Regional Flood Database:

2022 Major Flood Model Update

Byron Creek (BYR) Catchment

moretonbay.qld.gov.au

CITY OF MORETON BAY

Document Set ID: 70782935
Version: 10, Version Date: 12/02/2025

Acknowledgment of Traditional Custodians

City of Moreton Bay acknowledges the Jinibara, Kabi Kabi and Turrbal peoples and pays respects to Elders, past, present and emerging. Council recognises that the Moreton Bay region has always been a place of cultural, spiritual, social and economic significance to its Traditional Custodians. Council is committed to reconciliation and working in partnership with Traditional Custodians and Aboriginal and Torres Strait Islander communities to shape a shared future for the benefit of all communities within the City of Moreton Bay and beyond.

Contents

Table of Figures

Table of Tables

1 Introduction

City of Moreton Bay Council (Council) is committed to continuously upgrading and enhancing its region wide hydrologic and hydraulic flood model library since its development in 2009, as part of the establishment of Council's Regional Flood Database (RFD). The RFD flood model library is capable of seamless interaction with a spatial database to efficiently deliver detailed information about flood behaviour across the local government area and for the local community. The RFD model library includes coupled hydrologic and hydraulic models, one for each of the 'minor basins' within the Council area.

A Major Update to the RFD was initiated in 2019. Stages 1 to 3 involved testing proposed methods, preparing model data, and testing potential modelling approaches.

This report details the project methodology, results and outcomes of Stages 4 and 5 for the Byron Creek catchment (BYR), referred to as the 2022 RFD. Figure 1.1 presents the location of the Byron Creek catchment in the context of the wider Local Government Area (LGA) boundaries.

The primary objective of the Stage 4 study for BYR is:

- Update of the WBNM hydrologic model and TUFLOW hydraulic model according to the outcomes of the Stage 1 project utilising the findings of the Stage 3 project.

A key difference between Stage 4 for BYR and for other catchments in the RFD is that no 'hydraulic-equivalent' hydrology (HEH) model was developed. Additionally, no calibration or validation occurred based on data within the catchment. Calibration parameters were instead adopted to be consistent with other calibrated and validated RFD models.

The primary objectives of the Stage 5 study are:

- Design event modelling for existing (circa 2019 - 2022) and future conditions
- Design event flood surface creation for existing (circa 2019 - 2022) and future conditions

Document Set ID: 70782935
Version: 10, Version Date: 12/02/2025

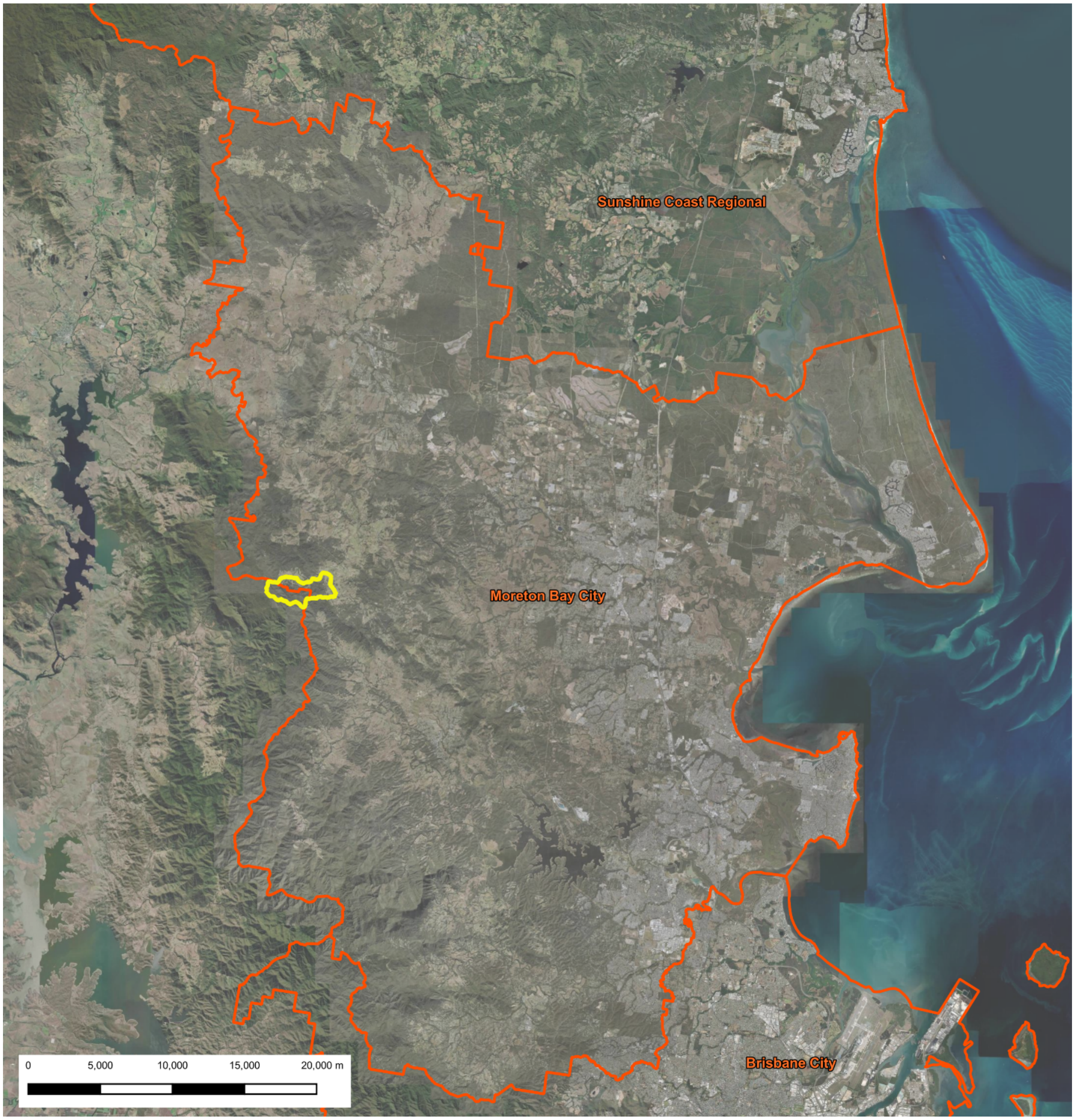


Figure 1.1 Byron Creek Minor Basin Locality

2 Background

The methodology behind the RFD is primarily based on the national guideline for flood estimation, Australian Rainfall and Runoff 2019 version 4.1 (Ball et al. 2019). This guideline underwent a major revision in 2016 (version 4.0) and a minor update in 2019 (version 4.1). The updated guideline, with recently collected new survey information (e.g. LiDAR flown in 2019) and recent flood information across the region, provides Council with an opportunity to undertake a major update to the RFD. This major update is being delivered in five stages, with Stages 1, 2 and 3 having been completed previously:

Stage 1 – Pilot Study – investigated the required/ recommended modelling methodology changes for the RFD, utilising ARR 2019 guidelines (Arup 2021).

Stage 2 – Hydrography Land use and Hydrology – entailed update of Council's land use roughness layers, catchment delineation and hydrology models (AECOM 2020).

Stage 3 – Hydraulic model configuration investigation – was an internal investigation conducted by Council staff reviewing recently released software computation methods and capabilities to identify potential application to RFD hydraulic model setup (Moreton Bay Regional Council 2021).

The RFD models for BYR consist of a WBNM hydrologic model and a TUFLOW hydraulic model. These were created at the initiation of the RFD project, commenced 2009 and completed in 2012. The BYR models were last updated in 2015 as part of a RFD Minor Update project which primarily involved updating terrain data from 2009 to 2014 data (BYR model completed in 2015, overall project occurred between 2014-2016). The previous version of the RFD is termed the 2014 RFD models or version 002c RFD. The major update documented by this report is termed the 2022 RFD update or version 003a RFD.

2.1 Catchment Description

The Byron Creek model area within Council's LGA is characterized by largely undisturbed, steep meandering streams with minimal dams and storage. Land-use within the Byron Creek catchment is mostly rural, with a smaller area zoned as environmental conservation. Most of the catchment is forested, with the upper catchment being cleared and featuring a few isolated dwellings and farm dams.

The Byron Creek catchment continues downstream to the west within the Somerset Regional Council LGA.

3 2022 Major Flood Model Update Details

3.1 Key Methodology Changes related to ARR 2019

The 2014 RFD models utilised hydrological and hydraulic data based on the guidance from Australian Rainfall and Runoff (ARR) 1987. However, in 2016, along with further updates in 2019, ARR underwent a significant revision, prompting the consideration of a broader range of hydrological variability in design estimates. This included the use of ensembles to run hydrological models, sampling different temporal patterns and other key hydrological parameters.

The ARR 2019 guidelines serve as a comprehensive and widely recognized resource, offering guidelines for estimating design flood characteristics across Australia. By incorporating the updates from ARR 2019 into the flood study, the analysis and assessments align with the most up-to-date understanding of rainfall patterns, hydrological processes, and flood behaviour.

By utilising the guidance provided in ARR 2019, this RFD update ensures it is based on the latest scientific knowledge and best practices in flood estimation. The updated guidelines consider various factors such as climate change projections, improved rainfall analysis techniques, and advancements in hydrological modelling. This incorporation enables a more accurate and robust assessment of flood risk, empowering stakeholders to make informed decisions pertaining to land-use planning, infrastructure design, and emergency management.

A key change introduced in ARR 2019 is the increased use of ensembles of design storms, specifically incorporating 10 temporal patterns per duration, with up to 100 storms per Annual Exceedance Probability (AEP). There is also a heightened sensitivity to Areal Reduction Factors (ARF) to account for spatial variation in rainfall. Given the time-intensive nature of simulating all storms and considering hydrologic variability within the hydraulic model, RFD Stage 1 guidance placed greater reliance on the hydrological models to identify critical storms.

Stage 1 of the RFD major update project demonstrated the viability of using a hydrologic model which produces similar results to the hydraulic model (termed a hydraulic equivalent hydrologic model or HEH model) to identify critical storms. A HEH model gives the ability to analyse ARR 2019 hydrologic variability at specific points of interest across the catchment without the need for a significant number of time-consuming hydraulic simulations. RFD TUFLOW models could be used to inform the hydrologic model storage and routing parameters giving a hydraulic equivalent hydrologic (HEH) model.

As such, the majority of the RFD models use the HEH approach for selection of critical design storms. However, as the BYR model is small in comparison to other RFD models, it was decided to not use the HEH approach. Instead, all storms are simulated in the TUFLOW hydraulic model for both the existing and future condition scenarios.

All ARR 2019 hydrological modelling was undertaken within the Catchment Simulation Solutions Storm Injector software version 1.3.7 along with the WBNM engine included with Storm Injector (version unspecified).

Subsequent to the completion of the majority of the BYR major update, an update to the climate change chapter within Australian Rainfall and Runoff was finalised in late 2024 (referred to as ARR version 4.2). This RFD major update does not incorporate ARR4.2 guidance.

