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Flood Model Update

Tooan Tooan and Lowlands Lagoon catchment

Fraser Coast Regional Council

2 August 2023



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Fraser Coast REGIONAL COUNCIL

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The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.



EXECUTIVE SUMMARY

Water Technology was commissioned to deliver the Tooan Tooan Coastal and Flood Risk Management Study and Plan. The first phase of the flood risk management plan was to review the adopted flood study (Advisian, 2018) for the catchment to ensure that it was fit-for-purpose as providing a comprehensive understanding of flood behaviour across the full range of possible flood events.

An URBS hydrologic model has been developed for the Tooan Tooan and Lowlands Lagoon catchment. There are no stream flow or water level gauges available in the Tooan Tooan and Lowlands Lagoon catchment area to facilitate model calibration. Subsequently, model validation focused on ensuring sensible parameters are adopted, comparison between hydraulic outputs and hydrologic outputs and validation against the Rational Method in lieu of a more robust methodology.

The existing TUFLOW hydraulic model developed by Advisian was used as the basis for this assessment. Modifications have been made based on the findings of the model review. The following updates to the model have been undertaken:

- Converted the model to a hydrologic and hydraulic model.
- Significant updates to the stormwater network were identified, including:
- Adverse gradients,
- Pipes not snapped or drawn the wrong way,
- Incorrect invert levels,
- Missing structures,
- Incorrect structure sizing, and
- Instabilities.

Adopted roughness values are considered outside the typical lower range limits, when compared to industry standards. The adopted roughness values in some areas were not reflective of the existing land use.

The URBS hydrologic and TUFLOW hydraulic model have been used to assess the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP 0.5% AEP, 0.2% AEP and PMF for the 30-minute, 60-minute, 2-hour and 12-hour durations and all ten temporal patterns.

The Tooan Tooan and Lowlands Lagoon catchment is vulnerable to both catchment event flooding and storm surge inundation. In addition to the above design catchment flood events, the 1% AEP storm surge and 5% AEP catchment event were modelled.

Climate change scenarios were modelled in alignment with Fraser Coast Regional Council's current approach to climate change. This includes consideration of a 2100 storm surge scenario and 2100 RCP8.5 high emissions scenario. Climate change scenarios modelled include:

- 1% AEP 2100 RCP8.5 Catchment Design Flood Event, and
- 2100 1% AEP Storm Surge and 5% AEP 2100 RCP8.5 Catchment Design Flood Event.

The update flood model is considered to provide a comprehensive understanding of flooding behaviour and is fit-for-purpose for undertaking the Flood Risk Management Study and Plan phase of the Queensland Flood Risk Management Framework.

CONTENTS

1	INTRODUCTION	6
2	HYDROLOGIC MODEL	7
2.1	Catchment Delineation	7
2.2	URBS Model Parameters	8
2.2.1	Catchment Parameters	8
2.2.2	Catchment Storage	10
2.2.3	Design Rainfall	10
2.3	Hydraulic Model	11
2.3.1	Pit and Pipe Network	11
2.3.2	Model Roughness	13
2.3.3	Model Topography	13
2.3.4	Boundary Conditions	14
2.4	Model Verification	15
2.4.1	Catchment Storage	15
2.4.2	Flow Validation	17
3	DESIGN EVENTS	19
3.1	Critical Duration	19
3.2	Design Event Modelling	19
3.2.1	Climate Change	19

APPENDICES

Appendix A Flood Mapping

LIST OF FIGURES

Figure 4-3	Tooan Tooan and Lowlands Lagoon Sub-catchment Delineation	7
Figure 4-4	Fraction Impervious for Lowlands Lagoon	9
Figure 4-5	Fraction Impervious for Tooan Tooan Creek	9
Figure 4-6	Tooan Tooan Stormwater Network	12
Figure 4-7	Lowlands Lagoon Stormwater Network	12
Figure 4-8	Modelled Roughness	13
Figure 4-9	Modelled Topography (m AHD)	14
Figure 4-10	Hydraulic Model Inflow Boundaries	15
Figure 4-11	URBS versus TUFLOW discharge comparison for the 1% AEP 60-minute storm duration	16
Figure 4-12	Locations for Flow Comparison	17
Figure 4-13	Regional Flood Frequency Estimation Model (RFFE) for total catchment area.	18

LIST OF TABLES

Table 4-1	URBS Model Parameters	8
Table 4-2	Comparison of Peak 1% AEP Flows	18

1 INTRODUCTION

Water Technology was commissioned to deliver the Tooan Tooan Coastal and Flood Risk Management Study and Plan. The first phase of the flood risk management plan was to review the adopted flood study (Advisian, 2018) for the catchment to ensure that it was fit-for-purpose as providing a comprehensive understanding of flood behaviour across the full range of possible flood events.

