Consultation Report

Part 1

ROCKHAMPTON REGION PLANNING SCHEME

MAJOR AMENDMENT VERSION 4 (LOCAL CATCHMENT AND RIVERINE FLOOD MAPPING)

- **Version 4.1 – North Rockhampton and Fitzroy River**
- **Version 4.2 – South Rockhampton**
- **Version 4.3 – Gracemere**
- **Version 4.4 – Mount Morgan**

Date of Engagement	4 April 2022 – 3 June 2022
Method of Engagement	Social Media, Community Meetings, Face to Face Meetings and Shopping Centre Stalls

Contents

1.0 Executive Summary

The purpose of this report is to provide an overview of the matters raised during the public consultation period for the proposed flood hazard overlay mapping (local catchments and Fitzroy River) changes to the Rockhampton Region Planning Scheme (major amendment versions 4.1-4.4). This report forms part of the submission to the Minister for State Development, Infrastructure, Local Government and Planning for final Ministerial Review in accordance with the *Planning Act 2016.*

The Minister for State Development, Infrastructure, Local Government and Planning advised Council on 20 February 2022 that it may proceed to public consultation of the proposed major amendment to the Planning Scheme.

The overall aim of the community engagement was to communicate and request feedback regarding the revised flood modelling and development controls related to the flood catchment areas to impacted property owners. The community engagement process also provided the opportunity to create community awareness of areas impacted by flooding. The revised flood studies also provide information to assist in flood emergency management planning and assist with the development of future flood mitigation options.

The consultation period occurred from 4 April 2022 to 3 June 2022. For this engagement, impacted property owners and community members were invited to submit comments or concerns, with a total of 271 submissions received.

Matters raised in submissions include but are not limited to the following:

- Accuracy of the flood modelling and proposed flood hazard overlay mapping.
- Concerns property values will decrease, and insurance premiums will increase.
- Concerns the lack of maintenance in the creeks and natural waterways is increasing the flooding extent.
- Adequacy of existing infrastructure and infrastructure upgrades to cater for larger flood events.
- Upstream developments exacerbating flooding.
- South Rockhampton Flood Levee proposal.
- Land acquisition and compensation; and

- Removal of property from the Flood Overlay Maps.

These matters are addressed in further detail under section 4.0 of this report. This includes detailed discussion of each of the issues raised, including technical information related to the flood modelling used and the flood mapping proposed for the planning scheme.

It is recommended that some minor changes be undertaken to the flood hazard overlay mapping. These changes have been undertaken where approved development applications have been approved after the adoption of the relevant flood study and more recent modelling by proponents demonstrates they are situated above the 1% AEP. These areas include Edenbrook Estate (Springbrook Close), Lily Place Industrial Estate, Crestwood Estate (Geoff Wilson Drive and Silver Wattle Street) and Varsity Park Estate (Diploma Street).

Further changes have been also undertaken to the Webber Park (Chalmers Street) and Wackford Street areas where infrastructure within these areas has been upgraded and revised modelling undertaken that outlines a new flood extent. No further changes are recommended to the policy requirements (i.e., flood hazard overlay code) as outlined in the planning scheme.

A valuable contribution was provided by a number of submitters that provided rain gauge information, ground levels and photos, which will help inform the next round of flood modelling undertaken by Council.

Every submission was reviewed and analysed in detail. Council has considered every submission and responded back to the submitters. The results of the public consultation process, along with proposed changes to the planning scheme will be submitted to State Government for adoption early 2023.

2.0 Background

As part of its on-going commitment to the Rockhampton Regional Council Flood Management Strategy, Council has completed several flood studies to improve its flood information and understanding of existing flood risks in the Rockhampton region. A key component of this involves updating existing flood studies, as well as undertaking new flood studies within the region.

The outcomes from these studies provide Council with a better understanding of flood behaviour, flood risk, and vulnerability, which assists with the development of flood mitigation options and informs future natural hazard overlays for associated development controls. The flood studies also provide information to assist in emergency management planning.

The current flood studies were presented at a Councillor workshop on 15 September 2020 and are available to the community via Council's website. Consultation with the community has occurred through the major amendment public consultation process.

As a result of new information, Council resolved to commence a major amendment to the Rockhampton Region Planning Scheme in accordance with Minister's Guidelines and Rules (Section 18 - Making or amending planning scheme – *Planning Act 2016*). The major amendment to the planning scheme has four versions being:

- Version 4.1 – North Rockhampton Catchments and Fitzroy River.
- Version 4.2 – South Rockhampton Flood Catchments.
- Version 4.3 – Gracemere Flood Catchment; and
- Version 4.4 – Mount Morgan Flood Catchment.

The amendment incorporates mapping from the updated flood studies for the Fitzroy River, Moores Creek, Splitters Creek, Limestone Creek, Ramsay Creek, and Frenchmans and Thozets Creeks, as well as new flood studies for previously unmodelled catchments for South Rockhampton, Wandal and West Rockhampton Catchment, Mt Morgan, and Gracemere North/South catchments. The proposed amendments also incorporate updated flood hazard profiling (i.e., from 4 hazard categories to 6 hazard categories for the current and updated creek and local catchment flood studies, and the Fitzroy River and the subsequent categorisation into Planning Area 1 and 2).

The following changes to the flood hazard overlay mapping are required:

- Updated Fitzroy River Flood Overlay Map OM-8A; and
- Updated Local Catchment Flood Overlay Map OM-8C.

Council submitted the major amendment to the Department of State Development, Infrastructure, Local Government and Planning for a State Interest Review on 12 November 2021.

The Department of State Development, Infrastructure, Local Government and Planning advised on 21 February 2022 that Council may proceed to the public consultation stage of making or amending a planning scheme. No conditions were attached, as the Director-General was satisfied that the proposed amendment appropriately integrates the relevant State interests.

3.0 Community Consultation Process

Rockhampton Region Planning Scheme version 4 was placed on public exhibition between Monday 4 April 2022 to Friday 3 June 2022 (40 business days). The following steps were taken to advise affected community members and provide information on what was being proposed:

- Public notice was placed in the Mount Morgan Argus on 30 March 2022 and Central Queensland Today on 2 April 2022.
- Letters (approximately 9,000) were sent to all owners and tenants of land affected by the amendment.
- Staff from the Strategic Planning unit and Infrastructure Planning unit met with members of the public by appointment and attended shopping centres; and
- Amendment documentation, flood studies, fact sheets and an interactive map service were made available on Council's website.

A total of 271 submissions were received (written submissions and via Council's engagement website).

3.1 Shopping Centre Information Booths

During the consultation period, there were four pop-up 'Information Booths' at Stockland Rockhampton, Allenstown Square, Gracemere Shopping World and Mount Morgan (Morgan Street). These were seen as an effective way to consult with residents, with many community members taking the time to seek additional information and clarification around the proposed changes to the flood hazard overlay.

