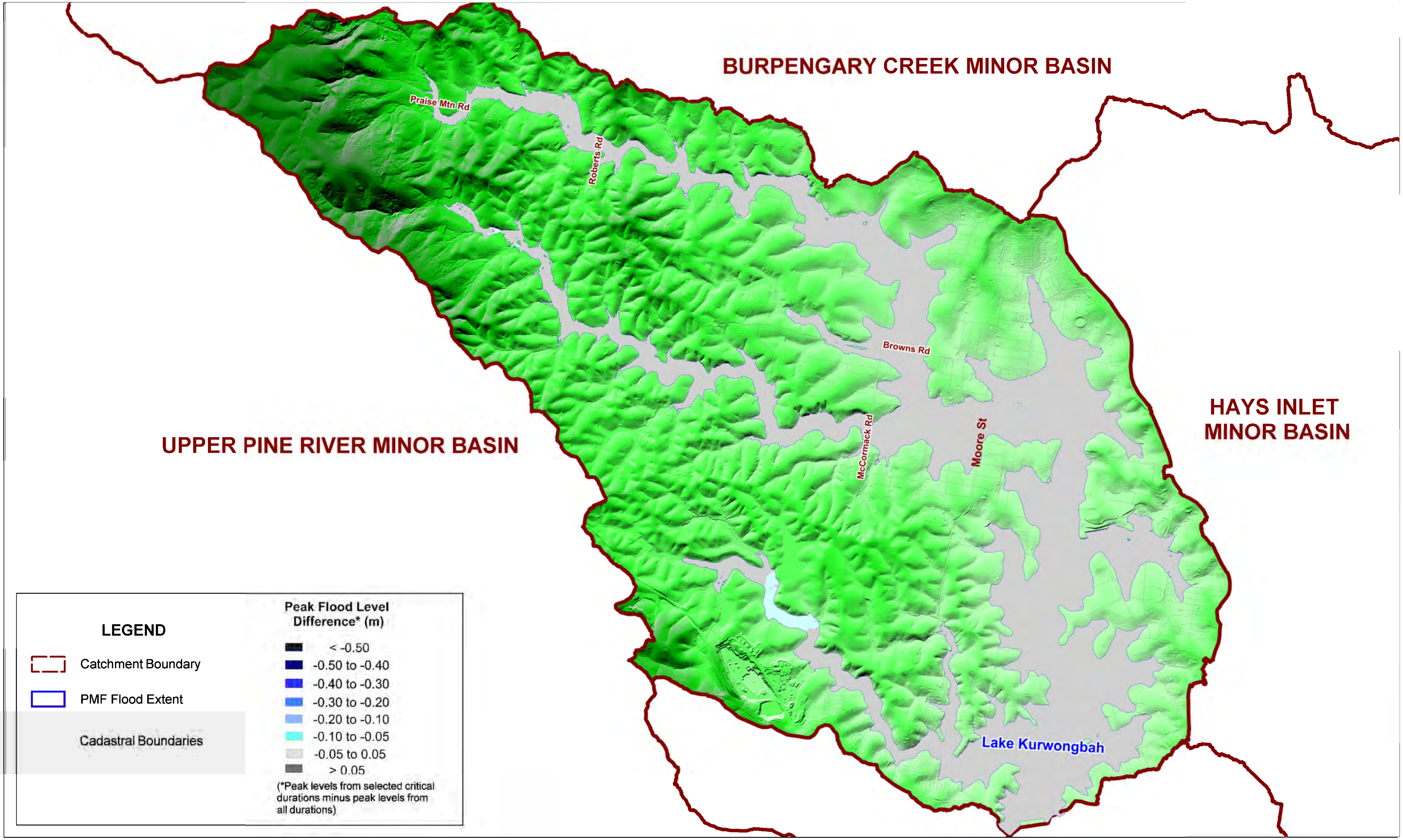

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FIGURE 3.5 - CRITICAL DURATION ASSESSMENT
PEAK FLOOD LEVEL DIFFERENCE - PMF

Project No: 301001-01156 | Figure:301001-01156-EN-DAL-0054 | Rev: 0

G:\301001\01156 PRJT - MBRC RFD Stg2-Pckg1 (not principal folder)\10.0 Engineering\Reports\SID\Figure\\Figure3.5_PMF_Critical_Duration_Assessment.wor

3.6 Sensitivity Analysis

MBRC adopted the use of a single EDS which approximates the flood levels and behaviour of the 100 year ARI critical duration design events. The EDS is useful for initial investigations into changes in model parameters and catchment characteristics, as it reduces the number of model runs required.

The 15 minutes burst in a 270 minutes storm envelope duration provides the best representation across all minor basins within the MBRC LGA. Therefore, the 100 Year 15 minutes burst in a 270 minutes envelope EDS has been adopted for the SID model.

The adopted EDS storm was utilised as a base case for the assessment of model sensitivity, climate change and future landuse scenarios as discussed in the following sections below.

3.6.1 Future Landuse Analysis

A future landuse scenario model run utilising the 100 year EDS event has been undertaken to assess the potential impact of increased vegetation in the Sideling Creek floodplains as part of the RFD Stage 2 project. This has been achieved by

- Changing medium dense vegetation to high dense vegetation; and
- Changing low grass/grazing to medium dense vegetation through the materials layer.

The results of this scenario model run were then compared to the 100 year EDS base case results to assess the potential flood impact to the SID minor basin as a result of increased vegetation on the floodplains.

3.6.2 Hydraulic Roughness Analysis

To check the sensitivity of the adopted model roughness values, all Manning's 'n' values were uniformly increased by 20% and applied to the 100 year EDS model. Results of the increased Manning's "n" values run were then compared to the base case run results to check how sensitive the model is to the initial selection of the roughness values.

3.6.3 Structure Blockage Analysis

A structure blockage scenario in the 100 year EDS event was run to simulate the effects of waterway crossings (culverts) becoming blocked during a flood event. This is a reasonably common occurrence and may be the result of debris being washed into the waterways during a flood. Recent storm event showed that the blockage is generally caused by accumulated debris, or larger items such as tree stems, wood planks, shopping trolleys or even cars. Blockages reduce the capacity for water to flow through stormwater infrastructure and force the water out of the channel, often increasing overland flooding.

The sub-project 2N report provided by SKM (SKM, 2012c) compared three potential debris risk categories to the culvert opening size, to determine culvert blockage factors. Table 3-6 summarises the blockage factors as presented in of the SKM report (Table 8-3 SKM, 2012c).

Based on the SKM blockage factors, MBRC has adopted the moderate blockage category to assess the culvert blockage sensitivity scenario in the SID model with the following updated blockage factors:

- 100% blockage for all culverts/pipes with culvert diameter/width less than 2.4m; and
- 15% blockage for culverts/pipes with culvert diameter/width larger than 2.4m.

Table 3-6 Blockage Categories and Factors (SKM 2012c)

Blockage Category/ Debris Potential	Culvert Blockage Condition	
	Full Blockage	Partial Blockage
High	If culvert < 6.0m diagonal	If culvert > 6.0m diagonal, apply 25%
Moderate	If culvert < 2.4m diagonal	If culvert > 2.4m diagonal, apply 15%
Low	If culvert < 1.2m diagonal	If culvert > 1.2m diagonal, apply 10%

3.6.4 Climate Change and Downstream Boundary Condition Analysis

As determined by MBRC, a climate change assessment to investigate the potential impact of projected increases in rainfall intensity on flooding has been undertaken for the SID minor basin. Downstream boundary condition sensitivity analysis for the Sideling Creek model is not required for this study due to the Sideling Creek Dam spillway controlling outflow from the model.

The rainfall intensity increase assessment used for this study is based on the project 2M reports (SKM, 2012b). A 20% increase of rainfall to the 100 year EDS event was applied to the WBNM hydrologic model to calculate inflow hydrographs for the TUFLOW model. The TUFLOW model was then run with the increased inflow hydrographs to assess the impact of climate change as a result of increased rainfall.

4 RESULTS AND OUTCOMES

4.1 Calibration and Verification

As discussed previously, no model calibration has been specifically carried out for the SID model due to insufficient historical data being available. Calibration and validation undertaken for other minor basins provided the model parameters adopted for the SID model.

4.2 Design Flood Behaviour

Design flood event modelling of minor basin runoff events was undertaken using the SID TUFLOW model for the 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000 year ARI design events and the Probable Maximum Flood (PMF) event. For each design flood magnitude, the model was run for the three nominated storm durations (refer to Section 3.5.1).

The performance of the model was monitored throughout the simulation. Careful attention was paid to ensure that flows through the 1D elements in the model as well as flows over the floodplain in the 2D domain were stable. Overland flow hydrographs were checked at key locations in the floodplain and the Sideling Creek Dam to ensure the simulation extended well beyond the peak throughout the study area. A modelling quality report of the SID model has been included in Appendix D of this report.

General patterns of flood behaviour that can be observed from the SID design run results include:

- Up to the 100 year ARI, flood flow is generally contained within channel with minor overbank flow at the upper reaches of the waterways and gullies within the minor basin.
- Significant overbank flow with complex two-dimensional flow behaviour occurs in and around the floodplain area of Sideling Creek upstream the northern inlet of Lake Kurwongbah. This area is bound by Moore Road to the east, McCormack Road to the west and up to a distance of some 1200m upstream of Browns Road to the north.
- Overbank flow also occurs at the upper reach of Sideling Creek at the section between Praise Mountain Road and Roberts Road during minor events.
- Flat flood surface profile and low velocities are generally present at the lower reach of Sideling Creek downstream of Moore Road and in Lake Kurwongbah.

4.2.1 Model Results

The following output types were used in the model to produce modelling results:

- Flood Levels (H flag);
- Flood Depth (D flag);
- Flood Velocity (V flag);

- Flood Velocity x Depth (Z0 flag);
- Flood Hazard based on NSW Floodplain Development Manual (DIPNR, 2005) (Z1 flag);
- Stream Power (SP flag);
- Unit Flow (q flag); and
- Inundation times (Times flag).

The model results were used to prepare a set of design flood map database, including inundation, peak flow velocity, hazard and stream power. The flood conditions for these flood map database were derived using the envelope (maximum) of the three critical storm durations for all studied events. Typical flood maps presented in Appendix E are the 100 year ARI design event as the focus of this project is on digital data, rather than provision of hardcopy flood maps. A description of the digital data provided to MBRC for incorporation into their RFD is summarised in Section 4.2.2.

4.2.2 Digital Data Provision

The Regional Floodplain Database is focused on structuring model input and output data in a GIS database held by MBRC. Therefore, all model input and output data in digital format will be provided to MBRC at the completion of the study. The digital data includes all model files and result files for all the design events, sensitivity analysis, climate change assessment and future landuse scenarios.

4.3 Sensitivity Analysis

The 100 Year Embedded Design Storm (EDS) with a 15 minutes burst and a 270 minutes envelope storm duration was simulated to form the base case for model sensitivity runs as described previously. The sensitivity runs undertaken for the SID minor basin have included future landuse, hydraulic roughness, structure blockage and climate change scenarios.

A plot for comparing flood levels of the 100 year EDS base case run against the 100 year ARI design storm is provided in Figure F1 of Appendix F. The plot demonstrates that differences in flood levels between the 100 year EDS and ARI design storm is generally within ±100mm across the study area.

4.3.1 Future Landuse Analysis

The predicted difference in peak flood levels for the future landuse (increase vegetation) scenario as described in Section 3.6.1 compared to the EDS Base Case is a general increase by 100-300mm along the watercourses at the middle to upper reaches with a maximum increase of 750mm at some local reach sections. Water level within Lake Kurwongbah is generally lowered by approximately 50mm due to the additional floodplain storage routing in the upstream reaches. Figure F10 in Appendix F shows the difference in peak flood levels between existing and the future landuse (increase vegetation) conditions.

4.3.2 Hydraulic Roughness Analysis

A hydraulic roughness sensitivity scenario has been simulated to assess an increase in roughness coefficients. Figures F2 in Appendix F illustrates the difference in peak flood levels between the sensitivity run and the Base Case utilising the 100 year EDS.

Model results indicate that an increase in Manning's 'n' roughness coefficients by 20% generally results in an increase of peak levels by less than 150mm. Upper reach waterways within the Sideling Creek minor basin shows an increase of peak flood levels by some 150mm. Flood level differences at the lower reach waterways and the Lake Kurwongbah are generally within the range of ±100mm.

4.3.3 Structure Blockage Analysis

A structure blockage analysis has been simulated utilising the 100 year EDS model as described in Section 3.6.3 to assess impact to the SID minor basin as a result of blockage of culverts. The difference in peak flood levels for the structure blockage modelling compared to the EDS Base Case is generally within the range of ±20mm. This is due to all the culvert crossings within the study area already being overtopped during the flood event in the base case scenario. As such, blockage of the culverts will only have minimal impact to the flood levels across the SID minor basin. Figures F3 in Appendix F illustrates the difference in peak flood levels between the Structure Blockage run and the Base Case utilising the 100 year EDS.

