Executive Summary

Background

The Sutherland Shire Overland Flood Study has been undertaken by BMT Commercial Pty Ltd ("BMT) for Sutherland Shire Council ("Council") to define the overland flood behaviour and associated flood risk within the urban areas of the Sutherland LGA that ultimately drain to the Georges River to the east and west of the Woronora River outlet, Woronora River and Port Hacking (a total catchment area of approximately 253 km^2). The study area and associated major catchments are shown in Figure 2. Please note that this study excludes the Gwawley Bay, Woolooware Bay, Bundeena Creek and Kurnell township catchments previously studied by Council, as well as the eastern portion of the LGA within the Royal National Park that drains east to the Pacific Ocean.

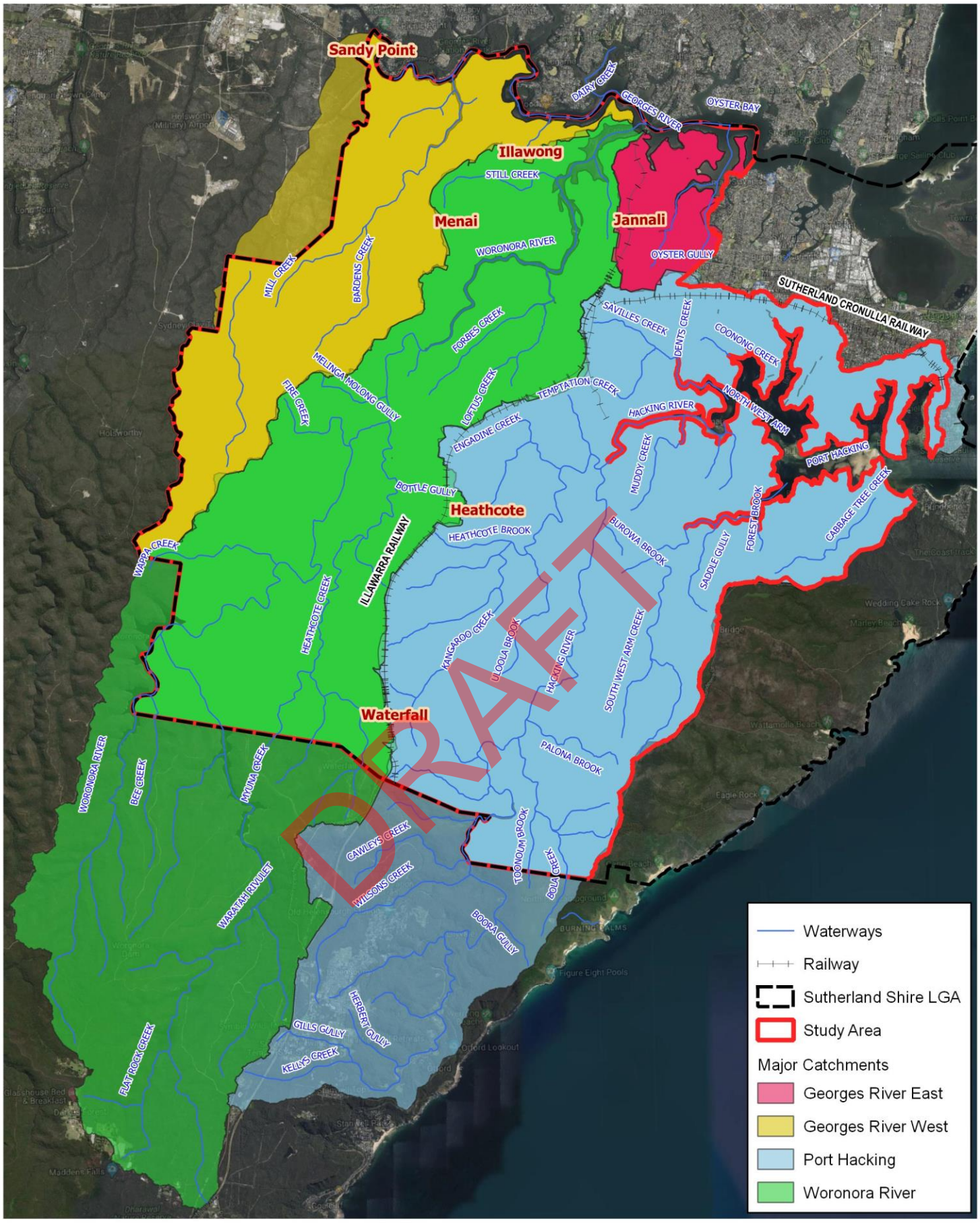
It is noted that the focus of this flood study is local overland flood conditions within the urban areas of the study catchments. The potential interaction of overland flows with receiving watercourses at the outlet of the catchments was also considered, however specific consideration of riverine flooding within the Woronora River and Georges River was beyond the scope of this study.