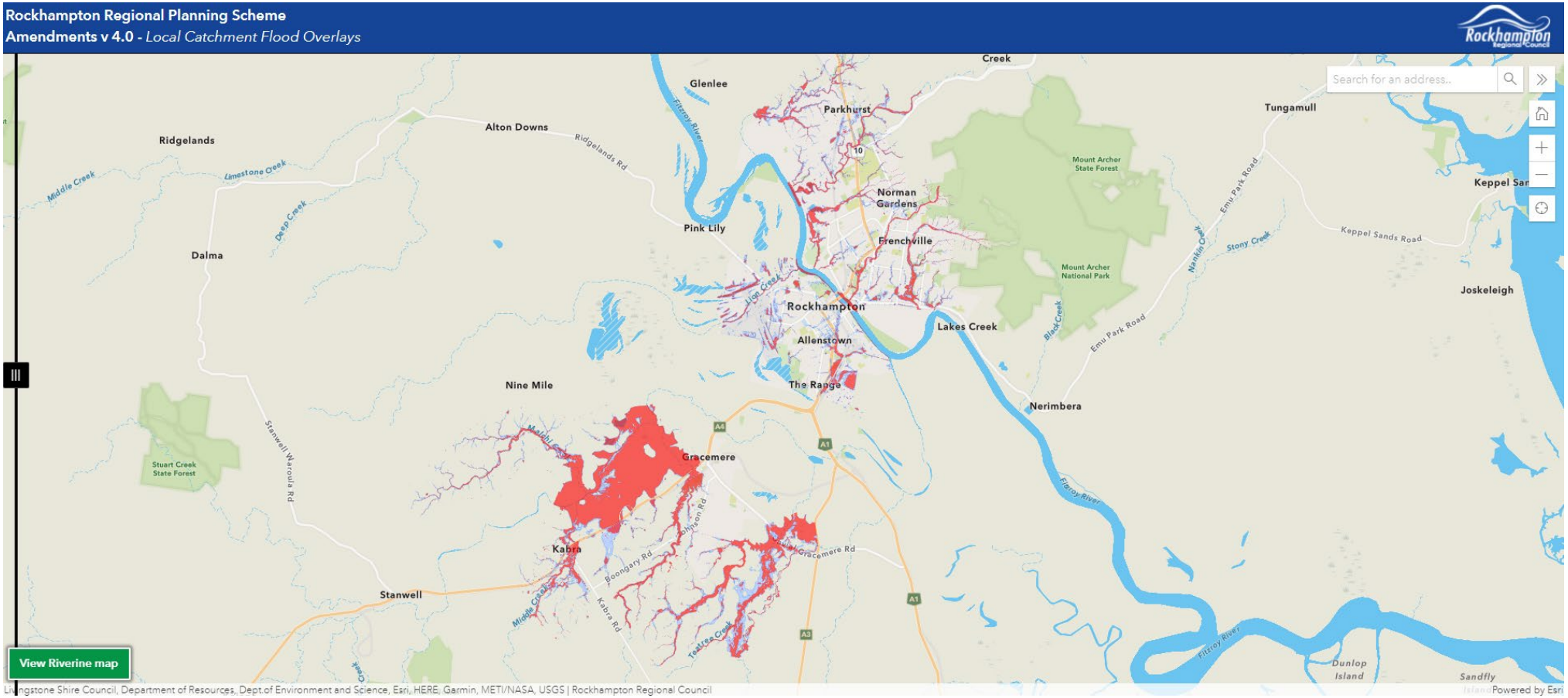
Images: Picture of the Information Booth at Stockland Rockhampton and Mount Morgan

3.2 Interactive Mapping

Interactive mapping was available on Council's project website (Engagement HQ) from the commencement of consultation on 4 April 2022. The mapping allowed community members to view the proposed/revised flood maps.

The mapping included a feature that allowed community members to enter a specific property address and compare the current flood maps and proposed flood maps.

Image: Screenshot of Interactive Mapping Site



4.0 Common Matters Raised in Submissions

During the public consultation period, a number of common matters were identified from the submissions received. Council provided a response to each submission. A complete record of all submissions with responses and recommended changes to the planning scheme will be provided as part of the submission to the Minister for State Development, Infrastructure, Local Government and Planning for final Ministerial Review in accordance with the *Planning Act 2016.* If an issue is not identified in this summary report, it does not mean it was given less weight.

The following common matters were raised by submitters:

- Accuracy of the flooding modelling used to inform the flood hazard overlay maps.
- Property Values and Insurance Premiums.
- Lack of maintenance in creeks and natural waters is causing flooding.
- Existing infrastructure is not adequate.
- Upstream developments have exacerbated the impacts of flooding.
- South Rockhampton Flood Levee.
- Land Acquisition and Compensation.
- Changes to flood behaviour due to development; undertaken since flood modelling was completed; and
- Removal of properties from the Flood Hazard Overlay Maps.

Each submission has been addressed regarding the issue raise, the current context and recommendation in relation to the proposed major amendment to the planning scheme.

4.1 Accuracy of Flood Modelling and Flood Overlay Maps

Several submissions received raised questions about the accuracy of the flood modelling used to inform the proposed flood hazard overlay maps. The planning scheme uses the flood overlay mapping to determine development controls for new development. The extent of the flood and whether it was a true representation of the 1% AEP flood event was disputed by submitters.

Council's Planning Scheme flood hazard overlay mapping has been derived from the flood mapping completed as part of the recent updated and new flood studies undertaken for the Fitzroy River, local creeks, and local catchments within the Rockhampton Region.

The updated creek and local catchment flood studies have focused on overland and creek flooding due to rainfall over the local catchment areas. The updated flood studies have been undertaken for the six creek catchments located within North Rockhampton, including:

- Ramsay Creek.
- Limestone Creek.
- Splitters Creek.
- Moores Creek.
- Frenchmans Creek; and
- Thozets Creek.

The following previously unmodelled local catchments have also subject to flood assessment:

- South Rockhampton.
- West Rockhampton.
- Wandal.
- Gracemere North Local Catchment (modelling only); and
- Mount Morgan.

Further information in relation to each of these flood models has been outlined under Attachment 1 – Accuracy of the flood modelling.

The updated flood studies and the resulting flood mapping and flood overlay have provided Council with an enhanced understanding of flood behaviour and flood hazard for the creek and local catchments that experience flooding during times heavy rainfall. This will support the administration of Council's flood code and floodplain planning provisions. The community consultation has sought to acquaint residents with the flood mapping and what this may mean for their property.

An anticipated outcome of the consultation process has been that residents will have greater awareness of the types of flooding that may be possible in their catchment areas, and the level of flood hazard that they may be exposed to at the individual lot and within the locality.

The specific treatments for addressing the flood risk (including current, future, and residual risk) in the catchments will be identified as part of future flood risk management studies that are being proposed as part Council's next phase of flood plain management actions to address flood risk. The flood risk studies will define flood risk, tolerable and intolerable risk specific to the catchment. This will likely result in significant changes to risk profiling and policy to align with a risk-based approach to floodplain management.

There are no proposed changes to the flood modelling undertaken, however as outlined later in this report, some minor changes are proposed to the flood overlay hazard mapping.

Information gathered during the consultation period will be used to inform future updates of Council's flood models.

4.2 Property Values and Insurance Premiums

Many submitters objected to the flood affectation designation of their land as they considered that it would result in an impact on the value of their property and make it harder to sell.

Insurance premiums vary across insurance agencies. While the flood hazard overlay mapping is produced by Council, there are regulatory frameworks that the insurance agencies must follow regarding how this information is used.

Whether or not the designation of land as having a flood risk has an impact on property values and sales, Council has a duty of care to the community and a legislative requirement to appropriately map and regulate new development via the planning scheme. The planning scheme seeks to ensure that development does not increase the risk to human life and property in areas that are affected, or potentially affected by

flooding. This occurs through the avoidance of natural hazards, such as flooding in new development areas.

Therefore, it's not recommended to change the planning scheme based on concerns raised regarding property values and insurance premiums.

4.3 Lack of Maintenance in Creeks and Waterways Exacerbating Flooding

Residents living along creeks and natural waterways, subject to flooding raised concerns about the level of maintenance in the creek beds and within natural waterways.

This is a matter that cannot be specifically addressed by the planning scheme and therefore it is recommended that no change occur to the planning scheme.
However, it is acknowledged that the maintenance of creeks and natural waterways is important. Council is working to implement better riparian management that seeks to achieve a balance between vegetation removal to promote better drainage, whilst retaining enough vegetation to ensure that the integrity and stability of the creek banks is not compromised. As such, the complete removal of vegetation such as trees and shrubs in the riparian areas of the creeks and the Fitzroy River is likely to cause greater erosion of the banks, which could in turn lead to bank slumping resulting in a reduction of the channel capacity for effective flow conveyance during storms and flood events.

The effect of vegetation overgrowth has been assessed as part of sensitivity scenarios in the flood modelling, and its effects on flood levels have been found to be marginal.

Whilst it will never be possible to completely mitigate localised impacts during a flash flood, Council recognises the importance of continuing to work with the community and other agencies to ensure the creeks and natural waterways are kept clear of debris and weed overgrowth to improve conveyance of flood flows during major storms.

Property owners play an important part in the maintenance of creeks by ensuring green waste is disposed of properly, especially palm fronds and grass clippings.

4.4 Existing Infrastructure is Not Adequate

Within established areas, residents and businesses raised concerns that the existing infrastructure was not adequate to address the localised flooding in the area.