A high-level review of the adopted hydraulic model noted that the model had been developed as a stormwater catchment model and a number of uncerainties in the model development were idenitified that were considered not to provide a fit-for-purpose basis for undertaking a flood risk management study. Key recommnendations from the review included:

- The adopted direct rainfall modelling was considered acceptable for modelling stormwater (overland) flow behaviour, however, did not provide a good representation of catchment flood behaviour. It was therefore recommended that fit-for-purpose hydrologic and hydraulic model was developed ensure model outputs were representative of waterway flooding rather than overland flow.
- Revise adopted losses to incorporate conservative losses for design events consistent with ARR19 in lieu of calibration data.
- Significant updates to the stormwater network were identified, including:
  - Adverse gradients,
  - Pipes not snapped or drawn the wrong way,
  - Incorrect invert levels,
  - Missing structures,
  - Incorrect structure sizing, and
  - Instabilities.
- Adopted roughness values are considered outside the typical lower range limits, when compared to industry standards. The adopted roughness values in some areas were not reflective of the existing land use.
- Re-assessment of base case required as post-processing details around critical duration and selected temporal patterns were not provided.
- Update of flood estimates for the full range of possible events, in line with Australian Rainfall and Runoff guidance.

The updated flood study was finalised in early 2023 and is considered fit-for-purpose, providing a robust and comprehensive understanding of flood behaviour across the full range of flood events from the 50%AEP flood event to the Probable Maximum Flood event. Outputs from the 2023 update provide included:

- Flood levels
- Flood depth
- Flood velocity
- Time to Inundation
- Duration of Inundation
- Flood Hazard (AIDR, depth-velocity product).

2 HYDROLOGIC MODEL

An URBS hydrologic model has been developed for the Tooan Tooan and Lowlands Lagoon catchment. There are no stream flow or water level gauges available in the Tooan Tooan and Lowlands Lagoon catchment area to facilitate model calibration. Subsequently, model validation focused on ensuring sensible parameters are adopted, comparison between hydraulic outputs and hydrologic outputs and validation against the Rational Method in lieu of a more robust methodology. Ultimately, the approach seeks to achieve hydrologic and hydraulic similarity that will ensure consistency and robustness of the models.

2.1 Catchment Delineation

Sub-catchment delineation was initially based on CatchmentSIM and then refined manually using GIS software. The study area has a significant pit and pipe network, sub-catchment delineation was refined to ensure appropriate representation of flood behaviour based on the pipe network.

Figure 2-1 presents the sub-catchment delineation for Tooan Tooan and Lowands Lagoon. The total catchment area is 9.94 km^2 and is divided across Tooan Tooan and Lowlands Lagoon as 5.28 km^2 and 4.66 km^2 respectively. The study area has been extended to the east to include more of Urangan Pier compared to the original Flood Study model.

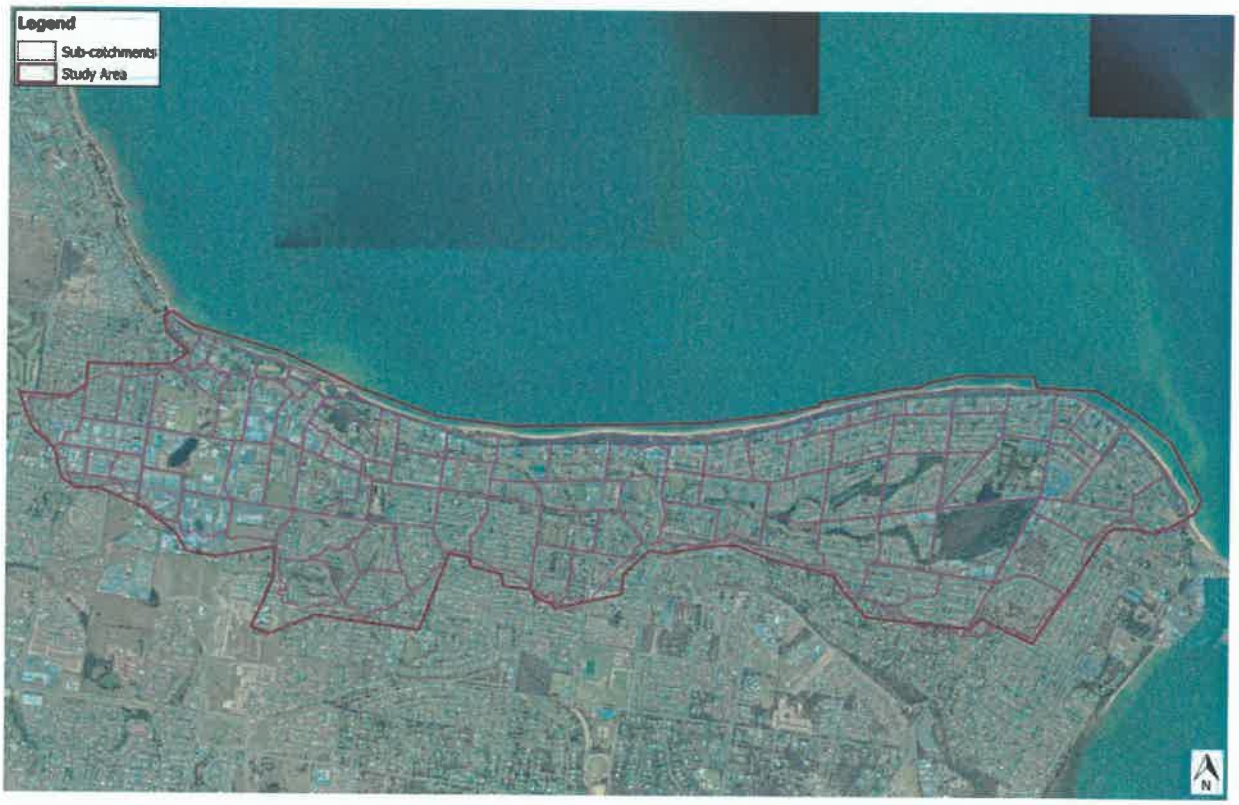


Figure 2-1 Tooan Tooan and Lowlands Lagoon Sub-catchment Delineation

2.2 URBS Model Parameters

URBS uses parameters to represent the routing between each sub-catchment. The primary parameters modified are:

- Alpha – catchment lag parameter and is approximately the inverse of wave celerity.
- Beta – catchment storage parameter.
- m – exponential catchment storage parameter.

