8.7 CCL 12/12/23 - ADOPTION OF THROSBY, STYX AND COTTAGE CREEK FLOOD STUDY

REPORT BY: PLANNING AND ENVIRONMENT
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PURPOSE

To adopt the *Throsby, Styx and Cottage Creek Flood Study.*

RECOMMENDATION

That Council:

1 Adopts the Throsby, Styx and Cottage Creek Flood Study (Rhelm, 2023) at **Attachment A**, with the amendment that flood mapping is identified as 'subject to further investigation' at John Parade, Merewether, and Kimbarra Close, Wallace Street and Gregory Parade, Kotara.

2 Adopts the 1% Annual Exceedance Probability (AEP) event in 2050 as the planning flood across the study area.

3 Endorses the removal of 47 properties in the study area with 0.01m^2 or less of probable maximum flood (PMF) extent within their boundary as flood affected

4 Notes the Throsby, Styx and Cottage Creek Flood Study - Public Engagement and Submissions Report at **Attachment B**.

KEY ISSUES

5 Newcastle is built on a floodplain and there is a high risk of flooding across the Newcastle LGA. Approximately 30% of residential properties are impacted by flash flooding which is high, comparative to other Local Government Areas (LGAs) across NSW.

6 The NSW Government's Flood Prone Land Policy and supporting Flood Risk Management Manual (2023) guides councils on managing flood risk to their communities through the flood risk management process. The manual was gazetted in June 2023 as the manual relating to the development of flood-liable land for the purposes of section 733 of the Local Government Act 1993. It replaced the NSW Floodplain Development Manual (2005).

7 CN is therefore responsible for identifying flood risk and managing flooding across the Newcastle LGA. The purpose of the *Throsby, Styx and Cottage Creek Flood Study* (Rhelm, 2023) (the Flood Study 2023) is to understand the extent and risk of flooding so CN can apply appropriate planning controls to reduce risk to life and property from flooding, build community resilience, provide information to improve State Emergency Services (SES) emergency response to local

residents during a flood event, and inform flood mitigation and management measures.

8 Prior to undertaking the Flood Study 2023, it was determined that the previously adopted *Throsby, Cottage and CBD Flood Study* (BMT WBM, 2008) (the Flood Study 2008) was significantly underestimating the flood depth of a 1% annual exceedance probability (AEP) event (the event used to set habitable floor levels of dwellings) by more than 0.5m. This means that if a 1% AEP event (that is, a 1 in 100-year flooding event) was to occur, which was similar in size to the Pasha Bulker storm, in some areas of the LGA properties built since 2008 may experience flooding as a result of planning controls not accurately reflecting the known flood risk.

9 The known inaccuracy in the Flood Study 2008 that adoption of the Flood Study 2023 will rectify, based on current (Flood Study 2023 1% AEP) flood risk, includes:

i) 845 residential properties at risk of flooding in a 1% AEP due to habitable floor levels being more than 0.5m lower than they should be, and

ii) 1,464 residential properties currently required under the Flood Study 2008 to build their habitable floor level more than 0.3m higher than they need to be (incurring unnecessary costs).

10 The Flood Study 2008 did not include the areas of Mayfield North, Newcastle East, or smaller coastal catchments draining to Bar Beach, Merewether Beach and Newcastle Beach. In addition, the Flood Study 2008 does not extend into the upper catchments of the study area, resulting in no flood mapping, controls or SES flood knowledge and planned responses in these areas.

11 The Flood Study 2008 was based on rainfall data and modelling methods from 1987 (36 years ago). Since the 2008 model was completed, the following guidelines have been significantly updated and implemented:

i) Australian Rainfall and Runoff: A Guide to Flood Estimation (Ball et all, Commonwealth of Australia, 2019)

ii) NSW Government Flood Risk Management Manual, The policy and manual for the management of flood liable land (Department of Planning and Environment, 2023)

iii) Australian Disaster Resilience Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (ADIR, 2017).

