

AGENDA

GOVERNANCE COMMITTEE MEETING

9 April 2024



You are hereby notified that a **Governance Committee Meeting** of Liverpool City Council will be held at **LEVEL 6, 35 SCOTT STREET, LIVERPOOL NSW 2170** on **Tuesday, 9 April 2024** commencing at 10.00am.

Please note this meeting is closed to the public. The minutes will be submitted to the next Council meeting.

If you have any enquiries, please contact Council and Executive Services on 8711 7441.

A handwritten signature in black ink, appearing to read "John Ajaka".

Hon John Ajaka
CHIEF EXECUTIVE OFFICER

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ITEM 01

Warwick Farm Precinct Plan: Issue and Option Paper

Strategic Objective	Evolving, Prosperous, Innovative Implement planning controls and best practice urban design to create high-quality, inclusive urban environments
File Ref	020367.2024
Report By	Brianna Van Zyl - Senior Strategic Planner
Approved By	Lina Kakish - Director Planning & Compliance

EXECUTIVE SUMMARY

The Warwick Farm Structure Plan (**Attachment 1**), developed by Council in 2020 and 2021 for the Warwick Farm horse training area, has been on hold since 24 November 2021 when Council resolved that:

- *'Council is provided with the information that allows Council to make a fully informed and fully educated decision on this matter, including the finalised regional flood evacuation study'.*

Council completed a Flood Evacuation Study for the Liverpool Collaboration Area and Moorebank, by Molino Stewart, in 2022 (**Attachment 2**). Since then, following various significant flood events across NSW, the NSW Government published the NSW Flood Inquiry. The NSW Flood Inquiry findings included recommendations that affected the Georges River Catchment (which includes the Warwick Farm Precinct), which was considered one of the high-risk catchments.

As a result, Council sent a letter to the Hon. Paul Scully, Minister for Planning and Public Spaces, on 5 June 2023 (**Attachment 3**). This letter sought further clarity around how Council should proceed with the assessment of Planning Proposals and land use policies within the Georges River catchment.

Council received a response on 22 September 2023 (**Attachment 4**) which reiterated the need for a risk-based approach to managing potential floods, stating the level of assessment undertaken for Planning Proposals and Development Applications must include a balanced consideration of all the risks and impacts. This response has acted as a catalyst for the Precinct Plan being re-presented to Council.

This Report outlines the issues associated with the Warwick Fam Precinct, as well as the latest Precinct Plan, including flooding, traffic, feasibility, and land fragmentation. This Report also

aims to provide further clarity to the community, and to establish clear next steps for the Precinct.

Council staff have identified three options on how to proceed, with these options detailed within this Report:

- Option 1 – Proceed with the existing Precinct Plan (November 2021);
- Option 2 – Conduct further investigations to rezone the Precinct to an industrial / innovation Precinct; or
- Option 3 – Retain existing zoning and development standards.

Due to existing constraints within the Precinct, and logistical issues proceeding with Option 1, Council staff are recommending proceeding with Option 2. This would provide opportunity for the rejuvenation of the Precinct, in a way that complements the Liverpool City Centre, whilst still addressing the environmental constraints. An industrial / innovation Precinct would also allow for the existing animal and training establishments to remain which supports the Warwick Farm Racecourse.

The next steps will involve a Council report to the next available Council meeting which will outline the options presented below.

RECOMMENDATION

That the Committee receives and notes this Report, and the proposed options on how to proceed with the Warwick Farm Precinct Plan.

REPORT

Background Information

The Study Area

The study area comprises approximately 25.5ha (including roads) and is bounded by the Hume Highway, Shore Street, Warwick Farm Sewage Treatment Plant land, Priddle Street, the Main South Railway Line, and Governor Macquarie Drive within Warwick Farm. It is located approximately 1-1.5km north-east of the Liverpool City Centre and 13.5km south-west of Parramatta. **Figure 1** shows the location of the study area.



Figure 1: Precinct Boundaries shown in red (Source: CM+)

History

On 11 December 2019, Council resolved to direct the CEO to engage Consultants to prepare a Precinct Plan for the rezoning of the Warwick Farm Precinct for a mix of uses. Council appointed a multi-disciplinary team led by Conybeare Morrison to prepare the supporting investigations to inform a Precinct Plan, including a Draft Contribution Framework for the provision of new infrastructure to support the Precinct.

Following the initial Council Resolution, the following has occurred:

- **25 March 2020:** Council endorsed (EGROW11) the Local Strategic Planning Statement (LSPS) which included 'Action 10.2' which commits to developing a Precinct Plan and Planning Proposal for the Warwick Farm Racing Precinct.
- **27 July 2020:** The draft Precinct Plan, Planning Proposal and associated studies were presented to the Liverpool Local Planning Panel. The Panel did not support the Planning Proposal proceeding to a Gateway determination, requiring updates to the flood impact assessment, further analysis on the potential environmental impact of the truck bypass and a report in relation to the cap of 18,800 additional dwellings for the Liverpool Collaboration Area.

- **26 August 2020:** Council considered the advice from the Panel and resolved that the draft Precinct Plan, Planning Proposal, and associated Contributions Plan be placed on public exhibition for 28 days.
- **14 September 2020 to 12 October 2020:** The Precinct Plan was placed on public exhibition.
- **28 April 2021:** The outcomes of the public exhibition were presented to Council (EGROW 04) where Council resolved for several changes to be made to the Structure Plan, Planning Proposal and Contributions Plan. Such amendments included: the inclusion of 240 Governor Macquarie Drive in the Precinct Plan, additional flooding considerations, and an Economic Review of the resultant gross floor areas achieved across the site to determine feasibility.
- **29 September 2021:** A Report detailing the changes to the draft package was tabled at Council. Council resolved (PLAN06) to place the Structure Plan, Planning Proposal and Local Contributions Plan on public exhibition.
- **8 October to 7 November 2021:** The Planning Package was placed on public exhibition.
- **24 November 2021:** The results of community consultation were reported to Council where the following was resolved: *“That Council defer this matter until Council is provided with information that allows Council to make fully informed and fully educated decisions on this matter, including the finalised regional flood evacuation study.”*

NSW Government Flood Inquiry

Since Council placed the Precinct Plan on hold, the NSW Government conducted the NSW Flood Inquiry in 2022. The Flood Inquiry made several recommendations that relate to the Georges River, which was considered a high-risk catchment along with the Hawkesbury-Nepean, Wilsons, and Tweed River catchments. This has added an additional layer of complexity to the Precinct.

Council staff have sought direction and clarity from the Department of Planning, Housing and Infrastructure (DPHI) on how to proceed with proposals in high and medium flood risk areas (**Attachment 3**). In September 2023, Council received a response from the DPHI on behalf of the Hon. Paul Scully, Minister for Planning and Public Spaces, which identified the need to move to a risk-based approach to managing potential floods (**Attachment 4**). The letter stated that the level of assessment undertaken for planning or development proposals are proportionate, and must include balanced consideration on the merits, risks and impacts.

Zoning under *Liverpool Local Environmental Plan 2008*

Under *Liverpool Local Environmental Plan 2008* (LLEP 2008), the Precinct contains a variety of existing land use zones:

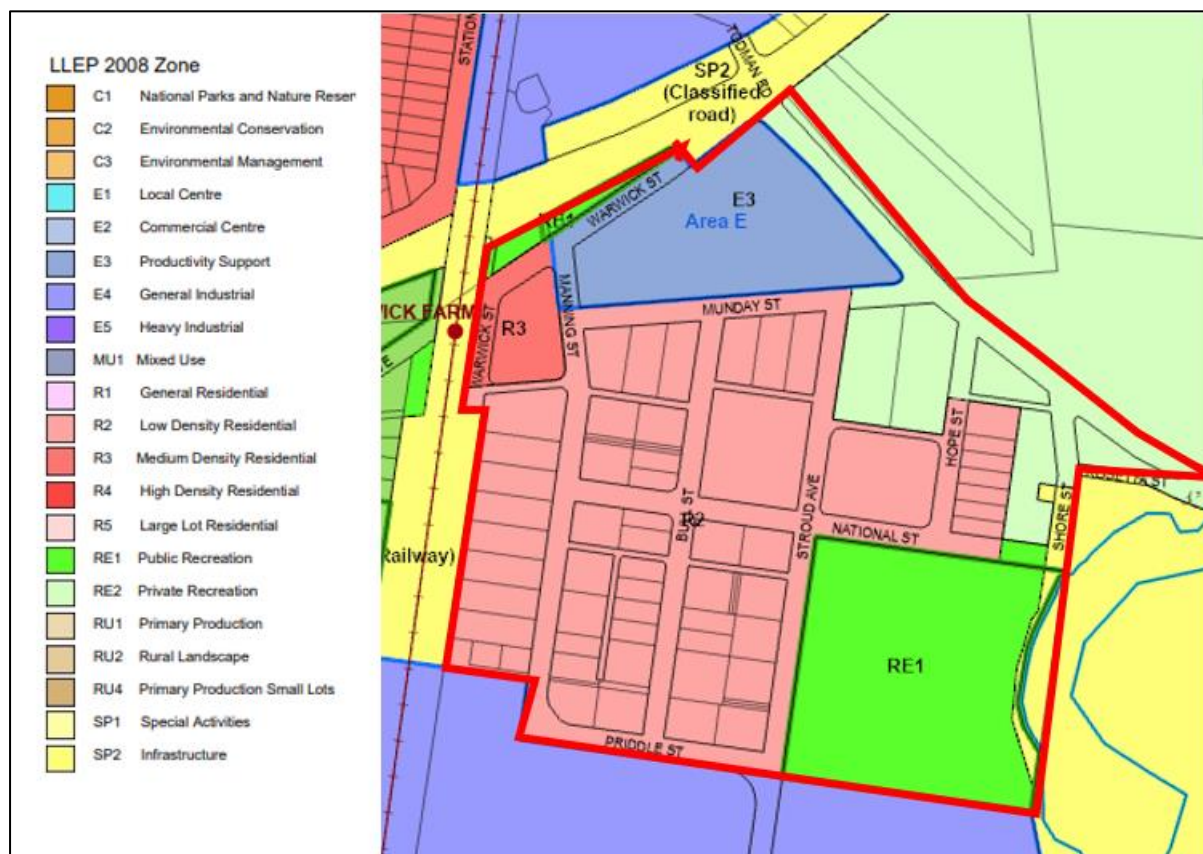


Figure 2: Existing Zoning map of Warwick Farm Precinct

E3 Productivity Support: This zone applies to 240 Governor Macquarie Drive between Munday Street, Warwick Street and Governor Macquarie Drive. The E3 Productivity support zone (formally B5 Business Development) permits offices, light industrial as well as warehouse or distribution uses (among others), however prohibits any residential uses. This land is currently vacant but was subject to a Planning Proposal to rezone to MU1 Mixed Use (formally B4 Mixed Use) and R4 High Density Residential. This detailed further below.

R2 Low Density Residential: This zone applies to the majority of the residential within the Precinct and permits dwellings houses which make up most development in this zone. Clause 16 of Schedule 1 of the LEP also permits animal boarding or training establishments, farm buildings and veterinary hospitals in the R2 zone which reflect several horse boarding and training establishments located in this area. Heights in this zone are limited to 8.5m with an FSR of 0.5:1.

R3 Medium Density Residential: This zone applies to a small pocket of land located opposite the station and developed with 2 storey townhouse style development. Heights in this zone are currently limited to 8.5m with an FSR of 0.5:1.

RE1 Public Recreation: This zone applies to Rosedale Oval and the embankment supporting the Hume Highway overpass.

SP2 Sewerage Systems: This zone applies to land immediately east of the Rosedale Oval playing surface and corresponds with the location of Horseshoe Pond and a small section of Shore Street within the Precinct.

RE2 Private Recreation: This zone applies to land fronting Governor Macquarie Drive and Shore Street in the northeast of the Precinct. It primarily accommodates horse boarding and training premises.

Draft Precinct Plan (September 2021)

The most recent Structure Plan (**Attachment 1**) (prepared by CM+ dated 26/09/2021, presented to Council on 24 November 2021) depicts the redevelopment of the Precinct for mixed use development including residential development.

Key features of the Precinct Plan include:

- A total of 294,162m² GFA, with:
 - 274,053m² of residential GFA
 - 20,109m² of commercial GFA
- Capacity for approximately 3,224 new residential dwellings (based on an average dwelling GFA of 85m²) and a population of approximately 7,383 (based on 2.29 persons per dwelling).
- An overall FSR of 1.04:1 across the entire Precinct (including open space) with an FSR of 3.35:1 on the Mixed-use Land and 2.20:1 on the R4 High Density Residential Zone.
- The tallest development near the station at 15 storeys generally stepping down to 12, 8, 6 and 4 storeys moving away from the station.
- Approximately 39,603m² of additional open space to supplement the existing Rosedale Oval that will be delivered as publicly owned land as well as privately owned, but publicly accessible.

The most recent Precinct Plan is shown in **Figure 3**.



Figure 3: Precinct Plan (Source CM+)

240 Governor Macquarie Drive

On 10 July 2018, Council received a Planning Proposal request to rezone land at 240 Governor Macquarie Drive, Warwick Farm from B5 Business Development to part R4 High Density Residential. The Planning Proposal request also sought to increase the floor space (FSR) development standard from 0.75:1 to 3:1 (equating to approximately 87,900m² GFA) and the height of building (HOB) development standard from 15m to 50m and to reduce the minimum lot size from 2000m² to 1000m².

At the Ordinary Meeting of Council on 11 December 2019, Council resolved (EGROW 09), to endorse “in principle” a Planning Proposal request for 240 Governor Macquarie Drive, Warwick Farm, subject to the Applicant submitting an amended Planning Proposal Report with modified floor space ratio of 2:1 or 500 dwellings (with access to the bonus FSR provisions of up to 3:1), and height of building control of 50m.

On 27 February 2020, Council submitted the Planning Proposal to the DPHI (formerly Department of Planning and Environment) for Gateway assessment. On 22 September 2020, Council received notification that Council's request for a Gateway determination had been refused. The DPHI cited several reasons for this, noting that investigations to inform the Warwick Farm Structure Plan, in which the subject site is located, should be undertaken as a

Precinct-wide approach. As such, it was recommended that this standalone Precinct be rolled into a consolidated Planning Proposal for the Precinct. 240 Governor Macquarie Drive was included in the Precinct Plan by Council resolution on 28 April 2021.

More recently, the landowners of 240 Governor Macquarie Drive have met with Council staff and are seeking to progress the redevelopment of 240 Governor Macquarie Drive either as a part of the Precinct, or as a standalone Planning Proposal. It is understood that the landowners are currently undertaking further design testing, and traffic modelling to determine the evacuation capacity of the Precinct.

A Development Application (DA-1134/2021) was approved by the NSW Land and Environment Court on 5 January 2023. The DA proposed:

- *‘Construction of a mixed-use development comprising specialised retail premises, food and drink premises, a centre-based child care facility, health services facilities and business identification signage with associated works including car parking, access, landscaping and civil work’.*



Figure 4: Photomontage of DA-1134/2021 (Leffler Simes Architects)

Part 1: Issues

This section of the Report details the issues with the draft Precinct Plan and the constraints of the Precinct, as background information for Part 2 of this Report which details future options.

A. Strategic Merit**Local Strategic Planning Statement**

Council's Local Strategic Planning Statement was endorsed in 2020. Planning Priority 10, '*A world class health, education, research and innovation Precinct*' includes aims to support development of the Liverpool Innovation Precinct and ensure land use planning supports the operation and growth of the Precinct for all in the health, education and innovation ecosystem. Specifically, Action 10.2 within the LSPS states:

"Prepare structure plan and Planning Proposal to rezone the Warwick Farm reaching Precinct to a mix of uses including B4" (Updated to MU1 Mixed Use as per the Employment Zoning Reform).

Collaboration Area – Liverpool Place Strategy

Planning Priority W2 'Working through collaboration' of the Western City District Plan includes the Liverpool Collaboration Area, which established a vision for this area. Within this plan, the Warwick Farm area is identified as being Innovation / Research / Health / Advanced Manufacturing.

The intent of the vision for this area is to support the health and education Precinct of the Liverpool City Centre. Specifically, the vision for this area is for *"a high-tech, transit-oriented, advanced manufacturing business park that leverages the growth of the health, education and equine sectors, excluding residential development"* (p10).



Figure 5: Place Strategy Vision, Collaboration Area Liverpool Place Strategy

Liverpool Innovation Precinct

The Precinct is directly east of the Liverpool Innovation Precinct (pink below), which focuses on Health and Education delivery in Liverpool.