The flood mapping identifies areas of the catchment that are susceptible to flooding from riverine, creek, and urban runoff. Council's flood studies have taken into account drainage infrastructure that was in place at the time of the flood study, The flood extents shown in the mapping depict the floodwater and/or overland flow that exceeds the capacity of the existing drainage system.

It is acknowledged that much of the region comprises of development that is many decades old, where drainage infrastructure is either unavailable, or if present, is not able to meet current design standards. This means that in many locations, the infrastructure does not have the capacity to convey nominal urban design flood flows (typically a minimum 1 in 2-year ARI design and above).

Similarly, overland flow paths are either not available or do not have sufficient capacity to convey surface runoff without impacting private property.

Council is progressively addressing legacy drainage concerns through the development of flood mitigation and drainage schemes. Recent examples of schemes that have been implemented to benefit the community and reduce impacts during flood include the North Rockhampton Flood Management Area (NRFMA) Stages 1 and 2 works, Webber Park, and the Wackford Street drainage schemes, as well as the Simpson Street, and McLaughlin Street drainage schemes.

Council maintains a Master Drainage program for addressing drainage concerns, with ongoing investigations and assessments being undertaken to address legacy drainage and flooding issues within the region. The investigations and subsequent implementation of the flooding and stormwater management schemes is prioritised based on risk to life and property, public safety, capacity, and budgetary allocation, and all schemes are reviewed periodically to ensure that the most concerning areas are being given priority to alleviate risk.

It is recommended that minor changes to the planning scheme be undertaken to include updated flood hazard overlay mapping both Wackford Street and the Webber Park area. This is due to a recent review undertaken, resulting in changes to the flood hazard extent and hazard categories.

4.5 Upstream Developments Exacerbating Flooding

Concerns were raised by submitters about the impacts of developments upstream that they believe have the potential to exacerbate the extent of flooding on downstream properties.

All new developments, as well as developments that have been undertaken since 2015 within the Rockhampton region are required to provide a stormwater management system. These systems manage stormwater quantity and quality to ensure that, following development, the flooding impacts attributable to development do not increase or cause adverse impacts to properties located upstream, adjacent, or downstream of the development site.
The efficacy of any stormwater management measures implemented as part of the development are required to be demonstrated via hydraulic and hydrologic modelling to ensure compliance with Council's planning scheme policies - with the stormwater management system to be designed in accordance with Planning Scheme Policy SC6.18 – Stormwater management policy, Planning Scheme Policy SC6.10 – Flood hazard, the Capricorn Municipal Development Guidelines, and best practice industry guidelines including the Queensland Urban Drainage Manual, and Australian Rainfall and Runoff.

Historical developments within the Rockhampton region have been required to comply with standards at the time of the development. It is acknowledged that much of the region comprises of development that is many decades old, where drainage infrastructure is either unavailable, or if present, is not able to meet current design standards. As mentioned previously, Council is progressively addressing legacy drainage concerns through the development of flood mitigation and drainage schemes using a prioritised process. Please refer to the section 'Existing Infrastructure not adequate' for more details.

It is recommended that no changes occur to the planning scheme flood overlay

mapping. The concerns raised and the information provided will however help inform future modelling and flood studies.

4.6 South Rockhampton Flood Levee

Submissions were raised requesting an update on the status of the South Rockhampton Flood Levee and whether the project would go ahead. Some submissions referred to the levee as providing a solution to their issues regarding being impacted by flooding from the Fitzroy River.

Council remains committed to the South Rockhampton Flood Levee project and is awaiting confirmation of funding from State or Federal Government to address the shortfall in construction costs.

Council continues to support the levee and we are working with other levels of Government to ensure that it's kept on their infrastructure agenda for our community. We remain hopeful that this project will come to fruition with all levels of Government working together to realise this important flood mitigation infrastructure for our community. While this is an important matter, the proposed amendments to the planning scheme do not directly relate to the South Rockhampton Flood Levee and therefore no change is recommended to the planning scheme.

4.7 Land Acquisition and Compensation

Residents and businesses requested whether compensation would be available for properties impacted the proposed flood hazard overlay maps.

Under the *Planning Act 2016* (the Act), section 30(4)(e) states that where a change to the planning scheme is to reduce the risk of serious harm to people or property from natural events, including flooding, and the planning scheme amendment has been undertaken in accordance with the Minister's rules, Council is exempt from paying compensation. Regardless of whether there has been a loss of development rights due to the inclusion of flood hazard mapping (reducing the risk to property or people), Council is exempt from compensation.

The Minister's rules include requirements that Council notify all affected landowners as part of the statutory consultation process and that Council consider all feasible alternatives to planning scheme controls to reduce the risk of serious harm from flooding, e.g., land acquisition, raising buildings so that their floor level is above the flood level, and stormwater detention and levees.
If a formal compensation claim is made under the provisions of the Act, an assessment of whether compensation would be best provided via acquisition of the land by Council would form part of the process. This matter is therefore fully addressed through the *Planning Act 2016*.

4.8 Development Undertaken Post Flood Modelling

Council received submissions from property owners and developers of newly constructed estates, whereby filling and excavation works had been completed since the flood modelling was completed and as part of development approvals.

The flood affectation status and flood hazard designations proposed by the planning

scheme amendment are based on the results of flood studies completed between 2017 and 2019.

Submissions received have identified four developments (mainly subdivisions) constructed since the studies were undertaken, that have incorporated changes to the landform, and implemented drainage measures in response to the inherent flood characteristics of the local catchment. Estates that have been developed since the flood studies have been undertaken, and which have adopted Council's flood study modelling to produce developed case scenarios confirming that the development is being located above the 1%AEP levels include the following developments:

- Edenbrook Estate.
- Lily Place Industrial Estate.
- Crestwood Estate; and
- Varsity Park Estate.

The submissions request that Council modify the planning scheme amendment prior to adoption so that it reflects the post-development conditions created by these developments and avoids purchasers having to make development applications for houses and ancillary structures on lots that are not identified as being at risk of flooding in the 1%AEP flood event.

The following is a brief comment on each:

Edenbrook Estate

Land within this subdivision is subject to flood inundation associated with Ramsay Creek which runs north of the site. Most of the area of flood risk is contained within land that has been dedicated to Council as open space / drainage reserve. There is a large area of flood risk in the north-eastern area that is currently in construction phase of the development. Additional lots will become affected as future stages of the subdivision are undertaken.

Lily Place Industrial Estate

Land within this subdivision is subject to inundation during storm and rain events within the Limestone Creek Local Catchment. The pattern of overland flow within the subdivision has been altered by road works, the installation of an underground stormwater network, and a detention basin, and changes to the profile of the land. Most of the area identified as being at risk of flooding is contained within land that has been dedicated to Council as open space / drainage reserve.

Crestwood Estate

Land within this subdivision is subject to inundation during storm and rain events within the Limestone Creek Local Catchment. The pattern of overland flow within the subdivision has been altered by road works, the installation of an underground stormwater network, and a detention basin, and changes to the profile of the land. Most of the area identified as being at risk of flooding is contained within land that has been dedicated to Council as open space / drainage reserve.

Varsity Park Estate

Land within this subdivision is subject to inundation during storm and rain events within the Limestone Creek Local Catchment. The pattern of overland flow within the subdivision has been altered by earthworks (such as the construction of retaining walls). Most of the area

identified as being at risk of flooding is contained within drainage easements.

It is recommended that minor changes occur to the flood hazard overlay mapping for Edenbrook Estate, Lily Place Industrial Estate, Crestwood Estate and Varsity Park Estate. These changes are based upon the flood management reports, including modelling undertaken as part of the development assessment process. Importantly, the earthworks and subdivision layout have also been completed, in accordance with the development approvals (operational works and reconfiguring a lot) obtained for these estates.

4.9 Removal of Properties from the Overlay Maps

The majority of submissions requested that their property be removed from the flood hazard overlay maps with the reason being that they hadn't seen flooding impact upon their property or believed that their property would not be subject to flooding from either localised flood events or by the Fitzroy River.