The outputs of this study will assist in Council's management of flood risk by identifying and assessing the existing and potential future flood risk (i.e. incorporating climate change), and informing strategic land use policy, flood-related development controls, and flood emergency management planning and response within the study area. It forms an initial stage towards the development of a comprehensive Floodplain Risk Management Study and Plan that will ultimately guide the direction of future floodplain risk management activities across these catchments with the specific aim of reducing the risk to life, property and infrastructure associated with overland flooding.

The project was completed based on best practice guidance and methodologies for flood studies in NSW and in accordance with the project requirements defined by Council and the Department of Planning and Environment (DPE).

The Flood Study is presented in the following two volumes:

- Volume 1: Report and Appendices (this document)
- Volume 2: Flood Mapping.



Title:

STUDY LOCALITY

Figure: 2

Rev: A

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BMT

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Community Consultation

Community consultation was completed via a number of different consultation methods at various points within the Flood Study process. This included:

- Study webpage established in September 2021 for the duration of the study and made available via Council's online community engagement portal (Overland Flood Study | Join the Conversation - Sutherland Shire Council (nsw.gov.au)).
- A social media release prepared by Council to advertise the study, community questionnaire and webpage on social media.
- Community questionnaire to gather relevant flood information from the community, including photographs, observed flood depths and descriptions of flood behaviour within the study area. The questionnaire was accessible through Council's online community engagement portal from 15 September to 15 October 2021. Three submissions to the online questionnaire were received.
- Public exhibition.

Overall, these community consultation activities have:

- Informed the community about the preparation of the Flood Study and its likely outcome, as a precursor to the development of a floodplain risk management study and plan.
- Provided an opportunity to collect information on the community's flood experience and their concerns on flooding issues.
- Maintained community engagement with the study and its outcomes.

Model Development and Verification

New hydrologic and hydraulic models were developed to define overland flood behaviour across the study area based on detailed and contemporary topographic data, latest modelling techniques and current best practice guidance (i.e. Australian Rainfall & Runoff 2019 (ARR2019)). This included:

- Hydrologic model of the four (4) major catchments within the study area, i.e. Woronora River, Georges River East, Georges River West and Port Hacking catchments, using the Watershed Bounded Network Model (WBNM) software. The outputs of the hydrologic modelling defined the flow hydrographs inputted into the hydraulic model.
- Two-dimensional (2D) hydraulic models of the urban floodplains within the Woronora River, Georges River East, Georges River West and Port Hacking catchments using the TUFLOW software. The results of these models define design flood conditions such as flood extents, levels, depths and velocities as outputs.

The WBNM and TUFLOW models were verified against available historical flow and flood information for events that occurred in May 2003, April 2015, February 2020 and March 2021 to confirm key model parameters and the capability of the models for producing reliable estimates of flood behaviour. Overall, the outcomes of the model verification indicated that the models provide consistently good outcomes across the four historical floods used for model verification, and provide suitable tools for estimating design flood behaviour across the study area.

Design Flood Simulation and Mapping

The verified WBNM and TUFLOW models were used to simulate a range of design flood magnitudes ranging from more frequent events to very rare events and define overland flood conditions. Specifically, this included the following design floods: 20%, 10% 5%, 2%, 1%, 0.5% and 0.2% Annual Exceedance Probability (AEP) floods and probable maximum flood (PMF).