12 There have also been major improvements in computing and modelling capabilities, and ground level estimation techniques (LiDAR) since 2008. The 2021 LiDAR used for the Flood Study 2023 continues to be the most up to date data available for the Newcastle LGA.

13 The previously limited study area in the Flood Study 2008, in conjunction with use of blockage factors (now required by ARR 2019), has resulted in flood extents extending further upstream across the entire study area of the Flood Study 2023 than previously identified.

14 Flood modelling in the Flood Study 2008 included culverts sized 900mm or greater. Due to the highly complex (from a flooding perspective) urban nature of our study area and the large area covered, advice from DPE during preparation of the Flood Study 2023 was to use culverts sized 750mm or greater, based on its experience working with other NSW councils which demonstrated the limited benefits / changes to flood behaviour from inclusion of smaller culverts and much larger, less stable models that result from inclusion of a high number of smaller culverts.

15 The installation of culverts for stormwater management by CN are designed for managing smaller, more regular occurring flood events, such as a 20% (1 in 5 year) or 10% (1 in 10 year), rather than these larger 1 in 100- year flood events.

16 The Flood Study 2023 was undertaken in accordance with the NSW Flood Risk Management Manual 2023 and has significantly improved CN's understanding of flood behaviour and risk across the study area, including increases in flood depth, extent and hazard in the study area, and the impacts of climate change on flooding behaviour.

17 Accompanying the Flood Study 2023, are key high resolution flood maps (at **Attachment C**) which will be available on CN's website after adoption through an interactive map and used for planning purposes, namely:

i) Peak Flood Depth and Elevation in a 1% AEP event in 2050 (climate change scenario);

ii) Peak Flood Depth and Elevation – Probable Maximum Flood (PMF); and

iii) Peak Flood Hazard PMF (an assessment of how hazardous the physical conditions of a flood are to people, cars, infrastructure and buildings).

18 It is recommended that the 1% AEP event in 2050 mapping is used as the planning flood across the study area to inform planning controls, such as setting the habitable floor level to the flood planning level (FPL) and requiring the use of flood resistant materials below the FPL, to improve community resilience to climate change. As all new developments that will be assessed by CN are expected by CN to have an operational lifespan of more than 26 years, this will result in these developments be appropriately constructed to be resilient to the impacts of one in 100-year flooding in 2050. The 1% AEP in 2050 and 1% AEP in 2100 are the identified climate change scenarios in ARR 2019.

19 The impact of using the 1% in 2050 AEP instead of the current 1% AEP as the planning flood in CN's Development Control Plan (DCP) within the study is as follows:

	1% AEP	1% AEP in 2050
Number of properties	18,500	20,970 (+13%)

20 The PMF mapping in the Flood Study 2023 identifies that 354 properties are no longer classified as 'flood affected', compared to the Flood Study 2008.

21 It should be noted that all properties identified within the 1% AEP in 2050 are already subject to planning controls under CN's DCP Flood Management B1(b).

22 Residents across the LGA are currently experiencing insurance premium increases (both with and without flood coverage). The increase in flood insurance premiums has occurred prior to the draft Flood Study 2023 being placed on public exhibition. Flood insurance increases are being experienced across Australia, driven in part by the high cost of damages from flooding experienced in NSW and QLD in 2022.

23 Use of the 1% AEP in 2050 for planning purposes will not influence insurance premiums until the year is approaching to 2050. Insurance companies use multiple tools to determine flood risks and also rely on their own studies and assessments to identify risk and associated premiums for individual properties. Insurance companies base their premiums on current risks over the next 12 months given they charge an annual premium, which can move up or down (but usually up). CN is encouraging residents to use the mapping from the flood study to have discussions with their insurer to adjust premiums when the flood extent is shown not to impact the dwelling, or if their house is raised above the flood level.

24 Following the adoption of the Flood Study 2023, the reliability of flood information, and the methodology used to determine flood behaviour and risk, will be different between the east and west areas of the Newcastle LGA. This will remain until the completion of the Hexham and Woodberry Swamp Flood Study, likely in 2025.