The updated Flood Catchment and Fitzroy River overlay hazard mapping for the planning scheme has been derived from flood modelling and assessments undertaken by consultants on behalf of Council. It is a State Government requirement for Council to release the mapping based on the 1% Annual Exceedance Probability (AEP) (i.e. a flood event which has a 1% chance in any given year of being equal to or greater than a flood the size of a 1 in 100 year flood event) extent to ensure the community are aware of the flood behaviour in their catchments, and for appropriate planning controls to be implemented for new development. Council's floodplain planning provisions are largely based on the 1% AEP flood.

The principal aim of the planning scheme is to ensure that new developments are appropriately located and are not subject to unacceptable risks associated with naturally occurring events such as flooding, bushfire, and the like. It is also important to emphasise that the independent flood studies identified these properties at risk of inundation during flood events. The planning scheme provides an effective response to the risk when applied to development in the region. Simply by removing the relevant overlays from the planning scheme will not prevent the possible impacts on insurance and property values.

While there is understanding for people who own property that may be impacted, Council has a duty of care to make residents aware of the flood potential in their areas, and where feasible to protect residents and their property from serious injury or loss of life and damage. As a result, the planning scheme needs to reflect the most up to date flood modelling and mapping for the Rockhampton Region.

It is recommended that some minor changes occur to the flood hazard overlay mapping. These changes are discussed previously under sections 4.4 and 4.7 of this report. In summary it is recommended that the flood hazard overlay maps be updated for Edenbrook Estate (Springbrook Close), Lily Place Industrial Estate, Crestwood Estate (Geoff Wilson Drive and Silver Wattle Street) and Varsity Park Estate (Diploma Street) based upon development approvals and onsite works being completed. Further changes are also recommended for Webber Park (Chalmers Street) and Wackford Street whereby infrastructure within these areas has been upgraded and revised modelling undertaken that outlines a new flood extent.

5.0 Recommendations

The following recommendations are provided as a result of the public consultation exercise undertaken:

1) That minor changes be undertaken to the flood overlay mapping. These areas include Edenbrook Estate (Springbrook Close), Lily Place Industrial Estate, Crestwood Estate (Geoff Wilson Drive and Silver Wattle Street) and Varsity Park Estate (Diploma Street). There will be an interim mapping change whereby these estates are clipped out of the current mapping, with appropriate disclaimers placed to inform those properties within these areas are situated above the 1%AEP as per the approved Development Application, with instructions to contact Council for further information and confirmation of flood affectation status for these areas. Further changes have been also undertaken to the Webber Park and Wackford Street areas whereby the mapping has been reviewed and updated.

2) That no change be undertaken to the policy requirements (flood hazard overlay code) as outlined proposed planning scheme document; and

3) That the flood models be updated based upon information received by submissions and following the receipt of updated LiDAR data (subject to budget and resources)

ATTACHMENT 1 – Technical Details for Flood Modelling

Accuracy of the flood modelling

Council's Planning Scheme flood hazard overlay mapping has been derived from the flood mapping completed as part of the recent updated and new flood studies undertaken for the Fitzroy River, local creeks, and local catchments within the Rockhampton Region. Flooding in Rockhampton can occur as a result of three different flood mechanisms, including:

- Riverine flooding due to rainfall over the Fitzroy River catchment.
- Overland flooding due to rainfall over the local urban catchment.
- Creek flooding due to rainfall over the local creek catchment.

These flood studies have been completed by independent expert consultants on behalf of Council.

The updated Creek and Local catchment flood studies have focused on overland and creek flooding due to rainfall over the local catchment areas. Updated flood studies have been undertaken for the six creek catchments located within North Rockhampton, including:

- Ramsay Creek.
- Limestone Creek.
- Splitters Creek.
- Moores Creek.
- Frenchmans Creek; and
- Thozets Creek.

The following previously unmodelled local catchments have also subject to flood assessment:

- South Rockhampton.
- West Rockhampton.
- Wandal.
- Gracemere North Local Catchment (modelling only); and
- Mount Morgan.

The key objectives of the flood studies were to:

- Develop detailed hydraulic models based on current best practice to simulate the flood characteristics and behaviour of the local catchment using the latest available data.
- Assess the existing flood behaviour within the study area. It is expected that these results will be used to inform long term infrastructure planning, future emergency planning and floodplain management.
- Develop clear and easy to understand flood mapping products for use in future community education, awareness campaigns and planning scheme updates.
- Determine key hydraulic controls within the study area to support the future assessment of potential flood mitigation options.

Flood modelling methods:

Council's flood studies included the development of calibrated numerical models to simulate baseline flood behaviour associated with a range of local rainfall design events and determining the resultant flood inundation extents, depths, velocities, and hazard.

The model set-up used for a particular study is typically based on several factors including topographic characteristics of the area, presence of major infrastructure, the size of the model domain, and expected simulation times. Each flood study undertaken used similar but slightly different flood modelling methods, however the use of LiDAR aerial

survey to inform the flood modelling and mapping was common across all the studies.

TUFLOW modelling, which utilises a combination of runoff-routing and direct rainfall approaches was used to determine overland flow paths and establish baseline flood extents and depths within the study areas. Overall, the modelling calibrated and validated well, with modelled behaviours anticipated to appropriately predict flood patterns based on the information provided at the time of completion of the studies.

A summary of the modelling method adopted for each study is provided below:

Frenchmans and Thozets Creeks Flood Study (AECOM 2017):

The Frenchmans and Thozets Creeks local catchments were modelled using a two-dimensional Direct Rainfall method approach to generate overland flow distributions, flood depths and velocities, and to ascertain the flood behaviour and flood hazard of Frenchmans and Thozets Creeks during times of storm and heavy rainfalls of various sizes and durations within the local catchments. The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 3m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions, to account for any backwater influences from the Fitzroy River.

The full council pipe network which was current at the time of the study was also incorporated into the hydrodynamic model.

The study also incorporated sensitivity analysis of the model results to assess the potential variability of the modelling results under a range of conditions. This included testing of the direct rainfall method against alternative hydrologic approaches, climate change, riverine and local catchment coincident flooding, testing the impact of changes to hydraulic roughness and the potential impact of infrastructure blockages.

Calibration and validation of the hydrology and overland routing was also undertaken as part of this study, against three recent flood/storm events including January 2013 (ex TC Oswald), February 2015 (ex TC Marcia), and ex TC Debbie in April 2017, utilising actual recorded levels as available. The model was found to calibrate and validate well and was able to replicate previous flood events within the catchment to a high level. This provided confidence to Council that the flood model was suitable for informing the flooding assessment of the Frenchmans and Thozets Creek catchments.

Moores Creek Flood Study (AECOM 2017)

The Moores Creek local catchment was modelled using a rainfall-runoff approach to develop the design hydrology, and a TUFLOW hydrodynamic model to generate overland flow distributions, flood depths and velocities, and to ascertain the flood behaviour and flood hazard of Moores Creek during times of storm and heavy rainfalls of various sizes and durations within the

local catchment. The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 3m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions, to cover any backwater influences from the Fitzroy River.

The full council pipe network which was current at the time of the study was also incorporated into the hydrodynamic model.

The study also incorporated sensitivity analysis of the model results to assess the potential variability of the modelling results under a range of conditions. This included testing of the direct rainfall method against alternative hydrologic approaches, climate change, riverine and local catchment coincident flooding, testing the impact of changes to hydraulic roughness and the potential impact of infrastructure blockages.

Calibration and validation of the hydrology and overland routing was also undertaken as part of this study, against three recent flood/storm events including January 2013 (ex TC Oswald), February 2015 (ex TC Marcia), and ex TC Debbie in April 2017, utilising actual recorded levels as available. The model was found to calibrate and validate well and was able to replicate previous flood events within the catchment to a high level. This provided confidence to Council that the flood model was suitable for informing the flooding assessment of the Moores Creek catchment.

Ramsay Creek Flood Study (AECOM 2017)

The Ramsay Creek local catchment was modelled using a rainfall-runoff approach to develop the design hydrology, and a TUFLOW hydrodynamic model to generate overland flow distributions, flood depths and velocities, and to ascertain the flood behaviour and flood hazard of Ramsay Creek during times of storm and heavy rainfalls of various sizes and durations within the local catchment. The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 3m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions to reflect the influence of the Fitzroy River, as required.