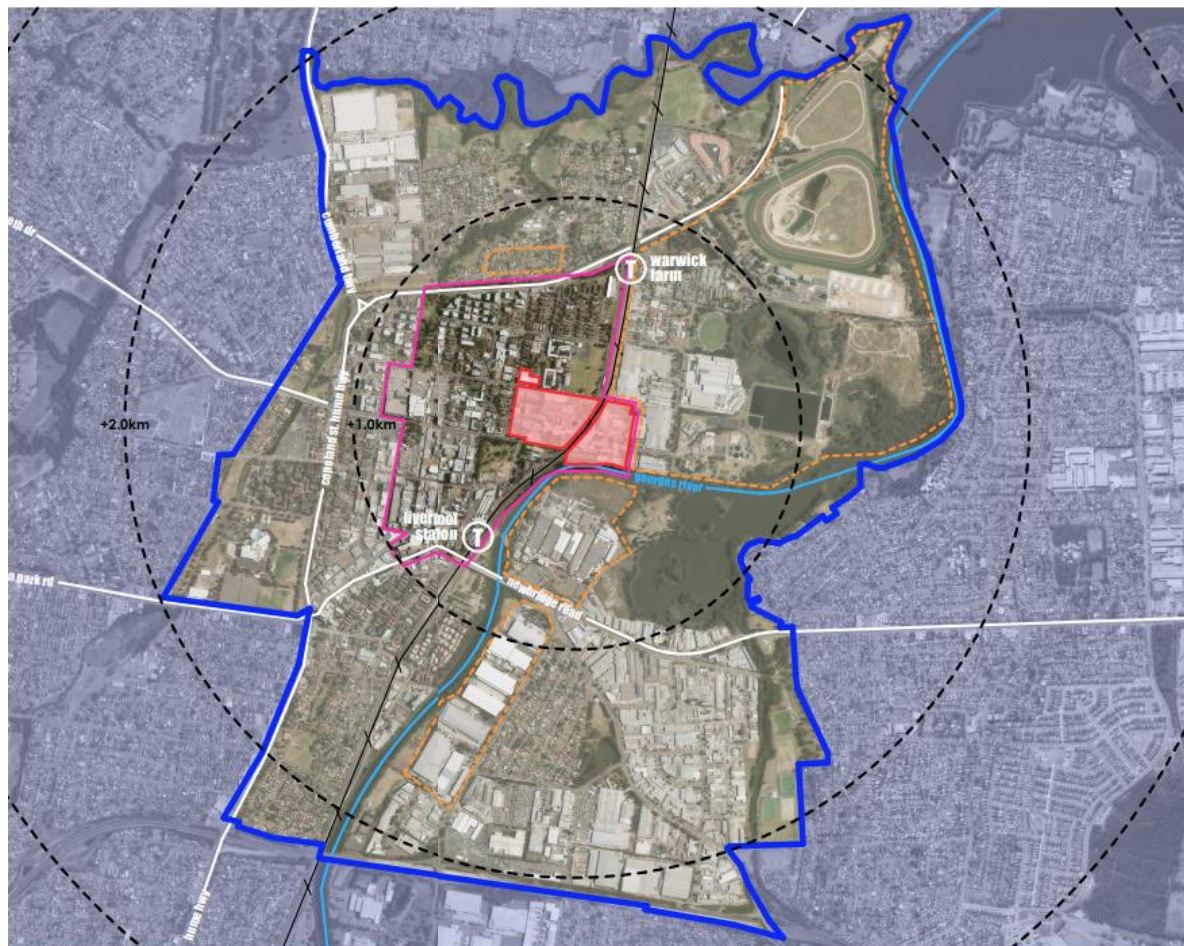


Figure 6: Liverpool Innovation Precinct (pink)

B. Site Specific Constraints

Flooding

The majority of the Precinct is mapped as high and medium risk flood prone land, with a small portion mapped as low risk (as shown in **Figure 7**, below). The site is identified as being prone to flooding from the Georges River catchment.

The site is not affected by the 20- year flood but would be inundated by the 100-year flood. Previous flood studies suggested the site would be classified as being a "medium flood risk" with inundation depth between 0.2m and 0.6m.

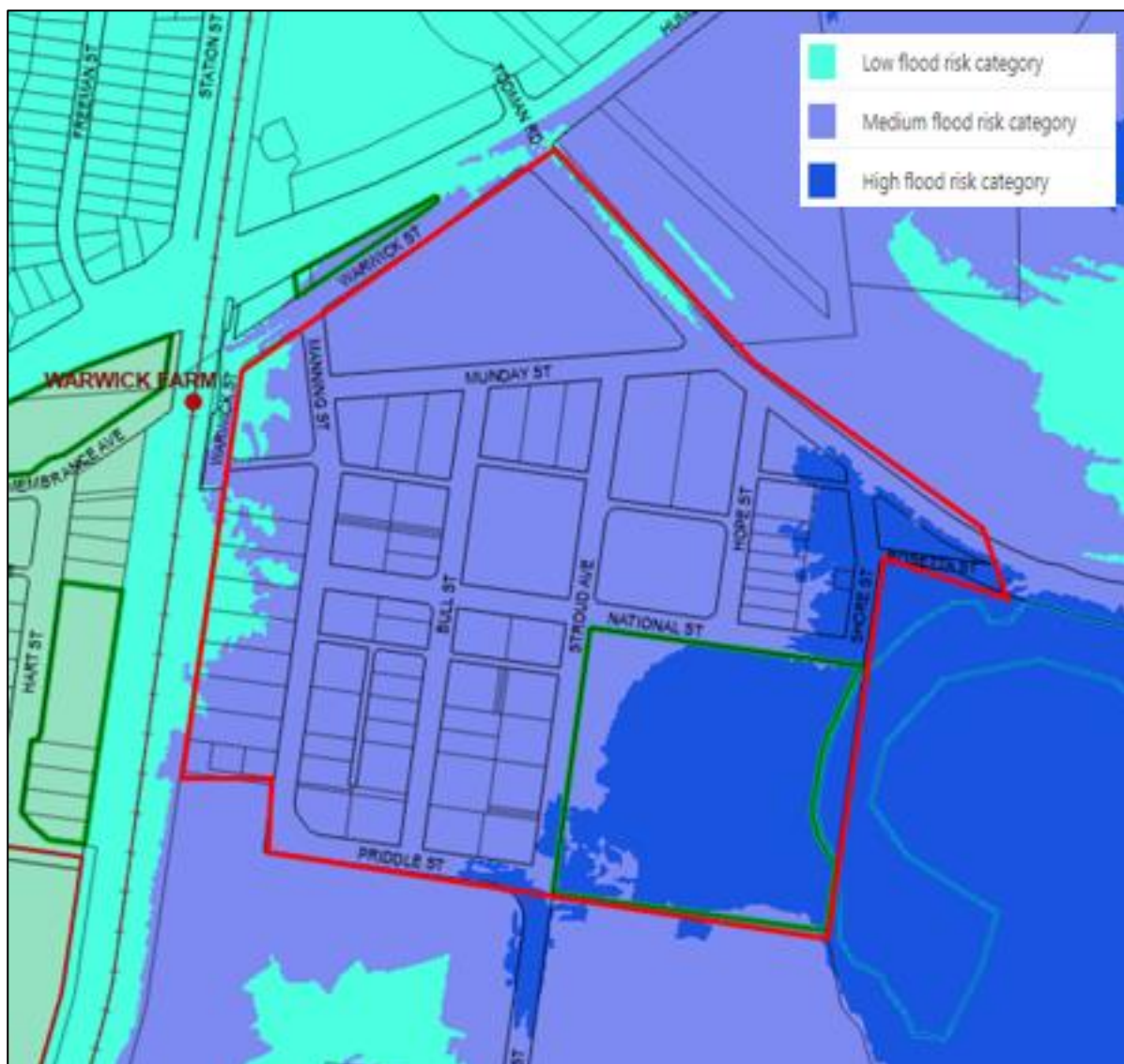


Figure 7: Council internal Flood Risk mapping

A Flood Evacuation Study for the Liverpool Collaboration Area and Moorebank was completed in 2022 by Molino Stewart on behalf of Council (**Attachment 2**). The study responded to the Liverpool Collaboration Area Place Strategy, which identified flooding and flood evacuation as potential constraints on growth in the area. It tested whether premises on the floodplain could evacuate safely when ordered to by the State Emergency Service (SES) in flooding events up to the probable maximum flood (PMF) level.

As such, the study models road capacity to determine whether development (existing and proposed) can evacuate within the available flood warning time given a 100% evacuation compliance rate as required by the SES. The study found that there is restricted capacity for additional development within the floodplain areas of the Liverpool Collaboration Area and Moorebank East.

“Spare” evacuation capacity was investigated at a high level for the large Planning Proposals. Specifically, the spare capacity for the subject Precinct was estimated at 864 vehicles. The most recent Precinct Plan for the Warwick Farm Precinct was estimated to generate 3,709 vehicles.

In addition, Shelter In Place was determined to be inappropriate for the area, and every building requires access above the 1% AEP. This is a significant design consideration and requires balancing significant cut and fill.

‘Ministerial Direction 4.1 Flooding’ states a list of considerations which the Planning Proposal must be meet or be justifiably inconsistent. Specifically, the Ministerial Direction states, a Planning Proposal must not contain provisions that apply to flood planning areas which includes (but not limited to):

- Permit developments in floodway areas;
- Permit development for the purpose of residential accommodation in high hazard areas;
- Permit a significant increase in the development and /or dwelling density of that land;
- Permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate; and
- Are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities.

The most recent Precinct Plan would be unable to demonstrate sufficient consistency with the above-mentioned Ministerial Direction.

Odour Buffer

The Precinct is affected by an odour buffer which is identified around the Warwick Farm sewerage treatment works. The buffer zone aims to reflect areas that may be subject to odour from plant based on distance, meteorological and topographic conditions. The full extent of the buffer area can be seen in **Figure 8** below.

Since at least the mid 1990’s Department of Urban Affairs and Planning (now DPHI) has released policy documents which seek to prevent residential and other sensitive uses from establishing in the odour buffers around sewerage treatment. As part of the previous exhibition for the Precinct Plan, Sydney Water raised concern about any proposals that would increase residential densities within the existing odour buffer zone. Council designed the subject Precinct Plan with this in mind.

