6 March 2024

Ms Catherine Van Laeren
Director, Metro West
Planning, Land Use Strategy and Housing
NSW Department of Planning, Housing and Industry
Locked Bag 5022
PARRAMATTA NSW 2124

Finalisation of Fairfield LEP 2013 (Amendment No.45) – Accelerated LEP Review Stage 2 Planning Proposal

Dear Catherine

This letter represents Council's formal response to the Department's request for feedback on the proposed making of the Fairfield Stage 2 Planning Proposal (PP) under s.3.36(1) of the EP&A Act.

I also refer to your letter to Council dated 20 November 2023, responding to Council's letter of 10 October 2023 (outlining Council concerns in relation to the Flood Advisory Panel (FAP)) regarding the Stage 2 PP. In particular, I note your advice that:

> "*the Department is committed to working with Council to ensure the best possible outcome given the strategic importance of this planning proposal while balancing flood considerations for the community*".

This letter provides Council position to facilitate finalisation of the Stage 2 PP, based on the principle of balancing strategic planning outcomes against important flood considerations impacting the community.

Council's position regarding the further progress of the Stage 2 PP is also underpinned by a review of the FAP advice of the Stage 2 PP by an independent flood expert, Stephen Molino – Director of Water Technology, as well as information contained in Council flood studies, and relevant findings and the recommendations of the NSW Flood Inquiry.

In regard to the Stage 2 PP draft instrument and LEP maps referred to Council for comment, Council does not support the Department's proposed blanket removal of all properties in the Stage 2 PP affected by the Probable Maximum Flood (PMF). This is based on Council's view that this response is based on inaccurate and unfounded technical advice provided by the FAP.

A. Independent Review of FAP Advice

The review undertaken by Water Technology (Attachment A) dispels the incorrect advice from the FAP regarding the status of the Council flood studies supporting the Stage 2 PP and the need to undertake new flood modelling as a result of such factors as climate change and flood events that occurred in the Georges River Catchment in 2021-2022.

Specifically, the advice from Water Technology highlights a number of fundamental technical matters relating to the Council flood studies that were not adequately considered or taken into account by the FAP, Technical Advisor Group (TAG) and State agencies that are summarised as follows:

- Concerns that Council flood studies do not utilise the Australian Rainfall and Runoff (ARR) 2019 methodologies/data. This would in fact result in significantly lower flood levels than the floods levels associated with the ARR 1987 methodology that have informed the flood studies applicable to the Stage 2 PP.

- None of the flood events which occurred in the Georges River in 2022 were extremely rare probabilities. These events are unlikely to increase projected flood levels in the more extreme events associated with the flood studies supporting the Stage 2 PP.

- The nature of flooding events in Fairfield City has three distinct components comprising flooding from creeks, the Georges River and overland flooding (attributable to blockages in stormwater drains).

- Flooding from creeks and overland flooding represent the greatest potential for impacting on the areas covered by the Stage 2 PP, but as per Water Technologies advice *"even in the most extreme flood events the flooding would not last for much more than a couple of hours".*

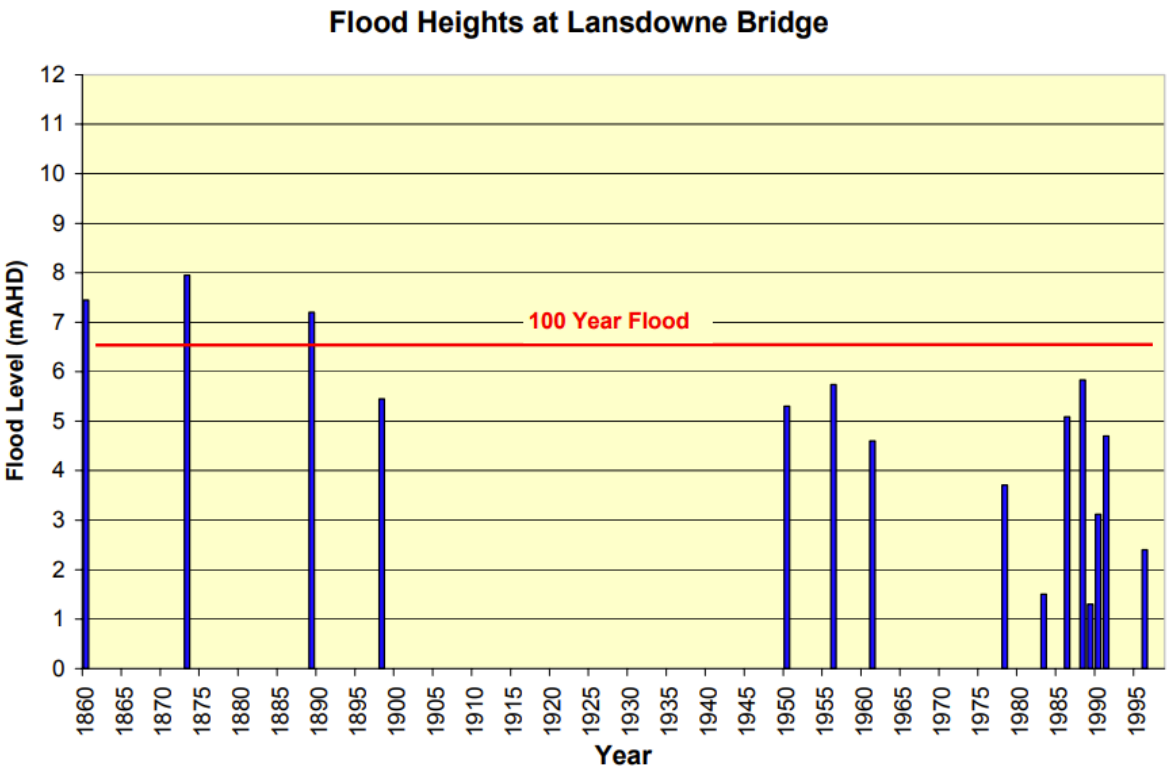
- Based on SES evacuation modelling assumptions and procedures, it takes an average of one hour for occupants to accept the need to evacuate and another hour to get ready to evacuate. In this respect, a more appropriate response in overland and mainstream flash flood (i.e. 2hr) events is for people to shelter in place.

In addition to the above, based on the comments from the TAG and State agencies, Council has major concerns that inadequate consideration was given by the FAP to flood emergency/evacuation, climate change issues and sensitivity analysis in the flood studies supporting the Stage 2 PP.

An example of this information is included in Attachment B (relating to Fairfield Town Centre from a 2020 study) and was referenced in the flood information package (relating to S.117 Ministerial Direction 4.3), provided to the Department and FAP prior to Council officers meeting with the FAP on the 12 May 2023.

B. Georges River – Rare flood events & evacuation warning times

By way of background, as shown in the following figure, since flood records have been first kept, over the last 160 years there has not been a PMF flood event experienced in the Georges River Catchment.



Extract from Georges River Floodplain Risk Management Study & Plan – Bewsher Consulting Ptd Ltd May 2004

Council does not discount the potential for rarer flood events occurring in future and the need to consider flood evacuation issues. To this end, the advice from Water Technology highlights a number of critical insights into current arrangements for flood evacuation processes applicable to Georges River Catchment as follows:

- The Bureau of Meteorology (BOM) has a flood forecasting system for the Georges River and it can provide between 6 and 12 hours warning of forecast flood heights at the Liverpool gauge which should provide adequate warning time for people in Fairfield LGA to evacuate ahead of flooding on the Georges River.

- This warning time is based on the time it takes floodwaters to travel from the upstream gauges down to Liverpool and would be the same regardless of whether it was a 1% AEP flood, 0.2% AEP flood or a PMF in the Georges River.

In light of the FAP advice regarding the need for modelling of rarer flood events up to the PMF, Council also requested Water Technology to produce a map showing the extent of the 0.2% (1 in 500 year) flood event for the Georges River within the Fairfield LGA, with details of this flood event included in Figure 3 of the Water Technologies advice.

Critical outcomes in relation to the Stage 2 PP are as follows:

- The 0.2% event has minimal impact on the town centres and residential areas covered by the Stage 2 PP.

- Council estimates the number of properties in the Stage 2 PP that are affected by the 0.2% event are as follows:
    - Carramar – 68
    - Fairfield Heights – 13
    - Fairfield Town Centre - 6

In addition to the above, it is noted that the key centres (Fairfield and Canley Vale) potentially affected by flooding from the Georges River are located toward the periphery of the extent of the PMF event. A recent analysis undertaken by Council indicates that for sections of Fairfield and Canley Vale the depth of the PMF flood waters in these centres are as low as 40cm and 30cm respectively.

It is noted that in relation to flood evacuation matters relevant to PMF flooding in high-risk catchments, Recommendation 18 of the NSW Flood Inquiry indicates that investigations into flood risk management matters should include:

> *"evaluation of the cost and effectiveness of risk mitigation efforts, including land preparation, planning use and management, to enable a better understanding of what works"*

In response the NSW Government indicated that:

> *"it supports improved flood planning, in particular for high-risk catchments. Consideration will be given to how the Government can support a consistent approach to flood planning via pilots"*

At this stage, no advice has been provided on the timing of the 'pilots' to investigate flood evacuation matters relevant to the Georges River Catchment in the event of a PMF flood event.

Given the uncertainty regarding the above, Council believes it should not be disadvantaged by the uncertainties regarding flood evacuation modelling for a PMF event in the Georges River, particularly given the validity of Council flood studies and maps and the amount of warning time (6-12hrs), that would be available for the community of the Fairfield LGA to evacuate for rarer floods including both the 1 in 500 and PMF events.

In light of the above, Council's view is that a more reasonable and balanced risk-based approach would be to defer properties affected by 1 in 500 year flood event as detailed above (total of 87 properties) as well as 11 properties affected by overland flooding alone in Carramar and Villawood with a flood hazard level H3-H4, until such time as further analysis of flood hazards and flood evacuation issues for these properties is undertaken by Council.

As referred to by Water Technology, it is understood that some consideration is being given to using the 1 in 500 year flood as a potential flood planning level (FPL) for high-risk catchments. It is noted that in Fairfield, this FPL would be generally captured with the 500mm freeboard or buffer level associated with the 1 in 100 year flood event that new development in the Fairfield LGA is required to be constructed above. This outcome would afford additional protection to new development associated with the Stage 2 PP adjoining areas affected by the 1 in 500 year flood.