4.3.4 Climate Change and Downstream Boundary Condition Analysis

The climate change scenario assessed an increase of 20% of the 100 year EDS rainfall intensity as described in Section 3.6.4. A 20% increase rainfall results in higher flood levels throughout the SID minor basin. Figure F4 in Appendix F indicates increase of peak flood levels for the increase rainfall scenario compared to the EDS Base Case is generally within the range of 100 to 300mm rise along the upper reaches. The flood level at Lake Kurwongbah is generally raised by 200mm.

A downstream boundary sensitivity run was not undertaken because Sideling Creek Dam behind Lake Kurwongbah is the downstream boundary for the SID model. The spillway of the dam will control water levels in the lake and the outflow of the SID model.

4.4 Model Limitations

The topography of creeks in the SID minor basin is defined using LiDAR data due to the absence of surveyed cross-sections or bathymetry. LiDAR data are unable to pick up ground levels below the water surface, and therefore the bed levels of creeks are not precisely represented in detail. This approach means that the flood levels, particularly for small flood events where a greater proportion of the flow is typically conveyed within bank (e.g. the 1 to 10 year ARI), may be overestimated. The extent of this over-estimation will vary according to local topographic factors.

Watercourses have also been represented in the 2D domain, for which the grid resolution is limited to 5m. In addition, for the narrower upstream reaches, a waterway landuse layer has not been incorporated. This may not allow adequate representation of the channel conveyance, particularly for the narrower upper reaches. In some instances this limitation may lead to the model over or underestimating conveyance in the watercourses for small flood events.

5 CONCLUSIONS AND RECOMMENDATIONS

The hydrologic modelling works undertaken in this study have utilised the WBNM (Watershed Bounded Network Model) software to calculate flood flow hydrographs for a range of design storm events to be used as inflows to the hydraulic model developed for the SID minor basin.

The hydraulic assessment under this project has included the development of a detailed 5m grid TUFLOW hydraulic model, a dynamically-linked 2D/1D hydrodynamic numerical model for the Sideling Creek minor basin. The TUFLOW model has been used to run the 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000 year ARI design events and the Probable Maximum Flood (PMF) event.

Separate critical storm duration assessments have been undertaken for the minor events (1, 2, 5 and 10 year ARI event), moderate and major events (20, 50 and 100 year ARI), very large and extreme events (200, 500, 1000, 2000 year ARI and PMF event) to determine three (3) critical storm durations for each design flood event for the purpose of predicting the peak flood behaviour of the SID minor basin including Lake Kurwongbah and Sideling Creek Dam.

Based on the critical duration assessments, the SID TUFLOW model has been utilised to run for the following three (3) nominated storm durations for each design flood event:

- Minor events (1, 2, 5 and 10 year ARI) - 1hr, 3hr and 6hr;
- Moderate and major events (20, 50 and 100 year ARI) - 1hr, 3hr and 6hr; and
- Very large and extreme events - 2hr, 3hr and 5hr.

The 15 minutes burst in a 270 minutes 100 year Embedded Design Storm (EDS) has been adopted and applied to the TUFLOW model. The EDS is useful for initial investigations into changes in model parameters and minor basin characteristics, as it reduces the number of model runs required. The adopted EDS storm was utilised as a base case for the comparison to model sensitivity, climate change and future landuse scenarios.

The Regional Floodplain Database is focused on structuring model input and output data in a GIS database held by MBRC. Therefore, all model input and output data in digital format will be provided to MBRC at the completion of the study. The data includes all model files for all the design events, sensitivity analysis, climate change assessment and future landuse scenarios.

The flood assessment undertaken for the SID minor basin as documented in this report has been successful in addressing the overall objectives of the study. It is recommended that this study report be accepted by MBRC and the associated model outputs be included in RFD for delivering seamless information about flood behaviour across the entire Moreton Bay Regional Council area.

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APPENDIX A: INFRASTRUCTURE DATA ASSESSMENT REPORT

WorleyParsons
resources & energy

EcoNomics

MORETON BAY REGIONAL COUNCIL

Infrastructure Data Assessment Report

Package 1

301001-01156 – EN-REP-0001

14 October 2010

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MORETON BAY REGIONAL COUNCIL
INFRASTRUCTURE DATA ASSESSMENT REPORT
PACKAGE 1

Disclaimer

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PROJECT 301001-01156 - INFRASTRUCTURE DATA ASSESSMENT REPORT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for Internal Review	R.Stewart/L.Cheung	K.Hegerty		13-Oct-10	N/A	
0	Issue for use	R.Stewart/L.Cheung	K.Hegerty	E.Reid	14-Oct-10		

CONTENTS

1. INTRODUCTION

WorleyParsons Services Pty Ltd has been engaged by Moreton Bay Regional Council (MBRC) to carry out detailed surface water modelling over two of the regional catchments in their Local Government Area (LGA). The two catchments are Upper Pine River (UPR) and Sidling Creek (SID). These make up 'Package 1' of MBRC's Regional Floodplain Database Project (RFD Project) and are referred to as 'minor basins' in the GIS data provided by MBRC.

At the commencement of this project, MBRC handed over an extensive data set including established 'broad scale' models and results. The purpose of this report is to identify and prioritise any additional floodplain infrastructure data which is necessary to complete the detailed modelling associated with the current project.

Due to the expansive catchment study areas of the project, it is difficult to convey the necessary level of data detail on Figures. For this reason an electronic copy of the GIS data associated with the findings of this report has been provided. The following electronic GIS data layers have been provided with this report:

1. "Existing Structure Junctions" (provided by MBRC). A data capture priority rating has been assigned to each of these structures;
2. "Identified Hydraulic Structures". This includes all additional structures identified by WorleyParsons including an associated data capture priority rating;
3. "Identified Basins/Dams". This includes all detention basins and dams significant enough to warrant incorporating into the modelling;
4. "Additional Buildings Identified in Floodplain". Includes buildings in the PMF flood extent that are not already included in MBRC's '"buildings" GIS layer.
5. "Miscellaneous Comments". Includes general comments relating data capture and modelling.

Figures provided with this report are for overview purposes only.

A fee proposal for WorleyParsons to carry out the data capture tasks identified in this report will be provided separately to MBRC for consideration.

2. AVAILABLE DATA AND GAP ANALYSIS

Floodplain Infrastructure Data provided by MBRC has been reviewed. Details of the available data and a gap analysis are provided below for each class of infrastructure data.

2.1 Bridges

Bridge design drawings have been supplied by MBRC for 7 locations. These will be useful for defining geometry of the bridge however it is noted that generally these drawings do not have elevation data on AHD.

In addition to these bridges numerous road crossings have also been identified within the proposed hydraulic modelling area using aerial imagery, digital elevation modes (DEMs), and the supplied hydrography. Identifying road crossings in this manner makes it difficult to distinguish between culverts and bridges. Consequently, when reviewing the catchment data to identify additional waterway crossings we have not distinguished between bridges and culverts.

Each waterway crossing has been assigned a priority rating of A, B or C. This is discussed further in Section 3.1.

The SID and UPR broadscale TUFLOW models provided by MBRC already have some bridges included (2d_lfcsh TUFLOW layer). The UPR TUFLOW has 10 established bridges and the SID model has 2 established bridges included. As these structures where incorporated at an earlier modelling phase, where a lower level of accuracy was acceptable, it is expected that these structures will need to be revisited to ensure a suitable level of accuracy for the current detailed modelling stage.

2.2 Culverts

The SID and UPR broadscale TUFLOW models provided by MBRC already have some culvert included (1d_NWK TUFLOW layer). The UPR TUFLOW has 82 established culverts and the SID model has 24 established culverts included. As these structures where incorporated at an earlier modelling phase, where a lower level of accuracy was acceptable, it is expected that these structures will need to be revisited to ensure a suitable level of accuracy for the current detailed modelling stage. For example it is understood that current culvert invert details are not based on ground survey, but rather on an inspection of the LiDAR DEM.

Potential culvert crossings within the proposed hydraulic modelling area have been identified in the same manner as for bridge crossings, as discussed in the previous section. The location of these structures is shown generally on the figure provided in Appendix 1 and they are also included in the electronic GIS data provided with this report.

It is also noted that the location of some culverts may only become apparent with a field inspection. This is likely to be the case for high level floodplain crossings which do not tie in directly with a defined waterway.

2.3 Trunk Underground Drainage

A review of the supplied aerial imagery over the proposed hydraulic modelling area has found no evidence of underground trunk drainage. This is to be expected in these rural Package 1 catchments.

2.4 Detention Basins / Farm Dams

No regional scale detention basins have been identified in any of the Package 1 basins.
There are numerous farm dams that are large enough to warrant incorporation into the modelling. . The location of these dams are shown generally on the Appendix figures and they are also included in the electronic GIS data provided with this report.

2.5 Terrain

Topography

The primary topographic data to be used for this project is Aerial LiDAR survey capture in 2009. This has been provided as raw xyz data points and also as a 2.5m grid digital elevation model (DEM**).**

The LiDAR survey has been filtered for ground elevation points and is considered to be of high quality and suitable for use in this study. However, some long and narrow gaps have been identified in the DEM near the western boundary of the UPR basin.

Bathymetry

For the purpose of this report bathymetry is defined as ground elevation level data in areas beneath standing water.

No bathymetry data has been provided for any of the Package 1 catchments.

One potential source of bathymetric data is old LiDAR data captured while water supply levels in the North Pine and Sidling Dams where very low. This older LiDAR would give a better representation of each of the dams bathymetry compared to the 2009 LiDAR survey which was carried out when the dams where relatively full.

2.6 Miscellaneous

Details of the Sideling Creek Dam and North Pine Dam are also available through various reports that have been provided by MBRC. Details include full supply level, spillway rating curves (including North Pine Spillway with various combinations of gate functioning), spillway and embankment crest levels. This data will be sufficient for the current project.

It is noted that some floodplain infrastructure is difficult to identify by studying aerial imagery and a DEM. One such example is in-stream weirs. No in-stream weirs were identified however it is worth confirming with the relevant authority as to whether any exist in these catchments.

Some buildings have also been identified in the floodplain that are not included in the MBRC supplied 'buildings' land-use layer. These additional buildings are also supplied in this report's GIS data layers.

3. PROPOSED DATA CAPTURE

The key additional data capture required for this project is survey of the numerous hydraulic structures including bridges and culverts.

No regional scale detention basins or trunk drainage works were identified and hence no data capture is required for these structure classes.

Data capture tasks have been assigned a priority rating. Details are provided in the following sections.

3.1 Prioritisation Methodology

Hydraulic Structure Overall Priority

Each identified road crossing has been assigned a high, medium or low data capture priority. Prioritisation of the hydraulic structures has been based on the following criteria:

1. Likely impact on flooding characteristics;
2. Proximity to urban areas;
3. Class of road associated with the infrastructure; and
4. Catchment Size.

Based on these criteria each hydraulic structure that has been identified has been assigned a priority class or A (high), B (medium), or C (low). The priority has been assigned by reviewing aerial imagery, DEMS and the supplied hydrography.

By way of example, a dirt road with a minor causeway crossing and no significant road embankment would be assigned a 'C' priority. A significant road crossing in an urban area or on a major road would be assigned an 'A' priority. An example of a 'B' priority structure is a rural road crossing with no surrounding residential properties.

The priority rating of each structure is provided in the GIS data provided with this report ('priority' field).

Priority of Hydraulic Structure Elements

In addition to assigning each structure a priority, a further breakdown in priority has also been assigned to the various elements of data capture associated with each hydraulic structure. This relates to the priority High (or A) and Low (or B) data capture tasks referenced in the project brief whereby priority High tasks are considered critical for a high quality modelling outcome and priority Low tasks could potentially be incorporated with desktop techniques and assumptions.

3.2 Data Prioritisation

Culverts

Each structure has been assigned an overall priority as discussed in Section 3.1. The priority for each structure is provided in the GIS data provided with this report.

In addition to this, each element of data associated with capture of structures can further be prioritised as follows:

Priority High Elements of Culvert Data Capture

Capture of these elements is considered critical to a high quality modelling outcome:

1. Culvert Type (Box / Pipe);
2. Size and number of barrels;
3. Upstream and downstream invert levels;
4. Material (concrete/corrugated iron); and
5. Handrail type and extents.

Priority Low Elements of Culvert Data Capture:

The remaining elements associated with culvert data capture as detailed in the Culvert Data Standard by Aurecon, are considered to have type Low Priority and could be incorporated into the modelling using desktop techniques and assumptions. These elements include

1. Wing walls:
2. Road elevation;
3. Handrail elevation;
4. Geo-referenced photos; and
5. Metadata.

Bridges

Each structure has been assigned an overall priority as discussed in Section 3.1.