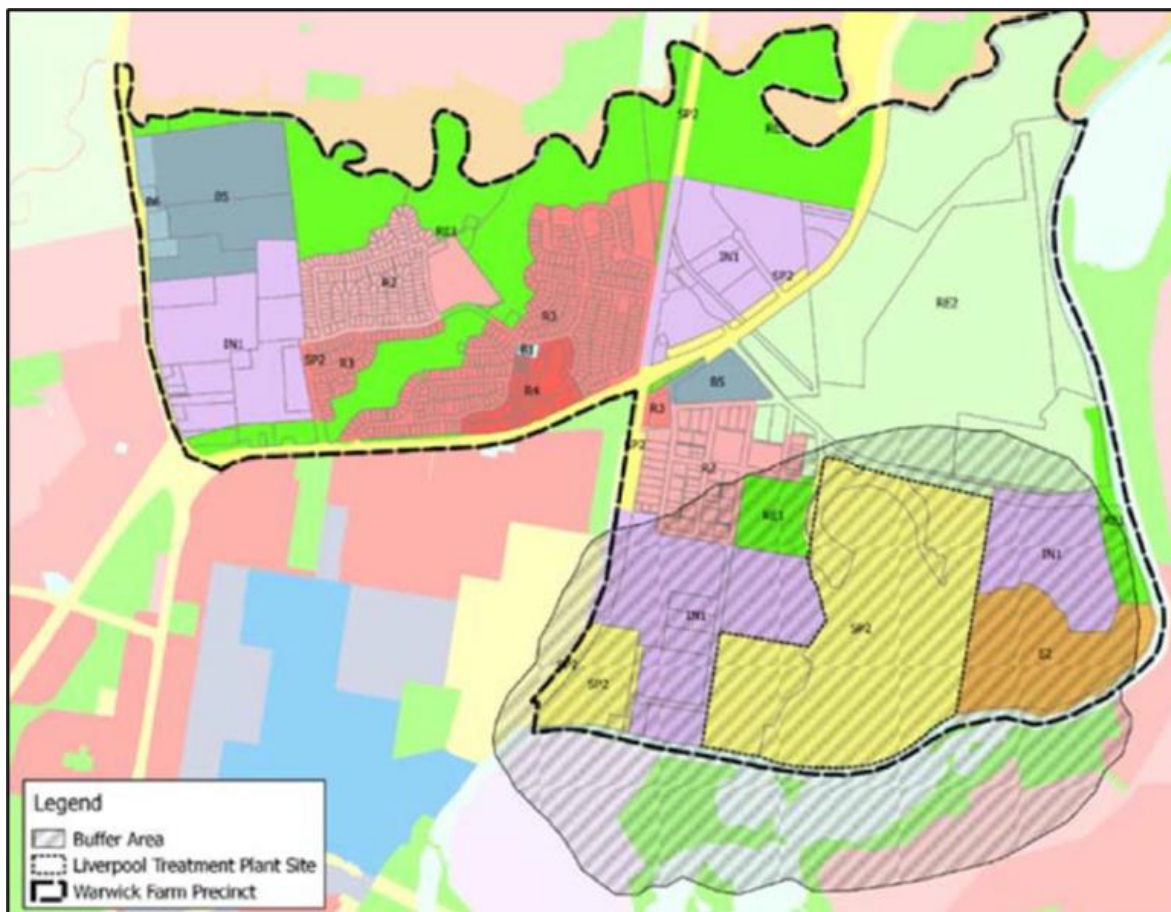


Figure 8: Odour buffer zone with associated sewerage treatments works.

C. Constraints of the Precinct Plan

Fragmented Land

Land within the Warwick Farm Precinct is generally in fragmented ownership, which further complicates the redevelopment of the Precinct. The most recent Precinct Plan seeks to encourage re-development by enabling the consolidation of various fragmented landholding for development, and the acquisition of land for open space and compensatory storage, however this increases the complexity of the proposal and negatively impacts the feasibility of redevelopment occurring.



Figure 9: Land ownership (Source: CM+)

Feasibility

The draft Precinct Plans had high costs associated with the Precinct due to requirements for consolidation of fragmented land and required infrastructure to support the development (raising of roads, flood mitigation works, open space acquisition, truck bypass, and pedestrian links across the railway).

Economic feasibility testing has been undertaken which found the financial feasibility tipping points of 3.35:1 for B4 Mixed Use zone and 2.2:1 for R4 High Density Residential zone. However, it's important to note that this feasibility testing was done in 2021, and there have been significant changes in the building industry since the study, such as increased material costs, trade shortages and higher interest rates. The Precinct is anticipated to have a higher tipping point now.

Contributions Plan

The Precinct Plan is supported by a draft Contributions Plan which aims to fund the solutions including flood evacuation route with flood free development as well as provision of new recreation and community facilities and address traffic related issues. This would have to be

revisited, and it is likely the contribution rates would increase. A summary of the proposed contributions rates is shown in the **Figure 10**.

Infrastructure category	Per resident or group home/hostel bed	Per 1 bedroom dwelling	Per 2 bedroom dwelling	Per 3 or more bedroom dwelling	Per m ² of non-residential GFA
Community facilities stratum land	\$630	\$1,135	\$1,450	\$1,954	-
Open space and recreation facilities	\$7,133	\$12,157	\$16,406	\$22,112	-
Roads and transport facilities	\$6,754	\$12,157	\$15,534	\$20,937	\$599
Drainage facilities	\$355	\$639	\$816	\$1,100	\$9
Plan administration and management	\$120	\$215	\$275	\$371	\$8
Total	\$14,992	\$26,985	\$34,481	\$46,474	\$616

Figure 10: Proposed Contribution Rates

Property Acquisition / Open Space

To facilitate future rezoning and redevelopment in the Warwick Farm Precinct as per the Structure Plan, there is a need to reserve some land for public purpose, including future open space and flood mitigation. The Precinct Plan provides for an increase of approximately 39,603m² of open space to meet the needs of the future population.

The larger areas of open space are proposed to be zoned RE1 Public Recreation and are included in the Contributions Plan for acquisition and embellishment. Specifically, the Precinct Plan provides the overall quantum of land for open space which is public or publicly accessible private open space is 1.25ha per 1,000 people which is slightly lower than the 1.5ha per 1,000 people identified in the Open Space Needs Analysis for the Liverpool Collaboration Area.

The additional open space is crucial to ensuring the redevelopment provides sufficient amenity for future residents, however, it does increase the cost to develop, and requires property acquisition of private land.

Staging of the Precinct Plan

Given the flood constraints within the Precinct, and to achieve a safe evacuation route, it will be necessary to raise key roads with the compensatory storage being provided within nominated open space areas. Specifically, the proposed development will need to ensure that the raising of the roads is included in the Draft Local Contributions Plan as each development site will need to complete full road construction. This will need to be undertaken in a staged manner, with sequencing from north to south in order to provide a continuous evacuation route

using the raised roads rising to the Warwick Street and Hume Highway intersection. The nominated future staging in the Precinct Plan attempts to minimise interface issues by including whole sections of raised road within the stage (see **Figure 11** below).



Figure 11: Draft Warwick Farm Precinct Plan - Staging Plan

Traffic

The road network throughout the Precinct is grid like with the only access points at Governor Macquarie Drive in the north and Scrivener Street in the south, and a minor left turn only at Warwick Street connecting to an elevated part of the Hume Highway overbridge of the rail line in the west. This means the Precinct carries a high volume of heavy vehicles traffic via

Manning and Priddle Streets. Council has resolved to investigate construction of a road around Rosedale oval to create a bypass for industrial traffic. A concept design has been prepared; however, it has not been funded.

The investigation informing the Precinct Plan have identified the following road intersection works for the Precinct:

- Delivery of a bypass for the industrial area between Governor Macquarie Drive and Scrivener Street, via Shore Street and a new road around the Rosedale Oval;
- Conversion of the Governor Macquarie Drive / Shore Street intersection to a signalised intersection, to connect with the bypass;
- Conversion of the Governor Macquarie Drive / Munday Street intersection back to a priority intersection due to the proximity to Shore Street;
- Dualling of Governor Macquarie Drive between Hume Highway and the Inglis Hotel access road; and
- Implementation of a dual lane right turn bay from Hume Highway eastbound into Governor Macquarie Drive southbound.

Community Consultation

The planning packages have been placed on public exhibition twice, with the initial public exhibition occurring between 14 September 2020 to 12 October 2020. During the public exhibition, Council received 20 submissions from the public. Most of these submissions supported rezoning the Precinct for high-density residential uses, however many raised concerns with various aspects of the Draft Plan.

The planning package was again placed on public exhibition from 8 October 2021 to 7 November 2021. Council received 26 submissions during the public exhibition. Of the 26 submissions received, 15 submissions were opposed to the plans and 11 were supportive of rezoning the Precinct in principle, however some raised issues with several elements of the planning packages and requested changes.

Since the Structure Plan has been placed on hold, Council staff have received ongoing calls and enquiries. The enquiries are generally from landowners within the Precinct seeking an update and/or clarification around the next steps. Questions in relation to flooding in the Precinct are also common.

Part 2: Options for the Warwick Farm Racecourse Precinct

The following options are presented to Council to consider how best to proceed with the Precinct Planning exercise.

Option 1: Proceed with the Precinct Plan prepared by CM+ September 2021 (Not recommended)

The most recent Structure Plan presented to Council in November 2021 depicts the redevelopment of the Precinct for mixed use development including residential development. As outlined previously, the key features of the Plan includes a total of 294,162m² of floor space (274,053m² of residential GFA, and 20,109m² of commercial GFA), creating capacity for approximately 3,224 new residential dwellings.