C. Consistency with Gateway Determination & Ministerial Direction

As previously advised to the Department, the Stage 2 Planning Proposal was drafted, exhibited and finalised under the former Section 9.1 Ministerial Direction 4.3 Flood Prone Land which was in force prior to February 2023 and which did not require Council to consider the full extent of flood risk beyond the Flood Planning Area (1 in 100 year + 500mm free board) up to the PMF.

To date, Council has not received any advice from the Department that it did not comply with legal obligations in considering flood considerations relevant to the Stage 2 PP under the above planning direction.

It is also noted that Council has recently been advised by a major landowner in the Fairfield town centre that its application under the Priority Assessment Program was not supported solely on the basis that Council's flood studies were unsatisfactory.

D. Conclusion

Council acknowledges that the nature of flooding issues in the Georges River are complex and that as a result of the NSW Flood Inquiry there are still a range of matters (the majority of which have only received in principle support from the State Government) requiring further investigation.

Fairfield City Council has a well-established record and commitment to working with State agencies and community in delivering major strategic projects whilst balancing flood considerations for the community.

In the spirit of continued collaboration, Council requests it be given the opportunity of a face-to-face meeting with relevant personnel from DPHI including state government flood experts to resolve a way forward for the Stage 2 PP having regard to the matters outlined in this letter.

I look forward to hearing from you and please contact me on 0429 208 705 or 9725 0278 if you wish to discuss this matter further.

Yours sincerely

Marcus Rowan
MANAGER – STRATEGIC LAND USE PLANNING

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

26 February 2023

Leonie Gray
Manager Catchment Planning - Catchment Planning
PO Box 21,
Fairfield NSW 1860

Via email: LGray@fairfieldcity.nsw.gov.au

Our ref: 24050046 Fairfield Town Centres Planning Proposal Advice Letter draft v1.1.docx

Dear Leonie

24050046 Fairfield Town Centres Planning Proposal Flood Advice

1 BACKGROUND

In June 2021, Fairfield City Council exhibited the Fairfield Stage 2 Accelerated LEP Planning Proposal which aimed to increase residential densities in and around a number of town centres located in the eastern part of the City through rezoning or changes to floor space ratios and building height controls (Figure 1). Amongst other things, it included provisions to amend the LEP with regard to flooding provisions. In light of the NSW Flood Inquiry 2022, the Department of Planning & Environment (DPE) set up a Fairfield Flood Advisory Panel (the Panel) as the Fairfield planning proposal was captured by the high risk classification applied to the Georges River Catchment by the NSW Flood Inquiry. The Panel was able to draw on advice from a Technical Advisory Group (TAG) and in January 2023, DPE requested that the Panel consider the Fairfield Town Centres Planning Proposal. The Panel consulted with Council, TAG and NSW Government agencies.

On 22 June 2023, DPE issued a Flood Planning Advice report which set out advice from the Panel. The Panel recommended that the Fairfield Town Centres Planning Proposal only proceed with the removal of all lots with a H3 or higher hazard rating, deferral of areas below the 1% AEP level until further flood modelling is completed and that those areas above the 1% AEP flood level be subjected to evacuation modelling before it is rezoned.

Fairfield Council requested that I review the Flood Planning Advice and related documents and provide an independent opinion on the Panel's recommendations. This letter sets out that opinion.

In preparing this letter I have made reference to the following documents:

- Fairfield LEP 2013 (Amend 46) - Flood Considerations - Sept 2022
- Briefing to Fairfield Flood Advisory Panel - 12 May 2023
- DPE Fairfield Flood Advice Report – 22 June 2023
- Council's Response to Fairfield Flood Planning Panel (FAP) Advice – 22 June 2023
- Fairfield City Council - Shelter in Place Policy Guidelines – Draft Report – Molino Stewart - May 2018
- Various Deliverables as part of the Georges River Floodplain Risk Management Study Phase 1 – Molino Stewart – 2022 – 2023.

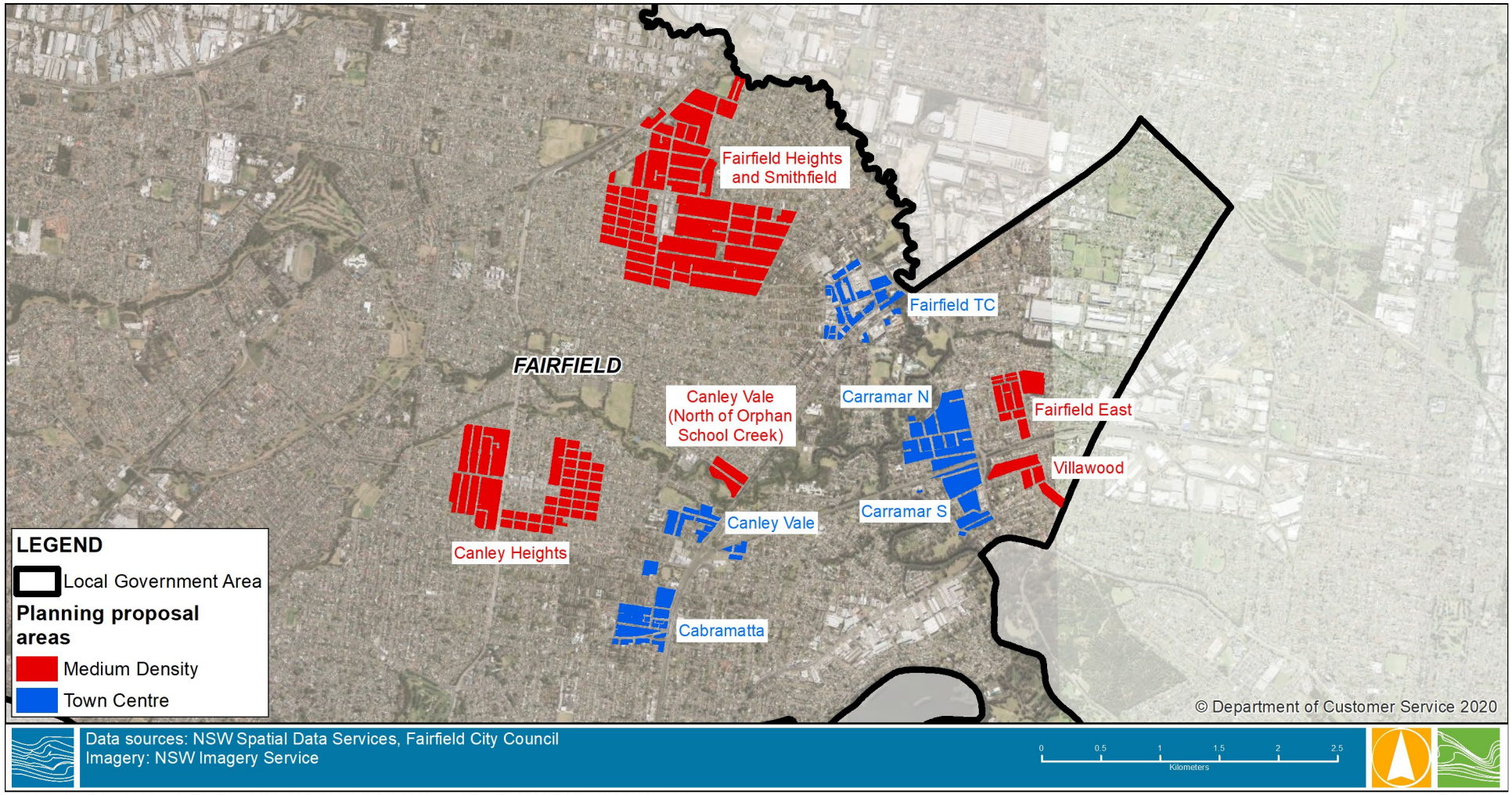


Figure 1: Planning Proposal Areas

2 PLANNING PANEL ADVICE

2.1 Observations

The Panel's advice summarises the key issues as:

- Flood modelling, hazard and behaviour
- Flood evacuation
- Mitigation measures

Under each of these headings the Panel made the following observations:

2.1.1 Flood modelling, hazard and behaviour

- The Georges River Flood Modelling is two decades old
- The flood modelling used in Council's Flood Considerations report did not use the Australian Rainfall and Runoff (ARR) 2019 methodologies but rather the outdated ARR 1987 methodologies
- The modelling does not include data from the most recent flood events
- The modelling does not adequately consider climate change
- Flood impacts in events greater than the 1% AEP floods have not been considered
- Overland flooding is primarily driven by capacity and blockages in the stormwater system

2.1.2 Flood evacuation

- No evacuation modelling has been undertaken and it should be undertaken for the full range of events up to the PMF
- Each proposal area is unique and has complex flood characteristics and overland flooding could cut evacuation routes
- Evacuation modelling would determine if road upgrades are required to overcome flood evacuation capacity constraints to support intensification.

2.1.3 Mitigation measures

- The Panel supports Council's approach of removing properties with a 1% AEP hazard rating of H3 or above but is not confident that the flood modelling used by Council to map the hazards can be relied upon to be accurate
- Using flood modelling which relies upon the latest flood data and adequately considers climate change impacts may increase the number of properties with a H3 or higher rating

2.2 Recommendations

The Panel recommended the planning proposal proceed under the following conditions:

- Remove lots with H3 or higher hazard rating on submitted mapping
- Defer remaining areas currently below the 1% AEP level and proceed to rezoning subject to:
  - New modelling incorporating latest flood data and climate change
  - Remove additional H3 or higher lots identified by the updated mapping
  - Use the updated FPL to determine land suitable for rezoning

- Proceed with rezoning of land above the current 1% AEP level subject to:
  - Evacuation modelling up to the PMF
  - Evacuation modelling must consider the impacts of overland flooding
  - Adoption of Cl5.22 of the Standard LEP
  - Identifying stormwater infrastructure improvements to address overland flooding
  - Identifying road network improvements to address evacuation requirements.

3 RESPONSE TO PANEL ADVICE

The following responds to each of the Panel's observations and recommendations bearing in mind the need to make informed decisions using the best available data.