In addition to this, each element of data associated with capture of structures can further be prioritised as follows:

Priority High Elements of Bridge Data Capture

1. Number / Length of spans;
2. Deck Thickness or soffit level;

3. Pier Configuration (width, shape, orientation etc);
4. Cross section of channel beneath the bridge; and
5. Handrail type and extents.

Priority Low Elements of Bridge Data Capture:

The remaining elements associated with bridge data capture as detailed in the Bridge Data Standard by Aurecon, are considered to have type B Priority and could be incorporated into the modelling using desktop techniques and assumptions. These elements include

1. Road elevation;
2. Handrail elevation;
3. Deck levels points;
4. Geo-referenced photos; and
5. Metadata.

Most bridge details are able to be sourced from the supplied bridge drawings however levels on the drawings will need to be converted to AHD and it is noted that not all bridge drawings are complete.

Farm Dams

Priority Low

It is proposed that the minor farm dams situated in the upper catchments upstream of the proposed hydraulic modelling extent will not be incorporated into the hydrologic or hydraulic modelling. While these small dams may have some impact on catchment hydrology (dependant on the level at the start of a rainfall event), the amount of work required to incorporate these dams into the modelling is not considered justified given that the impact of these dams is likely to be negligible if the dams are full at the start of a rainfall event.

While the farm dams in the upper catchments can justifiably be excluded from the modelling, there are several dams situated farther down in the catchments that are within the proposed hydraulic modelling area and are considered significant enough to warrant incorporation into the modelling. It is anticipated that the influence of the dam embankments on local hydraulic behaviour will be more significant that the storage effect of the impounded water.

It is proposed that these dams should be incorporated into the hydraulic model as follows:

1. Incorporate significant dams into the hydraulic modelling by creating a dam crest breakline. Ideally this should be based on Ground survey however a reasonable approximation should be possible in a lot of cases using aerial LiDAR survey; and

2. Defining initial water levels for the 2d grid within in each dam. It is recommended that a reasonable and conservative approach for this is to assume that the dams are full at the start of each simulation.

Terrain

Priority Low: Utilise Historic LiDAR for Dam Bathymetry

WorleyParsons proposed to utilise historic LiDAR data to supplement the North Pine and Sidling Creek dam bathymetries.

Priority Low: Stream Widths

It is noted that a stream width functionality has been included in the DEM processing utility developed for this project. A stream width field can be applied to the breakline strings that will be getting developed for the project. This is also considered to be a type of 'data capture' task in that it will improve the quality of the DEMs that will be generated for the project.

Miscellaneous

Priority High

It is proposed that relevant authorities should be contacted to confirm the existence of any instream weirs within the study area. If any are reported, then location and geometric details should be attained.

4. RECOMMENDATIONS

WorleyParsons recommends that MBRC should undertake or commission the undertaking of all data capture tasks detailed in this report. If budget and timing constraints limit the potential for this then, as a minimum, all data associated with priority "High" structures should be collected.

5. REFERENCES

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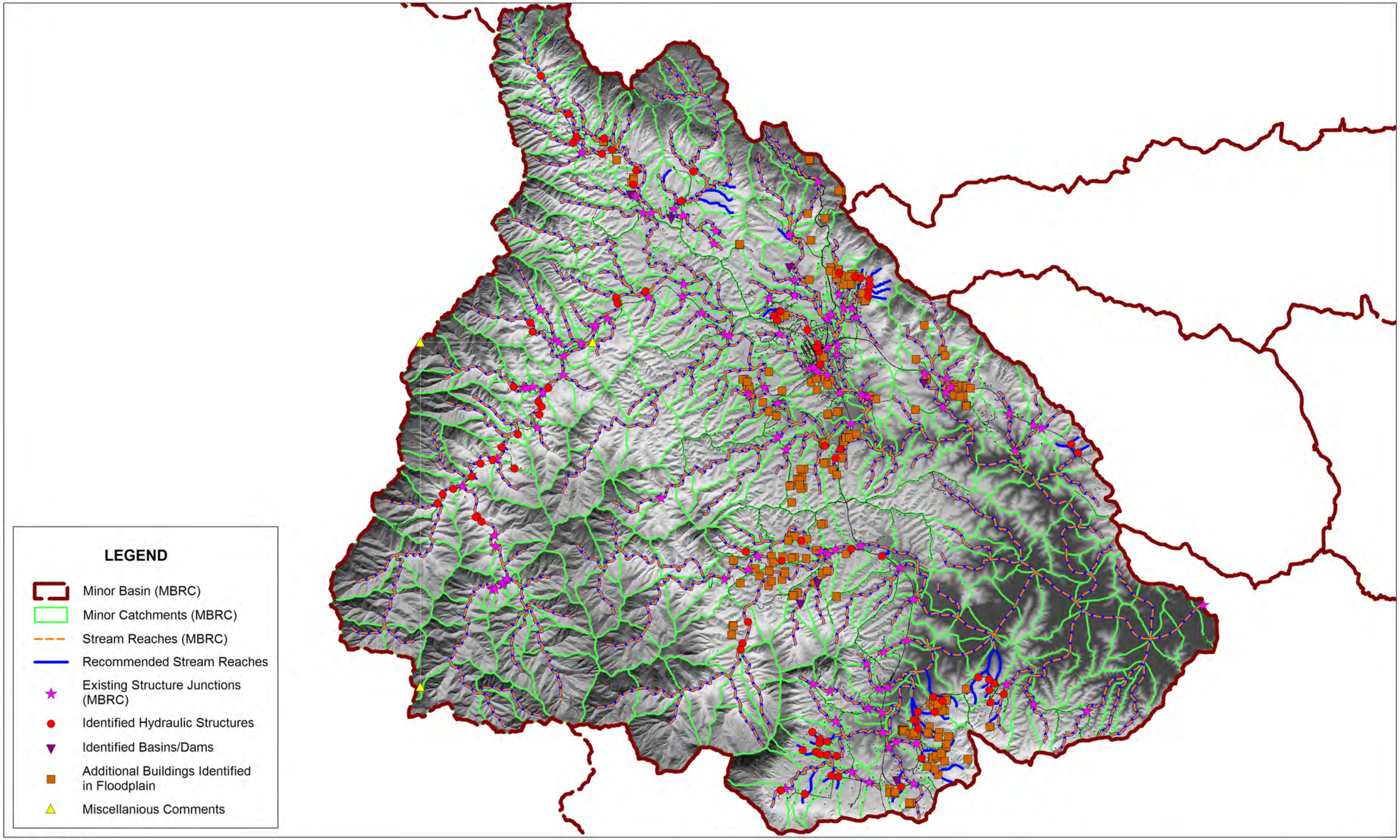
SEQWater, July 2009, “Report for Lake Kurwongbah, (Sideling Creek Dam), Flood Hydrology”

SunWater, June 2007, “North Pine Dam Design Flood Hydrology (Draft)”

WorleyParsons, September 2010 "Regional Floodplain Database - Floodplain Terrain"

Appendix 1 - Data Review Figures



All data supplied by MBRC.
Additional_Comments, Additional_Hydraulic_Structures, Additional_Bulidings, Additional_DamsBasins and MAR_Reach_Mod supplied by WorleyParsons on the 14/10/10

NOT TO SCALE

Rev	Date	Revision Description	ORIG	CHK	ENG	APPD
A	14/10/2010	Issued for use	RS	JM	RS	KH

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MORETON BAY REGIONAL COUNCIL

REGIONAL FLOODPLAIN DATABASE PROJECT

FIGURE 5
UPPER PINE RIVER DATA REVIEW

Project No: 301001-01156 | Figure: 301001-01156-EN-DAL-0005 | Rev: A

Compiled by SUNSHINE COAST INFRASTRUCTURE GIS SECTION

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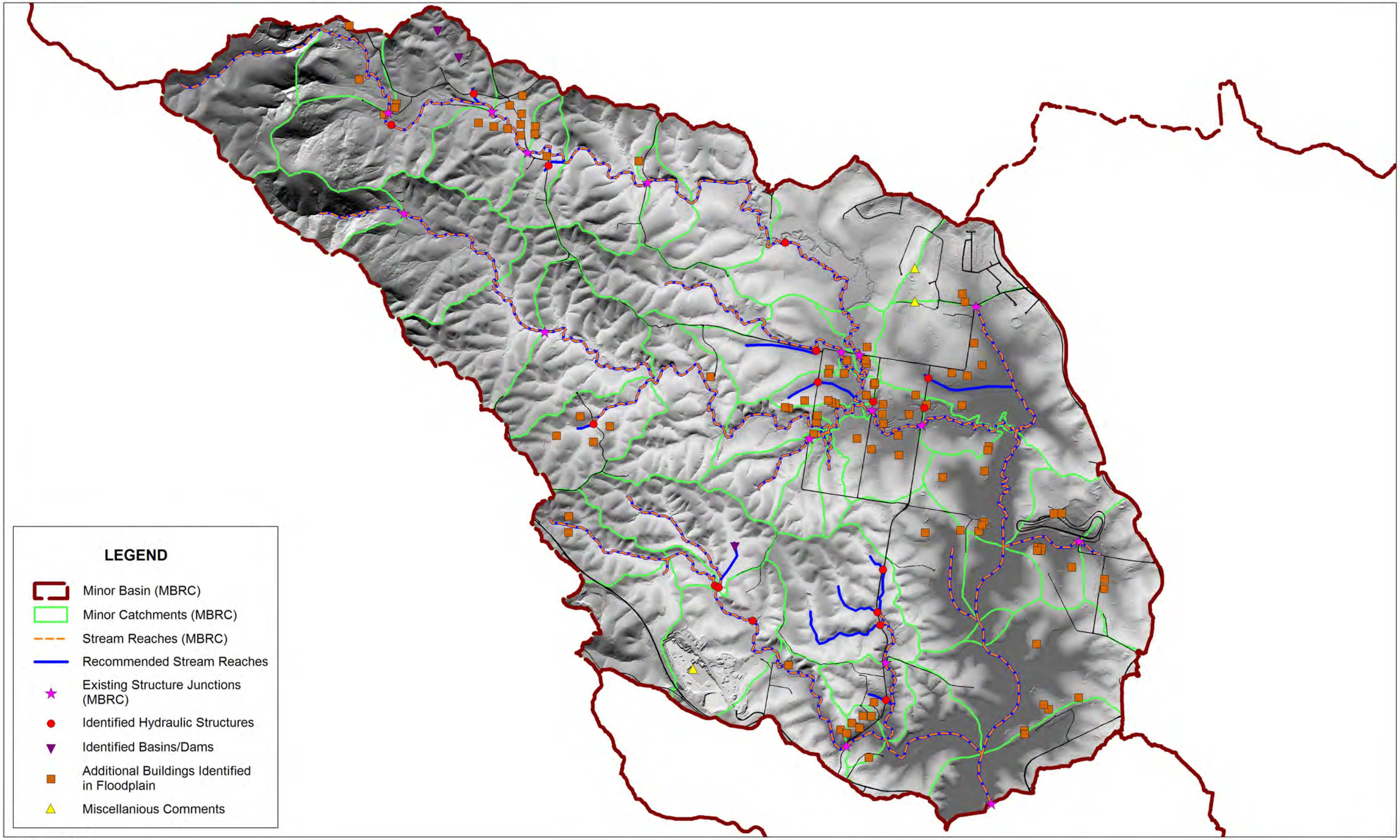

All data supplied by MBRC.
Additional_Comments, Additional_Hydraulic_Structures, Additional_Bulidings, Additional_DamsBasins and MAR_Reach_Mod supplied by WorleyParsons on the 5/10/10

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REGIONAL FLOODPLAIN DATABASE PROJECT

FIGURE 6
SIDLING CREEK DATA REVIEW

Project No: 301001-01156 | Figure: 301001-01156-EN-DAL-0006 | Rev: A

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APPENDIX B: HYDROGRAPHY REVIEW REPORT

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MORETON BAY REGIONAL COUNCIL

Hydrography Review Report

Package 1

301001-01156 – EN-REP-0005

16 November 2010

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MORETON BAY REGIONAL COUNCIL
HYDROGRAPHY REVIEW REPORT
PACKAGE 1

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PROJECT 301001-01156 - HYDROGRAPHY REVIEW REPORT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for Internal Review	L.Cheung	R.Stewart		16-Nov-10	N/A	
0	Issue for Use	L.Cheung	R.Stewart	K.Hegerty	16-Nov-10		

CONTENTS

1. INTRODUCTION

WorleyParsons Services Pty Ltd has been engaged by Moreton Bay Regional Council (MBRC) to carry out detailed surface water modelling over two of the regional catchments in their Local Government Area (LGA). The two catchments are Upper Pine River (UPR) and Sideling Creek (SID). These make up ‘Package 1’ of MBRC’s Regional Floodplain Database Project (RFD Project) and are referred to as ‘minor basins’ in the GIS data provided by MBRC.

At the commencement of this project MBRC handed over an extensive data set including established ‘broadscale’ models (including associated results and reporting) as well as their established hydrography layer. The hydrography data provided by MBRC includes their previously established stream reaches, stream junctions, major basins, minor basins, major catchments and minor catchments.