3.2 Rainfall Intensity-Frequency-Duration (IFD) Update

3.2.1 Intensities

Design flood estimates derived for the Byron Creek Catchment have been based on the design IFD guidance outlined in ARR 2019 in combination with the updated LIMB 2020 high resolution IFD estimates. A sensitivity assessment was undertaken by Water Technology (2022) which recommended the high-resolution dataset. The high-resolution dataset is at a more suitable resolution for application to subcatchments throughout the local government area. IFDs were extracted at each subcatchment centroid through the Storm Injector custom IFD ingest tool.

3.2.2 ARR 2019 Datahub

Design rainfall parameters such as temporal patterns, pre-burst values and areal reduction factors were obtained from the ARR 2019 Data Hub (http://data.arr-software.org/). Parameters near the centroid of the catchment are presented in Table 3.1.

Table 3.1 ARR 2019 DataHub Parameters

Parameter	Value
Longitude	152.7274
Latitude	-27.1018
River Region	North East Coast
River Name	Byron Creek
ARF parameters	East Coast North
Storm Initial Losses (mm)	20.0
Storm Continuing Losses (mm/h)	2.3
Temporal Patterns	East Coast North Point

3.3 WBNM Hydrological Model Update

3.3.1 Subcatchment Updates

The updated WBNM model and associated GIS files were based on the Stage 2 - Hydrography Landuse and Hydrology Study. The BYR WBNM contains 18 individual subcatchments, which were unchanged in geometry from the 2014 RFD model. Figure 3.1 below shows the WBNM subcatchment layout. Some minor discrepancies exist between the subcatchment boundaries and the latest LiDAR data, which would not materially affect model results. The hydrography should be reviewed and revised as necessary in a future update.

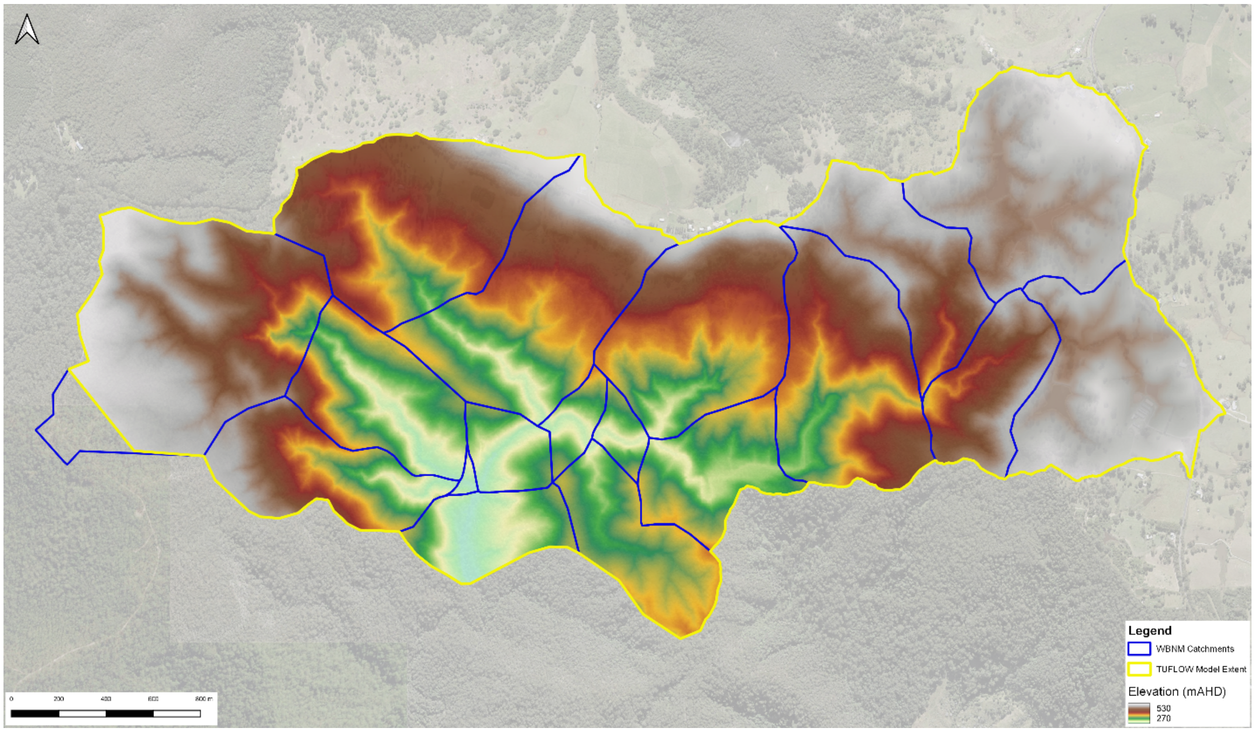


Figure 3.1 BYR WBNM Subcatchments

3.3.2 Impervious Areas

An Effective Impervious Area (EIA) raster dataset for the entire LGA was created for the RFD major update for the purposes of updating percentage impervious values in the hydrologic models, for both existing and future conditions. Impervious fraction calculations were not undertaken within the WBNM hydrologic model package or Storm Injector. Instead, an average calculation was undertaken in ArcMap using pervious/impervious rasters to determine the impervious fraction to be applied in the WBNM model for each subcatchment.

The Stage 1 project identified the manner by which a Total Impervious Area (TIA) raster is to be converted into an EIA raster. The existing conditions EIA raster was created using Stage 2 datasets (i.e. 2019 aerial photography based landuse classification) and based on guidelines provided in the Stage 1 Report. As such, the present-day raster represents catchment conditions in 2019.

The ultimate EIA raster was created by Council Staff using Stage 1 advice and based on the Local Government Infrastructure Planning (LGIP) ultimate development landuse raster. The LGIP ultimate development landuse raster was developed as part of the 2019-2021 LGIP stormwater quantity network planning project (adopted into the planning scheme in 2021). The raster assumes full development according to the land use intent of the planning scheme Strategic Framework Place Types. It is inclusive of growth areas but exclusive of investigation areas.

For context, strategic frameworks are developed to help create a longer vision (perhaps 25 years) for a local government area beyond that of the approximately 15 year timeframe of a Planning Scheme. The LGIP ultimate development landuse raster used by this project cannot have a timestamp allocated to it, as the timeframe for densification of existing landuses is difficult to estimate. However, it could be estimated that the landuse represented by the LGIP ultimate development landuse raster may be reached by approximately 2055.

For BYR, the existing scenario was modelled using the existing conditions EIA values. Future conditions were predominately modelled using the ultimate EIA values. Owing to the different base datasets used to create the existing and ultimate landuse layers, it is possible for the existing scenario EIA to be greater than the ultimate scenario EIA for a subcatchment. Where the ultimate EIA values were lower than the existing EIA value, the existing EIA values were adopted in the future scenario. Additionally, one subcatchment was partially outside of the ultimate EIA raster extent, and so the existing conditions EIA value was adopted. Figure 3.2 and Figure 3.3 below show the existing and ultimate EIA rasters for the Byron Creek catchment.

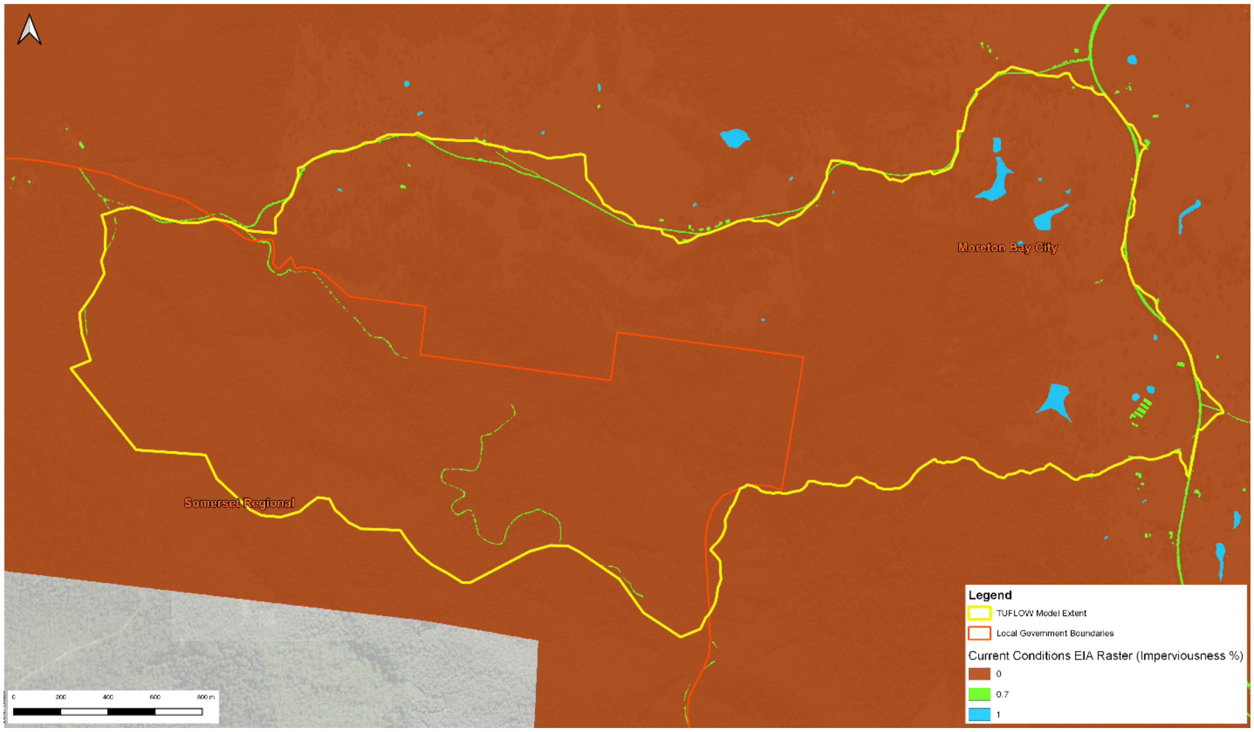


Figure 3.2 Current conditions EIA raster (BYR catchment)