25 Due to significant improvements in the way flood risk and behaviour is understood since the Flood Study 2008, two DCP flood management sections, namely B1(a) and B1(b), relating to flood prone land across the Newcastle LGA are required to enable a consistent application of planning controls until updated flood studies have been adopted for the entire Newcastle LGA. The draft DCP Flood Management B1(b) will apply to the Flood Study 2023 study area and has been updated in line with current guidelines and industry best practice, including the use of the *Australian Rainfall and Runoff (ARR) Guidelines 2019* and the *Australian Disaster Resilience (ADR) Guidelines 2017*, which is required to be used for all flood studies undertaken since the ARR 2019 guidelines were released by the Federal Government. The draft DCP Flood Management B1(a) will apply to the western part of the Newcastle LGA, which uses the Flood Study 2008, and references controls suitable for the 2008 methodology used at the time.

FINANCIAL IMPACT

26 CN was awarded grant funding through the Department of Planning and Environment's (DPE) Floodplain Management Program to contribute to the preparation of the *Throsby, Styx and Cottage Creek Flood Study (Rhelm 2023).* The remainder of the study was funded by CN.

27 Funding has been allocated in CN's forward budget for the completion of the *Hexham and Woodberry Swamp Flood Study* in 2023/24 and 2024/25 and the *Newcastle Flood Risk Management Study and Plan* (FRMSP) in 2025/26.

28 CN has been awarded grant funding through the Department of Planning and Environment's (DPE) Floodplain Management Program, in partnership with Cessnock and Maitland Councils, to contribute to the preparation of the *Hexham and Woodberry Swamp Flood Study*. Grant funding will also be sought for the preparation of the Newcastle FRMSP referenced above.

NEWCASTLE 2040 ALIGNMENT

29 The Flood Study 2023 is consistent with the strategic directions of the Newcastle 2040 Community Strategic Plan.

Sustainable
2.2 Action on Climate Change
2.1.2 Know and share our climate risk
2.1.3 Resilient urban and natural areas

2.2 Nature-based solutions
2.2.3 Achieve a water-sensitive city

IMPLEMENTATION PLAN / IMPLICATIONS

30 The Flood Study 2023 repeals and replaces the *Throsby, Cottage and CBD Flood Study (BMT WBM, 2008)* and associated flood mapping.

31 Planning controls for properties identified as flood affected in the Flood Study 2023 are detailed in the draft *DCP Flood Management B1(b)*, which identifies the planning flood as the 1% AEP in 2050 event. Newcastle LGA properties outside of the Flood Study 2023 study area will use the draft *DCP Flood Management B1(a)*, which specifies the planning flood as the 1% AEP event, under the 2008 Flood Study, until updated flood studies are completed across the LGA.

RISK ASSESSMENT AND MITIGATION

32 The adoption and implementation of updated flood studies is a key step in the flood risk management process, as outlined in the NSW Government's Flood Risk Management Manual (2023), shown in Figure 1 below:

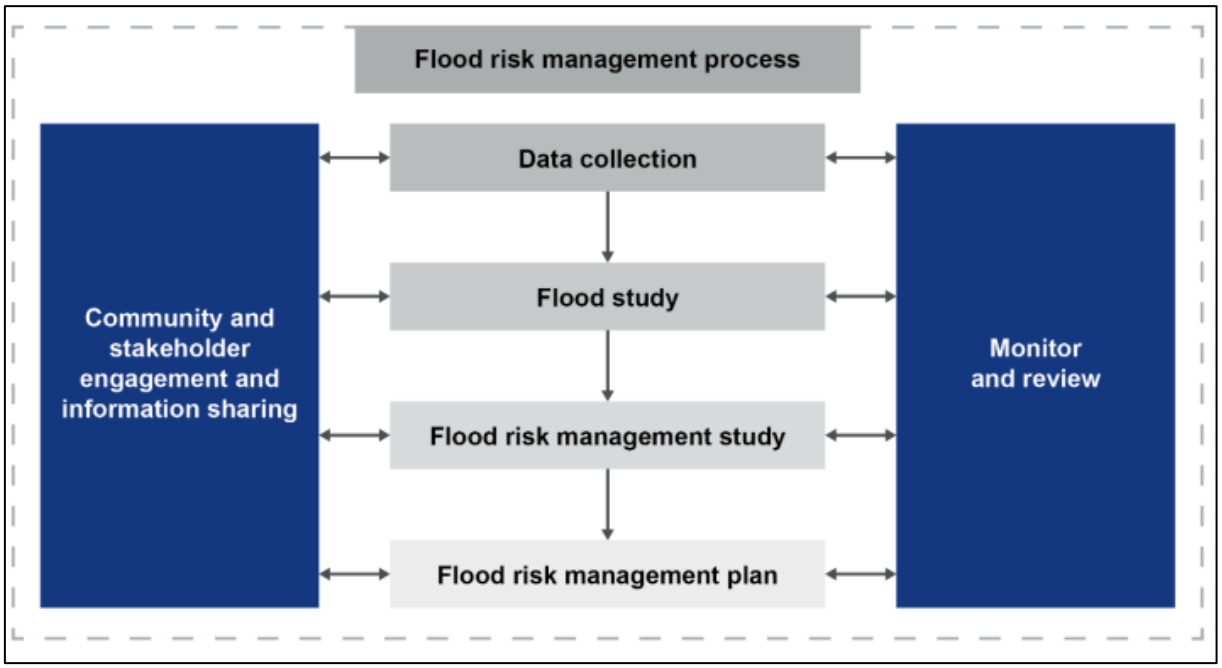

Figure 1: Flood risk management process (Flood Risk Management Manual 2023)

33 This manual (which includes the NSW Flood prone land policy) replaces the Floodplain development manual (DIPNR 2005) as the NSW Government's manual relating to the management of flood liable land in accordance with section 733 of the *Local Government Act 1993* (LG Act). This provides councils, statutory authorities, and state agencies and their staff, with indemnity for decisions they make and information they provide in accordance with the manual.

34 The NSW Flood prone land policy provides 'a merit-based approach to the selection of risk-based flood planning levels (FPLs), recognising the need to consider the risks associated with the full range of flooding events, up to and including the probable maximum flood (PMF)'.

35 Principle 5 in the Flood Risk Management Manual 2023 states that 'effective FRM relies on understanding the full range of floods and how flood behaviour, constraints and impacts vary between flood events and across the floodplain'.

36 In accordance with these requirements in the NSW Flood prone land policy and the Flood Risk Management Manual 2023, the Flood Study 2023 contains a series of maps, including Peak Flood Depth and Elevation in a 1% AEP event in 2050; Peak Flood Depth and Elevation – Probable Maximum Flood (PMF); and Peak Flood Hazard PMF.

37 Following the adoption of the Throsby, Styx and Cottage Creek Flood Study 2023 and the Hexham and Woodberry Swamp Flood Study 2024/25, CN will complete the Newcastle Flood Risk Management Study and Plan (FRMSP).

38 The flood risk management study provides the basis for examining and recommending management measures to manage flood risk, assessing options against a range of performance criteria related to their effectiveness, efficiency, practicality, feasibility, and community and environmental impacts.

39 The flood risk management plan builds on the recommendations of the flood risk management study to address existing, future and continuing flood risk and to limit the residual risk to the community. The flood risk management plan outlines how CN will effectively manage flood risk in the study area into the future for the benefit of the community, including making flood information available, land-use planning, emergency planning and disaster recovery, community flood awareness, flood mitigation works, and property modification projects, such as voluntary purchase and house raising projects.

40 Following the adoption of the Newcastle Flood Risk Management Study and Plan (FRMSP), flood risk management actions will be prioritised and undertaken through CN's capital works program.