WorleyParsons has reviewed the supplied hydrography data against other data provided for the project including aerial imagery and a 2.5m grid aerial LiDAR digital elevation model. Based on this review, we have identified issues and where necessary we have made recommendations to improve the suitability of the hydrography for use in the current detailed modelling project.

2. HYDROGRAPHY REVIEW

2.1 Issues Identified During Stage 1

No issues have been identified during Stage 1 of the RFD Project for either of the Package 1 catchments.

It is worth nothing however that some of the general issues raised for other minor basins (for example Mary River and Stanley River) are also considered relevant to the Package 1 minor basins. In particular, the issue of sub-catchment resolution in the upper catchments which could lead to reduced accuracy in flood modelling predictions.

2.2 Stream Connectivity

No issues with stream connectivity were found during the hydrography review for either of the Package 1 minor basins.

2.3 Inclusion of Floodplain Structures

The majority of major floodplain structures have been picked up in the stream junction GIS layer provided by MBRC. Additional structures have been identified by WorleyParsons and it is recommended that these be incorporated into the MBRC hydrography stream junction layer.

2.4 Existing Resolution/Detail

The current resolution of the MBRC hydrography is considered suitable for use in the RFD project. This is on the basis that stream routing will generally be carried out hydraulically by TUFLOW as opposed to relying on WBNM hydrologic model's stream routing functionality which is calculated as a function of sub-catchment area.

The reason for this distinction is that flow attenuation occurring from channel routing may be incorrect in some instances when calculated using a function of sub-catchment area. This is due to a number of factors including sub-catchment shape, slope, and also by the hydrography including minor stream reaches (tributaries) which are located within a regional floodplain and which can artificially reduce the representative catchment size of the main channel.

It has also been noted that the supplied hydrography layer includes a number of very small sub-catchments. The locations of these small-catchments can be found in the GIS layer provided in this report. It is recommended that consideration be given to consolidation of some of these sub-catchments

3. PROPOSED CHANGES

WorleyParsons' recommended changes to the hydrography are detailed in the GIS data provided with this report. Figures 1 and 2 in Appendix 1 give an overview of this data for each minor basin however due to the large extent of the study areas it is recommended that this data be reviewed using a GIS software package rather than relying on these figures.

The following GIS layers have been provided to describe our recommended changes to the hydrography layer.

1. 'Recommended Stream Reaches': A complete updated set of stream reaches for each minor basin based on MBRC supplied data and incorporating WorleyParsons' suggested changes.
2. 'Recommended Stream Junctions': GIS layer including additional stream junctions which should be included. These stream junctions have been incorporated along the stream reaches layer at locations where additional sub-catchments should be delineated.
3. 'Identified Hydraulic Structure': This is a copy of the identified hydraulic structures that were identified in WorleyParsons previous Package 1 Infrastructure Data Assessment Report (14/10/2010).
4. 'Miscellaneous Comments': Contains comments relating to the hydrography review. Comments are generally associated with highlighting issues with catchment delineation.

It is proposed that MBRC utilise WorleyParsons' GIS data layers to update the Package 1 hydrography. Additional catchments should be delineated along the recommended stream reaches layer at points contained within the recommended stream junctions layer and also the identified hydraulic structure layer.

The location of the additional stream junctions have been chosen based on several factors including:

1. To provide additional catchment break down in the upper catchments to reduce potential inaccuracies identified in the previous stage 1 broadscale modelling.
2. To provide increased sub-catchment resolution where appropriate.
3. To improve sub-catchment shape and length.
4. Stream junctions have also been put at new stream confluences in the recommended stream reaches layer.

4. RECOMMENDATIONS

It is recommended that MBRC update the Package 1 hydrography based on the proposed changes discussed in this report and detailed in the supplied GIS data.

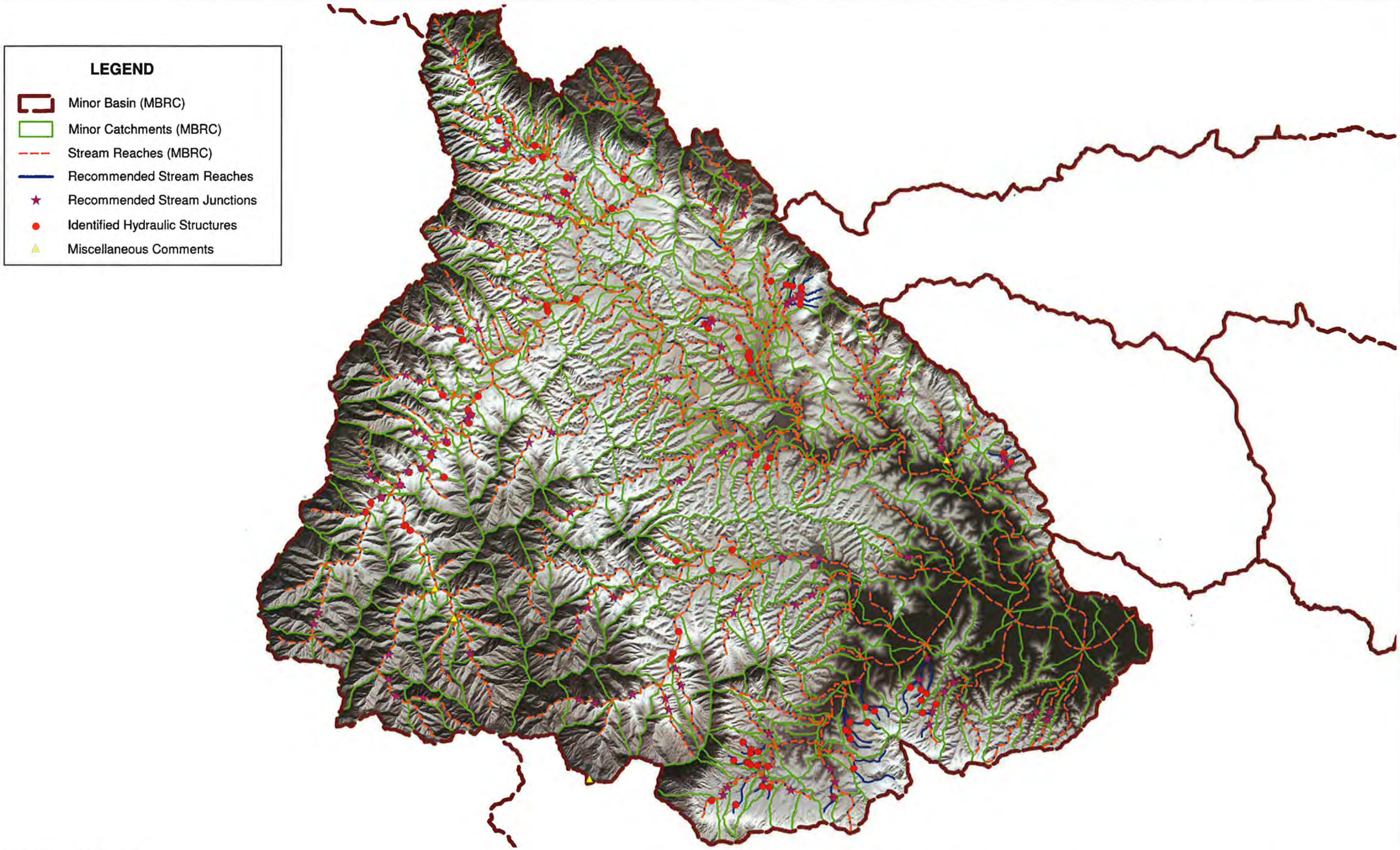
5. REFERENCES

BMT WBM, July 2010, *“Hydraulic Modelling (Broadscale) Regional Floodplain Database Stage 1 Sub-Project 1D”*

WorleyParsons, September 2010 *"Regional Floodplain Database - Floodplain Terrain"*

WorleyParsons, September 2010 *"Regional Floodplain Database, Design Rainfall - Burpengary Pilot Project"*

Appendix 1 - Hydrography Review Figures



Existing hydrographic data supplied by MBRC.
Miscellaneous_Comments, Identified Hydraulic Structures, Recommended Stream Reaches, Recommended Stream Junctions supplied by WorleyParsons on the 11/11/10

NOT TO SCALE

Rev	Date	Revision Description	ORIG	CHK	ENG	APPD
A	16/11/2010	Issued for use	RS	JM	LC	ER

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REGIONAL FLOODPLAIN DATABASE PROJECT

FIGURE 1
UPPER PINE RIVER HYDROGRAPHY REVIEW

Project No: 301001-01156 | Figure: 301001-01156-EN-DAL-0012 | Rev: A

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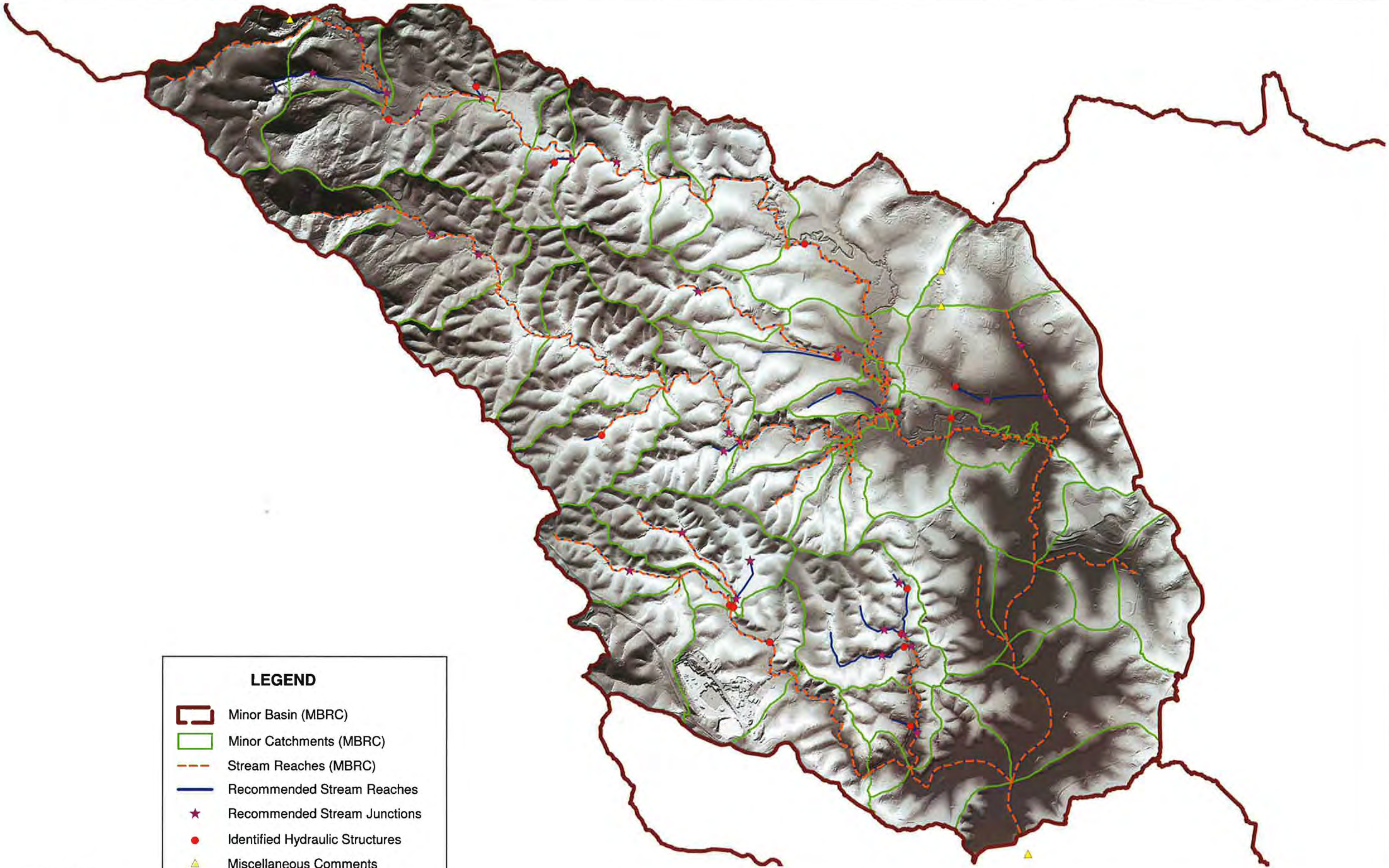

LEGEND

- Minor Basin (MBRC)
- Minor Catchments (MBRC)
- Stream Reaches (MBRC)
- Recommended Stream Reaches
- Recommended Stream Junctions
- Identified Hydraulic Structures
- Miscellaneous Comments

Existing hydrographic data supplied by MBRC. Miscellaneous_Comments, Identified Hydraulic Structures, Recommended Stream Reaches, Recommended Stream Junctions supplied by WorleyParsons on the 11/11/10

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Rev	Date	Revision Description	ORIG	CHK	ENG	APPD
A	15/11/2010	Issued for use	RS	JM	LC	ER

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REGIONAL FLOODPLAIN DATABASE PROJECT

FIGURE 2
SIDLING CREEK HYDROGRAPHY REVIEW

Project No: 301001-01156 | Figure: 301001-01156-EN-DAL-0013 | Rev: A

Compiled by SUNSHINE COAST INFRASTRUCTURE GIS SECTION

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APPENDIX C: CALIBRATION AND VALIDATION FEASIBILITY REPORT

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Calibration and Validation Feasibility Report

Package 1

301001-01156 – EN-REP-0003

8 November 2010

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MORETON BAY REGIONAL COUNCIL
CALIBRATION AND VALIDATION FEASIBILITY REPORT
PACKAGE 1

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PROJECT 301001-01156 - CALIBRATION AND VALIDATION FEASIBILITY REPORT

REV	DESCRIPTION	ORIG	REVIEW	WORLEY-PARSONS APPROVAL	DATE	CLIENT APPROVAL	DATE
A	Issued for Internal Review	R.Stewart	R.Stewart		8-Nov-10	N/A	
0	Issue for Use	L.Cheung	R.Stewart	E.Reid	8-Nov-10		

CONTENTS

1. INTRODUCTION

WorleyParsons Services Pty Ltd has been engaged by Moreton Bay Regional Council (MBRC) to carry out detailed surface water modelling over two (2) of the regional catchments in their Local Government Area (LGA). The two catchments are Upper Pine River (UPR) and Sideling Creek (SID). These make up 'Package 1' of MBRC's Regional Floodplain Database Project (RFD Project) and are referred to as 'minor basins' in the GIS data provided by MBRC.