The proposed zoning map is shown in **Figure 12** below:

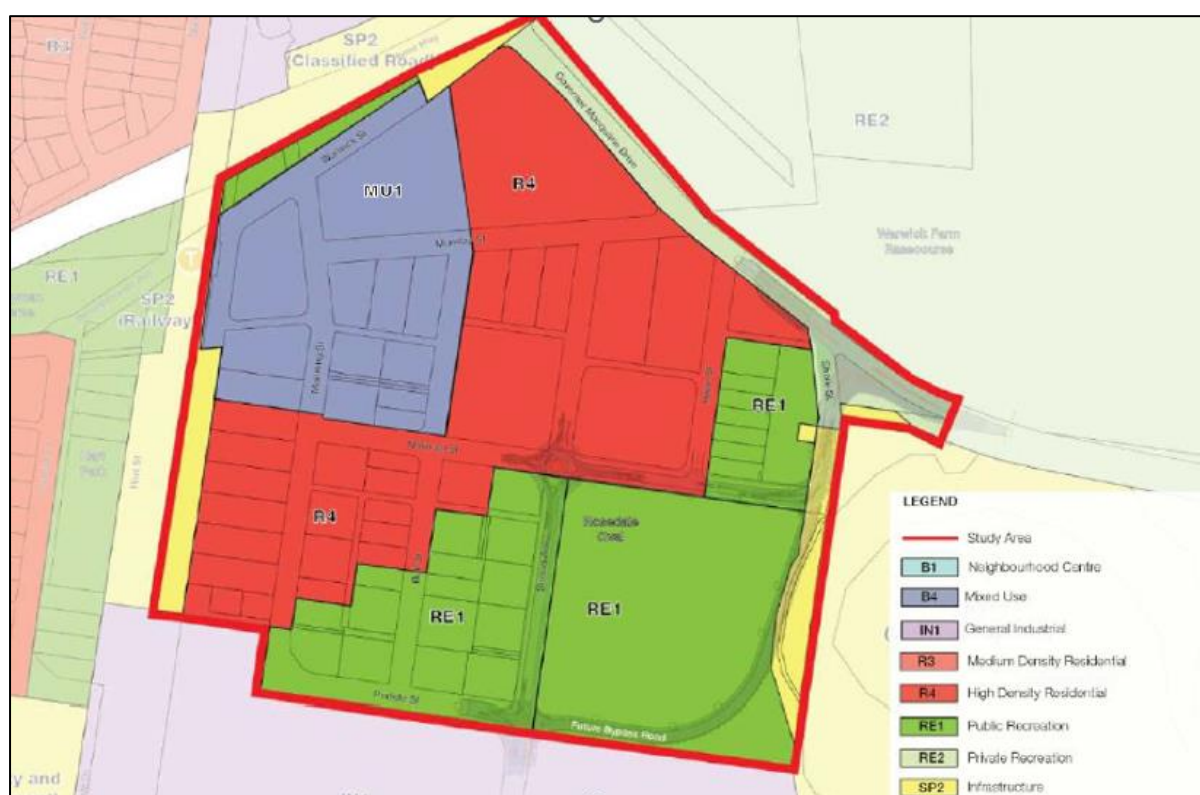


Figure 12: Proposed Zoning under Option #1 (Source: CM+)

Comment:

The area is significantly constrained in terms of flooding, evacuation, and the odour buffer. The subject Precinct Plan aimed to mitigate these constraints. However, this resulted in high costs to develop due to property acquisition and required significant infrastructure to mitigate the risks of flooding and evacuation.

In addition, the approach to addressing flooding in the Structure Plan will mean that the that increased densities can only be permitted on land which is raised above the 100-year flood level and that the flood storage will occur within sports fields and recreation areas required a

funded by the increased development in the draft Contributions Plan. The fragmented nature of the Precinct makes this extremely difficult.

The economic feasibility testing for the Precinct was done in 2021, however since then economic conditions for development have worsened and it is not expected to have the same feasibility tipping point as previously identified.

Given the constraints outlined above, and the density sought by the proposed Precinct Plan, it is considered unrealistic that it would be achieved in full. Flooding and evacuation are a significant hinderance on achieving the vision of the plan, and given the risk to life and property, is unlikely to be supported by the relevant NSW Government Agencies.

If the Structure Plan was to proceed as is, it would likely result in Council spending significantly more money to proceed with a plan which would be highly challenging to implement, and unlikely to be supported by the relevant NSW Government Agencies.

Option 2: Proceed with Industrial / Innovation Precinct (Recommended)

The subject Precinct is located approximately 1-1.5km northeast of the Liverpool City Centre, and located within the Liverpool Collaboration Area, and east of the Liverpool Innovation Precinct. The Collaboration area aims to target opportunities for growth in certain sectors including health and education.

This option would investigate the application of an industrial / business land use zoned for an innovation Precinct, as per the vision of the Liverpool Collaboration Area. This would complement the Liverpool Innovation Precinct, and encourage employment opportunities that support the hospital, and the Liverpool City Centre.

Options for this Precinct could include retaining the zoning on 240 Governor Macquarie Drive, and rezoning the remainder of the Precinct to E4 General Industrial. The proposed development standards will have to be further investigated.

The Precinct currently benefits from an additional permitted use under Schedule 1 of the LEP which permits the development of animal boarding or training establishment, farm buildings and veterinary hospital.

The E4 General Industrial permits both animal boarding or training and veterinary hospitals. Farm buildings are not listed as a permissible use but could be included under Schedule 1 of the LEP for continuity purposes. In addition, a bonus provision could be added to the Precinct for medical research and development. This would need to be further analysed.

Comment:

Flood planning controls are less stringent for industrial and business land uses, and given the flooding and evacuation constraints, non-residential uses may be better suited to the area. Whilst a large majority of the subject area is zoned R2 Low Density Residential, it is not of a general residential nature. The area is interspersed with several horse boarding and training facilities, which complements the Warwick Farm Racing Precinct on the northern side of Governor Macquarie Drive.

There has been previous studies and strategies that have looked to influence land changes in this area, with employment uses typically being regarded as being more compatible with the range of constraints that apply to the area. Specifically, the Liverpool Collaboration Area Place Strategy (2018) identifies the area as a high-tech, transit-orientated and advanced manufacturing business park that leverages from the health, education and equine sectors. The Place Strategy identifies the area as being in a high performance location which could make significant economic contributions.

By rezoning the majority of this area to non-residential use, the odour buffer would no longer be a significant constraint, because the zoning wouldn't permit residential and sensitive uses. This would provide additional flexibility to the Precinct.

In addition, rezoning this Precinct to a business / industrial Precinct will require less investment for infrastructure and would not result the same scale of open space acquisition. Further analysis would be required to establish if the staging plan is still required for evacuation purposes.

As an immediate next step, Council staff can conduct internal investigations and master-planning to scope the potential yield of the Precinct. This would include assessing the flood planning controls for industrial land in greater detail, and if the same amount of infrastructure investment is still required (staging plan, raising of the roads etc). It is estimated that this exercise would take approximately 9-12 months. Following further consultation and endorsement from Council, funding would be requested for further detailed testing.

It is anticipated that the final package would require the following documents to adequately justify the changes: Conceptual Design, Traffic Assessment, Economic Testing and Feasibility Studies, Detailed Flood Assessment, Open Space Needs Analysis Precinct Plan, and Contribution Plan. The proposal would also have to be reported to the Local Planning Panel.

This option would save Council from allocating significant funds for an outcome that would unlikely be supported by the NSW Government. It would also provide landowners with clarity on the future of the Precinct, and consultation would be required prior to a Planning Proposal endorsement, as per Council's Community Participation Plan.

If Option 2 is supported by Council, additional investigations would be required to support this option. Therefore, this option would have financial implications, and require future resourcing, however it is more likely to result in a positive way forward for the redevelopment of the Precinct. Additionally, there could be opportunity to partner with the DPHI to develop a plan that unlocks much needed industrial land to service the wider area.

Option 3: Retain Existing Zoning (Not recommended)

Given the environmental constraints and development challenges within the Precinct, Council could retain the existing zoning and development standards. The current uses complement the Warwick Farm Racecourse and are of local economic importance. This option would allow for development under the existing zoning, and not require the significant infrastructure investment to support it.

This would have no financial implications on Council, however, would not align with the actions outlined in the LSPS or vision of the Collaboration Area. Furthermore, existing flooding risks impacting the Precinct would remain.

Choosing this option may result in criticism from the community, who have participated in two previous public exhibitions. As previously noted, numerous emails and calls from residents are received by Strategic Planning, seeking clarification on how the Precinct will be developed in the future.

There are no financial implications relating to this recommendation.

FINANCIAL IMPLICATIONS

There are no financial implications associated with the Report however Council should note the following indicative financial implications associated with the three proposed options:

- Option 1 would require various issues to be resolved, requiring further investigations. So far approximately \$300,000 has been spent. Due to the constraints of the Precinct, it is highly unlikely this option would be progressed to the point of practicable implementation, even with further funding allocated;
- Option 2 provides a new vision for the Precinct and requires new studies to ensure the vision is viable. As an immediate next step, Council staff could draft a high-level Master Plan which includes potential development standards, and associated infrastructure needs. Once this was completed and endorsed by Council, further investigations to support a Planning Proposal could occur (e.g. Precinct Plan, Traffic Assessment, Economic Testing, Feasibility Studies, Detailed Flood Assessment, Open Space Needs Analysis, Contributions Plan and site-specific Development Control Plan). This would be outside the existing budget allocations for City Planning, and therefore require further

funding. It is estimated approximately \$500,000 may be required to progress this option; and

- Option 3 would have no associated financial implications.

CONSIDERATIONS

Economic	Facilitate economic development.
Environment	There are no environmental and sustainability considerations.
Social	There are no social and cultural considerations.
Civic Leadership	There are no civic leadership and governance considerations.
Legislative	Section 3.31 to 3.37 of the <i>Environmental Planning and Assessment Act 1979</i> .
Risk	This project is currently at the investigation stage, so considered to be low risk, and within Councils appetite. There is a risk of growing community frustration if an option for the redevelopment of the Precinct is not progressed.