The alpha, beta and m parameters for the URBS model developed as part of this flood study are presented in Table 2-1. These were modified as needed to better reflect the Tooan Tooan and Lowlands Lagoon catchment and improve results of the verification which is outlined separately in Section 2.4.

Table 2-1 URBS Model Parameters

Parameter	Alpha	Beta	m
Value	0.15	2.5	0.8

2.2.1 Catchment Parameters

Hydrologic parameters adopted for the URBS hydrologic model are summarised as follows:

- Initial Loss (IL) = 26 mm.
- Continuing Loss (CL) = 2 mm/h.
- Percent impervious area adopted for sub-catchments,
- Urbanisation based on land use mapping spatial analysis.

The IL and CL values adopted are consistent with the recommended values from ARR Data Hub for the Tooan Tooan and Lowlands Lagoon area. The CL was from reduced from 3.8 mm/h for Tooan Tooan and 5.7 mm/h for Lowlands Lagoon recommended from ARR Data Hub to 2 mm/h to be more conservative. Catchment impervious values are based on the existing land use and zoning, noting that the dominant land use is primarily residential and commercial zoning. Figure 2-2 and Figure 2-3 show the applied fraction impervious across the study area.



Figure 2-2 Fraction Impervious for Lowlands Lagoon



Figure 2-3 Fraction Impervious for Tooan Tooan Creek

2.2.2 Catchment Storage

The Tooan Tooan Creek and Lowlands Lagoon study area has significant storage throughout the catchment, and therefore there is difficulty representing the catchment utilising a simple runoff routing model. An artificial storage curve (SQ) has been applied in the URBS model immediately downstream of sub-catchments identified with significant storage. URBS uses parameters a and b based on the equation S = axQ^b where S (storage) is in ML and Q (discharge) is in cumecs. The parameters were altered based on the TUFLOW hydraulic results to ensure storage was reflected in the hydrologic model.

2.2.3 Design Rainfall

Design Rainfall temporal patterns and intensities for the site's local catchment were determined using the standard procedures outlined in Australian Rainfall and Runoff guidelines 2019 update (ARR 2019). The rainfall data, based on Rainfall, Intensity, Frequency (IFD) information, was sourced from the Commonwealth Bureau of Meteorology (the Bureau) 2016 IFD update. Two sets of IFD information have been adopted for the Tooan Tooan catchment and Lowlands Lagoon catchment.

2.3 Hydraulic Model

The existing TUFLOW hydraulic model developed by Advisian was used as the basis for this assessment. Modifications have been made based on the findings of the model review.

The following updates to the model have been undertaken:

- Converted the model to a hydrologic and hydraulic model.
- Significant updates to the stormwater network were identified, including:
  - Adverse gradients,
  - Pipes not snapped or drawn the wrong way,
  - Incorrect invert levels,
  - Missing structures,
  - Incorrect structure sizing, and
  - Instabilities.
- Adopted roughness values are considered outside the typical lower range limits, when compared to industry standards. The adopted roughness values in some areas were not reflective of the existing land use.
- Design events have been re-assessed due to the modifications made.

2.3.1 Pit and Pipe Network

The stormwater pipe network in the provided TUFLOW model was updated based on the findings from the model review. Fraser Coast Regional Council also provided GIS layers of Council's stormwater network. Both the existing model network and the provided Council network have been reviewed to inform updates to the network. Numerous erroneous pipe details and missing pipes have been updated to better reflect current catchment conditions. In cases where it was not clear if either network was correct (i.e., adverse gradients, or a significant decrease in flow area), assumptions have been made based on upstream and downstream pipe details. Figure 2-4 and Figure 2-5 present the updated stormwater pits and pipes included in the updated hydraulic model.



Figure 2-4 Tooan Tooan Stormwater Network



Figure 2-5 Lowlands Lagoon Stormwater Network

2.3.2 Model Roughness

Model roughness has been updated to reflect the existing land use (i.e., not based on future planning scheme zones). This was done by way of visual inspection across the study area. Figure 2-6 below shows the spatially varying roughness included in the model.



Figure 2-6 Modelled Roughness

2.3.3 Model Topography

The model topography used in the Advisian model has been retained. This includes 2015 LiDAR for Tooan Tooan and additional LiDAR for the foreshore area. Figure 2-7 below shows the adopted model topography.