At the commencement of this project MBRC handed over an extensive data set including established 'broad scale' models (including associated results and reporting) as well as several sources of historic flooding information. The purpose of this report is to assess the feasibility of carrying out historic event calibration and validation for the current detailed modelling project. This assessment is based on a review of the data set provided by MBRC.

2. AVAILABLE DATA

Details of the data available for calibration and validation modelling are provided in this section. This includes data provided by MBRC as well as information obtained from websites of the Bureau of Meteorology (BoM).

2.1 Stream Gauge Data

A total of five (5) river gauge stations providing stream data have been identified within the package 1 Minor Basins. These stream gauges now incorporate telemetry and form part of the BoM's flood warning system. Details of the river gauge stations are summarised in Table 1 below and details of the BoM's flood warning system in the vicinity of Package 1 Sub-basins are provided in Appendix 1.

Table 1 Package 1 Sub-basins River Gauge Stations

Gauge No	Station Name	Minor Basin
142800	Baxters Creek Alert	Upper Pine River
142106	Dayboro TM	Upper Pine River
142107	Kobble Creek TM	Upper Pine River
142801	North Pine Dam Alert	Upper Pine River
142803	Lake Kurwongbah Alert	Sideling Creek

Hourly flood level data has been provided by MBRC for the Kobble Creek TM and Dayboro TM gauges for the period ranging from August 1998 up to April 2009 and Lake Kurwongbah Alert gauge for the period ranging from May 1995 to March 2009. However, stream gauge data for Baxters Creek Alert and North Pine Dam Alert gauges has not been provided. It is expected that some form of continuous flood record should also be available for these two gauges.

2.2 Rainfall Data

There are several historic rainfall gauging stations with both continuous ('pluvio' or 'alert' data) and daily recording situated in and around the package 1 Minor Basins. The spatial coverage of these gauges should allow a sufficient representation of historic rainfall patterns associated with the large weather systems which have historically generated regional flooding in the large package 1 Minor Basins. We note that MBRC has supplied a rainfall database containing data for most of the rainfall gauging stations situated in and around Package 1 Minor Basins for the period between 1996 to June 2009.

2.3 Historic Flood Marks

A GIS layer called “OLD CAB Dist Historic Flood Levels’ has been provided by MBRC. However, this data layer does not contain any information relevant to the Package 1 Minor Basins.

No other historical flood mark data has been provided by MBRC and consequently no flood mark data is currently available for the package 1 minor basins.

2.4 Other Data

A GIS layer called “Maximum Height Indicators’ has been provided by MBRC. However, this data layer does not contain any information relevant to the Package 1 Minor Basins.

Another GIS layer called “WQ Event Monitoring Program’ has also been provided by MBRC. This GIS layout provides some historical flood information across MBRC LGA. However, this data layer also does not contain any information relevant to the package 1 Minor Basins.

It is recommended that long term historic flood level data in North Pine Dam and Kurwongbah Dam be sourced.

Several reports by other consultants have also been provided that contain some calibration data.

3. FLOOD EVENTS

3.1 Possible Events for Calibration/Validation

The following historic floods are considered the most appropriate for calibration and validation of the package 1 Minor Basins.

- December 1991: 345 mm rainfall at the Dayboro Post Office over a 50 hour period (peak 6 hour intensity of 31 mm/hr); It is noted that stream gauge data has not been supplied for this historic event.
- May 2009: This flood event started on the 19 May 2009 and finished on the 21 May 2009.It is the most recent flood significantly impacting the Pine River Catchment region (BoM, September 2009). A 420mm total rainfall was recorded in the event at the Baxters Creek Alert gauge station (peak 6 hour intensity of 18mm/hr). The rainfall data provided by MBRC has included this event but the stream gauge data is missing from this event. Nevertheless, it is expected that stream gauge data for this event could be easily sourced from the operating agencies.

It is noted that currently stream gauge data has not been provided for the December 1991 event. Due to the large size of this historic flood it is a desirable calibration event so it is hoped that sufficient flood mark data and stream gauge data can be obtained to enable calibration of this event. If this is not the case an alternative option is to calibrate to the March 2004 for which stream gauge data has been supplied by MBRC.

3.2 Feasibility of Calibration/Validation

There is sufficient rainfall data to carry calibration and validation for package 1 Minor Basins for the events described in Section 3.1 of this report.

The only historic flood level data currently available is associated with the various stream gauges within the region. It is recommended that this data be supplement with historic flood mark data for the two calibration events described in Section 3.1. This will improve the quality of the calibration that be achieved.

4. RECOMMENDATIONS

It is recommended that calibration and validation of the package 1 models be carried out for the events detailed in Section 3.1.

It is recommended that MBRC collect peak flood mark data for the package 1 catchments for the events detailed in Section 3.1.

It is recommended that continuous flood level data be sourced from the stream gauge stations across the UPR and SID Minor Basins (as described in Table 1 of this report) for the May 2009 and the December 1991 rainfall events. If sufficient data is not available for the 1991 event, calibration could be carried out for the more recent yet smaller March 2004 event.

It is recommended that peak flood level data be collected for each of the calibration events detailed in Section 3.1.

It is also recommended that data associated with long term historic flood levels in the North Pine Dam and Kurwongbah Dam be sourced.

5. REFERENCES

i. BoM, November 2009, *"Caboolture, Pine & Surrounding Rivers Flood Warning Network"* http://www.bom.gov.au/hydro/flood/qld/brochures/caboolture/map.shtml

ii. BoM, September 2009, *"Flood Warning System for the Pine & Caboolture Rivers"* http://www.bom.gov.au/hydro/flood/qld/brochures/caboolture/caboolture.pdf

iii. GHD (for MBRC), June 2010, *"Regional Floodplain Database, Sub-project 2K Historic Flood Information"*

iv. GHD (for SEQ Water), July 2009, *"Report for Lake Kurwongbah (Sideling Creek Dam) Flood Hydrology"*

v. John Wilson and Partners (for Pine Rivers Shire Council), May 2005, *"North Pine River Hydrology Final Report"*

vi. SunWater (for SEQ Water), June 2007, *"North Pine Dam, Design Flood Hydrology - DRAFT"*

Appendix 1 - BoM Caboolture, Pine & Surrounding Rivers Flood Warning Network

Australian Government
Bureau of Meteorology

MAP 142.1

Manual Heavy Rainfall Station
Daily Reporting Rainfall Station
Manual River Station
Telemetry Rainfall Station
Telemetry River Station

CABOOLTURE, PINE & SURROUNDING RIVERS

FLOOD WARNING NETWORK

Major Roads
Railway

Revised: Nov 2009

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APPENDIX D: MODELLING QUALITY REPORT

TECHNICAL NOTE

DATE	10 July 2010
TO	Moreton Bay Regional Council
FROM	Leonard Cheung
COPY	
PROJECT	301001-01156
SUBJECT	Sideling Creek Modelling Quality Report
DOC NO	
FILE LOC	

INTRODUCTION

A detailed TUFLOW model of the Sideling Creek River (SID) minor basin has been developed as part of Moreton Bay Regional Council's (MBRC) Regional Floodplain Database (RFD) Stage 2 project.

This technical note is prepared to demonstrate that the performance of the SID model is suitable for the intended use and the associated model outputs can be adopted by MBRC for the RFD to deliver reliable flood information across the SID minor basin.

MODEL PERFORMANCE

Model stability, warning messages and mass errors were monitored throughout model simulation periods to ensure that the model performance was acceptable. Careful attention has been paid to ensure that flood water flowing through the 1D structure elements in the model as well as flowing across the floodplain in the 2D domain were stable during model simulation period.

Overland flow hydrographs were checked at key locations in the floodplain (PO lines) and the Sideling Creek Dam to ensure the simulation has well passed beyond the peak throughout the SID study area, especially the downstream boundary at the spillway of Sideling Creek Dam.

To demonstrate there are no significant loss or gain of flood volumes during model runs, a check of the mass balance of the flood volumes for the three selected critical durations of the 10Yr, 100Yr ARI and PMF flood events has been undertaken and presented in the following Table 1.

Table 1: Mass Balance Check

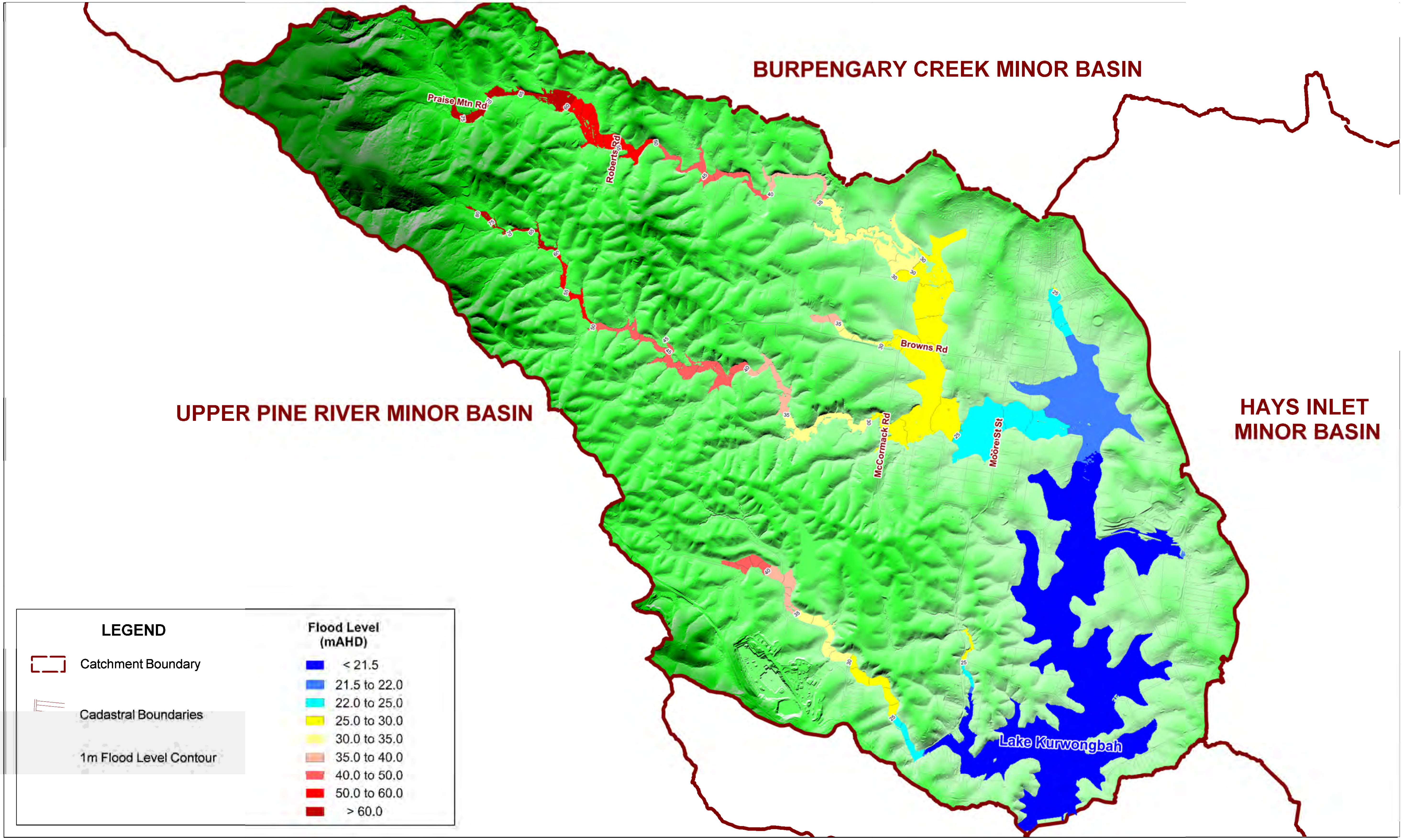
Event	10Yr ARI			100Yr ARI			PMF		
Critical Duration	060M	180M	360M	060M	180M	360M	120M	180M	300M
Volume at Start (m3)	9612415	9612415	9612415	9612415	9612415	9612415	9612415	9612415	9612415
Volume at End (m3)	10150121	10388068	10412879	10300106	10558580	10217259	11137993	11492142	10668642
Total Volume In (m3)	3382970	4937983	6468904	5261737	7835155	9785342	33235555	40389255	50533982
Total Volume Out (m3)	2712465	4215151	5763934	4390524	6938566	8866594	30975991	38407960	48872489
Volume Error (m3)	-132798	52822	95494	-183521	49576	-313904	-733985	-101567	-605265
Final Cummulative ME (%)	-1.31%	0.51%	0.78%	-1.78%	0.34%	-1.68%	-1.14%	-0.13%	-0.61%

The above table shows that there is no significant loss or gain of flood volume during the modelling and the mass balance errors are within the range of -1.78% to +0.78% for the selected critical duration runs of the three design events.