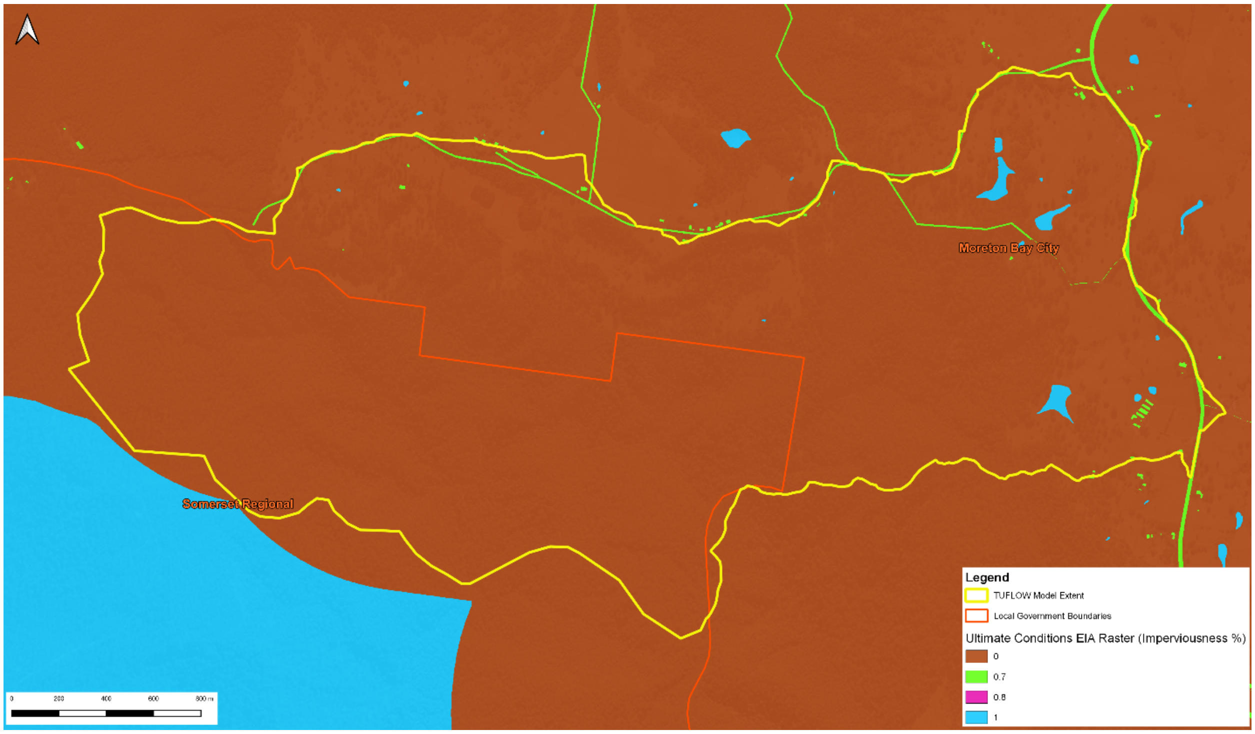


Figure 3.3 Ultimate conditions EIA Raster (BYR catchment)

3.3.3 Parameters

The Byron Creek Catchment WBNM model has adopted the following runoff routing parameters:

- Catchment Lag parameter (C) = 1.6
- Impervious surface reduction lag factor = 0.1
- Catchment non-linearity parameter (m) = 0.77

The parameters were informed by the calibration outcomes of neighbouring catchments since no calibration runs were undertaken for the BYR catchment.

3.3.4 Areal Reduction Factors

The pilot study recommended that areal reduction factors (ARFs) be calculated at each POI to run the WBNM design event models. Owing to the size of the BYR catchment, it was deemed unnecessary to apply an ARF factor. ARF application causes a reduction in rainfall and therefore this method is considered conservative.

3.3.5 Preburst Application

Preburst has been applied by injecting it prior to the storm. Pre-burst rainfall was applied generally following the methodology in the Stage 1 guidance, with the main exception of using the GSDM pattern in lieu of Jordan's pattern (undertaken for all catchments as part of the major RFD update). This alteration to temporal patterns was undertaken to ensure that preburst rainfall was not significantly affecting peak flow. Table 3.2 presents the temporal patterns as applied in Storm Injector.

An additional variance from the Stage 1 guidance was lack of factoring of perburst depth for extreme events and for the future condition scenarios. The 1% AEP preburst depth was utilised for the 1 in 1000 and 1 in 2000 AEP events; it was not scaled as recommended in the Stage 1 guidance. Additionally, whilst burst depth was adjusted by 20% for future conditions scenarios, preburst depth was not. The Stage 1 guidance was produced prior to the adoption of the LIMB 2020 rainfall depth datasets; review of preburst application methodology will likely be considered in future RFD udpates.

Table 3.2 Preburst Temporal Pattern

Temporal Pattern	Duration (min)	Applicable burst durations (min)	Applicable AEPs
GSDM	60	15 | 20 | 25 | 30 | 45 | 60	All
GSDM	120	90 | 120	All
GSDM	240	180 | 270 | 360 | 540 | 720 | 1080 | 1440 | 1800 | 2160	All

3.3.6 Future Climate

Simulations of year 2090 future conditions were performed by adopting the ARR 2019 interim RCP8.5 climate change scenario featuring an increase in rainfall intensity of 20%. The future climate modelling also incorporates ultimate landuse data as discussed in Section 3.3.2.

3.3.7 Design Event Rainfall Losses

Rainfall losses adopted for the design event modelling are based on the ARR Datahub (i.e. 20 mm Initial Loss and 2.3 mm/hr Continuing Loss). This approach is consistent with neighbouring RFD catchments.

3.4 TUFLOW Hydraulic Model Update

To assess the hydraulic characteristics of the Byron Creek Catchment, a detailed 2D TUFLOW model has been developed by updating and improving the 2014 RFD hydraulic model. The model is based on TUFLOW software version 2020-10-AF-iSP-w64, which incorporates "Heavily Parallelised Compute" (HPC) with an explicit solution scheme. The improvements have been guided by Stage 1 and 3 of the RFD project, and include:

- Adoption of TUFLOW build 2020-10-AF for model development.
- Adoption of Wu eddy viscosity algorithm (default for 2020-01 onwards)
- Maintained fixed 5m grid with updated 2019 LiDAR.
- Refinement of roughness layers to represent landuse more precisely in the catchment.
- HPC has been adopted with simulations using GPU hardware to improve run times. For example, the 1% AEP 120 minute TUFLOW simulation reduced from approximately 31 minutes to 2 minutes.

3.4.1 Model Layout and Extents

The model code boundary and domain extent have not been updated from the 2014 RFD model, apart from a negligible 2m adjustment to the domain. The TUFLOW model code boundary covers (practically) the entirety of the BYR catchment. A small upstream area on the west of the catchment is not within the model code boundary (see Figure 3.1). This area is upstream of any source-area inflow points and therefore does not impact the TUFLOW results. The code boundary extent has not been refined/reduced from the overall catchment boundary to allow future users to simulate larger events (such as the PMF) and to make cut down models without restriction. The BYR model uses a zero-degree orientation angle, which is consistent with the other 2022 RFD models.

3.4.2 Model Topography

The model base topography is represented using 1.0 m resolution 2019 LiDAR data. Bathymetry data was not included in the model; topographic modifiers were instead used to enforce flow paths ("gully lines"). Gully lines have a width of 5m and the levels were identified from the 2019 LiDAR data.

In a few localised places, the elevation value attributed to the gully lines is incorrectly configured, resulting in small bumps or 'hills' within the waterways. The majority of the affected areas lie outside Council's local government area. For those within the local government area, the impact is highly localized and does not affect overall model results.

Following a review of aerial imagery, it was concluded that the Byron Creek Catchment has not undergone any significant development since 2015. Inclusion of digital elevation models of new development was therefore not required.

3.4.3 Bridge Structures and Stormwater Pipes and Culverts

Bridge structures, stormwater network and culverts were not included in the 2022 RFD BYR model. A review of Council stormwater infrastructure GIS data confirmed the lack of major infrastructure in the area. In the next model update, data from the neighbouring Council is to be sought to review and identify if major infrastructure exists within the model extent.

Figure 3.5 provides an overview of the updated TUFLOW model geometry and its features.

3.4.4 Floodplain Roughness

Floodplain roughness files were developed using machine learning techniques, as outlined in the Stage 2 Report. The 2019 datasets are largely raster based and significantly refined compared to the 2014 data (vector datasets only). Table 3.3 presents the adopted roughness values for each landuse category and Table 3.4 shows the adopted depth varying roughness values. Roughness values were determined through a calibration process undertaken by other catchments as part of the major RFD update.

The BYR model used a Class 2 High Density classification in lieu of Class 1 High Density. The roughness values for Class 2 are approximately 57% higher than those for Class 1, making this a conservative approach.

Figure 3.4 illustrates the spatial variation in roughness applied in the BYR hydraulic model.

Table 3.3 TUFLOW Materials Roughness Values

Material ID	Manning's n	Description
1	Open_Space_001.csv	Open Space (grasses)
2	Low_Dense_Vegetation_002.csv	Low Density Understory - Vegetation
3	Medium_Dense_Vegetation_002.csv	Medium density Understory - Vegetation
4	High_Dense_Class2_Vegetation_002.csv	High density understory - Vegetation
5	0.04	Open Space - Mangroves (Marsh)
6	0.08	Low Density Understory - Mangroves
7	0.10	Medium density Understory - Mangroves
8	0.17	High density understory - Mangroves
9	0.04	Open Space - Crops (Fallow)
10	0.04	Low Density Understory - Crops
11	0.04	Medium density Understory - Crops
12	0.04	High density understory - Crops
13	0.015	Roads
14	0.015	Concrete
15	0.03	Waterbody
16	0.5	Buildings
17	0.5	Horticulture Buildings
18	0.025	Facilities
19	0.075	Railways

Table 3.4 Depth Varying Manning's Values

Open_Space_001.csv		Low_Dense_Vegetation_002.csv	
y (m)	n	y (m)	n

0	0.25	0	0.03
0.2	0.06	1.5	0.03
0.4	0.045	3.5	0.055
0.8	0.035	99	0.055
2	0.025		
99	0.025		
Medium_Dense_Vegetation_002.csv		**High_Dense_Class2_Vegetation_002.csv**	
y (m)	n	y (m)	n
0	0.05	0	0.09
1.5	0.05	1.5	0.09
3.5	0.075	3.5	0.18
99	0.075	99	0.18