The full council pipe network which was current at the time of the study was also incorporated into the hydrodynamic model.

The study also incorporated sensitivity analysis of the model results to assess the potential variability of the modelling results under a range of conditions. This included testing of the direct rainfall method against alternative hydrologic approaches, climate change, riverine and local catchment coincident flooding, testing the impact of changes

to hydraulic roughness and the potential impact of infrastructure blockages.

Limestone Creek Flood Study (AECOM 2017)

The Limestone Creek local catchment was modelled using a rainfall-runoff approach to develop the design hydrology, and a TUFLOW hydrodynamic model to generate overland flow distributions, flood depths and velocities, and to ascertain the flood behaviour and flood hazard of Limestone Creek during times of storm and heavy rainfalls of various sizes and durations within the local catchment. The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 3m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions to reflect the influence of the Fitzroy River, as required.

The full council pipe network which was current at the time of the study was also incorporated into the hydrodynamic model.

The study also incorporated sensitivity analysis of the model results to assess the potential variability of the modelling results under a range of conditions. This included testing of the direct rainfall method against alternative hydrologic approaches, climate change, riverine and local catchment coincident flooding, testing the impact of changes to hydraulic roughness and the potential impact of infrastructure blockages. Limited calibration and validation of the hydrology and overland routing was also undertaken against the 2017 (ex TC Debbie) event utilising actual recorded levels as available.

Splitters Creek Flood Study (AECOM 2017)

The Splitters Creek local catchment was modelled using a lumped hydrograph approach, with an XP RAFTS model to develop the design hydrology, and a TUFLOW hydrodynamic model for flow routing and determination of inundation extents, depths, velocities, flood hazard, and the flood behaviour of Splitters Creek during rainfalls of various sizes and durations within the local catchment. The TuFlow model used a 3m grid resolution to define the topography which is within the range of appropriate values for this type of urban flood mapping study.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions and the backwater influence of the Fitzroy River, and the Barrage as required.

The full council pipe network which was current at the time of the study was also incorporated into the hydrodynamic model, with sub-catchment flows evenly distributed to nearby manholes.

Calibration was also undertaken as part of this study, against the January 2013 (ex TC Oswald) event, in line with the previous flood study for this catchment. A sensitivity analysis of the model results was undertaken to assess the potential variability of the model results under a

range of conditions. This included climate change, riverine and local coincident flooding, testing the impact of changes to hydraulic roughness and the potential impact of infrastructure blockages.

South Rockhampton Local Catchment Flood Study (AECOM 2017)

The South Rockhampton local catchment was modelled using a two-dimensional Direct Rainfall method approach to generate overland flow distributions, depths, and velocities, and to ascertain the flood behaviour, flood hazard and pattern of inundation during rainfalls of various sizes and durations within the local catchment.

The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 3m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions, to account for any backwater influences from the Fitzroy River.

The full council pipe network which was current at the time of the study was also incorporated into the hydrodynamic model.

The study also incorporated sensitivity analysis of the model results to assess the potential variability of the modelling results under a range of conditions. This included testing of the direct rainfall method against alternative hydrologic approaches, climate change, riverine and local catchment coincident flooding, testing the impact of changes to hydraulic roughness and the potential impact of infrastructure blockages.

Calibration and validation of the hydrology and overland routing was also undertaken as part of this study, against three recent flood/storm events including January 2013 (ex TC Oswald), February 2015 (ex TC Marcia), and ex TC Debbie in April 2017, utilising actual recorded levels as available. The model was found to calibrate and validate well and was able to replicate previous flood events within the catchment to a high level. This provided confidence to Council that the flood model was suitable for informing the flooding assessment of the South Rockhampton Local catchment.

Wandal and West Rockhampton Local Catchments Flood Study (AECOM 2018)

The Wandal and West Rockhampton local catchment areas were modelled using a two-dimensional Direct Rainfall method approach to generate overland flow distributions, depths, and velocities, and to ascertain the flood behaviour, flood hazard and pattern of inundation during rainfalls of various sizes and durations within the local catchment.

The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 3m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions, to account for any backwater influences from the Fitzroy

River and the influence from Neerkol Creek, and Lion Creek was also considered and assessed.

The full council pipe network which was current at the time of the study was also incorporated into the hydrodynamic model.

The study also incorporated sensitivity analysis of the model results to assess the potential variability of the modelling results under a range of conditions. This included testing of the direct rainfall method against alternative hydrologic approaches, climate change, riverine and local catchment coincident flooding, testing the impact of changes to hydraulic roughness and the potential impact of infrastructure blockages.

Calibration and validation of the hydrology and overland routing was also undertaken as part of this study, against three recent flood/storm events including January 2013 (ex TC Oswald), February 2015 (ex TC Marcia), and ex TC Debbie in April 2017, utilising actual recorded levels as available. The model was found to calibrate and validate well and was able to replicate previous flood events within the catchment to a high level. This provided confidence to Council that the flood model was suitable for informing the flooding assessment of the Wandal and West Rockhampton Local catchment areas.

<u>Mt Morgan Local Catchment Flood Study (AECOM 2018)</u>

The Mt Morgan local catchment area was modelled using a two-dimensional Direct Rainfall method approach to generate overland flow distributions, depths, and velocities, and to ascertain the flood behaviour, flood hazard and pattern of inundation during rainfalls of various sizes and durations within the local catchment. The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 4m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions, and the influence of local creeks and the Mt Morgan Number 7 Dam was also considered and assessed as part of a wider regional Mt Morgan Model.

The full council pipe network which was current at the time of the study was incorporated into the hydrodynamic model.

As part of this study a sensitivity analysis of the model results was undertaken to assess the potential variability of the model results under a range of conditions. This included testing of the direct rainfall method against alternative hydrologic approaches, climate change, dam break and local coincident flooding, testing the impact of changes to hydraulic roughness and the potential impact of infrastructure blockages on the model.

Calibration and validation of the hydrology and overland routing was also undertaken as part of this study, against three recent flood/storm events including January 2013 (ex TC Oswald), February 2015 (ex TC Marcia), and ex TC Debbie in April 2017, utilising actual recorded levels as available. The model was found to calibrate and validate well and was able to replicate previous flood events within the catchment to a high

level. This provided confidence to Council that the flood model was suitable for informing the flooding assessment of the Mount Morgan Local catchment area.

Gracemere North Local Catchment area (AECOM 2019)

The Gracemere North Local catchment area was modelled using a two-dimensional Direct Rainfall method approach to generate overland flow distributions, depths, and velocities, and to ascertain the flood behaviour, flood hazard, and pattern of inundation during rainfalls of various sizes and durations within the local catchment. The modelling was undertaken utilising the TuFlow hydrodynamic software package, with a grid resolution of 3m which is in the range of appropriate values for detailed urban flood modelling.

Standard design rainfalls and losses were applied to the model, along with typical values of hydraulic roughness to characterise the impact of different land-uses on flooding, in line with national best practice guidance. Appropriate tailwater levels were applied for boundary conditions, to account for the influence from Neerkol Creek, Middle Creek, Gracemere Creek, Malchi Creek, and adjacent local catchments was also considered and assessed.

The modelled outcomes represent the best available flood information for this area.

Gracemere Creeks Flood Hazard Categorisation (AECOM 2019)

Flood modelling for Gracemere Local Creek catchment areas was undertaken in 2012, by Aurecon, and this formed the basis of the flood mapping and flood overlay for Gracemere. The modelling was updated in late 2019 by AECOM for the purposes of producing updated flood hazard mapping for Gracemere Creeks and Local Catchment areas to align with national best practice guidance for flood hazard classification. The updated mapping incorporates a revised flood hazard classification that delineates flood hazard into six categories (H1 to H6), as recommended by the Australian Rainfall and Runoff National Guidelines, to provide greater clarity on the hazard levels for a person or property exposed to floodwaters.

Flood Modelling Rationale Discussion

The modelling techniques applied for the different catchments are considered appropriate for mapping urban flood extents. Discussion on key aspects of the modelling approach is provided below.

Model Grid Resolution

It is noted that in general, a 3m hydrodynamic model grid resolution has been applied for the creek and local catchments which is within the range of appropriate resolutions for detailed urban flood mapping studies.