3.1 Flood modelling, hazard and behaviour

3.1.1 The Georges River Flood Modelling is two decades old

While the Georges River Flood modelling currently adopted by Fairfield City Council is two decades old, Liverpool City Council commissioned a new flood model of the Georges River a few years ago. That flood model used the latest methodologies in Australian Rainfall and Runoff and resulted in significantly lower flood levels for the 1% AEP flood and other events. Liverpool Council therefore decided to continue to adopt the results from the older flood model for urban planning purposes because they were more conservative. Fairfield Council is continuing to use the results from the older flood model for the same reasons.

3.1.2 The flood modelling did not use the Australian Rainfall and Runoff (ARR) 2019 methodologies but rather the outdated ARR 1987 methodologies

The most recent flood modelling in Fairfield LGA does use ARR 2019 but I acknowledge that the majority of the flood studies used to inform the planning proposal used the ARR 1987 methodology.

As discussed in Section 3.1.1, remodelling of the Georges River using the latest ARR methodology resulted in significantly lower 1% AEP and other levels than when the ARR 1987 methodology was used. Therefore, the Georges River flood modelling used in the planning proposal is conservative.

Similarly, I don't believe that updating the creek and overland flood models using ARR2019 is going to make that much difference. A comparison of 1987 and 2016 intensity, frequency, duration data for points within the Georges River Catchment were undertaken as part of the Georges River Floodplain Risk Management Study Stage 1. It showed that:

- 1987 rainfall is significantly higher than 2016 rainfall (which is used in ARR 2019) in lower and mid catchments, with 1987 1% AEP rainfall being higher than 2016 rainfall with climate change for many storm durations.
- In upper and southern catchments the comparison results are mixed, some storm durations have 1987 rainfall higher and some are lower, but differences are typically less than the lower and mid catchments.

Using ARR 2019 for the overland flows catchments therefore could actually result in lower 1% AEP flood levels than have currently been adopted.

Furthermore, there is no difference in the PMF calculation method between ARR 1987 and 2019 and so the analysis regarding PMF levels, hazard and durations in Georges River, creek or overland flood studies would not be affected.

3.1.3 The modelling does not include data from the most recent flood events

I don't believe that any of the floods which occurred in Fairfield LGA in 2022 were of extremely rare probabilities. I expect the flooding which occurred was anticipated by the flood models. While these events could be used to assist in model validation, they are unlikely to increase flood levels in the more extreme events which are being used for the planning proposal.

3.1.4 The modelling does not adequately consider climate change

The way in which climate change has been considered varies between flood studies and is a reflection of when they were undertaken. However, with the exception of the Georges River which has some tidal influence and therefore could be affected by sea level rise, flood modelling results would only change due to future increases in rainfall intensity due to climate change.

The potential effects of climate change can therefore be assessed by considering the modelling results for rarer floods. For example, the climate change impacts on the 1% AEP flooding could be represented by the 0.5% AEP flooding. I acknowledge that not all of the flood studies (particularly the older ones) have not modelled events between the 1% AEP and the PMF but those models could simply be rerun for the required events. Creating new flood models across the LGA would not be necessary.

3.1.5 Flood impacts in events greater than the 1% AEP floods have not been considered

I agree that flood impacts in events greater than the 1% AEP floods do need to be considered. However, there is adequate information in the existing flood studies for this to be done. For example, Figure 3 (below) includes an extract from the Georges River Flood Study Stage 1, showing the extent of the 0.2% (1 in 500 year) AEP. As a result of the 2022 NSW Flood Inquiry, it is understood that there have been some discussions within DPHI and NSW Reconstruction Authority of considering the implications of a 0.2% AEP flood planning level in high-risk catchments such as the Hawkesbury Nepean and Northern Rivers.

3.1.6 Overland flooding is primarily driven by capacity and blockages in the stormwater system

The observation is correct but it is also not practical nor affordable to provide stormwater system capacity which can cater for the full range of rainfall events. New urban stormwater systems are typically designed to carry the 5% AEP flows in piped systems and large events in overland drainage paths. It is difficult to retrofit established urban areas with pipe networks and dedicated overland flow routes with sufficient capacity to meet current best practices, even in areas of urban renewal. Therefore, there is likely to always be overland flow paths along roads and through private property in older urban areas of Fairfield LGA.

3.2 Flood evacuation

3.2.1 No evacuation modelling has been undertaken and it should be undertaken for the full range of events up to the PMF

In responding to this observation it is instructive to consider the nature of flooding across the region and what is an appropriate built landscape and emergency response to the potential hazards posed by flooding within Fairfield LGA.

Figure 2 shows the extent of Fairfield LGA and it shows that the areas which are the subject of most of the planning proposal sit within an area which is bounded to the north and east by Prospect Reservoir and Prospect Creek, to the south by the Georges River and Cabramatta Creek and to the west by the Western Sydney Parklands. This means to evacuate out of the area it is necessary to cross one of these perimeter features at one of the limited road crossings over them.

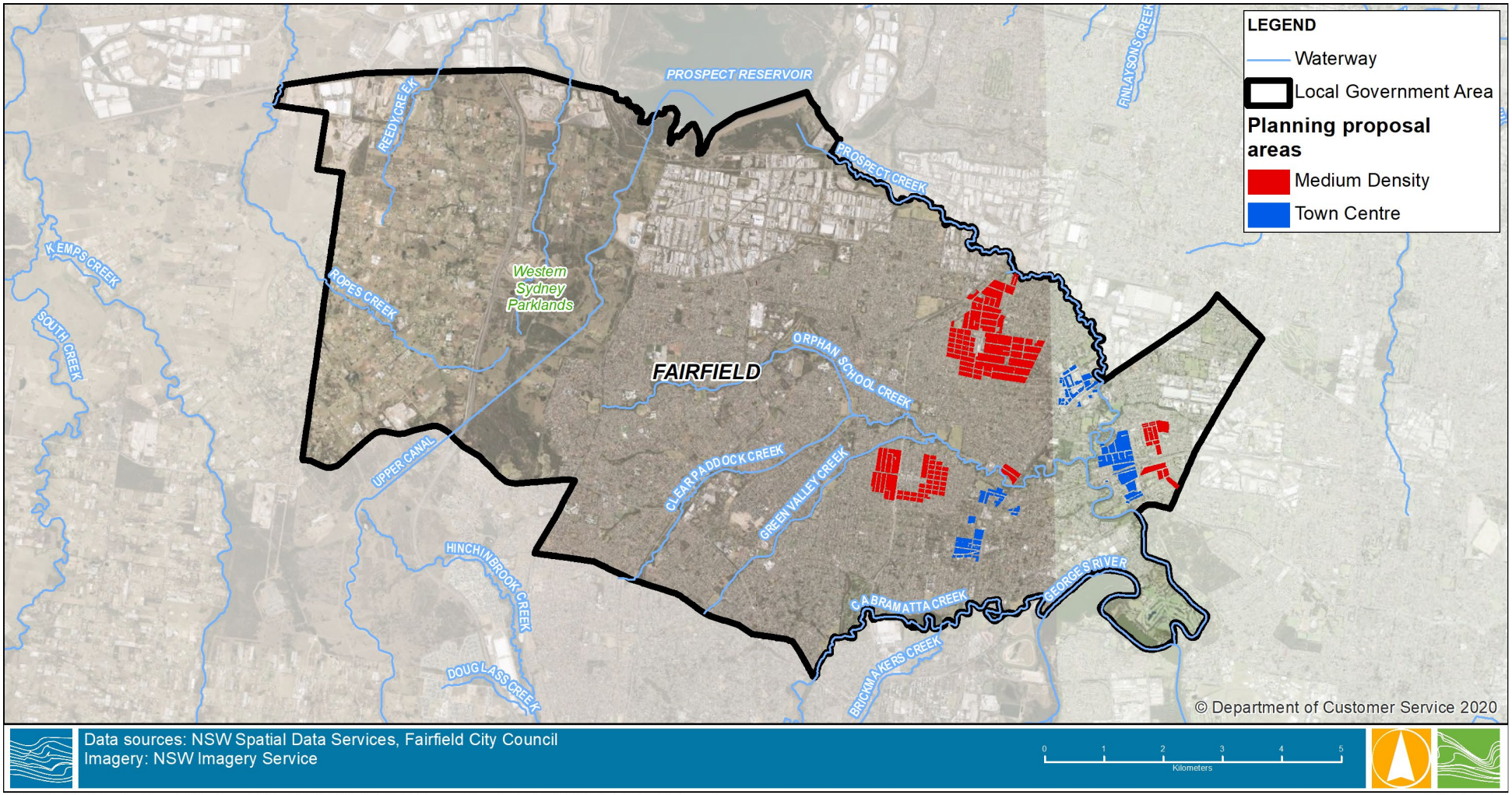


Figure 2: Fairfield LGA

The exceptions are Fairfield East, Carramar and Villawood which all sit to the east of Prospect Creek and north of the Georges River.

Figure 3 shows the extent of flooding from the Georges River in Fairfield and adjoining LGAs. and tributary catchments. Parts of Canley Vale, Fairfield Town Centre, and Carramar are within the extent of Georges River flooding. Fairfield Heights, Fairfield East, Smithfield, Canley Heights, Cabramatta and Villawood are only affected by creek flooding and/or overland flows.

The NSW SES models flood evacuation capability using its Timeline Evacuation Model which compares the time required to evacuate with the time available to evacuate. In calculating the time required to evacuate, the NSW SES assumes that it takes building occupants an average of one hour to accept that they need to evacuate and another hour to get ready to evacuate. In other words, from the time that residents receive a signal to evacuate to the time they leave their premises it takes about 2 hours. Furthermore, research has shown that even when an evacuation order is issued by the NSW SES, the majority of residents elect to stay within their dwellings until it is no longer safe to evacuate.

The appropriateness and practicality of evacuation from riverine flooding needs to be considered very differently to that from creek and overland flooding.

3.2.1.1 Creek and Overland Flooding

Given that there are no means of providing a practical advanced warning for overland and creek flooding, that it would take about 2 hours for people to be ready to evacuate after seeing flooding nearby and that most would choose not to evacuate before evacuation routes are cut, the practicality of evacuation from these floods in Fairfield LGA is questionable. In fact, not only would there be little warning of the flood arriving but even in the most extreme flood events the flooding would not last for much more that a couple of hours: it would have gone by the time most people would be ready to evacuate.

A more appropriate response in these “flash flood” catchments is for people to shelter within their dwellings providing that they are kept safe from floodwaters.