CONCLUSIONS

The quality of the SID model run has been reviewed. It is considered that the overall model performance is suitable for the intended use and the associated model outputs can be adopted for the MBRC RFD to deliver reliable flood information across the Sideling Creek minor basin.

APPENDIX E: FLOOD MAPS – 100 YEAR ARI



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Latitude / Longitude
Geocentric Datum of Australia 1994

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Rev	Date	Revision Description	ORIG	CHK	ENG	QA	APPD
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REGIONAL FLOODPLAIN DATABASE PROJECT (STAGE 2)
SIDELING CREEK
FIGURE E1 PEAK FLOOD LEVEL MAP - 100 YEAR ARI

Project No: 301001-01156 | Figure:301001-01156-EN-DAL-0055 | Rev: 0

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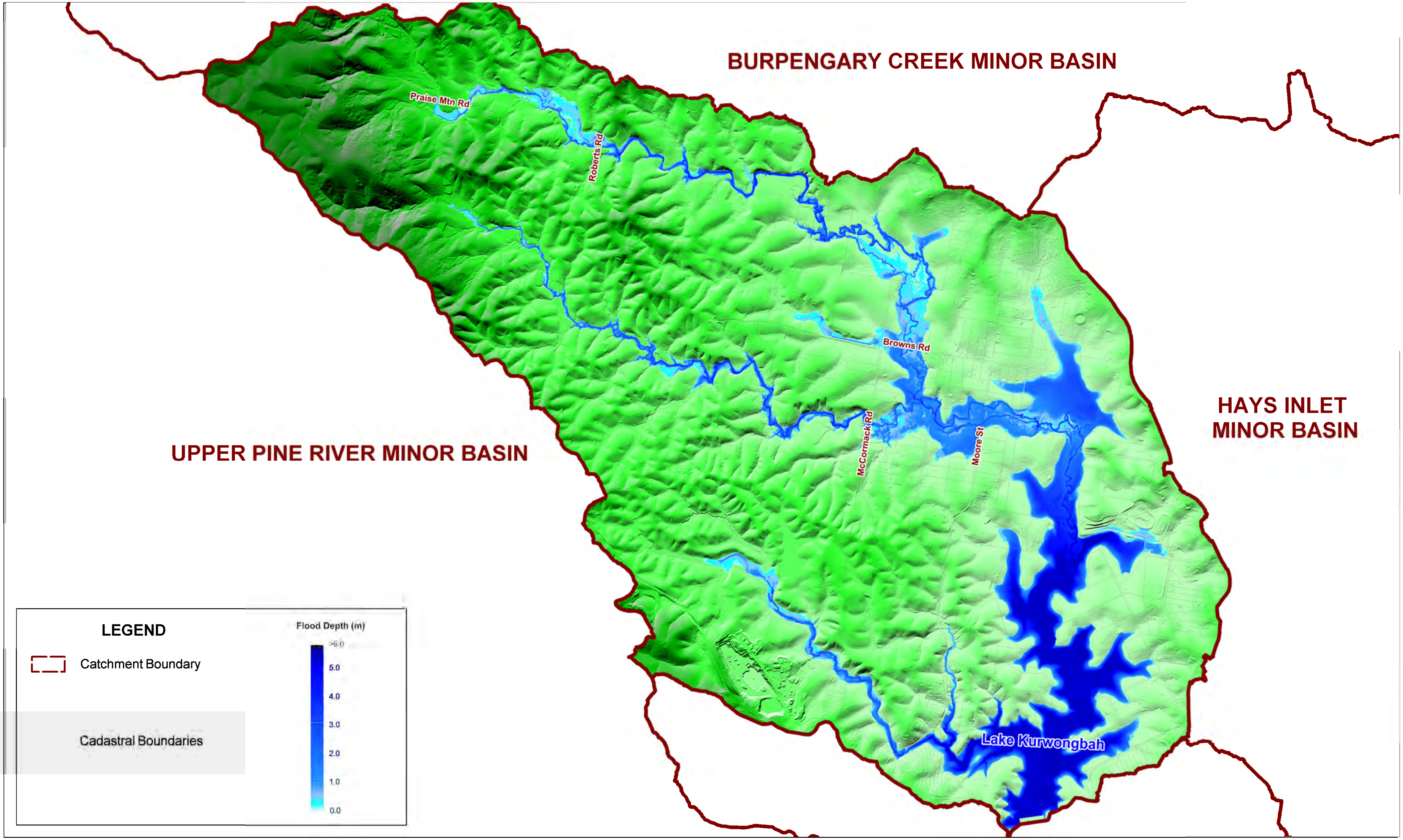

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REGIONAL FLOODPLAIN DATABASE PROJECT (STAGE 2)
SIDELING CREEK
FIGURE E2 PEAK FLOOD DEPTH MAP - 100 YEAR ARI

Project No: 301001-01156	Figure:301001-01156-EN-DAL-0056	Rev: 0

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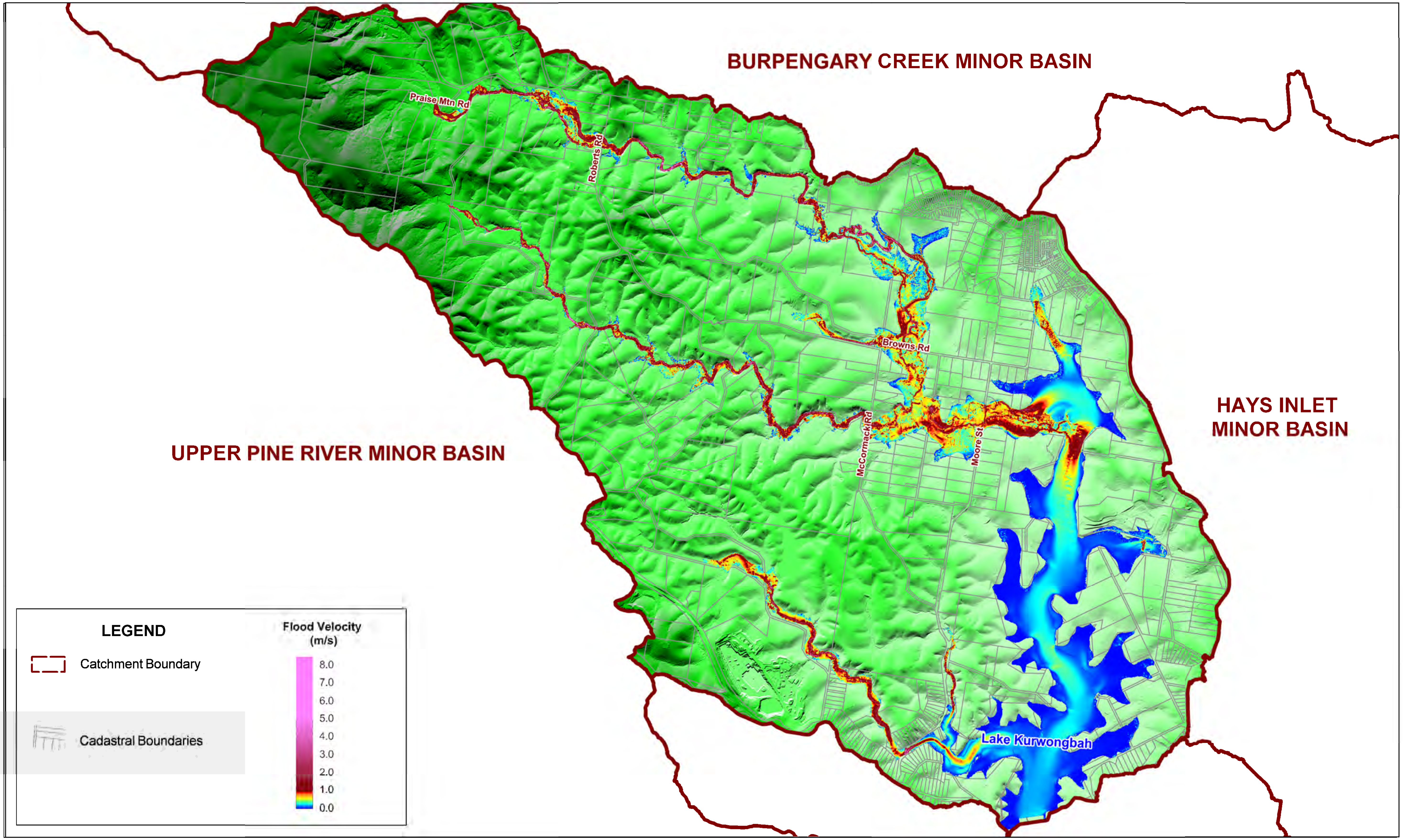

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Rev	Date	Revision Description	ORIG	CHK	ENG	QA	APPD
0	30/07/2012	Issue for use	LC	KH	LC		

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REGIONAL FLOODPLAIN DATABASE PROJECT (STAGE 2)
SIDELING CREEK
FIGURE E3 PEAK FLOOD VELOCITY MAP - 100 YEAR ARI

Project No: 301001-01156	Figure:301001-01156-EN-DAL-0057	Rev: 0

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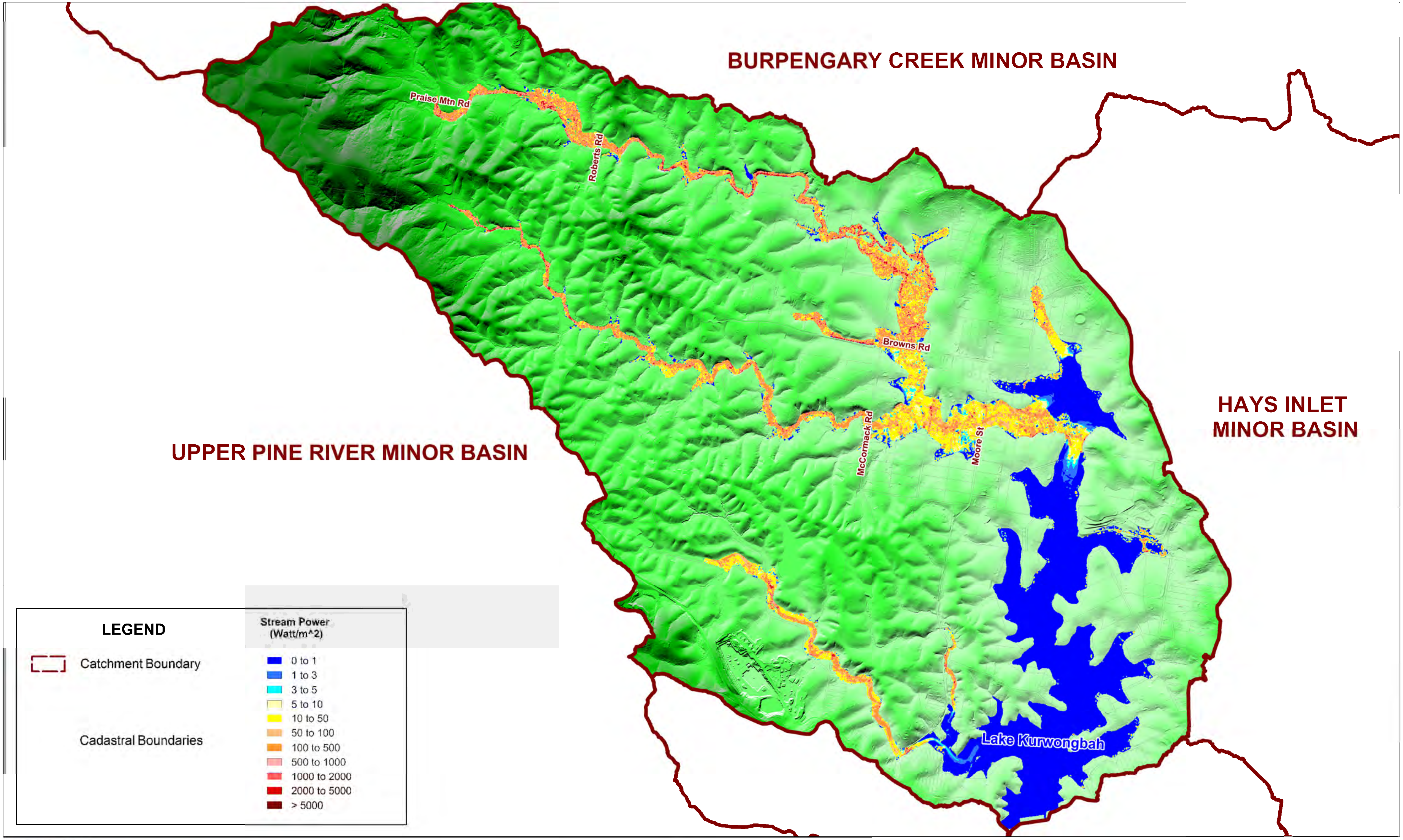