RELATED PREVIOUS DECISIONS

41 The *Throsby, Cottage and CBD Flood Study* was adopted by the Council in 2008.

42 At the Ordinary Council Meeting on 25 July 2023, Council resolved to place the draft *Throsby, Styx and Cottage Creek Flood Study* (Rhelm, 2023) on public exhibition.

43 At the Ordinary Council Meeting on 26 September 2023, Council resolved to place the draft *DCP Flood Mitigation B1(b)* on public exhibition, which references best practice guidelines and controls for properties identified as flood prone in the Flood Study 2023. The draft DCP also identifies the 1% in 2050 AEP as the planning flood.

CONSULTATION

44 The Flood Study 2023 has been completed in conjunction with DPE, ensuring the methodology used is consistent with best practice across NSW and integrates learnings from flood studies completed in similar catchments.

45 The draft Flood Study 2023 was placed on public exhibition for 28 days from 26 July to 24 August 2023. Engagement activities during the public exhibition period included a flyer box drop to 41,300 properties within the study area, 2,404 letters to newly identified flood affected property owners, 786 letters to no longer flood affected property owners, and 1,503 email notifications to residents signed up for the CN Flash Flood Alert Network and contributors to the first stage of the flood study public exhibition. CN’s online Facebook campaign reached 40,236 accounts and there were 19,870 views of the draft Flood Study 2023 on the Have Your Say Page, from 3,800 individual visitors. CN received 164 online survey responses, two agency submissions and an additional 36 email submissions. Two community drop-in sessions were held, as well as 26 one-on-one sessions with newly flood affected property owners and 13 community phone calls with CN or consultant (Rhelm) flood engineers.

46 Prior to the public exhibition period, meetings were held with Hunter Water, State Emergency Services (SES) and the Port of Newcastle, to discuss the outcomes of the draft Flood Study 2023.

47 Key feedback heard as a result of the public exhibition was:

i) concerns about increasing flood insurance (more generally and due to the release of the Flood Study 2023)

ii) concerns the Flood Study 2023 may decrease property values for those properties newly identified as flood affected (within the PMF extent)

iii) concerns with the accuracy of the flood mapping:

a) as property has not flooded historically

b) houses raised above flood levels should be excluded from flood prone classification

c) alleged inaccuracy of LiDAR

d) public exhibition flood maps were low resolution

iv) support and disagreement with the use of climate change projections and sea level rise in the study

v) concerns with factors that increase flooding:

a) increase in development since previous study in 2008

b) insufficient drainage maintenance by CN or Hunter Water

vi) requests for CN to undertake work to reduce flooding impacts.

48 A total of 13% of the online survey respondents supported the use of the 1% AEP in 2050 event to inform planning controls, with 4% unsure and 75% having no or unrelated comments. Only 8% of survey participants did not support the use of the 1% AEP in 2050 event as the planning flood. No comments were received on the use of the 1% AEP in 2050 event as the planning flood during the recent public exhibition of the revised DCP.

49 Concerns were raised by the community in relation to their property being classified as flood affected. Flood affected land is defined in the NSW Government Flood Risk Management Manual 2023 as land susceptible to flooding by the probable maximum flood (PMF) event. Flood affected land is also known as the floodplain, flood prone land and flood liable land. Hence, land mapped within the PMF extent is deemed 'flood affected' as defined in the Manual.

50 No culverts 750 mm or greater were identified in the vicinity of the Kotara train line at the time of data collection for the study, including Kimbarra Cl, Wallace St and Greggory Pde, Kotara, and hence were not included in the flood model for this location. It is recommended that PMF mapping is identified as 'subject to

further investigation' at this location and that culverts 750mm or greater are included in a revised model for this location.

51 Concerns were raised by the residents at John Parade, Merewether, in relation to the exclusion of culverts <750mm in flood modelling for this location. In response to resident concerns and the minimal extent of PMF mapped for properties in this location, it is recommended that flood mapping is identified as 'subject to further investigation' at this location and that appropriate culverts < 750mm are considered for inclusion in a revised model for this location.