Early in 2023 DPE issued a draft Shelter in Place Guideline. It suggested that SIP is the last resort evacuation option for development in greenfield and infill areas, noting that evacuation off-site is always preferrable. If this cannot be achieved, then SIP may be used if:

- The duration for flood inundation is less than six hours
- The development is not located in an area of high-risk (eg, floodways and H5 or H6 flood hazard areas)
- Access to on-site systems to provide power, water and sewerage services during and beyond the event for the full range of flooding
- The location of storage of food, water and medical emergency for SIP purposes should be above the PMF level and available during and beyond the event for the full range of flooding
- SIP floor level is above PMF
- SIP provides a minimum floor space per person
- SIP must be structurally safe and accessible during floods up to the PMF.

The duration of high hazard overland and creek flooding in the planning proposal areas is less than 6 hours, even in the PMF. Planning controls could be implemented to ensure that new development meets the above DPE criteria for sheltering in place.

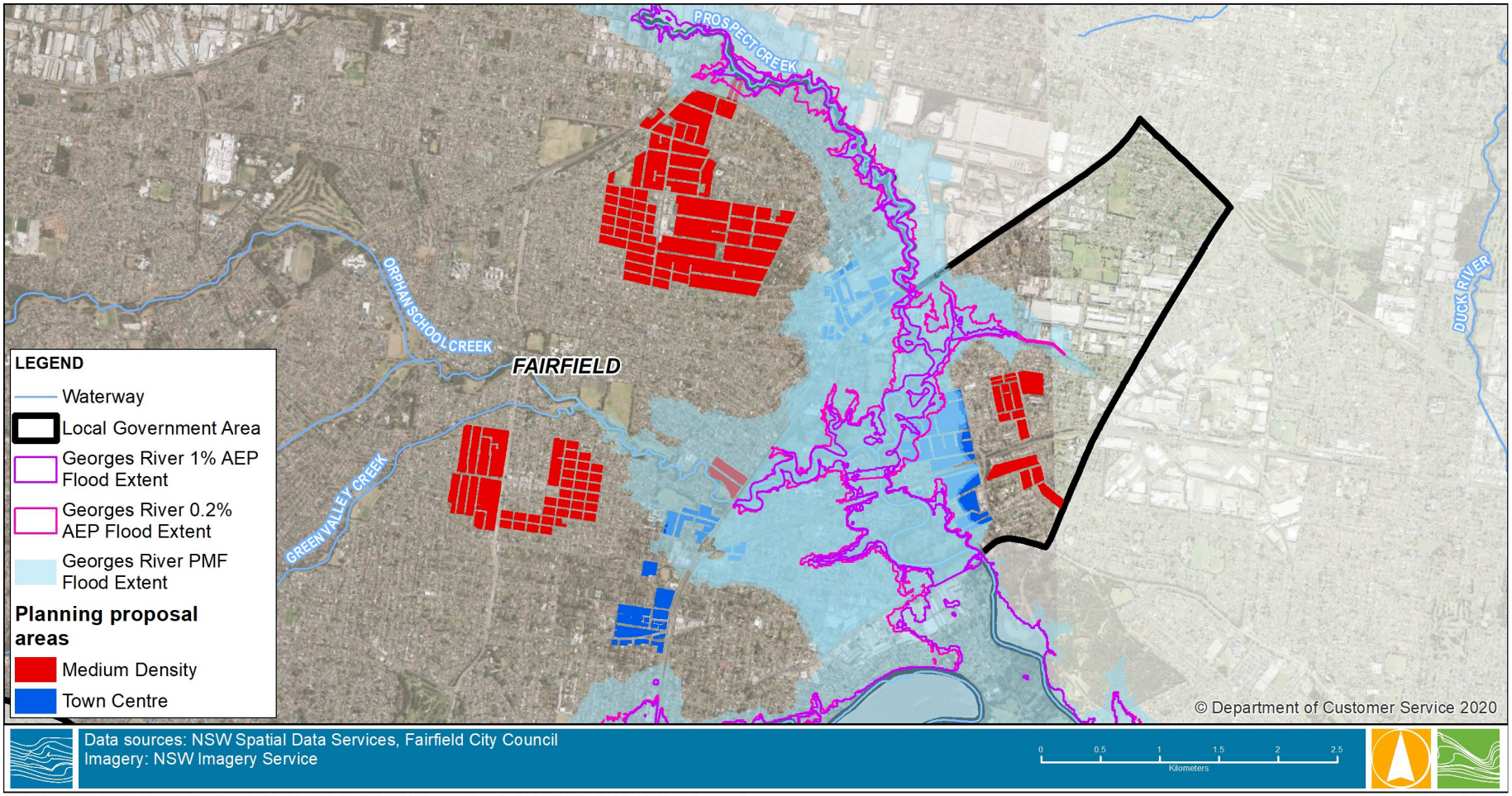


Figure 3: Extent of Georges River flooding

3.2.1.2 Riverine Flooding

The Bureau of Meteorology has a flood forecasting system for the Georges River and it can provide between 6 and 12 hours warning of forecast flood heights at the Liverpool gauge which should provide adequate warning time for people in Fairfield LGA to evacuate ahead of flooding on the Georges River. This warning time is based on the time it takes floodwaters to travel from the upstream gauges down to Liverpool and would be the same regardless of whether it was a 1% AEP flood, 0.2% AEP flood or a PMF in the Georges River. This would be used by the NSW SES to trigger evacuations from Georges River flooding.

Furthermore, the depths of flooding from the Georges River can make them highly hazardous and durations can exceed 24 hours. Evacuation, rather than sheltering in place is a more appropriate flood emergency response strategy for those parts of the planning proposal which are affected by Georges River flooding, although on the very fringes of the floodplain (possibly including parts of Carramar, Fairfield and Canley Vale which are the subject of the planning proposal) it may be possible to safely shelter in place.

I therefore agree that evacuation modelling of those areas which are potentially affected by Georges River flooding is appropriate. It would need to consider the interaction of evacuation traffic from existing development with that from the proposed planning areas. There is already a flood evacuation model for Georges River flooding in the Liverpool LGA and it includes sufficient information to estimate how much time is available for evacuation from flooding. It could easily be extended to cover the Fairfield LGA. While evacuation modelling can be a complex and expensive exercise, there are ways of undertaking some preliminary analysis at lesser cost to determine whether evacuation is feasible. The detailed modelling can then focus on those areas where more detailed modelling is required.

3.2.2 Each proposal area is unique and has complex flood characteristics and overland flooding could cut evacuation routes

Figure 4 shows potential flood evacuation centres within the Georges River catchment as identified in NSW SES local and regional emergency plans. None are within the Fairfield LGA and therefore none can be reached by people within most of the LGA without the need to get across one or more of the creeks within the LGA. These creek crossings flood in events more frequent than the 0.2% AEP flood which the NSW SES considers to be a suitable flood immunity for regional evacuation routes. Therefore evacuation out of most of Fairfield LGA during a flood is not a practical option.

Research in Australia has shown that the majority of flood fatalities occur when people drive or walk through floodwaters trying to get from point A to point B or when they recreate in floodwaters. The few instances of people drowning in their homes in recent years has been when high hazard flooding has occurred with little warning in events rarer than a 1 in 500 flood (Lockyer Valley 2011, Dungog 2015, Lismore 2022, Eugowra 2022).

Therefore, to adequately cater for those who need to evacuate from existing dwellings, let alone any new dwellings, and to reduce the chance of people driving through floodwaters to get to them, some local evacuation centres would need to be established. Figure 5 shows some suggested locations and evacuation routes to them from those who may have to evacuate ahead of Georges River flooding in Fairfield LGA. The routes shown would not only avoid creek crossings but also mostly avoid overland flow paths and therefore provide reliable evacuation routes for evacuees.

As discussed previously, those planning areas which are solely impacted by overland or creek flooding are better suited to sheltering in place rather than evacuation.

Where areas are affected by both riverine flooding and creek and/or overland flooding, the potential for the creek or overland flooding to disrupt evacuation would need to be considered in the evacuation modelling.