Over the years, model resolutions have generally become finer as computing power has increased, allowing larger grids to be computed in a reasonable time. Through Industry and Council experience in previous investigations as well as sensitivity testing, it has been demonstrated that, in general, a 5m grid resolution is sufficient to characterise urban flood behaviour. Adopting finer grids help to provide a better visual presentation and represent some local topographic features more clearly, but in general, peak flood depths and extents do not vary greatly with increased model resolution. There are also no discernible differences in the level of accuracy or

reliability in the model outputs, such as flood depth and extent.

Modelling Method

As described in the previous section, most of the flood studies for the creeks and local catchments used the direct method, whilst the Splitters Creek catchment has adopted a more traditional lumped hydrograph method.

The reasoning for the difference in approach is primarily one of timing. Until recently (within the last 7 years), the direct rainfall approach to urban flood modelling was not widely accepted by drainage authorities in Australia, as industry standards had not necessarily been updated to incorporate it. This has now changed with the national guideline 'Australian Rainfall and Runoff' supporting its use in flood studies and assessments.

Industry and Council experience over recent years suggests that adopting a direct rainfall approach is better suited to detailed council mapping studies where it is desirable to define and quantify flood impacts down to the local scale. Further discussion on the Direct Rainfall methodology is provided in section 4.10 of this document.

Model Validation

Each model produced as part of the flood studies has used a validation process to reconcile and ground truth design flows, whether this has been against the Rational Method, RORB model, or the previous flood study for peak flows. This provides confidence in the flood mapping outputs.

Sensitivity testing has indicated that peak design flows though the catchments were higher for the direct rainfall models when using standard parameters. This is consistent with literature and suggests that the direct rainfall models explicitly take account of surface ponding that would otherwise flow directly to a catchment outlet in a lumped hydrologic model.

Overall, sufficient checks have been undertaken for each model to provide confidence that the models developed, and results obtained are of an appropriate standard for the informing the planning scheme major amendment flood mapping and flood overlay.

Limitations of the flood modelling

It must be noted that the flood modelling has been based on the best available information at the time of the flood study and has been prepared for purpose of informing the potential flood behaviour of a river, creek, or local catchment. As such there are limitations to the flood model and its application. The National guideline Australian Rainfall and Runoff Revision Project 15 outlines several fundamental themes which are also particularly relevant regarding limitations of the hydraulic modelling undertaken as part of Council's flood studies, including:

- All models are coarse simplifications of very complex processes. No model can therefore be perfect, and no model can represent all of the important processes accurately.
- Model accuracy and reliability will always be limited by the accuracy of the terrain and other input data.
- Model accuracy and reliability will always be limited by the reliability / uncertainty of the inflow data.
- A poorly constructed model can usually be calibrated to the observed data but will perform poorly
- in events both larger and smaller than the calibration data set. No

model is 'correct' therefore the results require interpretation.
- A model developed for a specific purpose is probably unsuitable for another purpose without modification, adjustment, and recalibration. The responsibility must always remain with the modeller to determine whether the model is suitable for a given problem

Flood Mapping and Overlay Development

Council's flood mapping and flood overlay has been produced using an industry standard approach to filter out unnecessary flood data including areas with very shallow depths, and low velocity x depth. Once this filtering was completed, the mapping was reviewed, and additional refinement was undertaken to further streamline the data based on a minimum "puddle" area – i.e., an area that becomes isolated from the rest of the flood extent because the connecting flow path is too shallow. All puddles were assessed using engineering judgement to ensure that their removal would be unlikely to impose a future planning risk, and/or safety risk for evacuation or emergency service access. Following this rationalisation process and review, the current proposed flood overlay has been realised.

Closing comments

The updated flood studies and the resulting flood mapping and flood overlay has provided Council with an enhanced understanding of flood behaviour and flood hazard for the creek and local catchments which experience flooding during times heavy rainfall to support administration of Council's flood code and floodplain planning provisions.

The flood studies have helped to provide a baseline understanding of flood behaviour and flood overlay mapping which depicts flood inundation extents, depths, velocities, and hazard, as well as mapped natural overland flow paths. Some of the flow paths do fall within, or are in close proximity to, existing residential areas. The community consultation has sought to acquaint residents with the flood mapping and what this may mean for residents specific to their property.

It is anticipated that the consultation process has assisted residents to build and enhance their awareness of the types of flooding that may be possible in their catchment areas, and the level of flood hazard that they may be exposed to at the individual lot and locality level.

Specific treatments for addressing the flood risk (including current, future, and residual risk) in the catchments will be identified as part of future flood risk management studies which are being proposed as part Council's next phase of flood plain management actions to address flood risk. The flood risk studies will define flood risk, tolerable and intolerable risk specific to the catchment. This will likely result in significant changes to risk profiling and policy to align with a risk-based approach to floodplain management.

Direct Rainfall Methodology

Council's updated flood studies have utilised best practice flood modelling methodologies, including the use of direct rainfall/rainfall on grid to replicate storm and rainfall events to determine the flooding that may arise following such events in the creeks and local catchments with the region. This methodology has been adopted to determine the flood behaviour for the Fitzroy River, the local catchments, and

most of the local creek catchment areas, except the Splitters Creek flood study, which has utilised lumped hydrograph methodology.
Direct rainfall or 'rain-on-grid' modelling first appeared on the hydraulic modelling landscape in the mid-2000s using TUFLOW as an easier way to model rainfall runoff in urban environments instead of the traditional, and somewhat tedious approach of delineating sub-catchments for a hydrologic model, as was the case for traditional lumped hydrograph approach.

In traditional lumped hydrograph flood modelling, separate hydrological and hydraulic models are constructed. The hydrological model converts the rainfall within a sub-catchment into a peak flow hydrograph. This flow hydrograph is then applied to the hydraulic model, which estimates flood behaviour across the study
area.
In the direct rainfall approach, the hydrological model is either partially or completely removed from the process. The hydrological routing is undertaken in the two-dimensional hydraulic model domain, rather than in a lumped hydrological package. The direct rainfall method involves the application of rainfall directly to the two-dimensional model domains. The rainfall depth in a particular timestep is applied to each individual hydraulic model grid cell, and the two-dimensional model calculates the runoff from this cell.

The national guideline Australian Rainfall and Runoff's Revision Project 15 notes the following advantages of direct rainfall modelling:

- Use of the direct rainfall approach can negate the need to develop and calibrate a separate hydrological model, thus reducing overall model setup time.
- Assumptions on catchment outlet locations are not required. When a traditional hydrological model is utilised, an assumption is required on where the application of catchment outflows is made to the hydraulic model.
- Assumptions on catchment delineation are not required. Flow movement is determined by 2D model topography and hydraulic principles, rather than on the sub catchment discretisation, which is sometimes based on best judgement and can be difficult to define in flat terrains.
- Cross catchment flow is facilitated in the model. In flat catchments, flow can cross a catchment boundary during higher rainfall events. This can be difficult to represent in a traditional hydrological model.
- Overland flow is incorporated directly. Overland flow models in traditional hydrological packages require a significant number of small sub-catchments, to provide sufficient flow information to be applied to a hydraulic model.

There are also several disadvantages associated with the use of the direct rainfall approach:

- Direct rainfall is still a relatively newer technique, with limited calibration or verification to gauged data.
- The rain-on-grid approach can potentially increase hydraulic model run times.
- Requires digital terrain information. Depending on the accuracy of the results required, there may be a need for extensive survey data, such as aerial survey data. Insufficient resolution of smaller flow paths may impact upon timing.
- Routing of the rainfall applied

over the 2D model domain occurs according to the representation of the flow paths by the 2D model.

- The shallow flows generated in the direct rainfall approach may be outside the typical range where Manning's 'n' roughness parameters are utilised.

Through calibration to historic flooding data using available records captured for recent previous flood events and cyclones in the region, the rain on grid modelling produced as part of the flood studies has sought to replicate observed patterns of inundation and best represent of the likely on ground conditions that can occur during flood events.