52 It is recommended that 47 properties in the study area with 0.01m^2 or less of PMF extent within their boundary be not classified as flood affected.

53 Minor revisions will be made to the Flood Study 2023, as per the response to submissions table in the *Public Engagement and Submissions Report* at **Attachment B**, in relation to the notation of the Merewether and Kotara further investigations. A section on the public exhibition outcomes has been added to the Flood Study 2023.

54 The CN website will be updated with the Flood Study 2023 and high-resolution interactive flood mapping.

55 CN will continue to deliver community flood education programs, to raise awareness of flood risks identified in the Flood Study 2023, encourage sign up to the CN Flash Flood Alert Service and to improve knowledge on how to respond to flooding. This material will be developed in conjunction with the SES and will build on previous research and SES experience.

BACKGROUND

56 CN manages flood risk in accordance with the NSW Government's Flood Prone Land Policy and the Flood Risk Management Manual (2023), for the purposes of section 733 of the NSW *Local Government Act 1993*.

57 Newcastle is built on a floodplain and there is a high risk of flooding across the Newcastle LGA. Approximately 30% of residential properties are flood affected. CN currently uses the adopted *Throsby, Cottage and CBD Flood Study 2008* to base planning decisions on, and to manage risk to life and property.

58 Since 2008, there have been significant advances in flood modelling capability, LiDAR quality, and development across CN. In addition, the Australian Rainfall and Runoff guidelines for how to estimate flood impacts and behaviour was updated in 2019 by the Federal Government, with significant changes to modelling methodology, rainfall patterns, and estimation of climate change impacts.

59 Recent flood studies undertaken by consultants for development purposes have indicated that CN’s 2008 adopted 1% AEP flood levels are up to 0.5m lower than studies using best practice modelling and current development LiDAR.

60 CN needs to update the flood impact and behaviour knowledge across the Newcastle LGA in accordance with best practice guidelines, to inform appropriate planning decisions, to improve community resilience to floods, and to reduce the risk of loss of life resulting from flooding.

61 Over 50 NSW councils have been awarded grant funding by the DPE since the ARR was updated in 2019 to update local flood studies, in accordance with ARR 2019, including Blacktown, Campbelltown, Coffs Harbour, Fairfield, Liverpool, Shoalhaven, Penrith, Parramatta, Hawkesbury, Sutherland, Northern Beaches, Central Coast and Lake Macquarie.

62 Councils who have adopted updated flood studies based on the ARR 2019 include, but are not limited to:

i) Blacktown City Council
ii) Campbelltown City Council
iii) Shoalhaven City Council
iv) Camden Council
v) Fairfield City Council
vi) Camden, Blacktown Liverpool and Penrith (South Creek Cumulative Impact Assessment)
vii) Dubbo Regional Council
viii) Narrabri Shire Council
ix) Lithgow City Council
x) Bland Shire Council
xi) Coffs Harbour City Council.

63 Due to the complexity and different nature of flood response in the eastern side of the Newcastle LGA where creeks combine during rare events and drain to the harbour, and the western side where all catchments drain to Hexham Swamp, updated flood modelling and flood studies for the Newcastle LGA are being undertaken in two parts. The *Throsby, Styx and Cottage Creek Flood Study (Rhelm, 2023)* is the first flood study, for the eastern part of the Newcastle LGA, and for the study area shown at **Attachment D.** The Flood Study 2023 was completed first due to higher development pressure in flood affected areas. The flood study for the western part of the Newcastle LGA, *the Hexham and Woodberry Swamp Flood Study*, will commence in early 2024.

64 A flood study aims to define flood behaviour in sufficient detail to support the understanding and management of flood risk. Understanding flood behaviour and risk requires knowledge of local flood history; evidence of the types and scales of storm events that have previously caused problems to the community, an understanding of current catchment and floodplain conditions (for example, ocean conditions, landforms or built structures) that may influence flood behaviour and impact and how these have changed since key historic floods and how they may change into the future due to climate change, development and catchment changes; and an understanding of the scale of impacts that historic and design events have on the community. A flood study also provides a platform for developing information to support flood risk management, emergency management and land-use planning, and to inform consideration of flood risk management measures as part of flood risk management studies and plans.