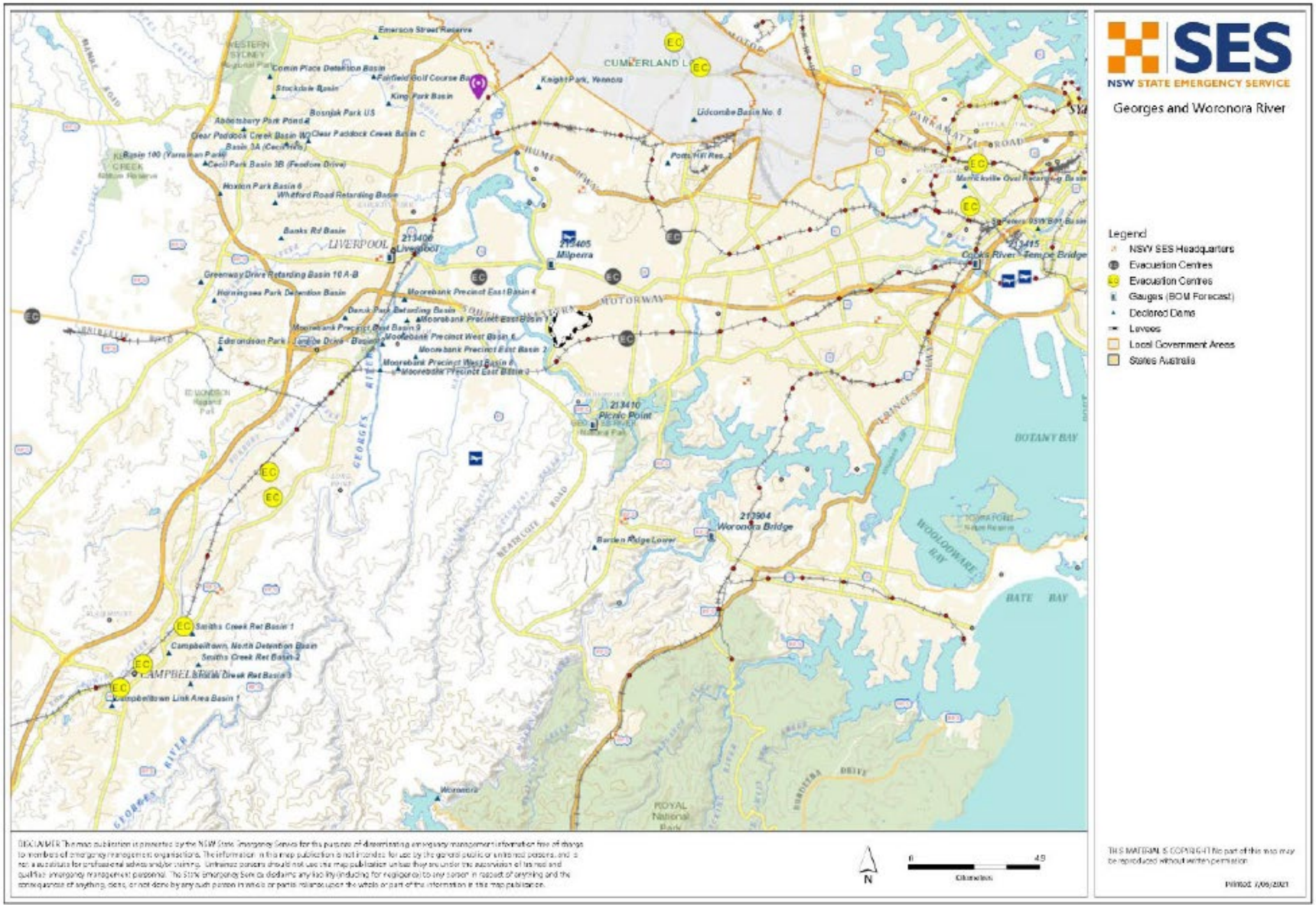


Figure 4: Evacuation Centres in Georges River Catchment

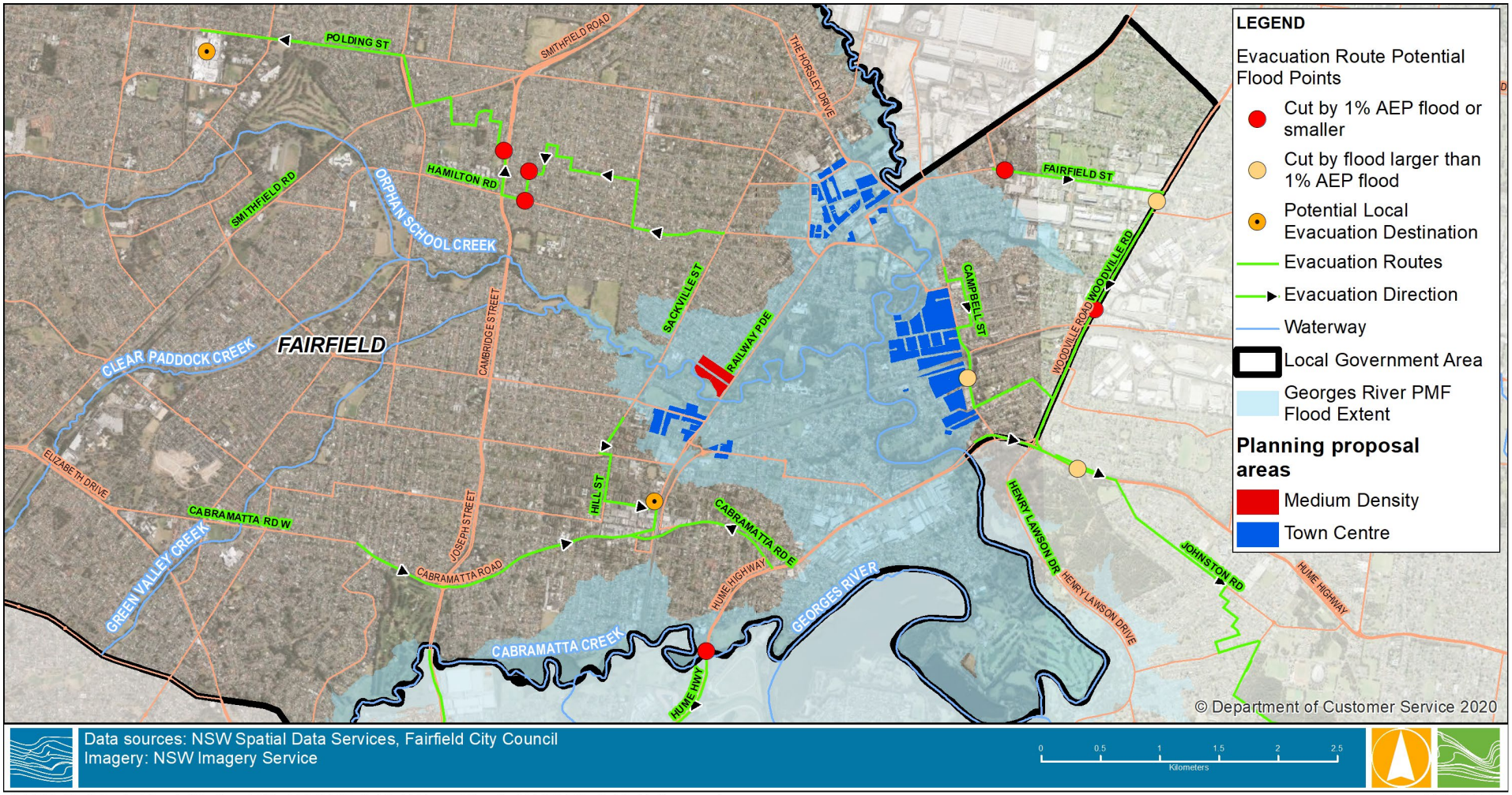


Figure 5: Potential evacuation routes and local evacuation centres for Georges River flooding in Fairfield LGA

3.2.3 Evacuation modelling would determine if road upgrades are required to overcome flood evacuation capacity constraints to support intensification.

I agree that flood evacuation modelling would identify road capacity constraints that would need to be overcome to support intensification.

3.3 Mitigation measures

3.3.1 The Panel supports Council's approach of removing properties with a 1% AEP hazard rating of H3 or above but is not confident that the flood modelling used by Council to map the hazards can be relied upon to be accurate

As discussed in section 3.1 there is nothing to suggest that the modelling used by Council cannot be relied upon.

3.3.2 Using flood modelling which relies upon the latest flood data and adequately considers climate change impacts may increase the number of properties with a H3 or higher rating

As discussed in Section 3.1 the modelling relied upon the latest flood data and could be used to test whether climate change is likely to increase the number of properties potentially exposed to high hazard flooding.

4 RECOMMENDATIONS

The Panel recommended the planning proposal proceed under the following conditions:

1) Remove lots with H3 or higher hazard rating on submitted mapping

2) Defer remaining areas currently below the 1% AEP level and proceed to rezoning subject to:
   - New modelling incorporating latest flood data and climate change
   - Remove additional H3 or higher lots identified by the updated mapping
   - Use the updated FPL to determine land suitable for rezoning

3) Proceed with rezoning of land above the current 1% AEP level subject to:
   - Evacuation modelling up to the PMF
   - Evacuation modelling must consider the impacts of overland flooding
   - Adoption of Cl5.22 of the Standard LEP
   - Identifying stormwater infrastructure improvements to address overland flooding
   - Identifying road network improvements to address evacuation requirements.

I understand that Council has agreed to recommendation (1) so I provide no comment on that.

With regard to recommendation (2), it is my opinion that there is no need to undertake any new flood modelling nor to update the FPL but I support sensitivity testing using existing models to determine whether additional lots would be affected by H3 or higher flood hazard due to climate change.

In relation to recommendation (3), I am of the view that evacuation modelling should be considered for those areas affected by Georges River flooding with longer durations of high hazard flooding in the PMF: being parts of Canley Vale, Fairfield Town Centre and Carramar. The other areas should adopt a shelter in place strategy to manage flood risk.

Yours sincerely

Director
WATER TECHNOLOGY PTY LTD

steven.molino@watertech.com.au

Water Technology pays respect to all First Nations peoples, their cultures and to their Elders, past and present.

5 Climate Change Analysis

Climate change is recognised as an important factor for inclusion in long-term planning. Nationally, an average increase of 1°C in both surface air and sea surface temperature has been experienced over the last century. The CSIRO has predicted an increase in extreme rainfall events and other extreme climate events such as drought, winds, storms and fire across the Sydney region (CSIRO, 2016).

The NSW Floodplain Development Manual (DIPNR, 2005) requires climate change to be considered in the preparation of Floodplain Risk Management Studies and Plans, with further guidance provided in:

- *Floodplain Risk Management Guideline – Practical Consideration of Climate* Change (DECC, 2007); and
- *Flood Risk Management Guide – Incorporating Sea Level Rise Benchmarks in Flood Risk Assessments* (DECCW, 2010).

5.1 Sea Level Rise

The NSW *Sea Level Rise Policy Statement* (DECCW, 2009) was prepared to support the consistent adaptation of projected sea level rise impacts, ensuring that sea level rise planning benchmarks were included for addressing coastal and flood-related sea level rise impacts. The benchmarks included projected increases in sea levels relative to the 1990 mean sea level of 0.4 m by 2050 and 0.9 m by 2100.

In 2012, the NSW Government announced it no longer recommended state-wide sea level rise benchmarks for use by local councils and accordingly provided councils with the flexibility to consider local conditions when assessing future hazards within their LGA. Despite this, these benchmarks remain the best available estimates in many LGAs.

FloodMit (2011) found that sea level rise along would have negligible impacts on flood behaviour and levels along Prospect Creek. Similarly, Molino Stewart (2015) inferred from this information that sea level rise would not impact flooding in Prospect Creek and excluded it from their study. As such, sea level rise impacts are not considered to impact on flood conditions within the study catchment and have been excluded from this study.

5.2 Rainfall

Current research predicts that one of the likely outcomes of future climate change will be an increase in flood-producing rainfall intensities. This may include increased frequency, duration and height of flooding and consequently increased number of emergency evacuations and associated property and infrastructure damage.

The predicted impact of climate change on rainfall conditions includes:

- increase in average annual rainfall – changes in annual rainfall conditions is unlikely to have a significant on impact on flooding regimes. However, wetter than average conditions may increase the opportunity for wet antecedent conditions at the onset of a rainfall event.