Industry and Council experience over recent years suggests that the direct rainfall approach is ideal for detailed council mapping studies where it is desirable to define flood impact down to the local scale to inform land use planning and future infrastructure planning. The direct rainfall methodology has been found to deliver more realistic outcomes for the depiction of the interaction of pipe flows and overland surface flows, as, the way in which storm flows interact between the pipe network and the surface is considered less "realistic" when a lumped hydrologic model is used, and sub-catchment flows are split between manholes in a somewhat arbitrary way. The lumped hydrology method assumes a high degree of efficiency in the drainage network and effectively unlimited inlet capacity at manholes as runoff is entered directly into the drainage system. Through this approach shallow surface storage in the upper catchment may be slightly underestimated and local surcharging of pipes overestimated. As such, catchments adopting the Lumped Hydrograph approach (e.g., the Splitters Creek Flood Study) could be slightly conservative in areas where flows have been assumed to enter the pipe system by being evenly distributed to pits within a sub-area. This would typically be in parts of the upper catchment and be represented by slightly greater flood extents in some areas. Despite this, the accumulation of excess stormwater flow in low points within the topography, which is where local flooding typically manifests, will generally still be well represented using the lumped catchment method, and the overall impact on flood depths, velocities and mapped extents is expected to be small. With direct rainfall methodology, assumptions on catchment outlet locations are not required, and the flow movement is determined by 2D model topography and hydraulic principles. This results in a much more realistic depiction of flows which can be conveyed within the stormwater infrastructure and the excess/surcharge flows that bypass infrastructure, which helps Council to understand the areas of potential flood hazard requiring enhanced land use planning, infrastructure upgrades and flood mitigation measures.

Model Validation

Calibration and validation of the TUFLOW flood models has been undertaken by simulating historical flood events and comparing the results to recorded / anecdotal data provided by Council. The models were calibrated to the 2015 flood event for most of the updated flood studies as, at the time the studies were being undertaken, the 2015 (ex TC Marcia) flood event had been the most recent in the region. During the early stages of the flood studies, the 2017 (ex

TC Debbie) flood event occurred, which yielded additional recorded data and anecdotal data.

The model parameters were varied to match anecdotal data by varying roughness, initial losses, continuing losses, and stormwater infrastructure assumptions (roughness and blockage). The models were verified to the 2017and 2013 events. Exclusion of the pre-burst rainfall was adopted in order to make model runtimes more manageable.

Varying tidal levels were applied to the 2013 and 2015 based on historic records, with the 2017 event utilising predicted tidal levels. Surveyed peak flood levels are generally based upon flood debris marks taken as close to the peak as possible or reported flood marks and are of varying levels of accuracy; therefore, they are less reliable than recorded gauge levels. Adopted calibration tolerances for anecdotal records have been adopted as ±0.30m.

Council's Rain on grid models have been validated to reconcile design flows against the Rational Method and/or XP RAFTS model for peak flows. This has also provided additional confidence in the flood mapping outputs.

Sensitivity testing has indicated that peak design flows though the catchments are higher for Direct Rainfall models when using standard parameters. This is consistent with literature as Direct Rainfall models explicitly take account of surface ponding that would otherwise flow directly to a catchment outlet in a lumped hydrologic model, which may not represent what actually happens on the ground.

Overall, there have been sufficient checks and validation processes undertaken for each model to provide confidence that the models developed, and results obtained are of an appropriate standard for informing the flood mapping and flood overlay for the Rockhampton Regional Council Planning Scheme major amendment.

Legacy Issues

Council acknowledges that many areas of the region were developed in low-lying areas and were designed before any flood information was available. We recognise these legacy issues and whilst we cannot change what has happened in the past, we can seek to embrace a more resilient future and make better planning decisions that are supported by enhanced policy and planning knowledge as well as awareness and understanding of storm and flood behaviour. Technological advancements mean that we now have available to us an indication of where flood water may go during rain and storm events, and where are there likely to be backwater effects and ponding when the Fitzroy River floods.

Council's planning scheme aims to ensure that any new developments are appropriated located and are not subject to unacceptable risks associated with naturally occurring events, such as flooding. The minimisation of flood damages through more informed and reliable planning, appropriate mitigation, education, and disaster response is the key to developing more resilient communities which will ultimately result in future growth and prosperity. The knowledge acquired from Council's flood studies helps to minimise loss, disruption, and social anxiety, for both existing and future floodplain occupants. It is envisaged that through continuous improvement and application of learnings, we will be able to avoid the planning issues of the past.

ATTACHMENT 2 – Responses to Common Matters Fact Sheet

Rockhampton Region

Flood Hazard Overlay Mapping Amendment

Response to Common Matters Raised During Public Consultation

Rockhampton Regional Council acknowledges the matters raised by residents in their submissions on the proposed Flood Overlays amendments to the Rockhampton Region Planning Scheme. There were several common concerns raised during consultation and these are summarised in this information sheet along with Council's responses.

Accuracy of Flood Modelling and Overlay Maps

Submitters raised concerns about the accuracy of the flood modelling and associated mapping with reference to their individual properties, local areas, and their own experience of flooding.

Council has an obligation to assess and communicate flood risks and to incorporate those assessments into its Planning Scheme to mitigate the exposure of the community and future development to those risks.

The flood studies informing the proposed Flood Overlay Maps were undertaken by independent registered professional engineers with extensive expertise in flood modelling. The modelling was undertaken using industry best practice and standard modelling tools. They were based on topographic data, land use and drainage infrastructure details available at the time.

The Flood Overlay Maps represent the 1% Annual Exceedance Probability (AEP) or 1 in 100-year Average Recurrence Interval (ARI) flood event. This means that flooding could be less in more frequent events and more extensive in less frequent or less likely events. It is possible that flooding at this level is beyond what an individual resident may have experienced at that location.

Amendments to the proposed Flood Overlay Maps will only be made in circumstances where there have been subsequent engineering assessments, such as for new developments where flooding has been assessed as part of the Development Assessment process.

In this instance minor amendments will be mase in Edenbrook Estate (Springbrook Close), Lily Place Industrial Estate, Crestwood Estate (Geoff Wilson Drive and Silver Wattle Street) and Varsity Park Estate (Diploma Street) based upon development approvals and onsite works being completed. Further changes will also be made for Webber Park (Chalmers Street) and Wackford Street where infrastructure within these areas has been upgraded and revised modelling undertaken that outlines a new flood extent.

Council is committed to periodically reviewing its flood studies over time to talk account of changes in standards and modelling methods and changes in topography. Information provided by residents as part of the Planning Scheme consultation process, including private rainfall records and flood levels, will be considered in future flood modelling updates.

Impacts on Property Values and Insurance Costs

Council acknowledges that the most recent flood studies and proposed Flood Overlay Maps may have an adverse impact on land values and insurance costs. Despite this, Council has a statutory obligation and duty of care to undertake these flood assessments and incorporate the findings into its Planning Scheme and disaster management.

It is important to note that flood risk is only one of the factors affecting home insurance premiums. Premiums also consider other risk factors such as building type, building age, security, and vulnerability to other natural hazards such as cyclones, bushfire, storms, earthquakes etc.

Most insurance companies already use their own flood mapping to determine premiums relating to flood risk. The insurance industry uses a range of flood maps and studies provided from a number of Local, State, Commonwealth, and private sources in setting the insurance premiums for properties.

Council does share its flood mapping with the Insurance Council of Australia, to ensure that insurance companies have access to reliable flood information.

Many submitters raised concerns regarding the devaluing of their property due to being affected by the flood hazard overlay mapping. It is important to distinguish between the disclosure of flood risk (through regulatory controls such as flood hazard overlay mapping) and actual flooding events. Property values are more likely to be impacted upon an actual flood event, rather than being designated within the flood hazard overlay mapping. In determining any effect of the flood hazard overlay mapping, it is also important to recognise that the level of flood risk does not in fact change but the mapping simply recognises an existing condition of the land.

Whether or not the designation of land as having a flood risk has an impact on property values and sales, Council has a duty of care to the community and a legislative obligation to appropriately map and regulate new development via the planning scheme. The planning scheme seeks to ensure that development does not increase the risk to human life and property in areas that are affected, or potentially affected by flooding. This occurs through the avoidance of natural hazards, such as flooding in new development areas.