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Latitude / Longitude
Geocentric Datum of Australia 1994

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Rev	Date	Revision Description	ORIG	CHK	ENG	QA	APPD
0	30/07/2012	Issue for use	LC	KH	LC		

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REGIONAL FLOODPLAIN DATABASE PROJECT (STAGE 2)
SIDELING CREEK
FIGURE E4 PEAK STREAM POWER MAP - 100 YEAR ARI

Project No: 301001-01156 | Figure:301001-01156-EN-DAL-0058 | Rev: 0

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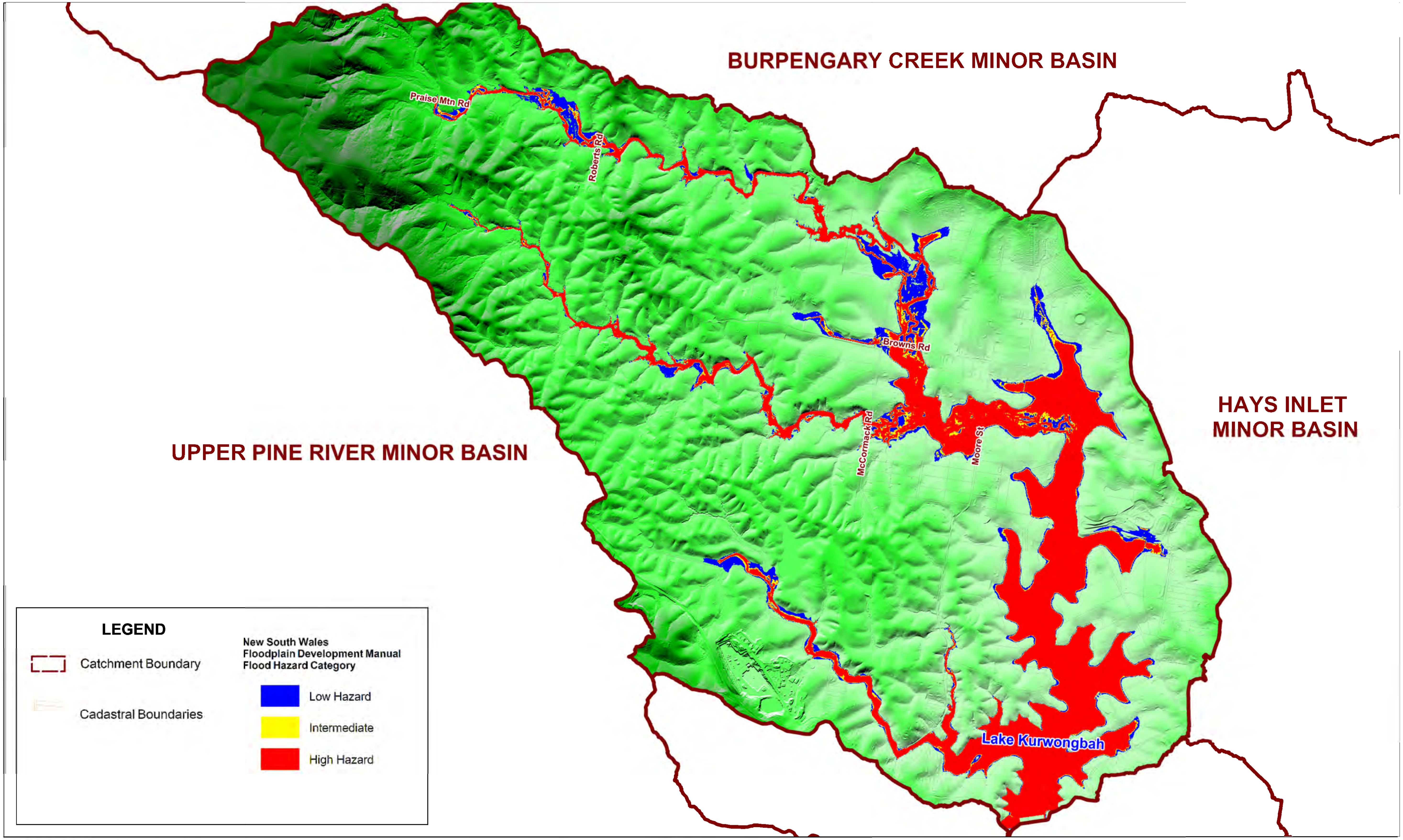

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Latitude / Longitude
Geocentric Datum of Australia 1994

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Rev	Date	Revision Description	ORIG	CHK	ENG	QA	APPD
0	30/07/2012	Issue for use	LC	KH	LC		

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FIGURE E5 PEAK FLOOD HAZARD MAP - 100 YEAR ARI

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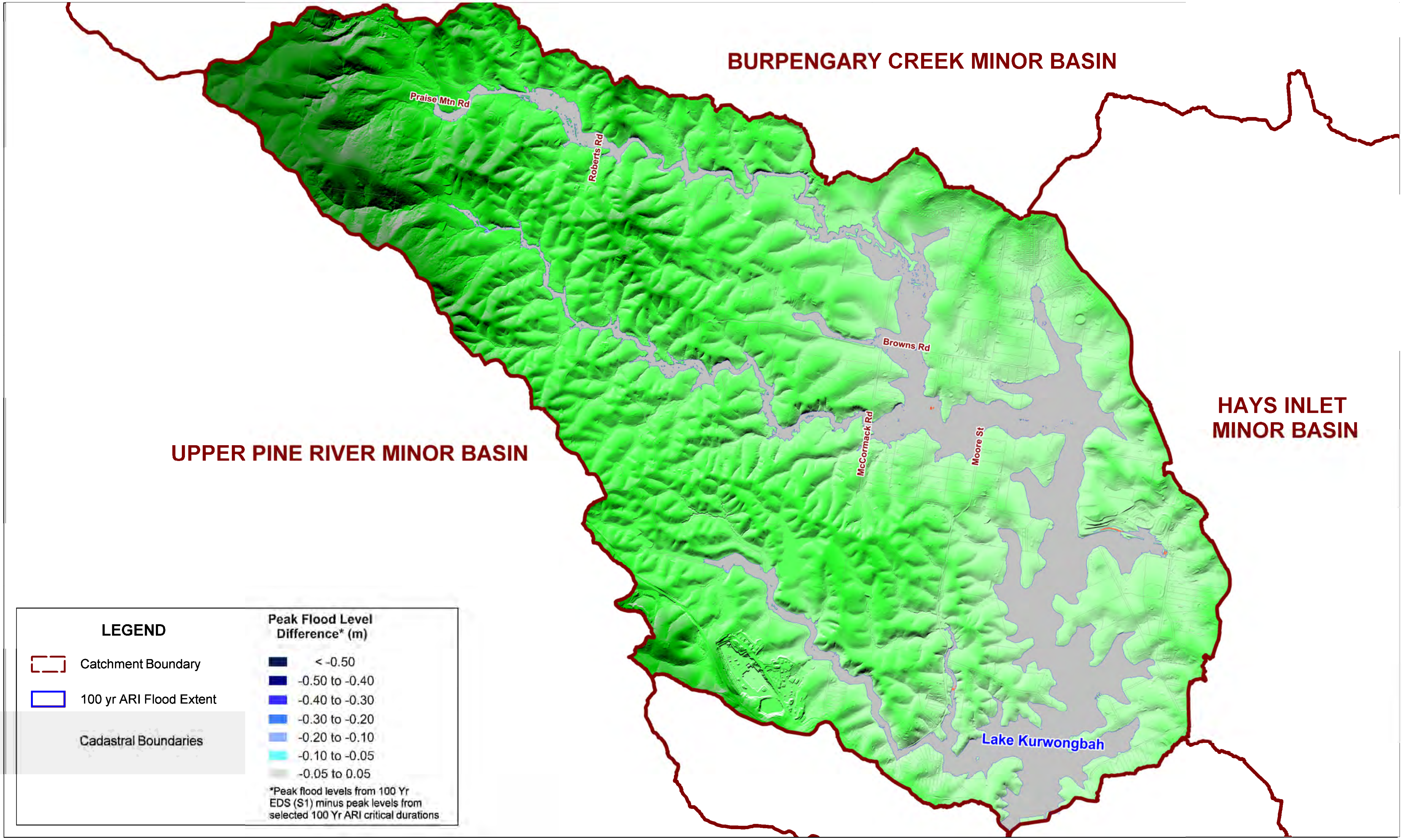
APPENDIX F: MODEL SENSITIVITY ANALYSIS MAPS



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Latitude / Longitude
Geocentric Datum of Australia 1994

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FIGURE F1 FLOOD LEVEL DIFFERENCE BETWEEN EDS AND SELECTED CRITICAL STORM DURATIONS - 100 YR ARI (S1)

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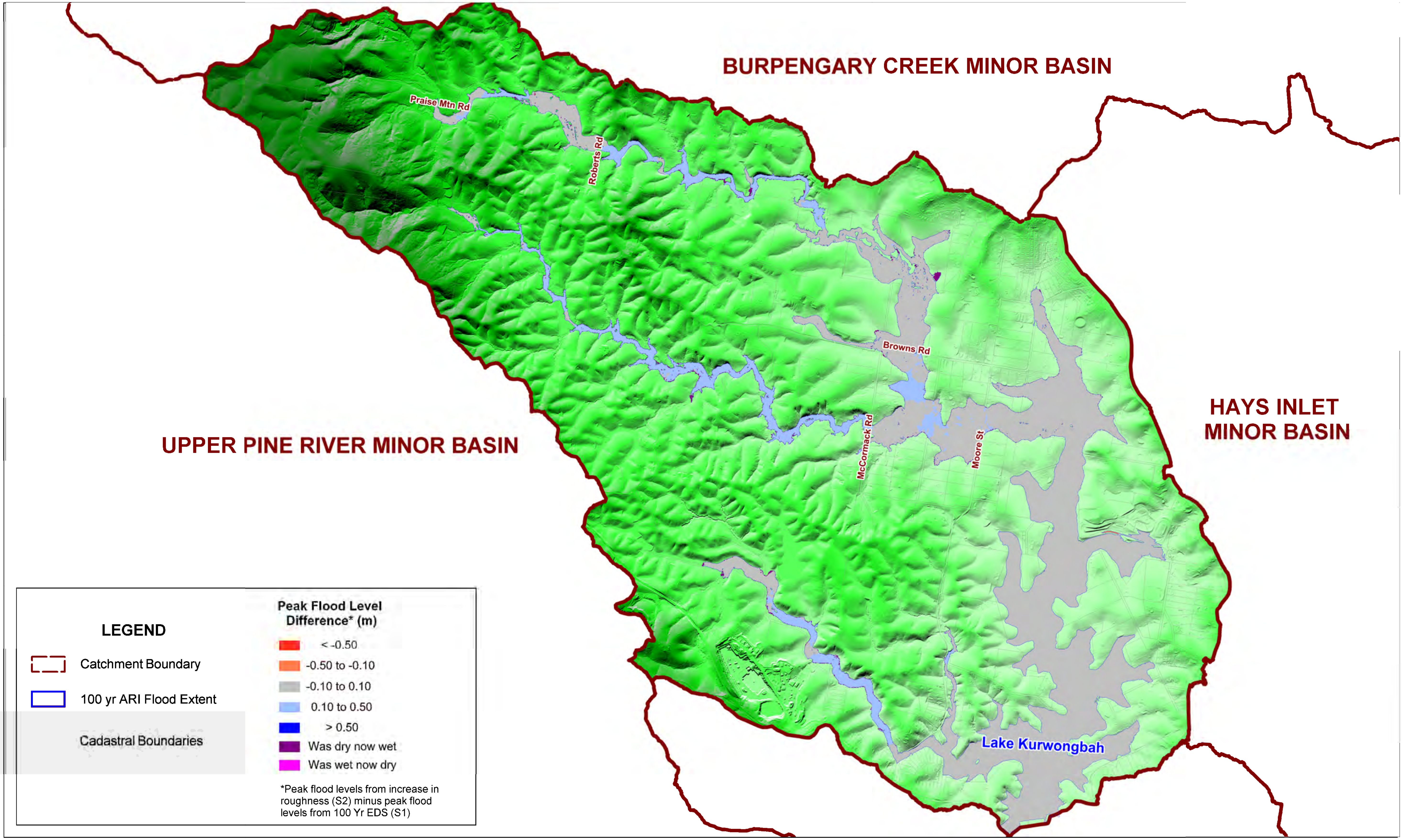