ATTACHMENTS

1. Attachment 1: Warwick Farm Structure Plan
2. Attachment 2: Georges River Flood Evacuation Modelling Report
3. Attachment 3: Letter to the Minister for Planning and Public Spaces
4. Attachment 4: Response from NSW Government- Deputy Secretary-OBO Minister - NSW Flood Inquiry 2022

The most recent Warwick Farm draft Precinct Plan, draft Planning Proposal, draft Contribution Plan, Summary Fact Sheet, Flood Assessment, Traffic Assessment and Fact Sheet on Property Acquisition can be found through this link:

https://liverpool.infocouncil.biz/Open/2021/11/CO_20211124_AGN_439_AT_SUP_WEB.htm



Prepared for: **LIVERPOOL CITY COUNCIL** 

www.cmplus.com.au
21043 | August 2021

REVISED WARWICK FARM STRUCTURE PLAN

URBAN DESIGN REPORT

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REVISED WARWICK FARM STRUCTURE PLAN

Revision	Date	Description	By	Chk	App
01	23/08/21	Revised Warwick Farm Structure Plan Urban Design Report	WW/DW	WW	DN
02	26/08/21	Revised Warwick Farm Structure Plan Urban Design Report Rev 02	WW	DN	

Prepared for:  

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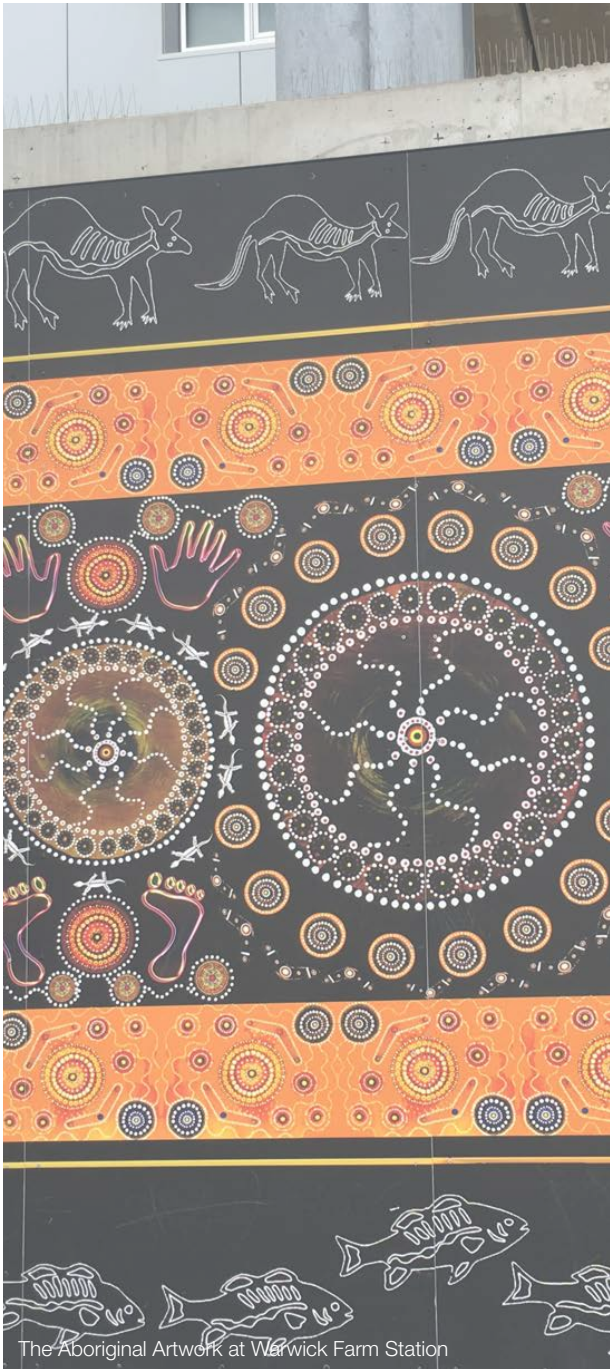


Rosedale Oval



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Warwick Farm Station



1.0 Introduction

1.1 Background Introduction

Conybeare Morrison International (CM⁺) and the consultant team are engaged by Liverpool City Council (LCC) to conduct a study of the Warwick Farm Precinct (the precinct) and develop a Structure Plan as well as the associated Planning Proposal and Contributions Plan to submit to the Department of Planning, Industry and Environment (DPIE) for Gateway determination.

In the December 2019 Council meeting, Liverpool City Council decided to support a B4 Mixed Use zoning within the precinct and deliver a high quality Urban Renewal Precinct with optimal urban design outcomes. Council has also resolved to support in principle the Planning Proposal at No. 240 Governor Macquarie Drive (GMD), lodged by SJB Planning on behalf of Warwick Farm Central (Projects) Pty Ltd, with reduced height and density as well as a new VPA offer. Subsequently, Council prepared and lodged a Planning Proposal to the DPIE on the 25th of February 2020 seeking to amend the Liverpool Local Environmental Plan 2008 (LLEP 2008).

The draft Structure Plan was developed to include the design described in the previously submitted Planning Proposal for No. 240 GMD. It was then placed on the public exhibition in late 2020 and 20 public submissions were received including submissions from Sydney Water and Transport for NSW (TfNSW). A financial feasibility study was conducted in this period in light of the Liverpool Planning Panel comments and the Council resolution. On 21 September 2020, the Planning Proposal at No. 240 GMD was refused by the DPIE at the gateway determination, citing a lack of strategic merit. The DPIE states in the Gateway determination letter that the Warwick Farm Structure Plan and its associated studies should inform the planning of No. 240 GMD.

In April 2021, Council resolved to further refine the exhibited Warwick Farm Structure Plan to incorporate the feedback received from the community, the DPIE and the latest regional studies. Therefore, CM⁺ and the consultant team were re-engaged by LCC to update the exhibited Warwick Farm Structure Plan and the associated Planning Proposal and Contributions Plan.

The following issues were considered in amending the structure plan:

- Respond to feedback received during public exhibition of the draft plans.
- Incorporate the outcomes of regional transport, flood, and open space studies.
- Respond to the outcomes of feasibility testing.
- Incorporate the 240 Governor Macquarie Drive site into the draft planning proposal and structure plan, considering DPIE's Gateway refusal and feedback received from public exhibition.
- Conduct a detailed flood impact assessment to better understand land needed for flood mitigation and potential flood mitigation options.



Figure 1: Aerial view of the Warwick Farm Precinct



1.0 Introduction

1.2 The Study Area

The Warwick Farm Precinct is located in the Liverpool Council Local Government Area (LGA), in the suburb of Warwick Farm. The Liverpool CBD, which is the third largest CBD of Metropolitan Sydney, is approximately 1.5km (10-minute drive) to the southwest of the precinct. The Warwick Farm Racecourse is across Governor Macquarie Drive to the northeast of the precinct.

The precinct has an area of approximately 28.4 hectares and is bounded by the Hume Highway to the northwest, the railway corridor to the west, Priddle Street to the south, Horseshoe Pond to the east and Governor Macquarie Drive to the northeast.

It is well connected to the surrounding suburbs, parks, sport and recreational facilities as well as educational facilities. Rosedale Oval, located within the precinct, is an 'A-Grade' Cricket Ground. A children's playground is located within Rosedale Oval along National Street. Hart Park is across the railway corridor to the west of the precinct. Liverpool Hospital is approximately 800m to the southwest of the precinct.

The precinct is also well served by the Hume Highway, major roads, local roads and public transport. Warwick Farm Station, which is serviced by T2 Inner West / Leppington, T3 Liverpool / Lidcombe and T5 Richmond / Leppington lines, provide frequent train services to the major strategic and local centres, including Liverpool CBD, Parramatta CBD and Sydney CBD.

The Warwick Farm Precinct currently has a mix of uses, however most are related to the equine business. Residential, hotel and motel accommodation is scattered within the precinct. A general industrial area is immediately adjacent to the Warwick Farm Precinct to the south, which generates a large amount of heavy vehicle traffic movements through Manning and Munday Streets to Governor Macquarie Drive and the Hume Highway. The conflict of uses between small vehicles, heavy vehicles, pedestrian and horses is one of the major issues within the precinct.

Council, at its December 2019 meeting, has also identified the Manning Street Bypass as a priority project to redirect heavy vehicles away from entering the core of the precinct, therefore facilitating the redevelopment of the precinct to mix of uses, including

B4 Mixed Use zone. The Manning Street Bypass project is at the preliminary stage. Detailed information regarding the proposed Manning Street Bypass will be made available to the public once the design is finalised.



Figure 2: The Warwick Farm Precinct



1.0 Introduction

1.3 Project Objectives

The project aims to:

- Rezone the Warwick Farm Precinct to a mix of uses, including B4 Mixed Use, R4 High Density Residential and RE1 Public Recreation consistent with the Liverpool Local Strategic Planning Statement (LSPS).
- Incorporate 240 Governor Macquarie Drive into the overall precinct planning.
- Develop a well considered Structure Plan for the precinct to guide future development.
- Achieve the objectives and actions identified in the Liverpool Local Strategic Planning Statement (LSPS).
- Mitigate the potential traffic and flooding impacts.
- Improve the public domain, including pedestrian / cycling linkages, wayfinding and new public spaces.
- Deliver public benefits as a result of the redevelopment.
- Reconsider the appropriate height and density across the entire precinct based on the analysis of constraints and opportunities and feedback received.
- Amend the Planning Proposal and Contributions Plan based on the revised Structure Plan to submit to the DPIE for a Gateway Determination.