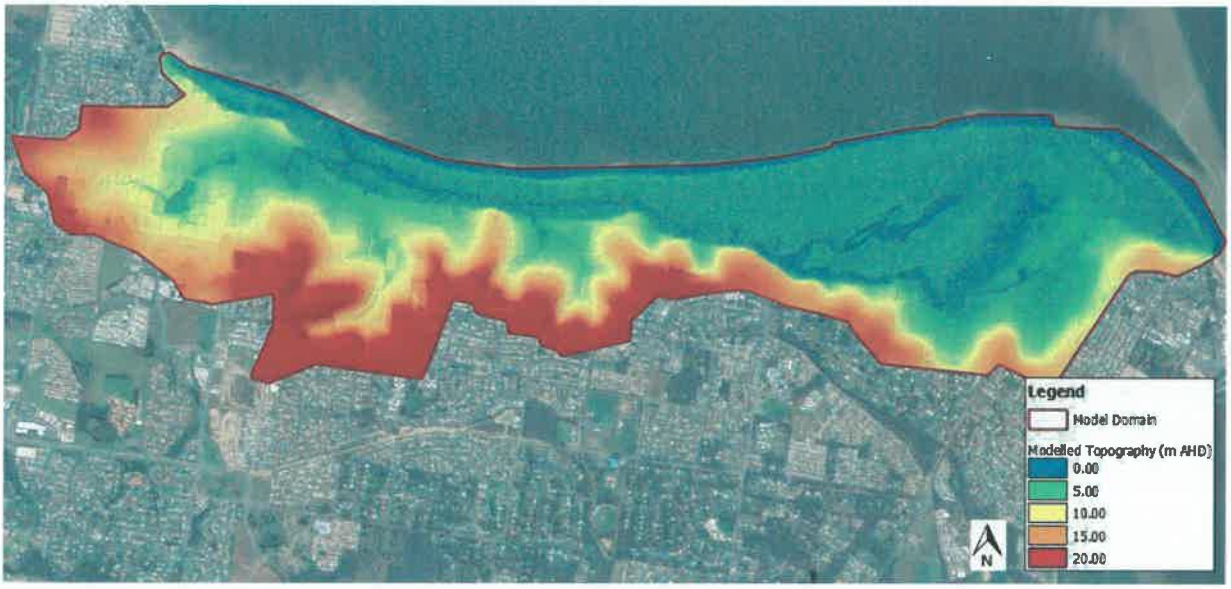


Figure 2-7 Modelled Topography (m AHD)

2.3.4 Boundary Conditions

The Advisian model adopted a constant water level was applied to the downstream boundary to represent tidal conditions. This applied normal depth flood slope boundary has been applied to the remainder of the study area boundary. No changes have been made to the downstream boundary conditions.

Model inflows polygons were initially based on the subcatchment breakdown developed as part of the URBS hydrologic model. The inflows have been represented in the hydraulic model as a series of local catchment Source Area (SA) polygon inflow boundaries, which are shown in Figure 2-8. The SA polygons are distributed to 1D pit nodes where the trunk drainage is the main flow path through the catchment. For catchments where a clear creek or channel is the main conveyance a standard SA polygon is applied in which flow is initially distributed to the lowest elevation cell and then distributed proportioned by depth thereafter. There are no total inflows applied in the hydraulic model. Therefore, the routing is undertaken within the hydraulic model. The routing will be replicated in the URBS hydrological model through a joint calibration process detailed in Section 2.4.

Initially the subcatchment boundary polygon was applied as the SA boundary although it is acknowledged that there are limitations with this approach in complex urban environments where there can be multiple flowpaths and the trunk drainage can have a different flow direction to the terrain. To address these complexities several subcatchment inflow locations were either split or enforced to cells at the outlet. For the splitting of subcatchments, the flow was proportioned by estimated catchment area weighting. This process can involve splitting flow between trunk and creek 2D cells within a single catchment respectively.



Figure 2-8 Hydraulic Model Inflow Boundaries

2.4 Model Verification

2.4.1 Catchment Storage

As outlined in Section 2.2.2, the Tooan Tooan Creek and Lowlands Lagoon catchment has significant storage and therefore can be difficult representing the catchment using a simplistic runoff routing model. Artificial storage curves were applied in URBS to represent this catchment storage at various locations in the catchment. The parameters were iterated and refined to best replicate the TUFLOW hydraulic results. Figure 2-9 below shows the comparison of flows observed in URBS compared to flows observed in TUFLOW for the 1% AEP 60-minute temporal pattern 5. This shows there is generally good agreement between the URBS hydrologic model and hydraulic model when comparing the same duration and temporal pattern. It should be noted that only a single design storm was tested and that the hydrological storage curves may not be applicable for a different storms with different rainfall intensities or temporal patterns. Given the difficulties in replicating the storage in the catchment, the TUFLOW model provides a better representation of the complex catchment routing / storage and has been relied upon for the design event modelling approach. The URBS model has only been relied upon for local hydrograph inflows and any extraction of flows within the catchment should be interrogated in the TUFLOW model.