Flood modelling methodology

65 The Flood Study 2023 has been developed by Rhelm, a specialist consultancy working across NSW local government, including for Hawkesbury City Council, Wollongong City Council and Central Coast Council.

66 DPE partnered with CN to develop the Flood Study 2023 and has had technical oversight of the project, with CN's primary contact being Richard Murphy, Senior Natural Resource Officer Leader - Water Floodplains and Coast. DPE has been involved in every step of the project - from development of the technical details within the brief; participation in every project meeting; being on call to discuss technical concerns and options; providing guidance based on their experience in being involved in other studies completed for similar, highly urbanised flash flood catchments; and providing review comments on each section of the report as it was submitted.

67 The process of building a flood model follows the following steps:

i) Building an initial model based on all available asset, structure and LiDAR data
ii) Using ARR 2019 to estimate parameters for the initial model run
iii) Runing the model against a historic flood, and modifying the parameter assumptions (within acceptable limits) until the model can replicate historic flood levels
iv) Runing the customised model against another historic flood (for this study it was two additional floods) to see if the customised model can replicate these flood levels as well. If the model passes this test, the model is used to estimate flood behaviour for design events (10%, 5%, 2%, 1%, climate change scenarios and PMF). If it does not pass, the model is reviewed, and re-calibrated / additional data is collected and included.

68 All assumptions made in the model, including parameters like blockage factors and rainfall losses (infiltration and ponding that does not become runoff), were included in the initial model directly from ARR 2019 recommendations. The model was then run with the rainfall recorded from the 2007 Pasha Bulker flood, and the model results were compared against the survey flood heights taken after the Pasha Bulker flood.

69 It was found that when the model used the ARR 2019 recommended blockage factors, the 2007 survey flood event levels were underestimated (that is, the modelled flood levels were lower), particularly in the upper areas of the catchment. To replicate flooding levels in the upper parts of the catchment, higher blockage factors needed to be used on culverts and small bridges.

70 With specialist technical input from Rhelm and DPE, the blockage factors recommended in ARR 2019 were retained (slightly underestimating the flood impacts in the upper areas of the catchment), as it was not desirable to adopt onerous blockage factors that increased flooding in the model's design events based on Newcastle's one known significant flood (2007 Busha Pulka flood).

71 In addition to the peer review by DPE, the Flood Study 2023 was also peer reviewed by an external consultant, Blue Coast Consulting Engineers, who specialise in coastal management.

72 Following the completion of the two flood studies across the Newcastle LGA, CN will re-convene the Flood Risk Management Committee, to advise and prepare the Newcastle Flood Risk Management Study and Plan (FRMSP), that will cover the entire Newcastle LGA. The Newcastle FRMSP will replace the current Newcastle City Wide Flood Risk Management Plan (FRMP) and Wallsend Commercial Area FRMP.

OPTIONS

Option 1

73 The recommendation as at Paragraph 1,2, 3 and 4. This is the recommended option.

Option 2

74 Not adopting the Flood Study 2023. The adoption of the Flood Study 2023 is required through the NSW Government's Flood Risk Management Manual (2023). This not the recommended option.

Option 3

75 Not adopting 1% AEP event in 2050 as the planning event for the Flood Study 2023 study area. This is not the recommended option.

REFERENCES

ATTACHMENTS

Attachment A: Throsby, Styx, Cottage Creek Flood Study (Rhelm, 2023)

Attachment B: Throsby, Styx and Cottage Creek Flood Study Public Engagement and Submissions Report

Attachment C: Key flood maps from the draft Throsby, Styx, Cottage Creek Flood Study (1% AEP in 2050, PMF, PMF Hazard)

Attachment D: Study area for the draft Throsby, Styx and Cottage Creek Flood Study 2023

Attachments A - D distributed under separate cover