1.4 The Team

The CM+ led Consultant Team includes the following expertise:

- Project Management - CM+
- Urban Design - CM+
- Strategic, Statutory Planning and Contributions Plan- GLN Planning
- Transport Planning - SCT Consulting
- Flood Management - WMA Water
- Economic and Land Valuations - Atlas Urban Economics
- Quantity Surveying - Mitchell Brandtman
- Social and Community Planning - Cred Consulting

The Consultant Team has worked closely with Liverpool City Council to deliver this project. The team structure is illustrated in Figure 3.

1.5 Methodology

This project has been undertaken in two phases. Phase 1 of the project was focused on development of a draft Structure Plan based on Council's resolution in 2019. Subsequently, the draft Structure Plan was put on public exhibition. Phase 2 of this project is to amend the exhibited Structure Plan addressing the community feedback, the DPIE's Gateway determination on No. 240 Governor Macquarie Drive and the relevant regional studies.

Phase 1 - Draft Structure Plan Methodology

- Attend an Inception Meeting with Council to familiarise with the background information and confirm the project objectives, program and deliverable.
- Conduct a site visit of the precinct and its surrounding context to familiarise with the area.
- Undertake background information review.
- Conduct Urban Design Analysis, planning study, traffic and transport study, flood study and social infrastructure study to identify constraints and opportunities.
- Establish the Urban Design Vision and Principles for the precinct.
- Develop Structure Plan options based on the Urban Design Vision and Principles as well as the input from the Consultant Team.
- Workshop with Council on the Structure Plan options.
- Develop and document the preferred Structure Plan option, based on the feedback from Council and the Consultant Team.
- Present the Structure Plan to Councillors and to the Liverpool Local Planning Panel and finalise the plan addressing comments received.

Phase 2 - Refinement of the Exhibited Structure Plan Methodology

- Review the additional information, the DPIE and community feedback.
- Refine the Urban Design Vision and Principles for the precinct.
- Develop Structure Plan options based on the refined Urban Design Vision and Principles as well as the input from the Consultant Team.
- Workshop on the Structure Plan options.
- Conduct a detailed flood impact assessment.
- Develop and document the preferred Structure Plan option, based on the feedback from Council and the Consultant Team.
- Present the Preferred Structure Plan to Councillors.
- Finalise the revised Structure Plan based on the feedback received.



Figure 3: The team structure





2.0 Planning Context

2.1 Strategic Context

A Metropolis of Three Cities

The Greater Sydney Regional Plan - A Metropolis of Three Cities by the Greater Sydney Commission is a 40 year vision for Metropolitan Sydney. It envisions a 30-minute city, where residents live within 30 minutes travel of their jobs, education and health facilities, services and great places. The three cities identified in the Plan are:

- The Eastern Harbour City
- The Central River City
- The Western Parkland City

The Regional Plan projects that almost half of the population growth in Greater Sydney over the next 40 years will reside west of Parramatta in the Central River City and the Western Parkland City. It is projected that the population of Western Parkland City will grow from 740,000 in 2016 to 1.1 million by 2036 and to over 1.5 million by 2056.

The Regional Plan promotes the ongoing growth of the Western Parkland City. It emphasises the role of collaboration, and encourages urban renewal and new neighbourhood establishment close to the existing centres, including the Liverpool CBD. A place-based approach, that provides great public spaces, and Transport-Oriented Development (TOD), is encouraged to deliver high quality neighbourhoods and a healthy lifestyle in the Western Parkland City.

The Warwick Farm Precinct will contribute to the Liverpool Metropolitan Cluster which comprises civic, health, education, residential, retail and commercial uses. The Hume Highway connects the precinct to the M5 Motorway, which forms part of the Sydney Orbital Network. The precinct is approximately 1.5km to the Liverpool CBD (10-minute drive), 14km to the Parramatta CBD (30-minute drive), 27km to the future Western Sydney Airport (35-minute drive) and 40km to the Sydney CBD (40-minute drive). The precinct is also close proximity to Warwick Farm Station. The revisioning of the precinct presents a TOD opportunity and enables the creation of a high-quality new neighbourhood that fulfils the 30-minute city vision in the Regional Plan.

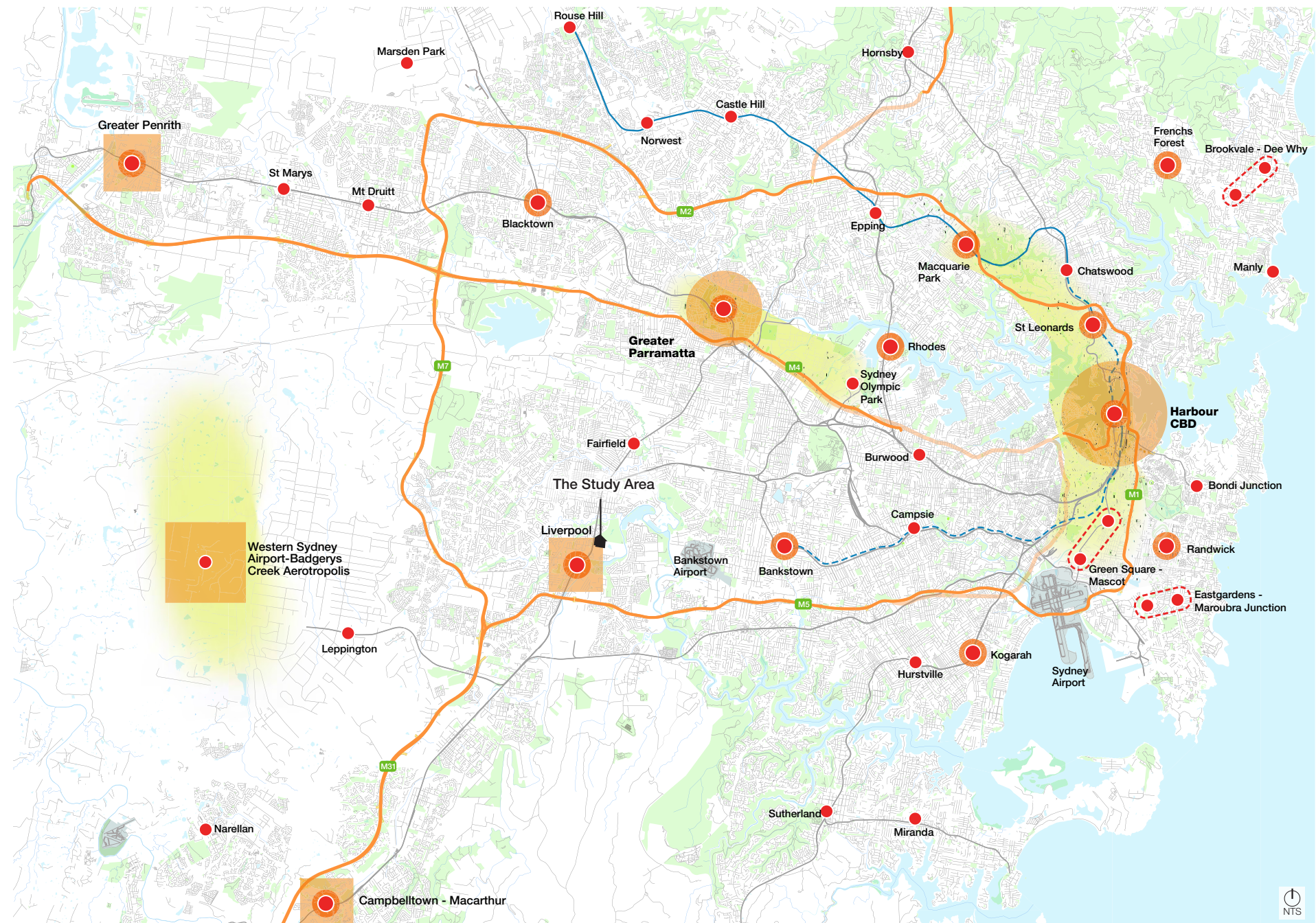


Figure 4: The Study Area in strategic context



2.0 Planning Context

Western City District Plan

The Western City District Plan (the District Plan) is a 20-year plan to manage growth and achieve the 40-year vision identified in the Regional Plan. The District Plan will guide the growth of the Western Parkland City to year 2036.

The District Plan covers eight individual councils, including Liverpool City Council. It is projected that the Western City District will have a population of 1,534,450 by 2036, which is an additional 464,450 people compared with 2016. The Western City District will accommodate 27% of the total population growth in Greater Sydney. An additional 184,500 dwellings are projected by 2036, which comprises 25% of the total housing increase in Greater Sydney. The District Plan also estimates that an additional 370,200 jobs will be created which is 15% of the Greater Sydney total.

The District Plan emphasises the importance of transport infrastructure to facilitate the population and job growth of the district. It promotes housing diversity and easy access to public transport and infrastructure, including schools, hospitals and community facilities. Active transport, including walking and cycling paths, and green links will improve the district's livability.