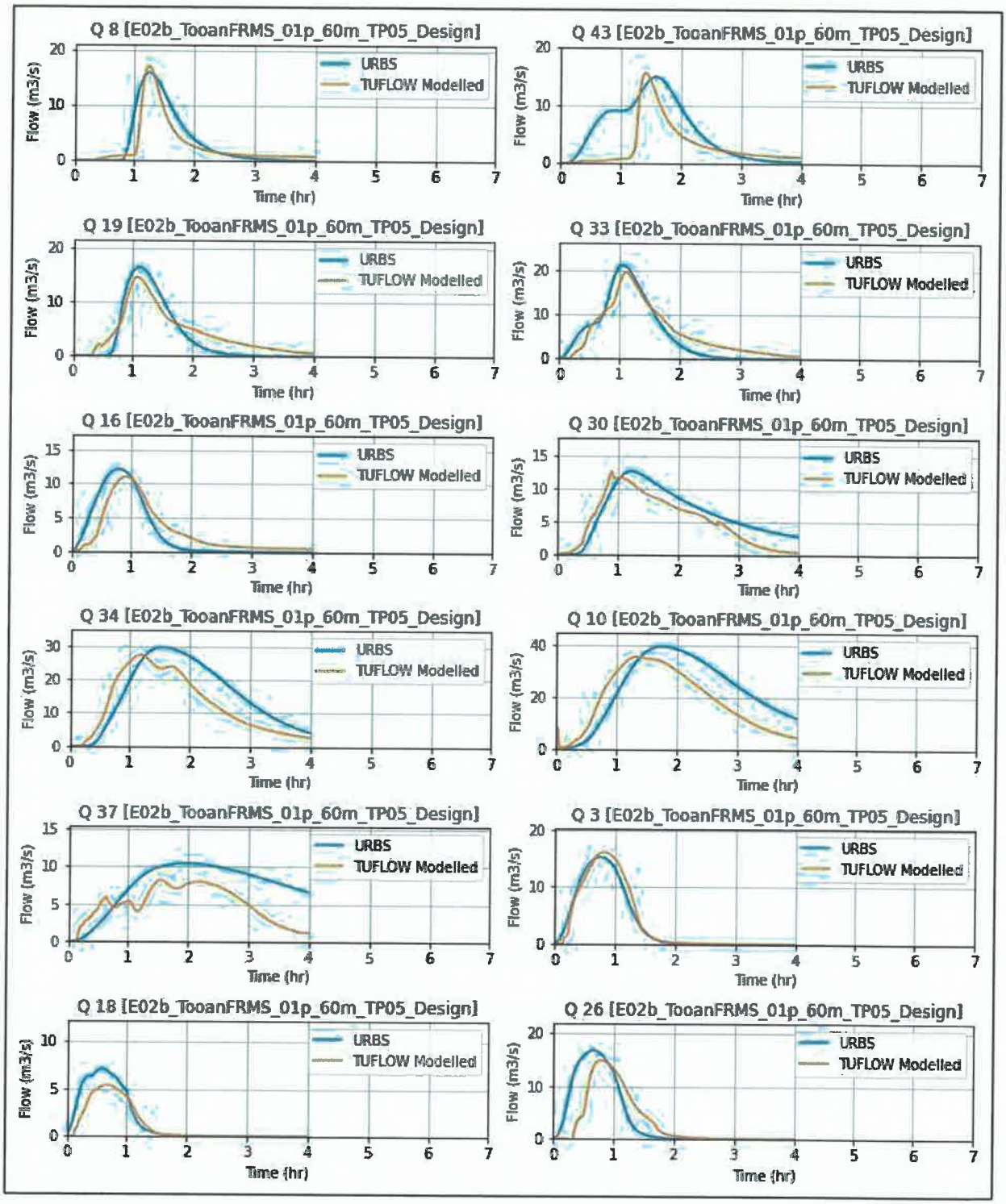


Figure 2-9 URBS versus TUFLOW discharge comparison for the 1% AEP 60-minute storm duration

2.4.2 Flow Validation

There are no available stream gauges within the Tooan Tooan and Lowlands Lagoon Catchment. Additionally, there are no flood level marks or survey levels from previous flood events to support model validation. Given this, the model flows were compared to the rational method and the Regional Flood Frequency Estimation model (RFFE). Locations where peak flows have been compared are shown in Figure 2-10. Table 2-2 below shows the results of the peak flow comparisons from the URBS hydrologic model, TUFLOW hydraulic model and the rational method. Figure 2-11 presents the results for the RFFE model at the outlet only (Catchment_38).

As discussed previously, the Tooan Tooan catchment and Lowlands Lagoon catchment have significant storage. This means the rational method and RFFE flows are likely significantly overestimating the peak catchment flows. As such, the difference seen between the rational method flow and RFFE model flows when compared to the peak flows from URBS and TUFLOW is significant. Without a stream flow gauge or event data, it is difficult to validate flows confidently. Given this, the peak flows have also been extracted from the URBS hydrologic model assuming no catchment storage. This is to provide a more like for like comparison and shows a much better match to the rational method flows. This provides more confidence in the overall model setup and model parameterisation.