Document Set ID: 70782935
Version: 10, Version Date: 12/02/2025

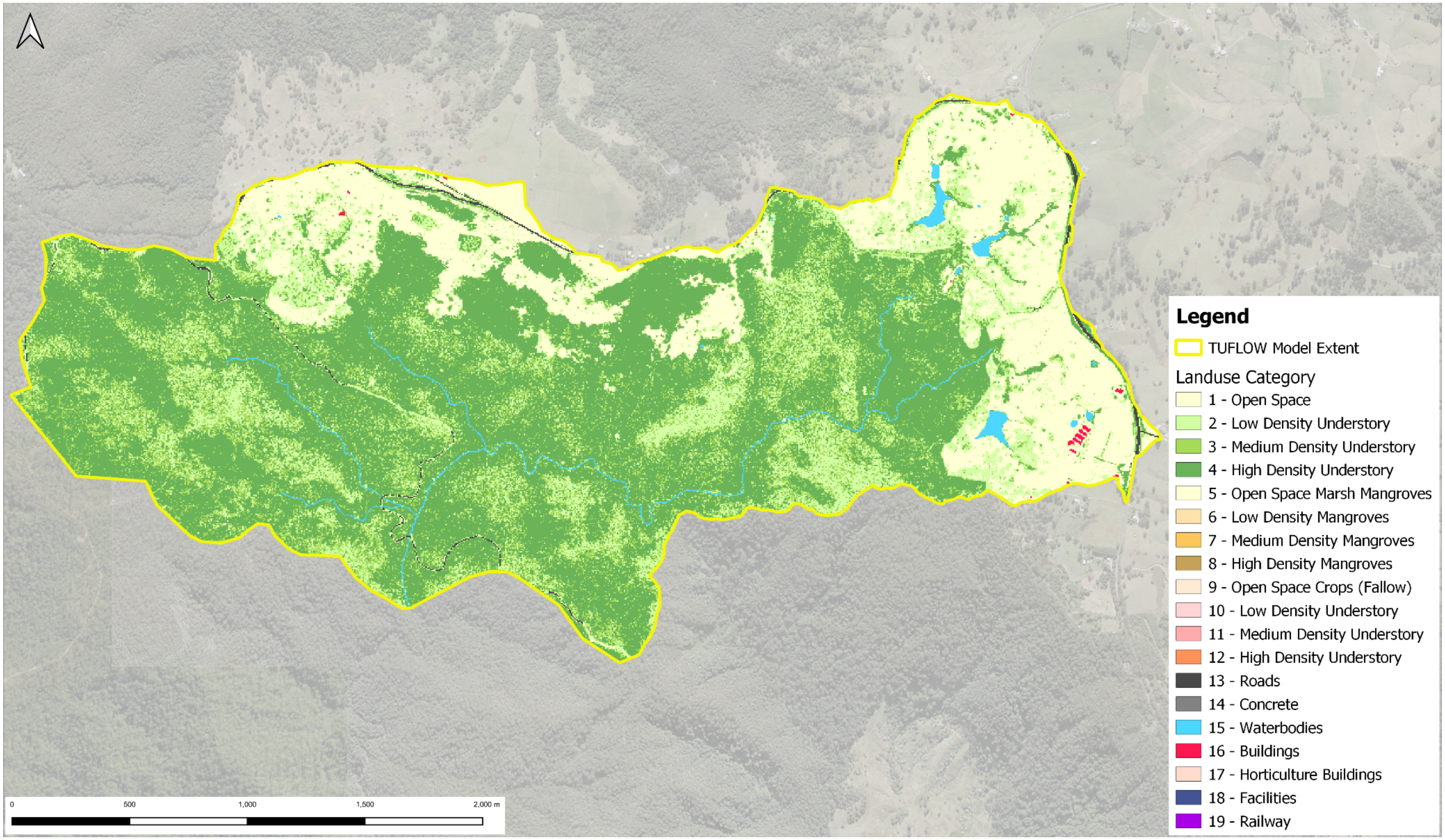


Figure 3.4 Hydraulic Model Roughness Layout

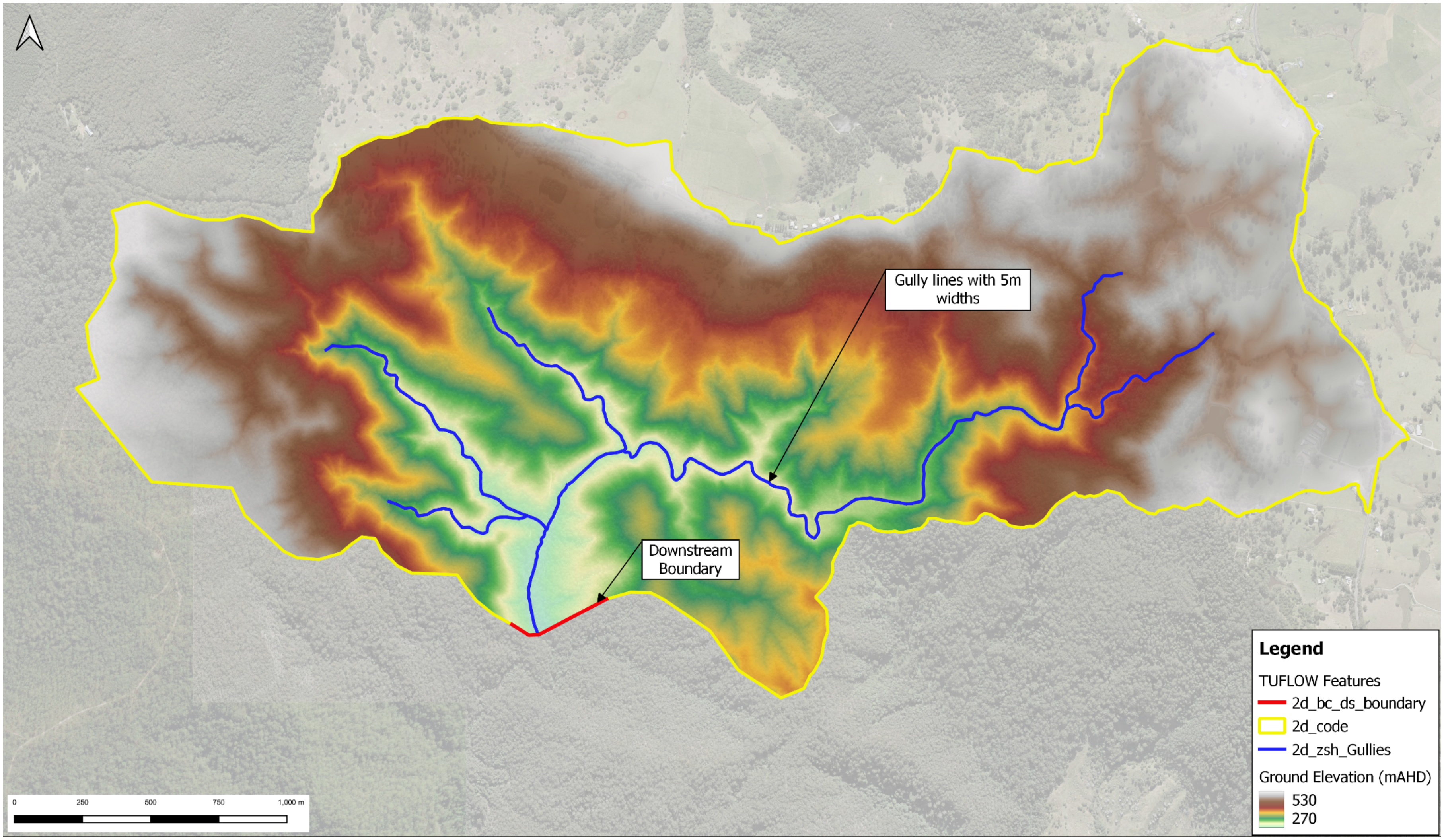


Figure 3.5 TUFLOW Model Features

3.4.5 Inflow Boundaries and Initial Water Levels

Model inflows polygons were based on the subcatchment breakdown from Stage 2. The inflows have been represented in the hydraulic model as a series of local catchment Source Area ("SA") polygon inflow boundaries. With this approach, flow is initially distributed to the lowest elevation cell and then applied in proportion to depth within the subcatchment polygon area. There are no total inflows applied in the TUFLOW model; channel routing is undertaken within the hydraulic model.

One inflow polygon touches the downstream boundary, which should be reviewed and updated in the next model update.

No initial water level polygons were included in the model. Although there are some farm dams in the MAR catchment, the model inflows locations are situated downstream of these dams.

4 Model Methodology and Simulations

4.1 Calibration Limitations

Calibration runs for the BYR catchment were not undertaken due to a lack of water level gauge and floodmark data within the area. Instead, the BYR model benefited from the region-wide RFD model update process. For example, the BYR model utilises roughness values developed in the calibration/validation process for neighbouring catchments.

4.2 Design Event Selection

Due to the relatively small size of the catchment, it was feasible to model the full ensemble of events for all scenarios (i.e. both existing unblocked E00 and future unblocked F00) (see Table 4.1).

Table 4.1 Existing Unblocked Scenario (E00) and Future Unblocked Scenario (F00) Modelled Events

AEP	Duration (mins)	TP	Bucket (ARF)
0.05%, 0.1%, 1%, 2%, 5%, 10%, 20%	20, 25, 30, 45, 60, 90, 120, 180, 270	1 to 10	A (ARF = 1)

4.3 TUFLOW Hydraulic Model

4.3.1 Model Setup

The model topography, roughness and other parameters used for design event modelling are consistent with the setup described previously in Section 3.4. The design event model is named "BYR_R_003a_~s1~_~e1~~e2~_~e3~_04.tcf", where:

- s1 – Existing or future scenarios

- E00 = Existing climate and land use with zero blockage applied to culverts and bridges.
- F00 = Future climate (20% increase in rainfall) and future land use based on planning layers with zero blockage applied to culverts and bridges.

- e1 – Annual Exceedance Probability of the event expressed in years.
- e2 – Duration of the event expressed in minutes.
- e3 – Temporal Pattern (TP01 to TP10)

4.3.2 Existing Climate Simulations

The 20%, 10%, 5%, 2%, 1%, 0.1% and 0.05% AEP design events have been simulated in the TUFLOW model for the existing unblocked (E00) scenario. A blockage scenario was not simulated.

E00 events were run in WBNM with embedded burst smoothing (using Storm Injector) and with the removal of events with greater than 40% smoothing, per guidance from the Stage 1 project.

4.3.3 Future Climate Simulations

The 20%, 10%, 5%, 2%, 1%, 0.1% and 0.05% AEP design events were simulated for the future climate conditions unblocked scenario (F00), which included increased rainfall intensity (20%) and ultimate landuse EIA values. Embedded burst smoothing and filtering was utilised per guidance from the Stage 1 project.

4.3.4 Design Event Structure Blockage

The TUFLOW model does not include any stormwater network, culvert or bridge features. Blocked scenarios were therefore not simulated in the TUFLOW hydraulic model.

4.3.5 Adopted Design Tailwater Conditions

Tailwater conditions were defined using an HQ boundary with a water surface slope of 0.02m/m. Draw-down occurred at the tailwater boundary (outside Council's Local Government Area), but this did not affect model results within the area of interest. The water surface slope is to be amended in future RFD updates.

5 Model Results and Outcomes

5.1 Design Flood Behaviour and Processing

Appendix A includes the “processed” maximum water depth grids for the existing unblocked (E00) and future unblocked (F00) scenarios for the 1% AEP event. All results were processed (using TUFLOW Asc_to_Asc utility) as follows:

- The median water level was developed for each duration based on the modelled temporal patterns (up to 10 temporal patterns per duration)
- For each AEP, the maximum water level was developed based on the median surfaces (9 durations for each AEP)

Table 5.1 lists the predominant critical durations for all AEPs. Figure 5.1 shows the spatial distribution of critical durations for the 1% AEP event.

The processed results were checked for AEP neutrality by comparing the peak water level surface for each AEP event and confirming that rarer events had greater levels than the more frequent events.