The design modelling outputs were used to develop a comprehensive set of design flood maps to visualise the potential flood behaviour and associated flood risks across the study area. This includes peak flood level, depth, velocity, hazard and flood function mapping. These mapping outputs are presented in Volume 2: Flood Mapping.

Summary of Flood Behaviour

Overland flow within the study catchments is caused by short duration, intense rainfall events (i.e. high rainfall totals over short time periods typically in the order of hour(s) or less) and when the rainfall within a catchment falls onto impervious or saturated areas, is unable to infiltrate into the ground and instead becomes runoff which contributes to overland flow. This behaviour is most easily observable on “hard surfaces” (e.g. roads, houses and pavements) within the urban environment, where very little rain is able to infiltrate and runoff quickly turns into rapid overland flow or ponding. However, this type of runoff can also occur in more pervious areas, during intense periods of rainfall capable of exceeding the infiltration capacity of the soil.

Overall, the flood behaviour across the study area is typically characterised by relatively shallow overland flow within the upper catchment areas, which is initiated when the capacity of the available stormwater drainage network is exceeded by local catchment runoff. Within the lower catchment areas, major overland flow paths are formed as the size of the upstream contributing catchments increase. Areas of significant flooding are typically located where a major overland flow path is not aligned along a roadway or an alternative easement, or within local topographic depressions.

During smaller magnitude floods, such as the 20% AEP to 5% AEP, overland flow flooding in urban areas is typically contained within defined waterways and roadway corridors. However, during larger magnitude events, such as the 2% AEP flood and larger, property inundation occurs in some parts of the study area when overland flow from an upstream catchment area drains through a property to its discharge point or when flow within a roadway overtops the layback / kerb and drains through a property.

Flood modelling results were also reviewed to identify several key flood locations or flooding “hotspots” with a concentration of flood impacted properties or significant inundation as a result of overland flow flooding. Where feasible, future investigations and potential floodplain risk management activities should be aimed at reducing the flood risk in these hotspot locations. It is noted that across the study area, the largest number of hotspots were identified within the Port Hacking catchment (relative to other major catchments within the study area).

Sensitivity and Climate Change Assessment

Sensitivity analyses were undertaken to assess the potential impact of variation in model parameters on predicted design flood behaviour. Sensitivity tests included changes to:

- Hydraulic roughness (Manning’s n value)
- Hydraulic structure blockage (both globally and structure-specific blockage)

The results of the sensitivity assessment indicated that flood levels were most sensitive to changes in hydraulic structure blockage.

The potential impacts of climate change, including increased rainfall intensity and sea level rise, were also assessed. The results of the climate change assessment indicate that climate change does have the potential to increase the existing flood risk.

Whilst it is acknowledged that there is still considerable uncertainty associated with climate change predictions and current information suggests rainfall intensity is not predicted to reach the upper limits

considered as part of this study until at least approximately 2090, potential changes in climate conditions should be closely monitored as there is potential for impacts to overland flood levels across the urban floodplain.

Information to Support Decisions

Flood planning and emergency response information, including definition of the Flood Planning Area (FPA), Flood Control Lots, Flood Risk Precincts and Flood Emergency Response Classifications (FERCs), was also be developed based on the predicted flood characteristics and will aid in Council's decision making within the floodplain. These mapping outputs are presented in Volume 2: Flood Mapping.

Notably, the derivation of a FPA and identification of flood control lots has been undertaken based on a methodology determined and agreed with Council (refer Sections 9.2 and 9.3), noting that the FPA was based on the application of a flood planning level (FPL) equivalent to the 1% AEP flood level plus 0.5 m freeboard. This has identified properties within Council's GIS cadastral lot database that are:

- FPA and PMF tagged
- PMF tagged only (i.e. within the PMF extent but beyond the FPA extent)

The number of flood control lots identified in the study area is listed in Table 1.

Table 1. Flood Control Lots within the Study Area

Flood Control Lot Tagging	Number of Lots Tagged (Total Cadastral Lots within Modelled Extent = 48,612)
FPA	6,886
PMF	9,741