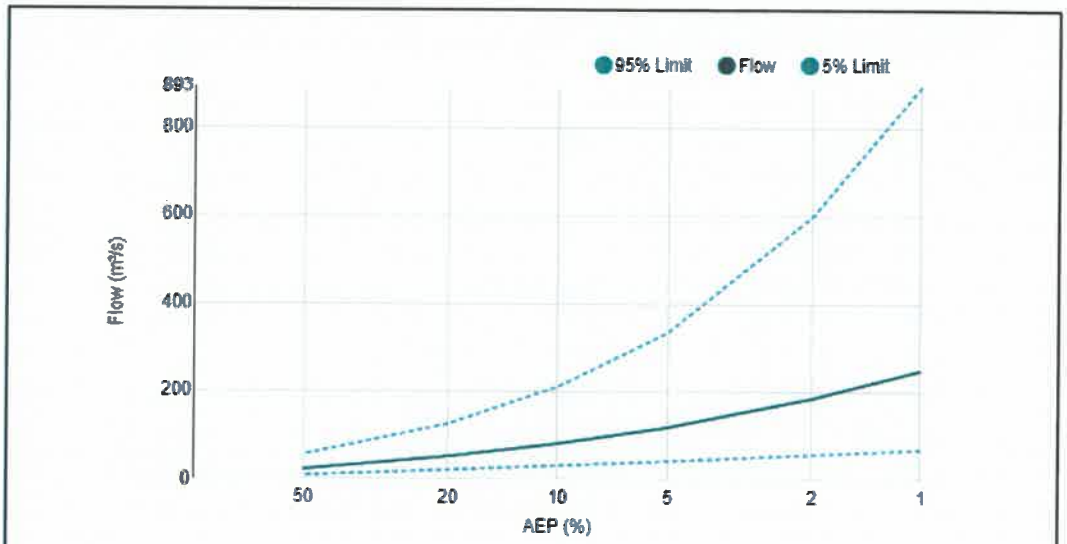
Further to this, the difference between the URBS and TUFLOW flows can be explained by TUFLOW providing a much better representation of catchment routing when there is significant storage and a complex stormwater network present. However, when comparing flows between URBS and TUFLOW for the same duration and same temporal pattern, as seen in Section 2.4.1, there is good agreement between flows. However, this was only for a single event and due to TUFLOW's better representation of catchment routing, the critical duration and mean temporal pattern selected for the peak flows is different across the two models. This further reinforces that the URBS hydrologic model main purpose is to develop local inflows and the TUFLOW should be relied upon for catchment routing in the design event modelling.



Figure 2-10 Locations for Flow Comparison

Table 2-2 Comparison of Peak 1% AEP Flows

Catchment Name	URBS Flow (m3/s) No Storage Applied	URBS Flow (m3/s)	TUFLOW Flow (m3/s)	Rational Method
Catchment_38	123.8	49.7	68.44	133.7
Catchment_34	74.0	36.2	58.8	88.2
Catchment_33	24.2	21.2	29.5	34.0
Catchment_8	29.7	19.6	34.2	43.8
Catchment_30	52.4	15.7	16.2	48.8



*The catchment has unusual shape. Results have lower accuracy and may not be directly applicable in practice.

AEP (%)	Discharge (m^3/s)	Lower Confidence Limit (5%) (m^3/s)	Upper Confidence Limit (95%) (m^3/s)
50	22.4	8.89	56.0
20	51.7	21.5	126
10	81.5	31.7	211
5	119	42.1	334
2	185	57.1	598
1	249	68.9	893

Figure 2-11 Regional Flood Frequency Estimation Model (RFFE) for total catchment area.

3 DESIGN EVENTS

3.1 Critical Duration

The URBS hydrologic model was assessed for the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and PMF for the 30-minute up to the 24-hour storm duration and all 10 temporal patterns. Generally, the 30-minute to 2-hour storm durations were found to be critical in the hydrologic model. However, given the storage present in the study area through the lake system all durations were assessed in the hydraulic model. The TUFLOW hydraulic model was initially assessed for the 1% AEP only for the 30-minute up to the 24-hour storm duration for all ten temporal patterns to inform the identification of the critical durations. It was found that generally, the 30-minute, 60-minute, 2-hour and 12-hour were critical across the study area.

3.2 Design Event Modelling

The URBS hydrologic and TUFLOW hydraulic model have been used to assess the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP 0.5% AEP, 0.2% AEP and PMF for the 30-minute, 60-minute, 2-hour and 12-hour durations and all ten temporal patterns.

The Tooan Tooan Catchment and Lowlands Lagoon Catchment is vulnerable to both catchment event flooding and storm surge inundation. In addition to the above design catchment flood events, the 1% AEP storm surge and 5% AEP catchment event was modelled.

Results of the design event catchment modelling is described in Section **Error! Reference source not found.**.

3.2.1 Climate Change

Climate change scenarios have been modelled in alignment with Fraser Coast Regional Council's current approach to climate change. This includes consideration of a 2100 storm surge scenario and 2100 RCP8.5 high emissions scenario. Climate change scenarios modelled include:

- 1% AEP 2100 RCP8.5 Catchment Design Flood Event, and
- 2100 1% AEP Storm Surge and 5% AEP 2100 RCP8.5 Catchment Design Flood Event.

4 CONCLUSION

Water Technology was commissioned to deliver the Tooan Tooan Coastal and Flood Risk Management Study and Plan. The first phase of the flood risk management plan was to review the adopted flood study (Advisian, 2018) for the catchment to ensure that it was fit-for-purpose as providing a comprehensive understanding of flood behaviour across the full range of possible flood events.

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The URBS hydrologic and TUFLOW hydraulic model have been used to assess the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP 0.5% AEP, 0.2% AEP and PMF for the 30-minute, 60-minute, 2-hour and 12-hour durations and all ten temporal patterns.

The Tooan Tooan and Lowlands Lagoon catchment is vulnerable to both catchment event flooding and storm surge inundation. In addition to the above design catchment flood events, the 1% AEP storm surge and 5% AEP catchment event were modelled.

Climate change scenarios were modelled in alignment with Fraser Coast Regional Council's current approach to climate change. This includes consideration of a 2100 storm surge scenario and 2100 RCP8.5 high emissions scenario. Climate change scenarios modelled include:

- 1% AEP 2100 RCP8.5 Catchment Design Flood Event, and
- 2100 1% AEP Storm Surge and 5% AEP 2100 RCP8.5 Catchment Design Flood Event.