Table 5.1 Predominant critical durations for all AEPs

Event (AEP)	Critical Duration/s (minutes)
20%	180
10%	180
5%	180
2%	120
1%	120, 180
0.1%	120, 90
0.05%	120, 90

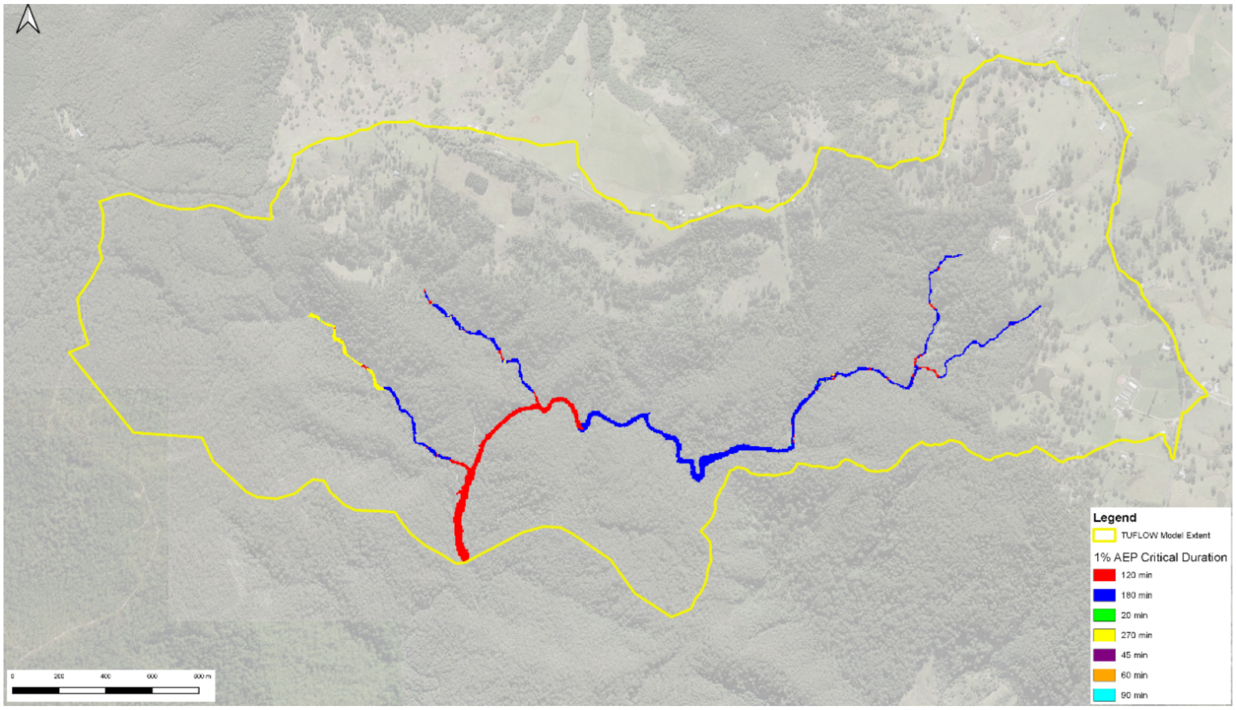


Figure 5.1 1% AEP Critical Durations

5.2 Comparison to RFD 2014

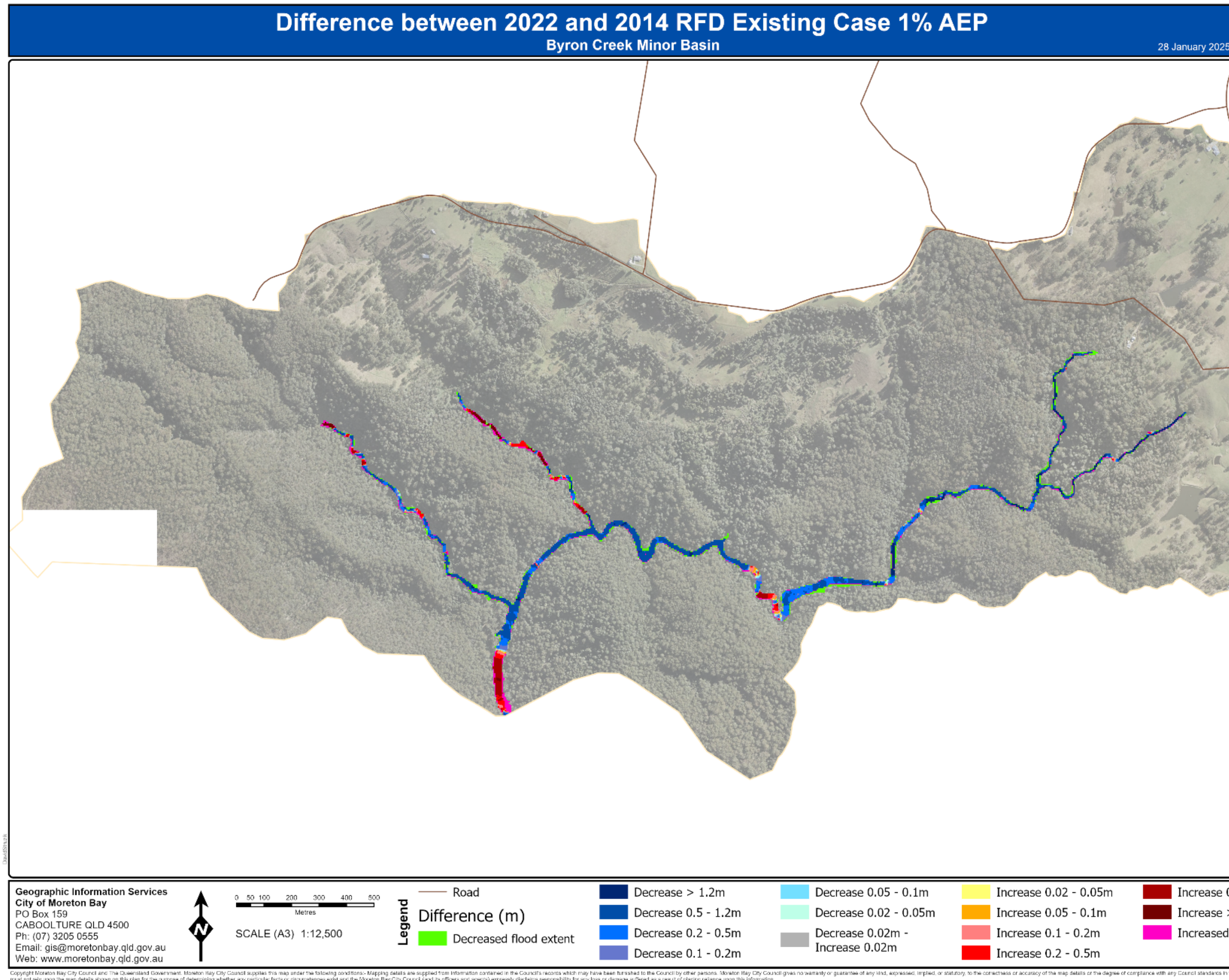


Figure 5.3 presents the difference in 1% AEP peak flood level developed by this major update project (E00 of this study, referred to as the 2022 RFD) as compared to that of the previous model version, the 2014 RFD. In general, the peak water levels have decreased across the catchment, typically by approximately 700mm.

The decrease in water levels is partially attributable to decreased riparian roughness values (Manning's n values), with more of the waterways in the updated model set to 'Waterbody' or 'Low Dense Vegetation', in place of 'Dense Vegetation'. This is based on the vegetation density rasters generated by the Stage 2 project, which considered understory vegetation as opposed to being limited to an aerial view of vegetation canopy to estimate roughness values.

A comparison of TUFLOW model inflows in the 2014 and 2022 RFD MAR models was completed, focused on the 1% AEP 60minute event, which was chosen as this event is critical at one location near the downstream part of the catchment. The average (over all subcatchments) peak inflow for these events was approximately 31% lower for the 2022 RFD model, which is likely the main contributor to the decrease in water levels throughout the model.

There is a reduction in rainfall for the 2022 RFD model (LIMB IFD) as compared to the 2014 RFD model (1987 IFD). A comparison between the IFDs was completed for 8 locations within the BYR catchment. The results showed a consistent trend across all locations; for durations less than 3 hours, the LIMB IFDs are lower than 1987 IFDs.

There are a few localised areas of water level increases, especially on the north-western tributaries of Byron Creek. These are caused by 'hills' within the 2019 LiDAR (see Figure 5.2). For the most part, the impacted areas are outside of the CMB local government area. A 'limited reliability' statement should be placed on model results in these areas. A future model update should rectify the model issues at these locations.

A comparison of the future scenario 2022 RFD 1% AEP and the 2014 RFD Design Flood Event (DFE) was also completed (see Figure 5.4). The DFE is the maximum of a suite of scenarios primarily based on the Moreton Bay Design Storm; a 15 minute in 270minute embedded design storm. A similar water level differences was noted to that discussed above.

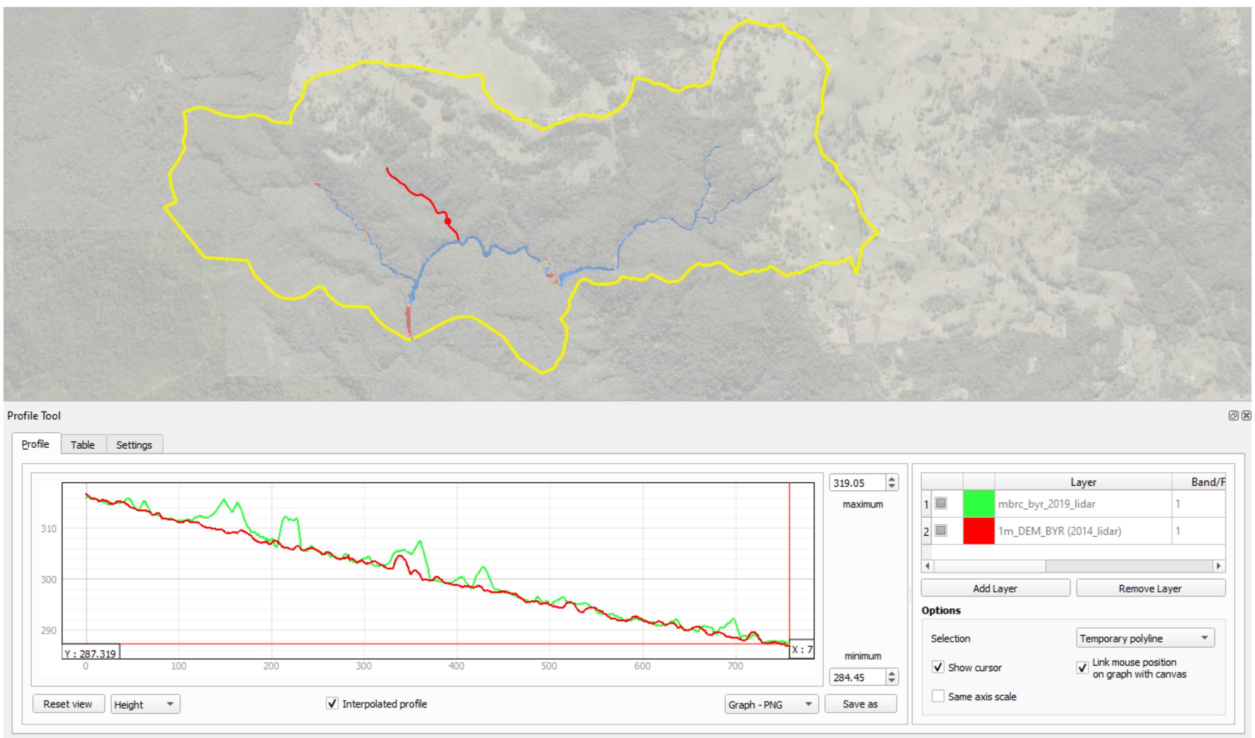


Figure 5.2 2019 vs 2014 LiDAR profile. 2019 LiDAR includes some 'hills' within Byron Creek