Lack of Maintenance in Creeks and Waterways Exacerbating Flooding

Residents living along creeks and waterways subject to flooding raised concerns about the level of maintenance in the creek beds and within natural waterways.

Council acknowledges these concerns and notes that management of vegetation in creeks and waterways is a balance between capacity to convey floodwater, maintaining the stability of the waterway's bed and banks and protecting environmental values.

The effect of vegetation overgrowth has also been assessed as part of sensitivity assessments in the flood modelling, and its effects on flood levels have been found to be marginal.

Whilst it is not possible to completely mitigate localised impacts during a flash flood, Council recognises the importance of continuing to work with the community and other agencies to ensure the creeks and natural waterways are maintained to improve conveyance of stormwater during major storms.

Adequacy of Existing Drainage Infrastructure

Within established urban areas, residents and businesses raised concerns that the existing drainage infrastructure was not adequate to address the localised flooding in the area.

Council's flood studies have considered drainage infrastructure that was in place at the time of the study. In general terms piped drainage networks are designed to standards well below the 1% AEP and consequently will not have significant impacts on larger floods.

It is acknowledged that much of the region comprises of development that is many decades old, where drainage infrastructure is either unavailable, or if present, is not able to meet current design standards. This means that in many locations, the infrastructure does not have the capacity to convey nominal urban design flood flows - typically a minimum 1 in 2-year ARI design and above.

Similarly, overland flow paths are either not available or do not have sufficient capacity to convey surface runoff without impacting private property.

Council is progressively addressing legacy drainage concerns through the development of flood mitigation and drainage schemes. Recent examples of schemes that have been implemented to benefit the community and reduce impacts during flood include the North Rockhampton Flood Management Area (NRFMA) Stages 1 and 2 works and the Webber Park, Wackford Street and Simpson Street drainage schemes.

Council maintains a master drainage program for addressing drainage concerns, with ongoing investigations and assessments being undertaken to address legacy drainage and flooding issues within the region. The investigations and subsequent implementation of flood mitigation and drainage schemes is prioritised based on risk to life and property, public safety, capacity, and budgetary allocation.

Upstream Developments Exacerbating Flooding

Concerns were raised by residents about the impacts of developments upstream that they believe has the potential to exacerbate the extent of flooding on downstream properties.

All new developments within the Rockhampton region, as well as developments that have been undertaken since 2015, are required to provide a stormwater management system.

These systems manage stormwater quantity and quality to ensure that, following development, the flooding impacts attributable to development do not increase or cause adverse impacts to properties located upstream, adjacent, or downstream of the development site.

The effectiveness of any stormwater management measures implemented as part of the development are required to be demonstrated via hydraulic and hydrologic modelling to ensure compliance with Council's planning scheme policies, technical standards and industry guidelines including the Queensland Urban Drainage Manual and Australian Rainfall and Runoff.

Historical developments within the Rockhampton region have been required to comply with standards at the time of the development. It is acknowledged that much of the region comprises of development that is many decades old, where drainage infrastructure is either unavailable, or if present, is not able to meet current design standards. As mentioned previously, Council is progressively addressing legacy drainage concerns through the development of flood mitigation and drainage schemes using a prioritised process.

South Rockhampton Flood Levee status

Submissions were raised requesting an update on the status of the South Rockhampton Flood Levee and whether the project would go ahead. Some submissions referred to the levee as providing a solution to their issues regarding being impacted by flooding from the Fitzroy River.

Council remains committed to the South Rockhampton Flood Levee project and continues to advocate for funding from State or Federal Governments. While this is an important matter, the proposed amendments to the Planning Scheme do not directly relate to the South Rockhampton Flood Levee or any other planned but unconstructed infrastructure.

Property Acquisition and Compensation

Residents and businesses requested whether compensation would be available for properties impacted the proposed flood hazard overlay maps.

The Planning Act 2016 deals with compensation. Section 30(4)(e) of the Act states that where a change to the planning scheme is to reduce the risk of serious harm to people or property from natural events, including flooding, and the planning scheme amendment has been undertaken in accordance with the Minister's rules, Council is exempt from paying compensation.

Removing Property from the Flood Overlay Maps

Many submissions requested that their property be removed from the flood hazard overlay maps with the reason being that they hadn't seen flooding impact upon their property or believed that their property would not be subject to flooding from either local flooding or by the Fitzroy River.

As noted earlier, the only changes to the Flood Overlay Maps will be where development approvals or drainage schemes have occurred and are supported by professional engineering assessments after Council's flood studies.

Attachment 3 - Response to common matters letter

Rockhampton Office
232 Bolsover St, Rockhampton
Gracemere Office
1 Ranger St, Gracemere
Mount Morgan Office
32 Hall St, Mount Morgan

6 March 2023

Our Ref: RRPS-PRO-201
Enquiries: Strategic Planning
Telephone: (07) 4932 9000 or 1300 22 55 77
Email: planningscheme@rrc.qld.gov.au

L Baxter
135 Hyde Street
Frenchville Qld 4701

Dear L Baxter,

RESPONSE TO SUBMISSION ON THE PROPOSED ROCKHAMPTON REGION PLANNING SCHEME – FLOOD OVERLAY MAPS

Thank you for making a submission on the proposed amendment to the Rockhampton Region Planning Scheme.

The issues raised in your submission has been carefully reviewed against the provisions of the *Planning Act 2016,* the proposed planning scheme amendment and the interests of the community as a whole. On the 28 February 2023, Council formally adopted a response to the specific issues raised in your submission. For Council's response to your submission, please refer to the enclosed information outlining common matters raised throughout the submissions.

A report summarising Council's responses to major issues raised by the community during the consultation period is also available on our website at engage.rockhamptonregion.qld.gov.au.

In accordance with the *Planning Act 2016,* the proposed amendment to the Planning Scheme has been updated to include adopted changes resulting from public consultation and has been forwarded to the Minister for State Development, Infrastructure, Local Government and Planning for final review.

The Minister will advise if Council can proceed with adoption of the proposed amendment, with or without additional conditions. Council will then formally consider adoption of the amendment to the Rockhampton Region Planning Scheme and determine a commencement date, which will be advised via Council's website and local media.

Should you require any assistance or clarification about your submission please contact Council's Strategic Planning Unit on 07 4932 9000 or email strategicplanning@rrc.qld.gov.au.

Yours faithfully,

Cameron Wyatt
Coordinator Strategic Planning

Attachment 4 - Response to individual matters letter

Rockhampton Office
232 Bolsover St, Rockhampton
Gracemere Office
1 Ranger St, Gracemere
Mount Morgan Office
32 Hall St, Mount Morgan

6 March 2023

Our Ref: RRPS-PRO-201
Enquiries: Strategic Planning
Telephone: (07) 4932 9000 or 1300 22 55 77
Email: planningscheme@rrc.qld.gov.au

B Neven
PO Box 1460
Yeppoon Qld 4703

Dear B Neven,

RESPONSE TO SUBMISSION ON THE PROPOSED ROCKHAMPTON REGION PLANNING SCHEME – FLOOD OVERLAY MAPS

Thank you for making a submission on the proposed amendment to the Rockhampton Region Planning Scheme.

The issues raised in your submission has been carefully reviewed against the provisions of the *Planning Act 2016,* the proposed planning scheme amendment and the interests of the community as a whole. On the 28 February 2023, Council formally adopted a response to the specific issues raised in your submission. Please refer to the enclosed response in relation to your submission.

A report summarising Council's responses to major issues raised by the community during the consultation period is also available on our website at engage.rockhamptonregion.qld.gov.au.

In accordance with the *Planning Act 2016,* the proposed amendment to the Planning Scheme has been updated to include adopted changes resulting from public consultation and has been forwarded to the Minister for State Development, Infrastructure, Local Government and Planning for final review.

The Minister will advise if Council can proceed with adoption of the proposed amendment, with or without additional conditions. Council will then formally consider adoption of the amendment to the Rockhampton Region Planning Scheme and determine a commencement date, which will be advised via Council's website and local media.

Should you require any assistance or clarification about your submission please contact Council's Strategic Planning Unit on 07 4932 9000 or email strategicplanning@rrc.qld.gov.au.

Yours faithfully,

Cameron Wyatt
Coordinator Strategic Planning