- increases in rainfall intensity – climate change impacts on flood producing rainfall events are expected to show a trend for more frequent, higher intensity storms.

In 2007, the NSW Government released a guideline for the *Practical Consideration of Climate Change* in the floodplain management process that advocates consideration of increased design rainfall intensities of up to 30 percent (DECC, 2007). The *State of the Climate* report (CSIRO, 2016) notes that the frequency and intensity of rainfall is projected to increase across most of Australia, however the increases in rainfall will vary depending on the region.

Dowdy et al. (2015) includes projected changes in heavy rainfall events including the potential increase in 20-year return period maximum 1-day rainfall as shown in Figure 5-1. The blue and purple columns in Figure 5-1 represent the RCP4.5 and RCP8.5 scenarios respectively. The relative change in the 20-year return level of maximum 1-day rainfall is approximately 18% for the low-emissions pathway (RCP4.5) and 25% for the high-emissions pathway (RCP8.5).

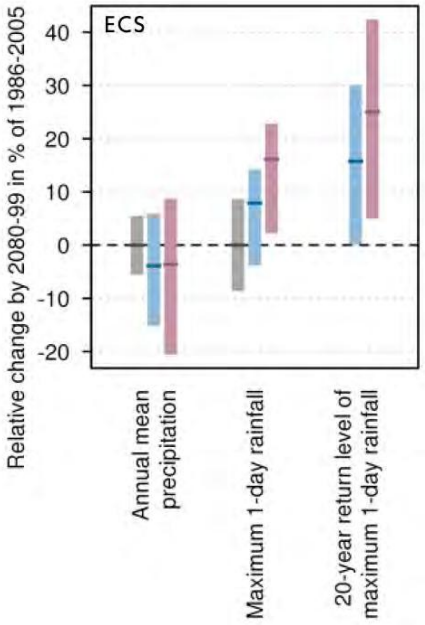


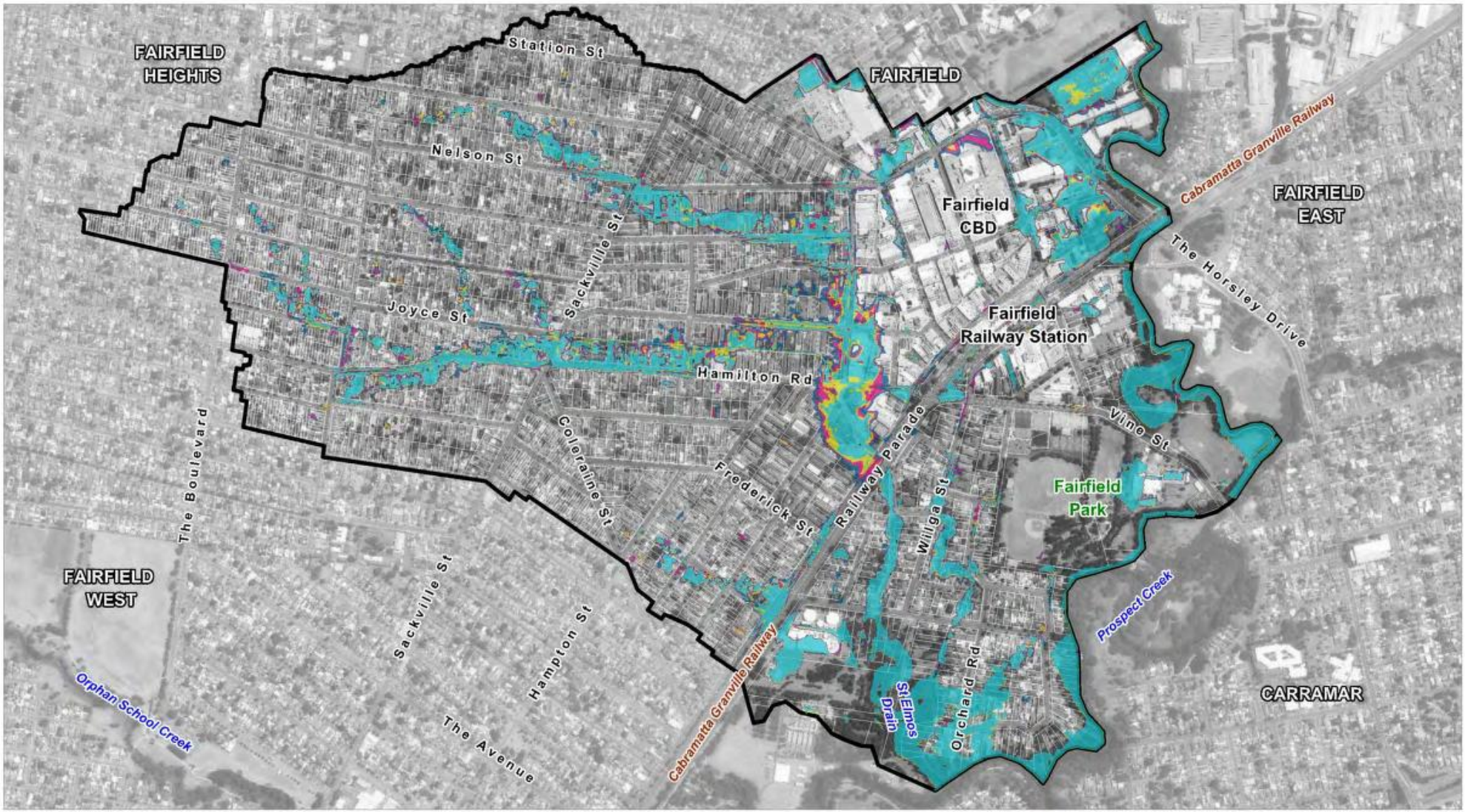
Figure 5-1 Projected Changes in Rainfall (Dowdy et al, 2015)

Therefore, due to the uncertainty associated with projected rainfall increases, an analysis of climate change related increases in rainfall and the impact on future flood conditions within the catchment has been undertaken on the 1% AEP event with 10%, 20% and 30% increases in rainfall. Modelling of these projected rainfall increases is in accordance with the Practical Consideration of Climate Change Floodplain Risk Management Guideline (DECCW, 2007).

The change in peak flood extents is shown in Figure 5-2. It is evident that there is little change to the 1% AEP flood extent across most of the catchment, with the greatest change in extent shown along the stretch of Barbara Street between the Cabramatta-Granville Railway and Harris Street.

Impacts on peak flood levels are included in Appendix A. Similar to the flood extents, the greatest impact on peak flood level is along Barbara Street upstream of the rail culvert during all of the modelled climate change scenarios. Peak flood levels along Barbara Street increased by 0.2, 0.4

and 0.5 m for the 10%, 20% and 30% increase in rainfall scenarios. The most upstream reaches were minimally impacted with peak flood level increases up to 0.09 m during the 1% AEP with 30% increased rainfall.



LEGEND

Flood Hazard Category

- Baseline 1% AEP Event
- 1% AEP Event + 10% Rainfall
- 1% AEP Event + 20% Rainfall
- 1% AEP Event + 30% Rainfall
- Cadastre
- Study Area

Title:

Climate Change Analysis

Figure: **5-2**

Rev: **B**

N

0 250 500m

Approx. Scale

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6 Review of Flood Emergency Management

The following chapter provides a review of emergency management for overland flooding of Fairfield CBD.

The *Fairfield Local Flood Plan*, last updated in 2016 by the NSW SES, provides high-level guidance in relation to flood preparedness, response and recovery measures. A new valley *Flood Emergency Sub Plan* (Georges River Valley including the Woronora River the Georges and Woronora River Valley Flood Emergency Sub Plan) is currently in preparation by the NSW SES. This Valley Plan will replace the 7 Local Flood Plans (one of which being Fairfield) providing an overarching plan for riverine flooding on the Georges/Woronora River system. The Local Flood Emergency Sub Plans will be repealed as the information related to these areas are in the new River Valley Flood Plans.

6.1 Fairfield Local Flood Plan

The *Fairfield City Local Flood Plan 2016* (the Flood Plan) has been prepared by the NSW State Emergency Service (SES) and adopted by the Local Emergency Management Committee (LEMC). It forms a sub-plan of the Local Disaster Plan (DISPLAN), and covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding within Fairfield City Council

A summary of the information contained in the Flood Plan is outlined below:

- Flood Preparedness – measures taken to prepare for flooding including:
  - maintenance of the Flood Plan
  - ensuring SES participation in floodplain management
  - development of flood intelligence (including undertaking flood studies and floodplain management studies and plans)
  - development and maintenance of flood warning systems
  - public education, and
  - SES training
- Response – measures taken to respond to flood events, including:
  - operational management including defining clear roles or responsibility during flood events;
  - response operations
  - provision of flood information and warnings (including issues and dissemination of flood warnings);
  - road and traffic control
  - evacuation plans
- Recovery – measures taken to recover from a flood event

Riverine flooding is largely the focus of the existing Plan and in the context of the current study area identifies existing flood risks within part of the Prospect Creek floodplain. Prospect Creek flood conditions are monitored through the existing flood warning gauge network. Existing residential and commercial property at risk from Prospect Creek mainstream flooding has been considered as part of the Prospect Creek Floodplain Management Plan Review (Bewsher, 2010). In addition, the Local Flood Plan identifies flood risk associated with:

- flooding of key road routes including The Horsley Drive and Railway Parade Fairfield
- special use properties prone to flooding including Patrician Brothers Fairfield, Fairfield High School and Fairfield Nursing Home.

Whilst not included in the 2016 Fairfield Local Flood Plan, the previous 2005 Fairfield Local Flood Plan listed potential evacuations centres including:

- Police Citizens Youth Club, Railway Parade, Cabramatta
- Fairfield RSL Club, Dale Street, Fairfield.

The Fairfield RSL Club is located within the CBD overland flow catchment, opposite and southeast of the railway station. This building is central to the flood affected areas and only marginally impacted by the design PMF flood event. The Police Citizens Youth Club is positioned 2 - 3 km south of the flood affected areas in and around Fairfield. No specific details are provided in relation to evacuation routes within the Fairfield CBD overland catchment.

The *Canley Corridor Floodplain Risk Management Study* (Molino Stewart, 2015) included an emergency management review for an overland flooding catchment similar to the Fairfield CBD study area. Acknowledging a similar “flash flood” environment as the Fairfield CBD study area, it was noted that with limited opportunity for flood warning there is very little time for the SES to provide complex response activities in the highly built up catchment. Coupled with potentially limited local resources, the SES role in the catchment would likely concentrate on the prevention, preparedness and recovery functions.