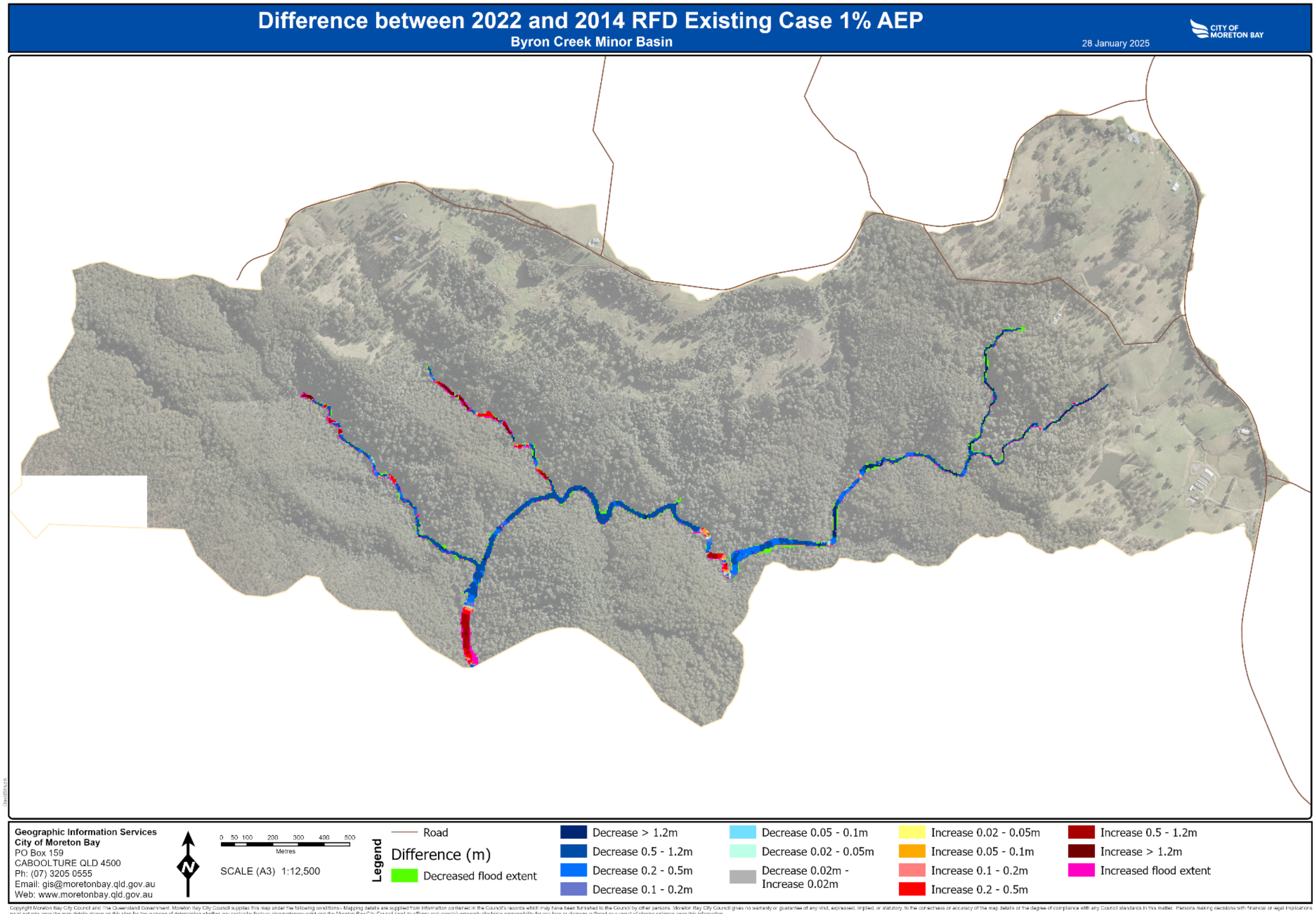


Figure 5.3 Difference between 2022 and 2014 RFD existing scenario 1% AEP (2022 minus 2014)

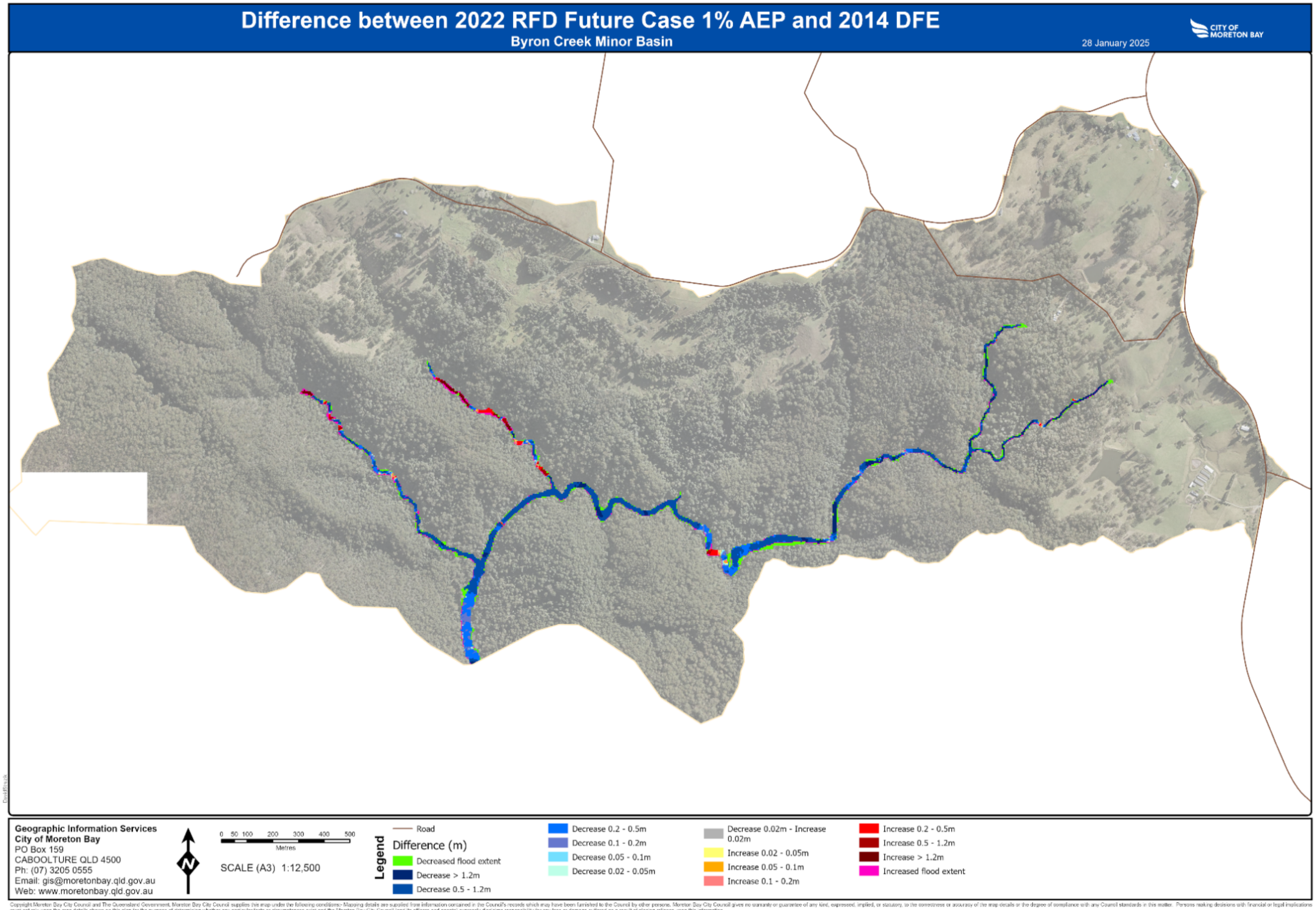


Figure 5.4 Difference between 2022 Future Scenario 1% AEP and 2014 RFD DFE (2022 minus DFE)

5.3 Technical Considerations and Model Health

The BYR design model (BYR_R_003a_~s1~_~e1~~e2~_~e3~_03.tcf) requires 0.29GB RAM to initialise (with xf files). A PC running one simulation is recommended to have a minimum of 0.6GB RAM.

A single simulation can be performed on a NVIDIA GeForce RTX 3090 at a simulation time to real time ratio of approximately 180:1 (i.e, 180 hours of model time takes 1 hour to simulate), which appeared to be similar across AEPs.

Simulation timesteps (dt) were plotted for all runs and the minimum dt values for each AEP are shown in Table 5.2 and Table 5.3 below. Generally speaking, the minimum dt values are within the range of a sound model of this size.

Table 5.2 Minimum simulation timesteps for each AEP (existing scenarios)

AEP	Minimum dt (s)
20%	0.4
10%	0.4
5%	0.3
2%	0.3
1%	0.25
0.1%	0.25
0.05%	0.25

Table 5.3 Minimum simulation timesteps for each AEP (future scenarios)

AEP	Minimum dt (s)
20%	0.4
10%	0.25
5%	0.25
2%	0.25
1%	0.25
0.1%	0.25
0.05%	0.25

Control numbers for the simulations with the longest clock times (E00 0.05% AEP 270 minutes TP8 and F00 10% AEP 180 minutes TP2) are shown in Figure 5.5 to Figure 5.8. The existing scenario event shown in Figure 5.6 has a diffusion number (Nd) of 0.3 at the time of the minimum dt. This suggests that there may be instabilities caused by a poor boundary setup. The future scenario event show in Figure 5.8 has a high diffusion number (Nd) and a high Courant number (Nu). This suggests that there may be instabilities caused by a poor boundary setup and/or high velocities. There is potential to improve model efficiency in the future by rectifying unstable model features.

Document Set ID: 70782935
Version: 10, Version Date: 12/02/2025

The location of minimum dt values was reviewed. The minimum dt value in the 0.05% AEP 270minute TP8 storm is associated with an area of steep terrain and a high velocity-depth product. There is potential for the model to be improved in this location with the smoothing of terrain.