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FIGURE F2 INCREASE IN ROUGHNESS FLOOD LEVEL IMPACT - 100 YEAR EDS (S2)

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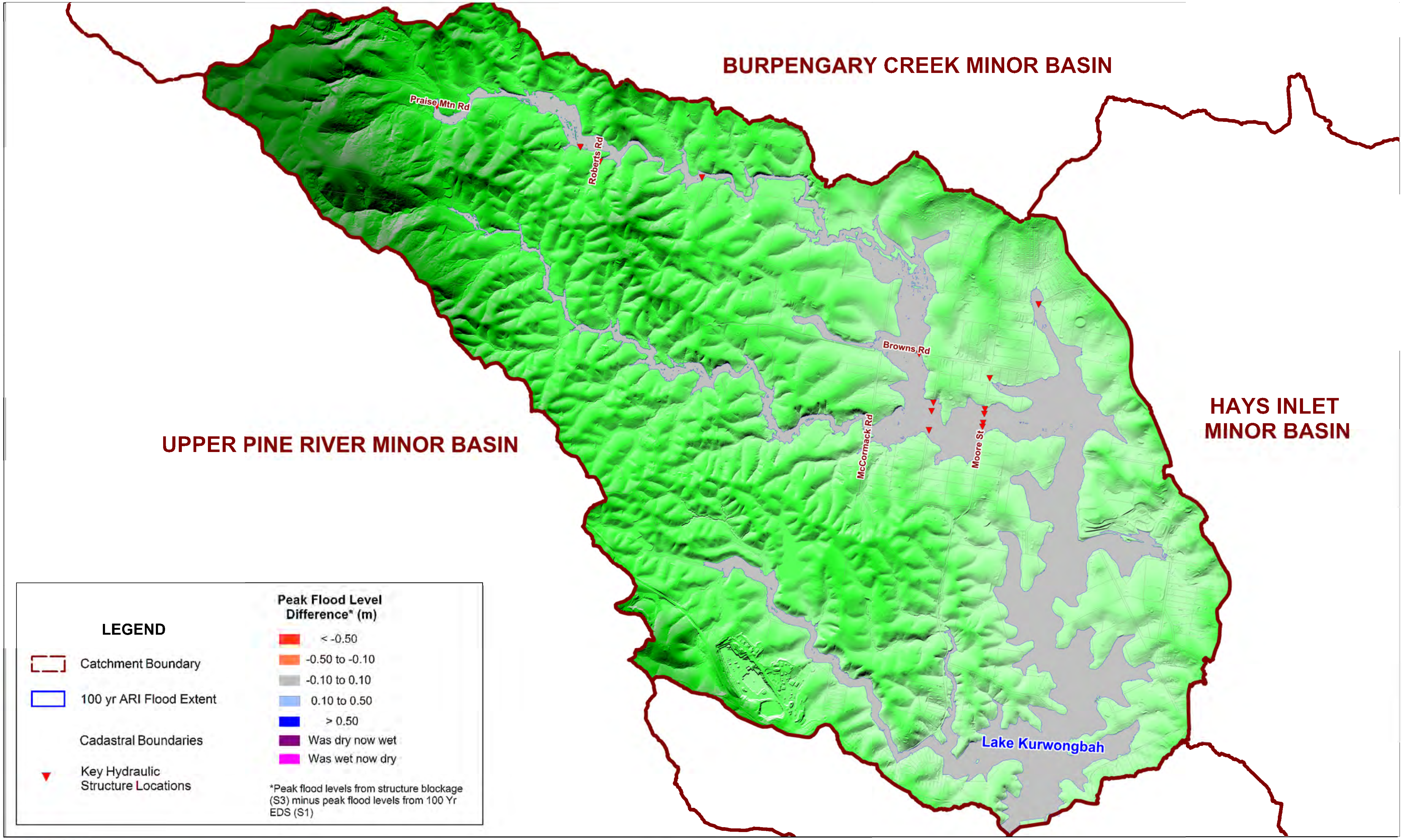

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FIGURE F3 STRUCTURE BLOCKAGE FLOOD LEVEL IMPACT - 100 YEAR EDS (S3)

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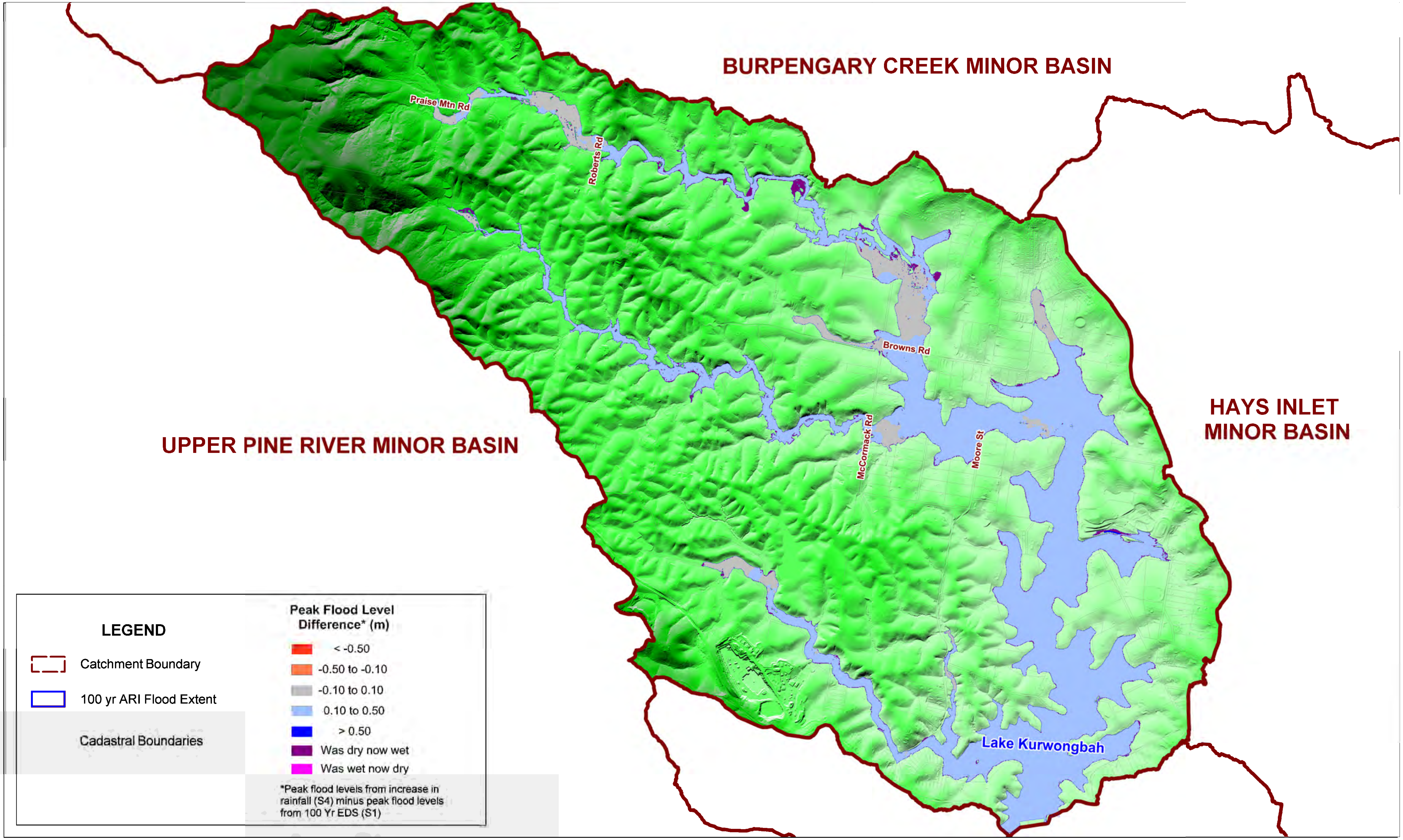

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Latitude / Longitude
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REGIONAL FLOODPLAIN DATABASE PROJECT (STAGE 2)
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FIGURE F4 INCREASE IN RAINFALL FLOOD LEVEL IMPACT - 100 EDS (S4)

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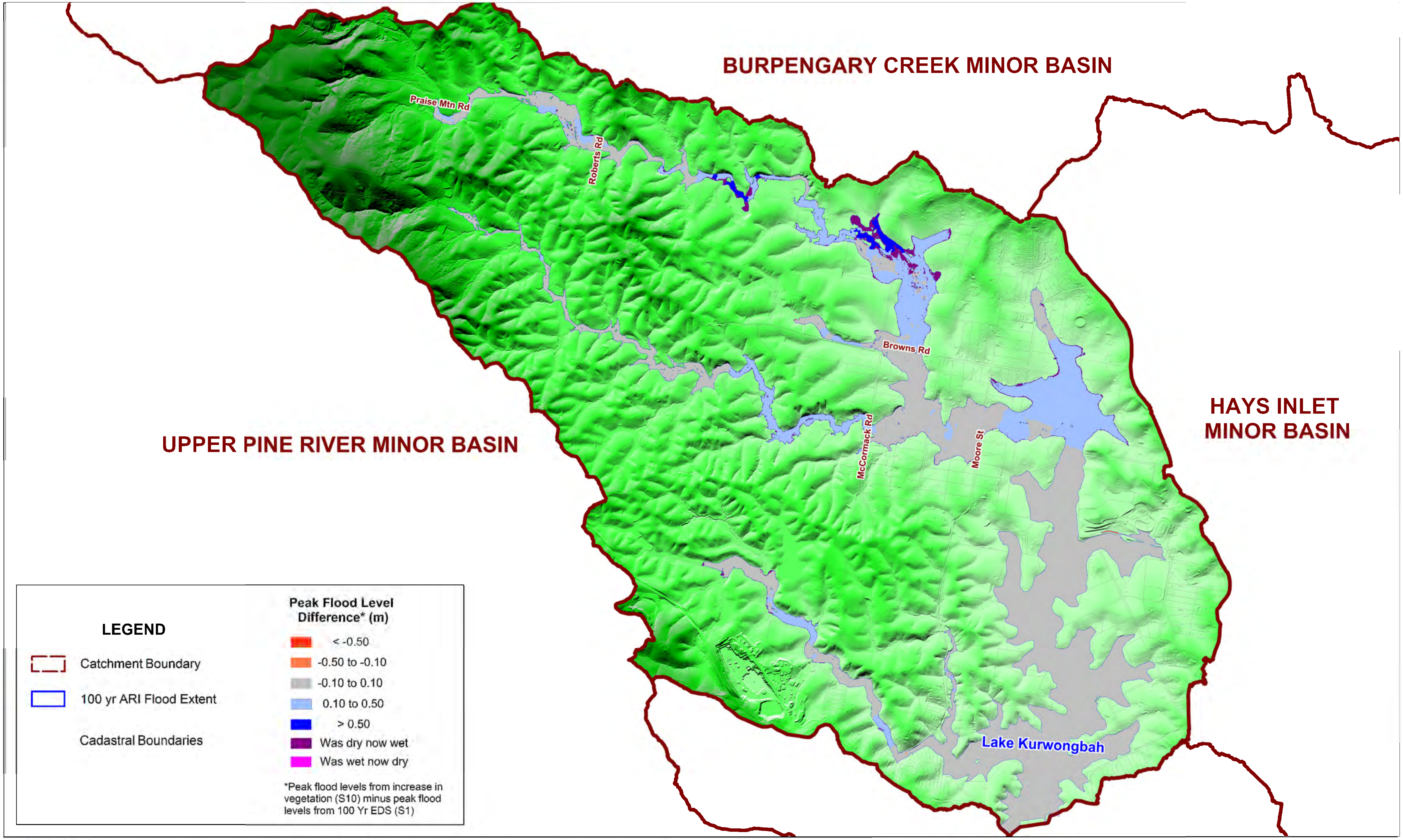

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FIGURE F10 INCREASE IN VEGETATION FLOOD LEVEL IMPACT - 100 EDS (S10)

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