The update flood model is considered to provide a comprehensive understanding of flooding behaviour and is fit-for-purpose for undertaking the Flood Risk Management Study and Plan phase of the Queensland Flood Risk Management Framework.

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APPENDIX A
FLOOD MAPPING





Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

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20% AEP Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

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10% AEP Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study

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5% AEP Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
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2% AEP Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
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Local Authority: Fraser Coast Regional Council		

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1% AEP Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study

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1% AEP Climate Change RCP8.5 and 0.8m SLR Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

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0.5% AEP Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

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Local Authority: Fraser Coast Regional Council		

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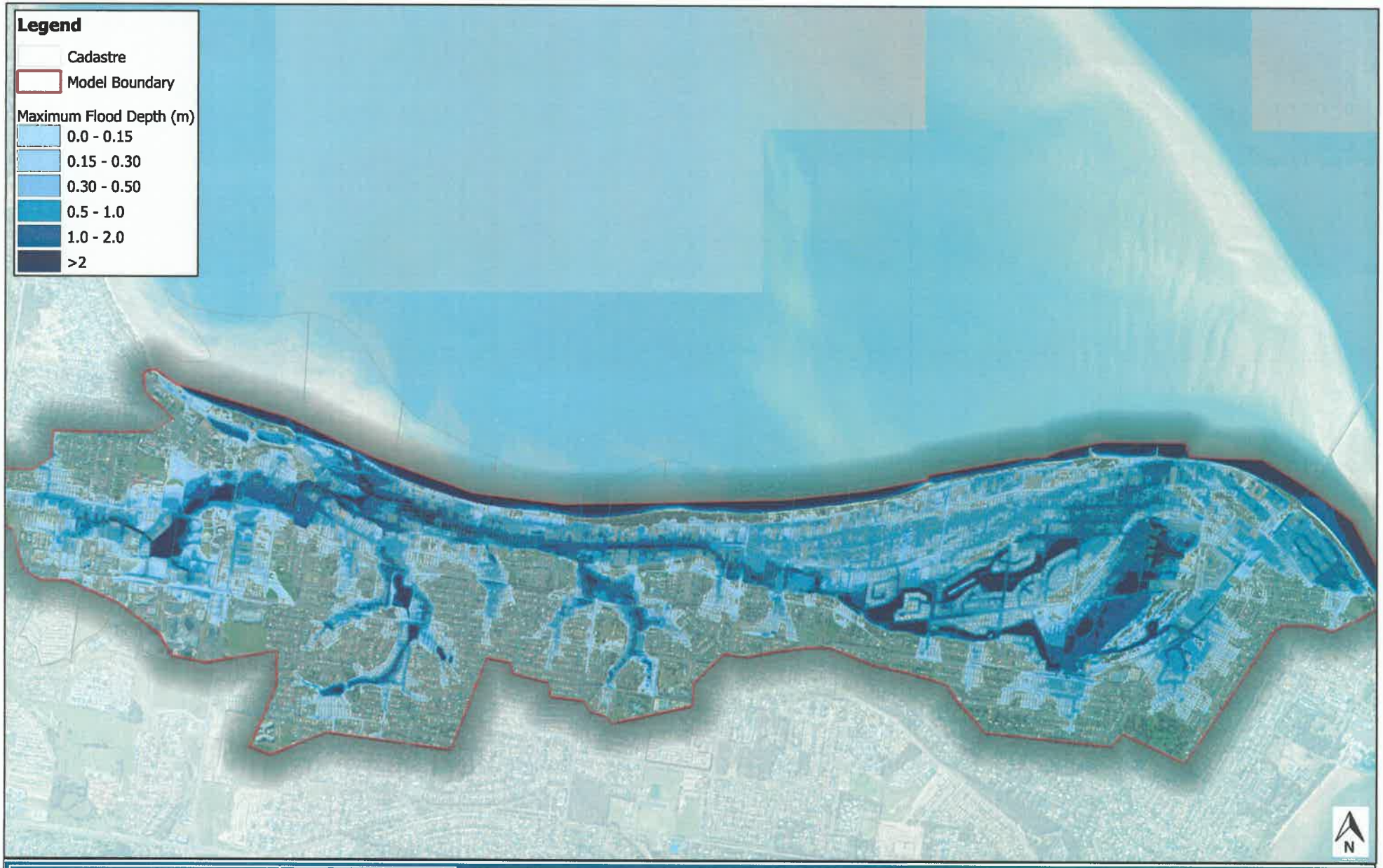
0 500 1,000 1,500 2,000 m

0.2% AEP Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

023-06-19T14:46:01.171



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

PMF Flood Depth (m) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study

Project: 22020172

WATER TECHNOLOGY

023-06-19T14:46:07.754



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

5% AEP Catchment Event with 1% AEP Storm Surge Event Flood Depth (m) Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

2023-06-19T14:46:15.641



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

2100 RCP8.5 Climate Change 5% AEP Catchment Event with 1% AEP Storm Surge Event - Flood Depth (m)

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

023-06-19T14:46:22.586



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

20% AEP Peak Water Surface Level (m AHD) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

023-06-19T14:37:04.861



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

10% AEP Peak Water Surface Level (m AHD) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

D23-06-19T14:37:13.816



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

5% AEP Peak Water Surface Level (m AHD) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

023-06-19T14:37:23.290



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

2% AEP Peak Water Surface Level (m AHD) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