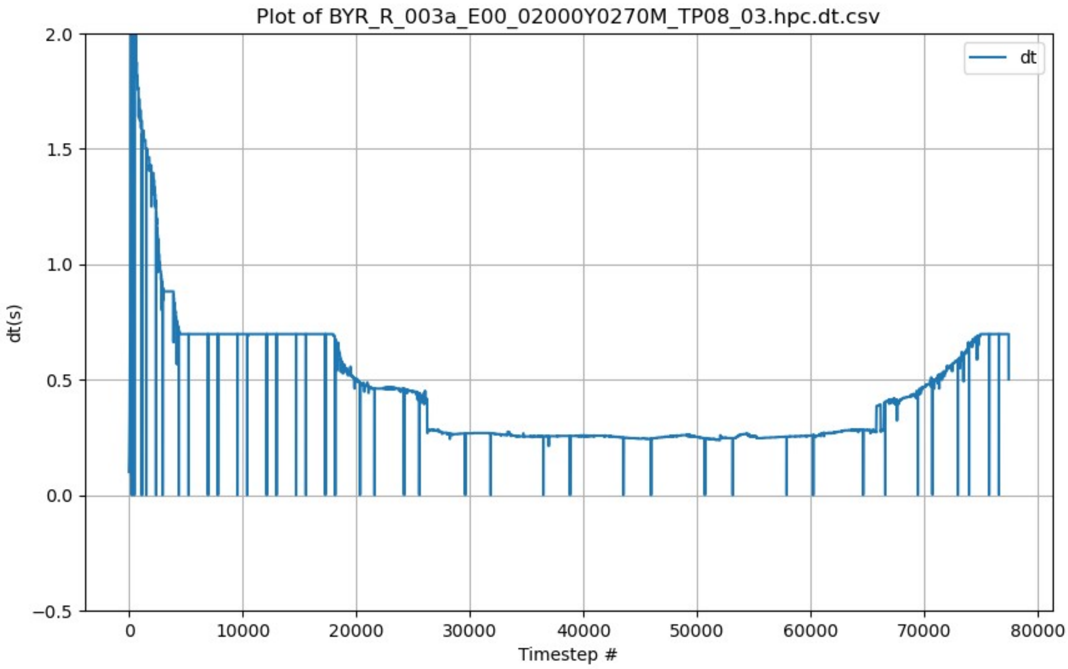


Figure 5.5 Plot of longest clock time simulation timesteps for the existing scenario

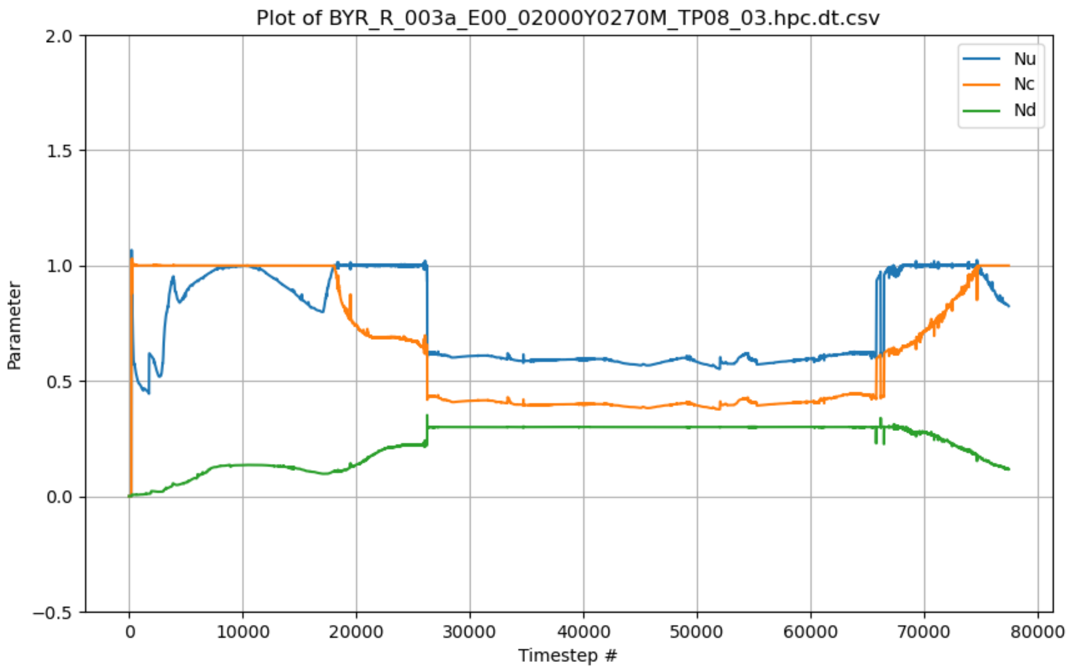


Figure 5.6 Plot of longest clock time simulation control numbers for the existing scenario

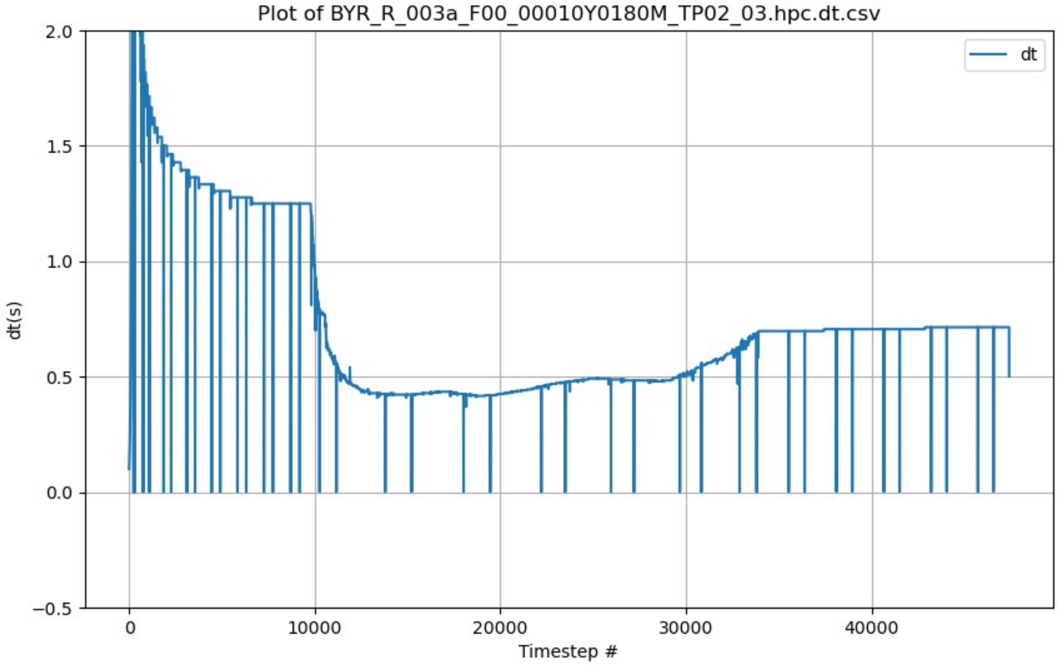


Figure 5.7 Plot of longest clock time simulation timesteps for the future scenario

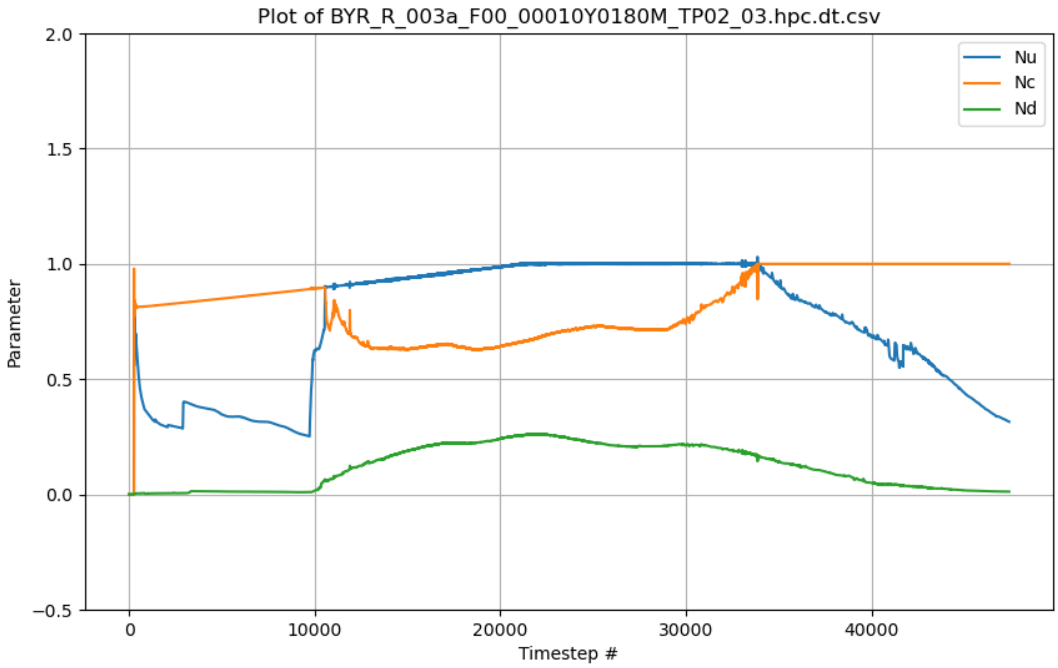


Figure 5.8 Plot of longest clock time simulation control numbers for the future scenario

5.4 Model Limitations

Watercourses within the Byron Creek catchment were represented using a fixed 2D grid size of 5m, with streamlines at the locations of main flow paths. This may not allow adequate representation of waterways narrower than 5m in width.

The model terrain is based on available 2019 LiDAR. No new developments were identified or included to update the data. It may be possible that there are small areas of the model that do not represent current terrain conditions.

The adopted model roughness was based on previous work undertaken by external consultants and approved by Council Staff. Spatially, the materials layers are highly refined and represent a substantial improvement from the previous 2014 RFD modelling.

As documented in Section 3.3.4 ARF factors were not considered in this model. ARF application causes a reduction in rainfall and therefore this method is considered conservative.

There is an area in the model for which the model results are likely erroneous owing to 'hills' within the 2019 LiDAR (see Section 3.4.2).

6 Conclusion

As part of the Stage 4 and 5 update of the RFD for Byron Creek (BYR), an updated WBNM hydrologic model (created as part of the Stage 2 study) and a TUFLOW hydraulic model have been developed according to the latest industry guidance (ARR 2019). The models were specifically set up in accordance with the requirements outlined by City of Moreton Bay for the 2022 Regional Flood Database (RFD) project. An aim of the project was to promote a consistent approach to model upgrade across the entire Local Government Area and facilitate the integration of the model and its outputs into Council's database.

The primary objective of the project was to deliver the WBNM and TUFLOW model and its associated outputs in a digital format. Therefore, this report presents only a selected subset of the results obtained from the model. This information can be integrated into Council's flood database and utilised for further analysis and management of flood risk in the Byron River Catchment.

The information obtained from the model will support informed decision-making processes related to floodplain management, land-use planning, and infrastructure development in the area.