Molino Stewart (2015) further notes during consultation with the NSW SES acknowledged particular challenges with flooding in the Canley Corridor catchment including:

- there are less than 50 volunteers and staff within the local unit servicing a population of more than 50,000 potentially affected by flooding within the whole of the Fairfield City LGA.
- there are locations within the LGA where the flood hazards are significantly greater than those in Canley Corridor and these would need to be given priority.
- it will be extremely difficult to call on neighbouring SES units as they are more than likely to be employed in similar flood emergencies in their areas and the short response time of the overland flooding means that would be insufficient time for responders from outside the LGA to arrive before the flooding had peaked.
- the potential for high hazard floodwaters along the roads, particularly in the middle of the catchment, will make it dangerous for building occupants to leave or for SES personnel to try and reach them after a short time into the larger floods.

The above constraints for flood emergency response may be considered typical in an urban overland flooding context and applicable to the Fairfield CBD study area.

A key outcome of the emergency response review undertaken for the Canley Corridor Floodplain Risk Management Study was the acknowledgement that the shelter in place option is the most practical and safest response for building occupants during a flood. This recognised that for most locations in the catchment it is safer to stay within buildings rather than evacuate through more hazardous flood waters in the street. The 'flashy' nature of flooding suggests that it will always be difficult to ensure everyone in the floodplain evacuates prior to flooding of evacuation routes. Similar flood conditions are prevalent in the Fairfield CBD catchment. This also recognises the typically short duration and low hazard of floods in this area, which suggests that isolation is likely to be limited to about a few hours in most events. The study noted that as a way of reducing existing risks to life, shelter-in-place should at least be made available for the concessional development category. It is also defensible for existing residential areas where urban renewal is occurring.

Accordingly, the Floodplain Risk Management Plan recommendations incorporated:

- update of Local Flood Plan to acknowledge that evacuation is not a practical option for most buildings and provision for shelter in place is appropriate for new developments
- community education material to incorporate content on sheltering in place
- review DCP to ensure development controls continue permitting a shelter in place approach.

Given the similar nature of the flash flood environment of the Fairfield CBD, these recommendations around shelter in place are considered appropriate in the current study.

6.2 Flood Emergency Response Planning Classification of Communities

The Office of Environment and Heritage (formerly Department of Environment and Climate Change), in conjunction with the State Emergency Service (SES) developed the *Flood Emergency Response Planning Classification of Communities* (2007) guideline. The guideline provides a process for classifying flood-affected communities according to their vulnerability during flood emergency response and by the impact that flooding has on them. This is undertaken to assist in future planning for catchments and for the implementation of response strategies by the SES. During flood events, the normal functioning of services within the community can be altered, impacting on evacuation, resupply and rescue of those affected. Flood-affected communities can be classed as:

- flood islands (high or low)
- trapped perimeter areas (high or low)
- areas able to be evacuated (with overland escape routes or rising road access)
- indirectly affected areas, and
- overland refuge areas.

A description of each of the above is given below.

Flood Islands

Flood islands are areas of higher ground within a floodplain linked to flood-free valley sides by only one access route with no alternative overland access. This route can become inaccessible to cars by floodwater preventing vehicular or pedestrian evacuation and creating a 'flood island'. These islands can be further classed according to what happens to the island following the evacuation route being cut and are generally categorised as **high flood islands** and **low flood islands**.

A **high flood island** includes sufficient land above PMF flood levels to provide refuge for the number of people in the area. During flood events, the area is surrounded by floodwater with potential property inundation and community isolation occurring. The higher ground above PMF flood levels allows people to retreat to safety, limiting the direct risk to life. Due to the surrounding floodwater, resupply is required via boat or air if the area is not evacuated prior to the access road being cut off.

A **low flood island** is an area where the land is below the limit of flood (the PMF level), or where there is insufficient land above the limit of flooding to accommodate for the number of people in the area. During flood events, properties are inundated and the community becomes isolated. If floodwater continues to rise after the area becomes cut off, the island will be completely inundated by floodwater leaving stranded people prone to drowning.

Trapped Perimeter Areas

Trapped perimeter areas are generally inhabitable or potentially habitable areas at flood fringe regions of the floodplain where the only practical overland access is through flood prone land which may be inaccessible during flood events. Trapped perimeter areas do not allow for people to retreat to higher ground as the topography may be too low or impassable structures may block access routes. Trapped perimeter areas are further classified as **high trapped perimeter areas** or **low trapped perimeter areas** according to what happens after the evacuation route is cut off.

A **high trapped perimeter area** includes sufficient land located above the limit of flooding (such as the PMF event) to accommodate for the number of people in the area. During a flood event, the area may become isolated by floodwater and property may be inundated. However, there may be higher ground above the PMF level available for people to retreat to, limiting the direct risk to life. The trapped area would require resupply by boat or air if not evacuated prior to the access road being cut off.

A **low trapped perimeter area** is located below the limit of flooding or may not provide sufficient land above the limit of flooding to accommodate for the number of people in the area. During a flood event the area is isolated by floodwater and properties may become inundated. If floodwater continues to rise after the area becomes isolated, the area will be completely covered. Stranded people are susceptible to drowning.

Areas Able to be Evacuated

These areas are located on flood prone fringes in the floodplain, or on the valley sides in areas able to be evacuated. Areas able to be evacuated are further classed as **areas with overland escape routes** or as **areas with rising road access** depending on the type of evacuation access available. These communities contain low-lying areas from which people will be progressively evacuated to higher ground as the level of inundation increases.

Areas with overland escape routes are those where access roads to flood free land cross lower lying flood prone areas. As such, evacuation can only take place by road until the access roads are closed by floodwater. Escape from rising floodwater is possible via walking to higher ground with those unable to do so evacuated via boat or air. If inundation occurs prior to evacuation, rescue will likely be from rooftops.

Areas with rising road access are those where access roads to flood free land rise steadily uphill away from rising floodwaters. As such, the community cannot be completely isolated before inundation reaches it maximum extent, even during the PMF event. Evacuation can occur by vehicle or on foot as floodwater rises and people should not be trapped unless evacuation is delayed.

Indirectly Affected Areas

Indirectly affected areas are located outside the limit of flooding and are consequently not inundated, nor do they lose road access. These areas may be indirectly affected as a result of flood-damaged infrastructure or due to the loss of transport links, electricity supply, water supply, sewage or telecommunications services. As such, these areas may require a resupply or evacuation.

Overland Refuge Areas

Overland refuge areas provide an area for flood-affected areas of the floodplain to be evacuated to but are isolated from the edge of the floodplain by floodwaters. These areas are essentially flood islands or trapped perimeter areas and should be categorised accordingly to determine their vulnerability during flood events.

6.2.1 Classification of FERP Communities for Fairfield CBD

The classification of communities for Flood Emergency Response Planning (FERP) is typically undertaken at a broad or precinct scale to assess relative vulnerability of the community in flood emergency response. However, for the Fairfield CBD catchment Council has requested the mapping to be undertaken at a lot scale. There is considerable detail at lot scale to consider with respect to availability of road/pedestrian evacuation routes from individual properties, the timing and severity (flood hazard) of flood inundation with respect to route closure.

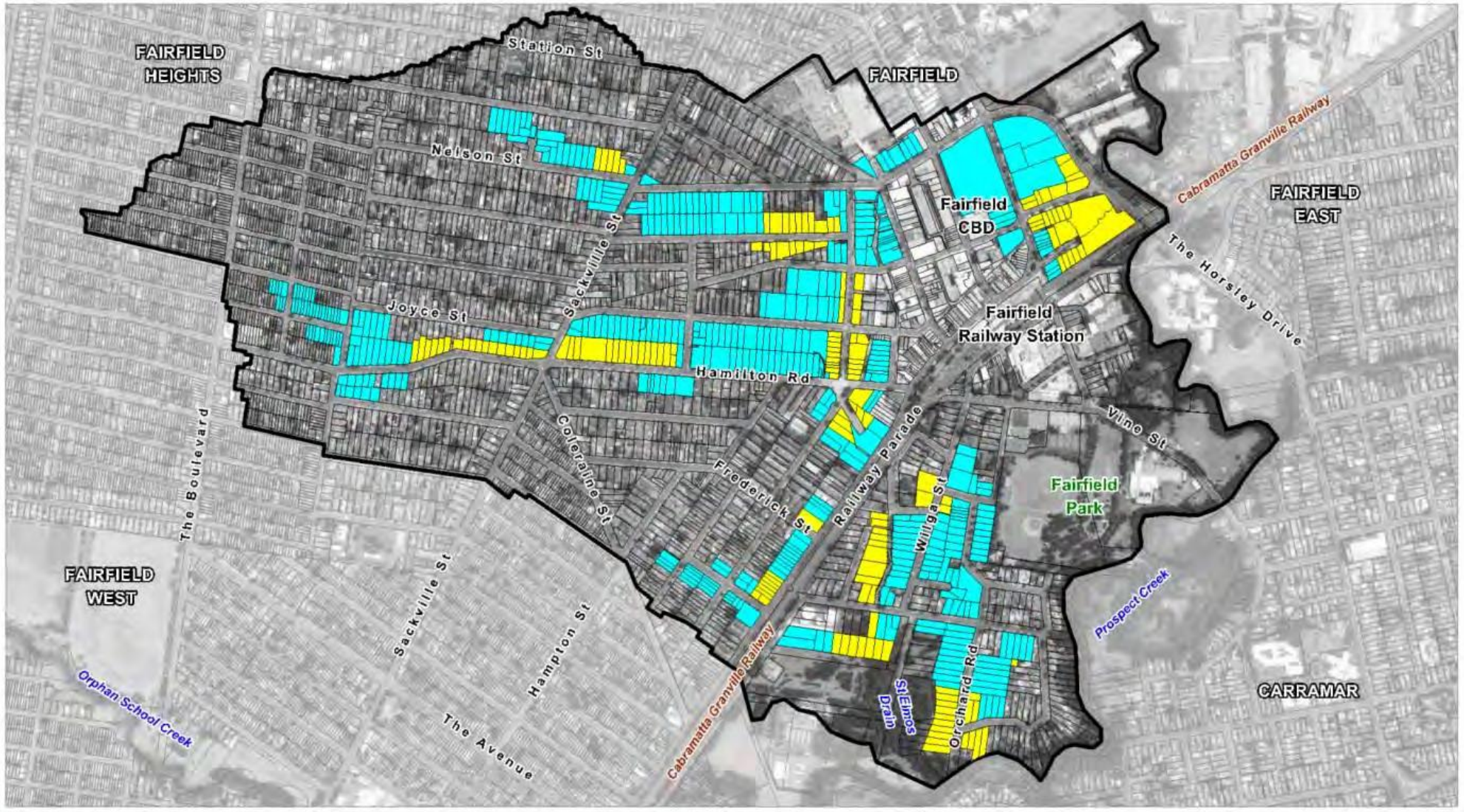
The FERP classifications for the 1% AEP and PMF events are shown in Figure 6-1 and Figure 6-2 respectively. The key consideration in the mapping is the availability of evacuation routes. The urban overland flooding regimes are complex in this regard with a high degree of variability in flood hazard (depth and velocity) typically along any given vehicular or pedestrian route. Relative timing and duration of inundation can also be variable. The mapping shown adopted a somewhat conservative approach in assessing trafficability of roads for vehicular access and availability of pedestrian routes. The flood inundation and hazard classifications at the peak of the flood event were typically used to assess access routes. This recognises the typically flashy nature of the catchment in that peak flooding conditions may be reached very quickly from the onset rainfall in the major events. Accordingly, this may limit the response time of individuals within the catchment to make appropriate evacuation choices.