023-06-19T14:37:31.490



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

20% AEP Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

023-06-19T14:23:56.010



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

10% AEP Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

2023-06-19T14:24:02.959



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

5% AEP Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

023-06-19T14:24:10.661



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

2% AEP Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

023-06-19T14:24:17.387



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

1% AEP Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

023-06-19T14:24:24.343



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1% AEP Climate Change RCP8.5 and 0.8m SLR Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

023-06-19T14:24:31.540



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

0.5% AEP Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

2023-06-19T14:24:39.760



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

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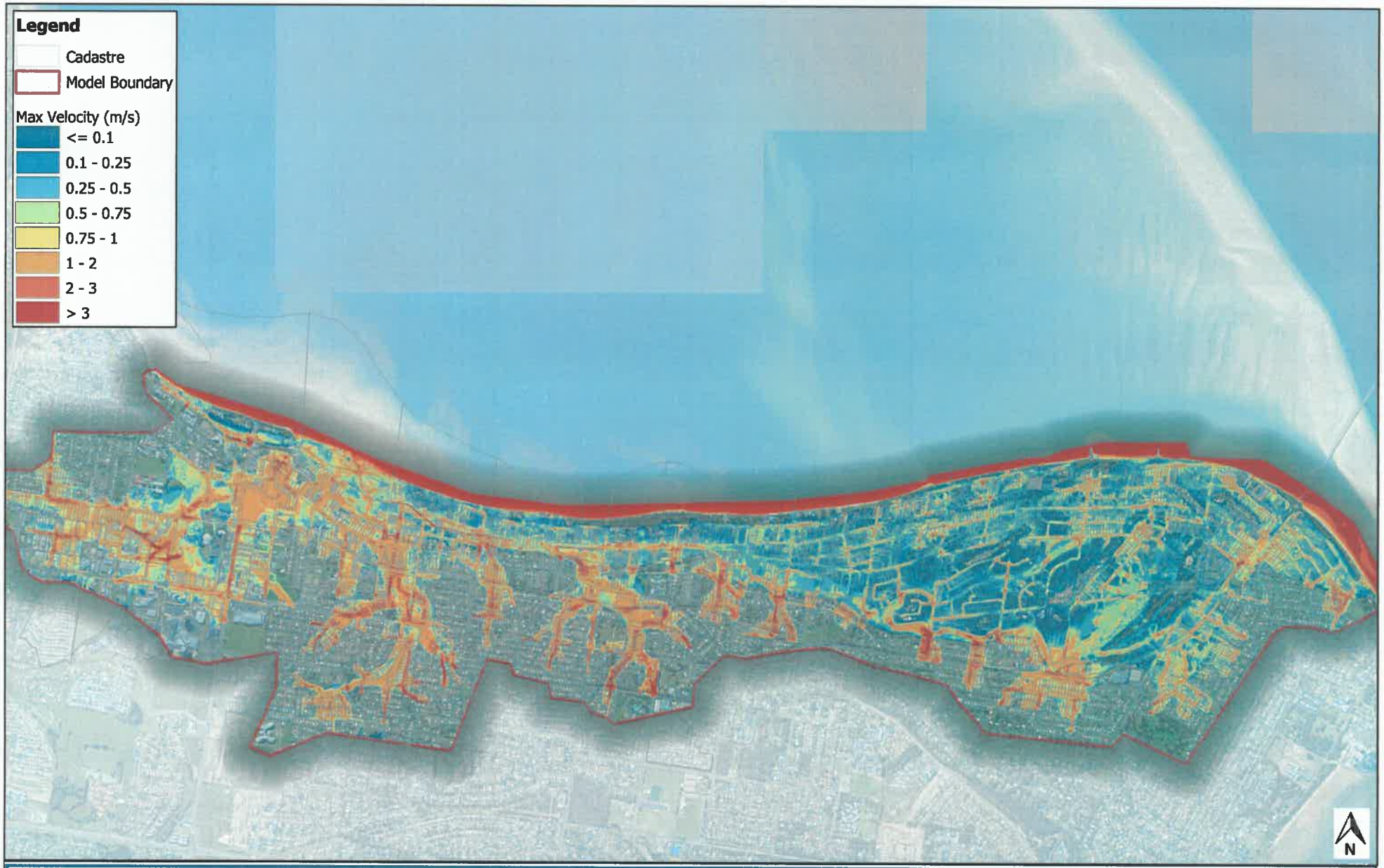
0 500 1,000 1,500 2,000 m

0.2% AEP Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

WATER TECHNOLOGY

023-06-19T14:24:48.850



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

1:22,000

0 500 1,000 1,500 2,000 m

PMF Velocity (m/s) - Existing Case

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WATER TECHNOLOGY

023-06-19T14:24:54.225



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

5% AEP Catchment Event with 1% AEP Storm Surge Event - Velocity (m/s) - Existing Case

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

023-06-19T14:25:01.650



Details	Figure Revision	Date
Original Size: A1	1	20/02/2023
Co-Ordinates: GDA94 / MGA56		
Water Technology Pty Ltd		
Imagery Source: Google Earth 2019		
Local Authority: Fraser Coast Regional Council		

2100 RCP8.5 Climate Change 5% AEP Catchment Event with 1% AEP Storm Surge Event - Velocity (m/s)

Tooan Tooan Coastal and Flood Risk Management Study
Project: 22020172

1:22,000

0 500 1,000 1,500 2,000 m

WATER TECHNOLOGY

2023-06-19T14:25:08.158



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