Future model updates may consider the below items, to potentially improve model results and performance:

- Incorporation of minor updates identified as part of the internal and independent technical reviews
- Inclusion of new stormwater network and development information (standard maintenance activity)
- Inclusion of latest LiDAR/topography information (at the time of writing, 2023 LiDAR flown by the Queensland State Government is available for the catchment)
- Review of bridge modelling methodology to incorporate latest industry guidance (e.g. TUFLOW Method D, 2d_bg shp, etc.)

- Incorporation of latest ARR guidelines, particularly regarding climate change modelling
- Review of Fraction Impervious layers
- Review of appropriate pre-burst value for use with LIMB 2020 IFDs
- Inclusion of pre-burst scaling for both extreme events and future climate scenarios

7 References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, “Australian Rainfall and Runoff: A Guide to Flood Estimation”, Commonwealth of Australia

Arup, 2021, “Moreton Bay Regional Council Regional Flood Database ARR 2019 Pilot Study Part 1 Methodology Report & Part 2 Pilot Study Report”

AECOM, 2020, “Regional Flood Database - Stage 2 - Hydrography Landuse and Hydrology”

Moreton Bay Regional Council, 2021, “Regional Flood Database – Stage 3 Analysis Summary”

Bureau of Meteorology, 2016, “Design Rainfall Data System” available at: http://www.bom.gov.au/water/designRainfalls/revised-ifd/

WMA Water, “LIMB 2020 IFD - High Resolution”, available at: https://data.arr-software.org/

BMT, 2022, “Memorandum - Final HEH Modelling Methodology”

WorleyParsons, 2012, “Regional Flood Database - Hydrologic and Hydraulic Modelling Report - Byron Creek (BYR)”

Hydrology and Water Management Consulting, 2015, “Regional Flood Database - 2014 Model Maintenance Report for Byron Creek (BYR)”

Document Set ID: 70782935
Version: 10, Version Date: 12/02/2025

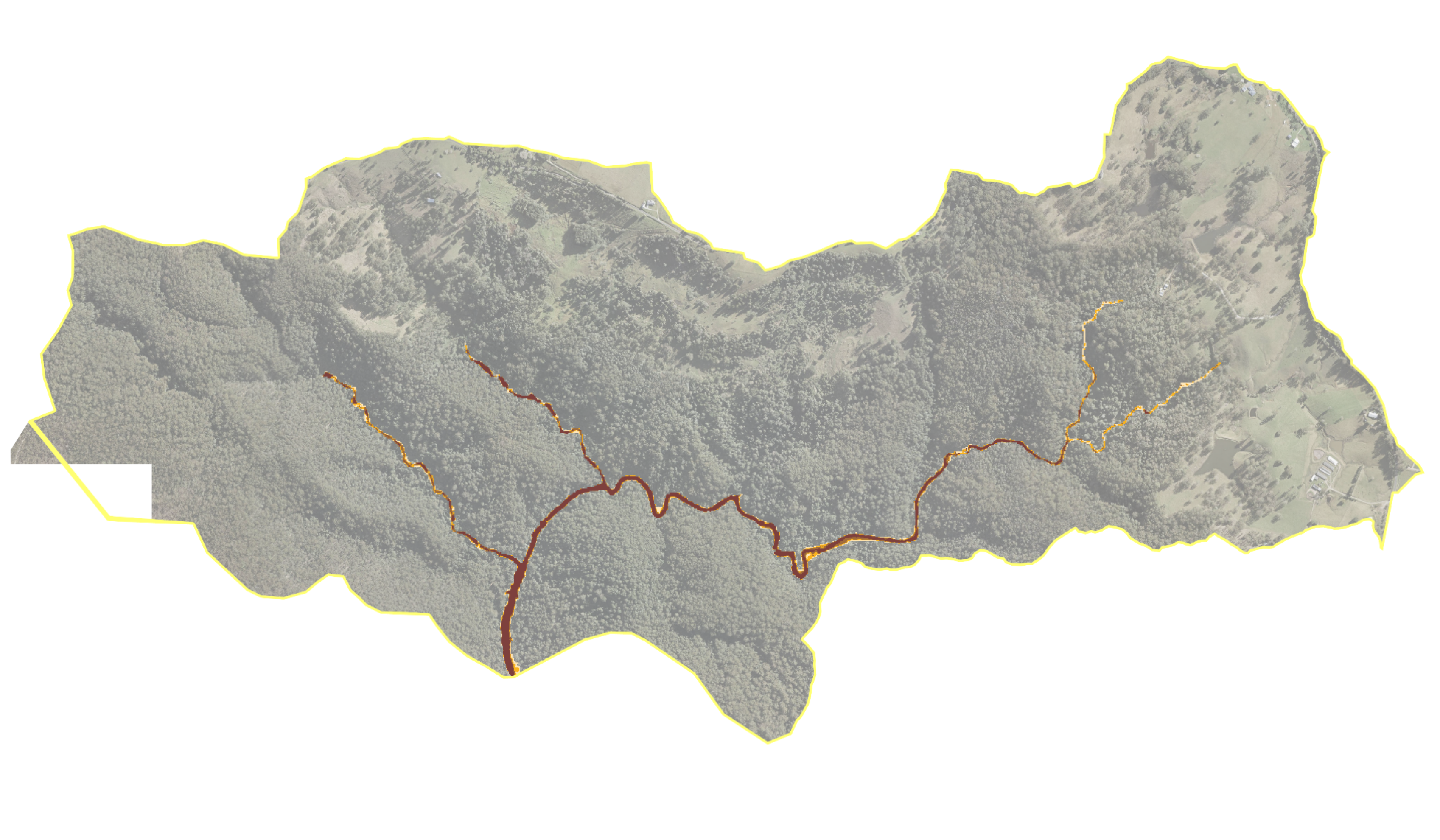
Appendix A Processed Results

2022 RFD Existing Unblocked, 1% AEP Depths

Byron Creek Minor Basin

28 January 2025

CITY OF MORETON BAY



Geographic Information Services
City of Moreton Bay
PO Box 159
CABOOLTURE QLD 4500
Ph: (07) 3205 0555
Email: gis@moretonbay.qld.gov.au
Web: www.moretonbay.qld.gov.au

N

0 50 100 200 300 400 500
Metres

SCALE (A3) 1:12,500

Legend

Existing Unblocked (E00) 1% AEP Depths (m)

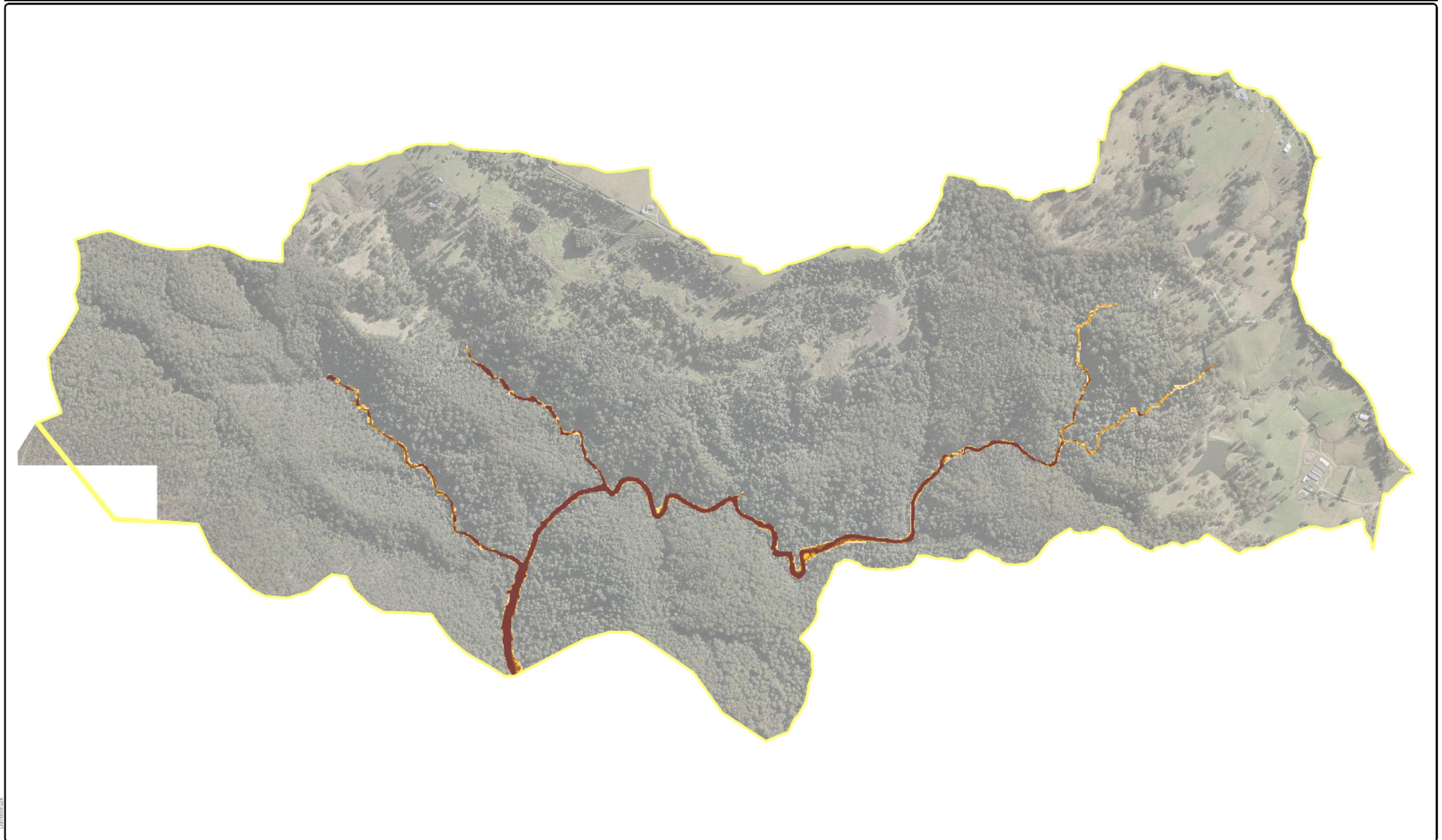
- 0 - 0.25m
- 0.25 - 0.5m
- 0.5 - 1m
- >1m
- TUFLOW Model Extent

2022 RFD Future Unblocked, 1% AEP Depths

Byron Creek Minor Basin

28 January 2025

CITY OF MORETON BAY



Geographic Information Services
City of Moreton Bay
PO Box 159
CABOOLTURE QLD 4500
Ph: (07) 3205 0555
Email: gis@moretonbay.qld.gov.au
Web: www.moretonbay.qld.gov.au

N

0 50 100 200 300 400 500
Metres

SCALE (A3) 1:12,500

Legend

Future Unblocked (F00) 1% AEP Depths (m)

- 0 - 0.25m
- 0.25 - 0.5m
- 0.5 - 1m
- >1m
- TUFLOW Model Extent

Document Set ID: 70782935
Version: 10, Version Date: 12/02/2025