Access roads were considered to be not suitable for vehicle evacuation when the hazard class was H2 (unsafe for small vehicles) and above. Pedestrian routes were considered non-viable for hazard class H3 (unsafe for all vehicles, children and the elderly) and above.

Being a relatively small urban catchment, the typical duration of inundation within the Fairfield CBD catchment would be short, typically 1-2 hours. The duration of peak flooding conditions affecting evacuation and flood access may be very short in some instances. Accordingly, isolation issues are likely not significant in the study. From a flood emergency response perspective therefore, the most critical classification within the CBD is the low flood island category. This identifies properties which may become isolated during a flood event with no available refuge above the PMF level.

In the Fairfield CBD catchment area, there are five zones where there is a concentration of low flood island properties as summarised below:

- Hamilton Road – there are many properties adjacent to Hamilton Road with a low flood island classification under PMF conditions. In major flood events, Hamilton Road is a significant overland flow path as shown in the mapping in Appendix A. Under PMF conditions, typical peak depths of flooding through the Hamilton Road corridor are in excess of 0.8m. The hazard mapping in Appendix A also provides for typically H4-H5 hazard classification.
- Nelson St / Wrentmore Street Road – similar to Hamilton Road, the Nelson Street / Wrentmore Street corridor represents another significant west to east overland flow path through the catchment. Early closure of evacuation routes again coupled with high hazard flood conditions at the PMF level provide for a string of properties at high risk.
- Fairfield CBD / commercial area – in major events, many of the access roads in the CBD area would be subject to inundation particularly with the convergence of the Hamilton Road and Wrentmore Street flow paths. The broader CBD area also lies within the backwater influence of the railway embankment. Accordingly, under PMF conditions, flood depths may rise considerably in this area prior to overtopping of the railway. The majority of properties in the CBD area are two-storey, however, the mapping has not considered the configuration of buildings and general availability to access higher floors. A more detailed investigation of this may be considered in future assessments.
- Railway Parade – under PMF conditions, the backwater influence of the railway embankment provides for high hazard flood conditions along Railway Parade adjacent to the embankment. Dependent on the rate of rise in these areas, pedestrian evacuation particularly in PMF conditions may not be possible.
- Wilga Street – the Wilga Street corridor represents the major overland flow path for floodwater overtopping the railway embankment under PMF conditions. Floodwaters at high depth and velocity can move through this corridor towards Orphan School Creek.



LEGEND

Design Event

- Low Flood Island
- High Flood Island
- High Trapped Perimeter
- Overland Escape Route
- Rising Road Access
- Study Area

Title:

1% AEP Flood Emergency Response Classification

Figure: **6-1**

Rev: **A**

N

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Approx. Scale

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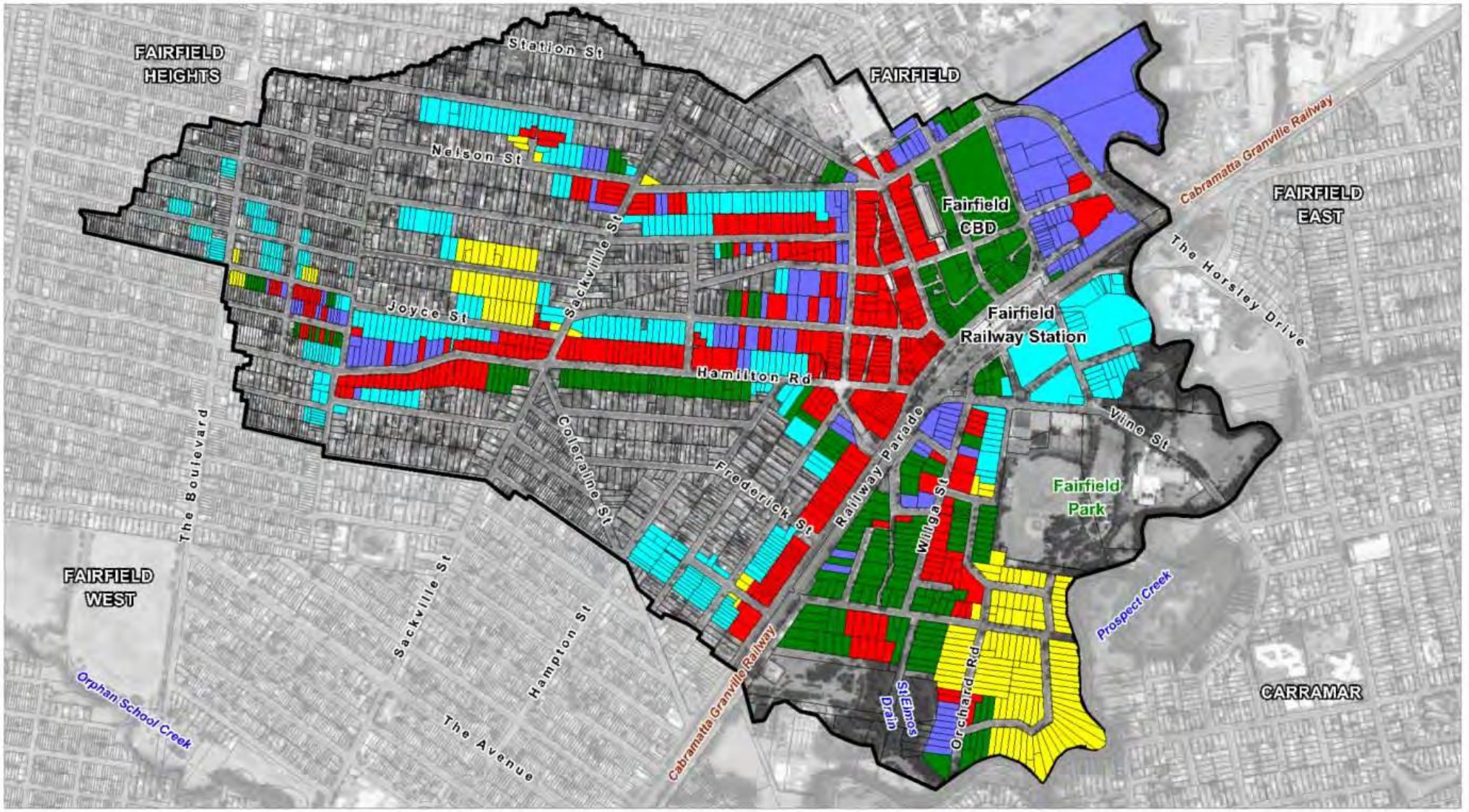

LEGEND

Design Event

- Low Flood Island
- High Flood Island
- High Trapped Perimeter
- Overland Escape Route
- Rising Road Access
- Study Area

Title:

PMF Flood Emergency Response Classification

Figure: **6-2**

Rev: **A**

BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.

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Approx. Scale

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Coordinated evacuation from any of these areas is unlikely given the flashy nature of flooding with self-directed evacuation the reality. As noted in the FERP mapping, there is a high potential for property isolation due to evacuation/access routes being cut, potentially early in an event or with minimal warning time. This reinforces the potential need for a shelter in place option with appropriate planning conditions.

6.3 Flood Education

Flood education is a key emergency management response measure in educating the community relating to flood risk, evacuation, preparation, insurances and flood mitigation. Through the community consultation, 64% of respondents indicated they would not know how to protect themselves or their property during flooding events and 98% had not prepared a plan for their household or business to follow during an event. Furthermore, 73% of respondents had never seen or heard of information relating to flooding in the area. This information bolsters the requirement for a community flood education program to assist in flood preparedness and awareness.

In 2012, Molino Stewart was engaged to undertake Council's Flood Education and Awareness Project for Fairfield City. As part of the program, data was collected via survey to determine the level of flood awareness and preparedness. Challenges for community flood education were identified to be the large cultural and lingual diversity in the local population. Over 20% of the population within the suburb of Fairfield speak a language other than English and do not speak English well or at all. As such, flood education programs for the Fairfield community need to recognise the cultural and linguistic diversity and cater for these needs, particularly those part of vulnerable cohorts. Education programs, including verbal and written material, should be conducted in multiple languages to increase public safety, reduce property damages and increase the recovery of flood-affected communities.

As noted in the Flood Preparedness Manual (Attorney-General's Department, 2009), planning for floods requires a sound understanding of the flood threat to the community, knowledge of flood hazards and the impacts of flood events. Therefore, community education programs need to focus on conveying the current and future flood risk on a local level (including individuals understanding the risk to their properties), assist in the preparation of flood emergency plans, and ensure that the population understands what is required of them and the relevant emergency organisations during flood events. As stated, this information needs to be delivered in multiple languages and in both verbal and written information available face-to-face, directly to vulnerable residents, online and in commonly accessed businesses/organisations around the community.