Collaboration Area - Liverpool Place Strategy

The Liverpool CBD and the Warwick Farm Precinct are identified as part of the Collaboration Area, which promotes rezoning land for additional housing, improving connections, and undertaking urban renewal of the Warwick Farm Precinct. The District Plan nominates a five year housing target of 8,250 for Liverpool. In addition to the housing target, a baseline job target of 36,000 by 2036 (7,000 increase compared with 2016) is nominated for Liverpool.

The 2019 NSW Population Projections by DPIE estimates the population of Liverpool will increase by 229,450 and reach 441,450 people by 2041. A total of 156,800 dwellings is projected by year 2041.

The Liverpool Collaboration Area Place Strategy

The District Plan has identified the Liverpool area as a Collaboration Area as it involves complex urban challenges. The Place Strategy sets out the vision and actions to enable the redevelopment of the area.

The Warwick Farm Precinct is identified as an Innovation / Research / Health / Advanced Manufacturing area under the Place Strategy. The Place Strategy also identifies the need to upgrade the

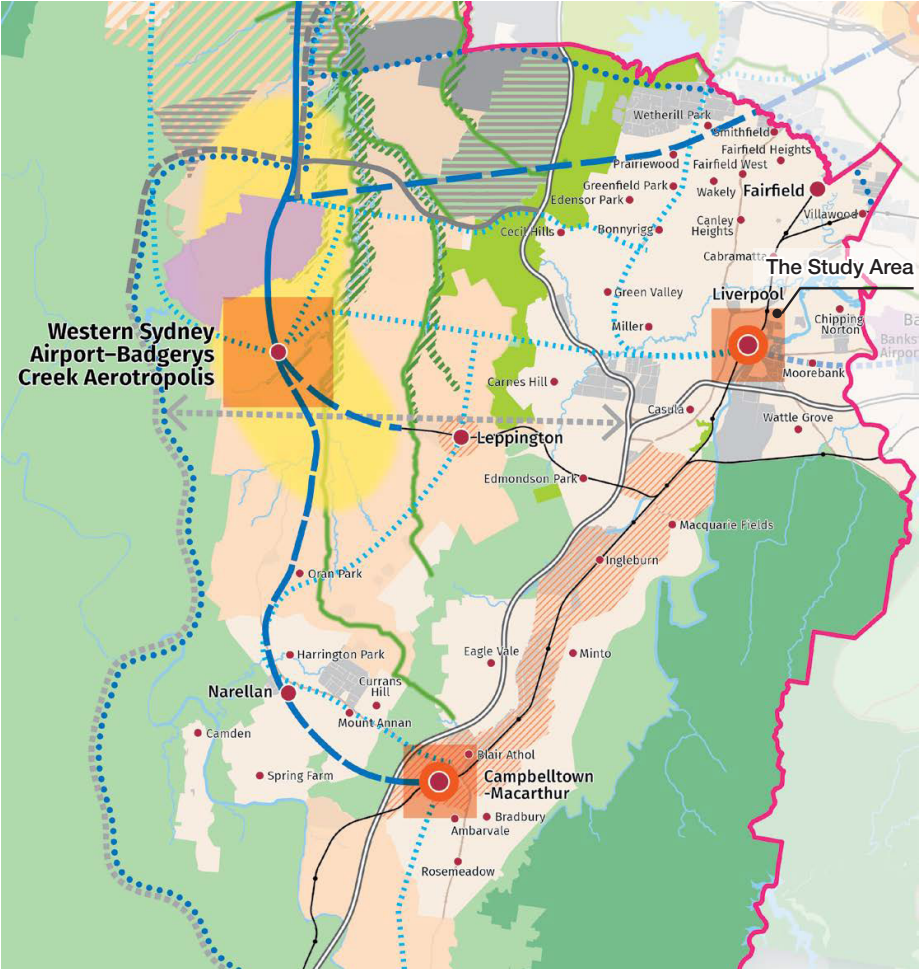


Figure 5: West District Plan

Warwick Farm Station Interchange underpass, the commuter car park and its access as a priority. The vision outlines in the Liverpool Collaboration Area Place Strategy for the Warwick Farm Precinct is included in the Liverpool Local Strategic Planning Statement which has been endorsed by the Greater Sydney Commission.



Figure 6: Liverpool Collaboration Area Plan



CM⁺

2.0 Planning Context

River Sensitive Liverpool: Cool, Comfortable, Connected Ideas for the Liverpool Collaboration Area

In February 2019, a two-day workshop was co-hosted by Liverpool City Council and Sydney Water. The workshop intended to explore opportunities to deliver Council's Water Management Policy and implement the priorities and actions of the Liverpool Place Strategy. A report was published by the Cooperative Research Centre for Water Sensitive Cities (CRC) summarising the workshop outcomes.

There were 35 participants from eleven organisations that attended this workshop, including:

- NSW Department of Planning, Industry and Environment (DPIE)
- NSW Office of Environment and Heritage (now a part of DPIE)
- Greater Sydney Commission
- NSW Department of Health
- NSW Environmental Protection Authority
- Sydney Water
- Liverpool City Council
- CRC
- Property developers

The workshop envisaged providing public access to both Horseshoe Pond and the Georges River foreshore area within the Liverpool Sewage Treatment Plant, which are currently owned by Sydney Water (refer to Figure 7).

The workshop also identified the next steps to realise the ideas proposed. It identified that Council and Sydney Water co-develop the strategic masterplan for the Sydney Water site.

Council has been working with Sydney Water to deliver the masterplan for the Sydney Water Site.

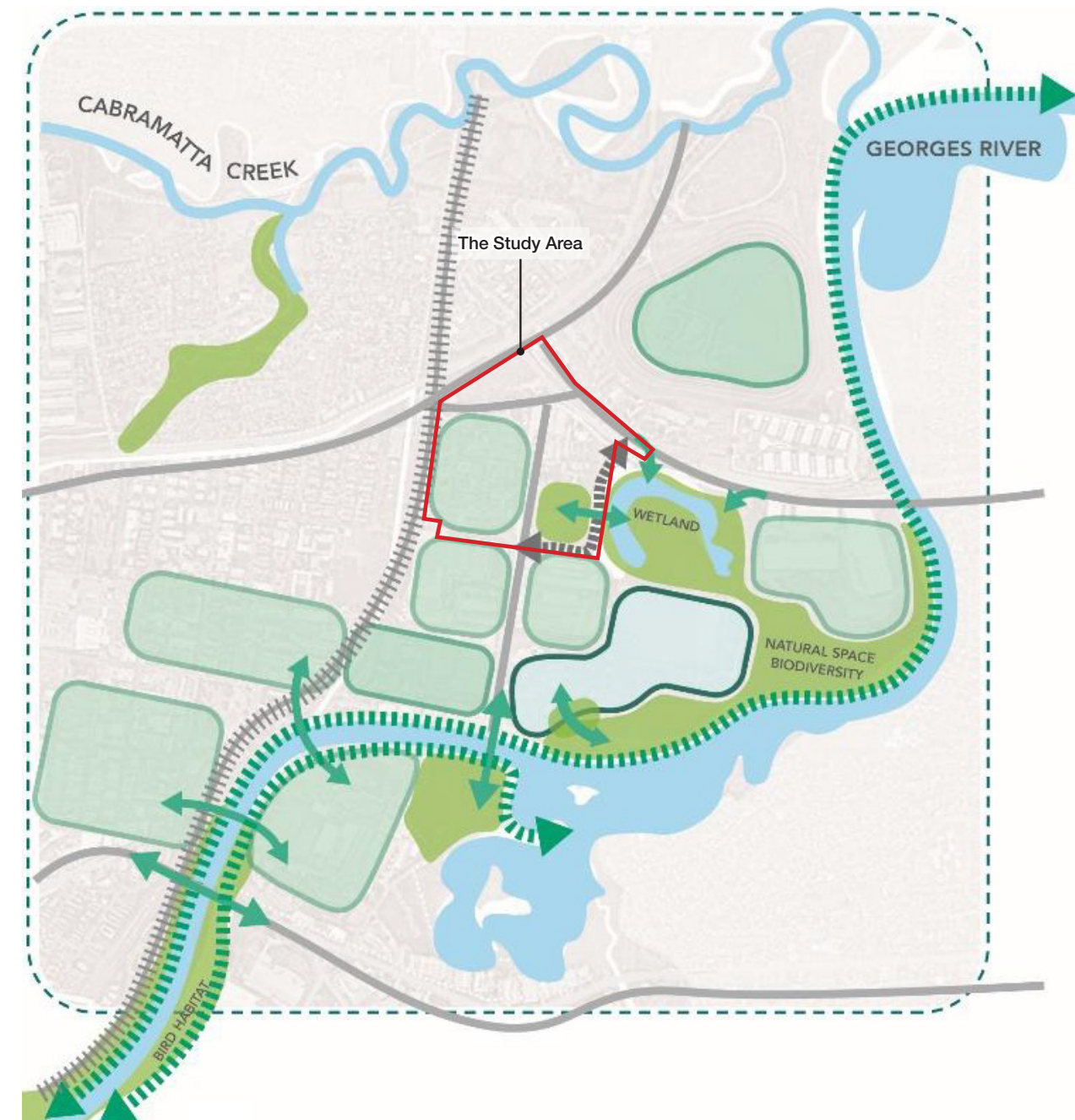
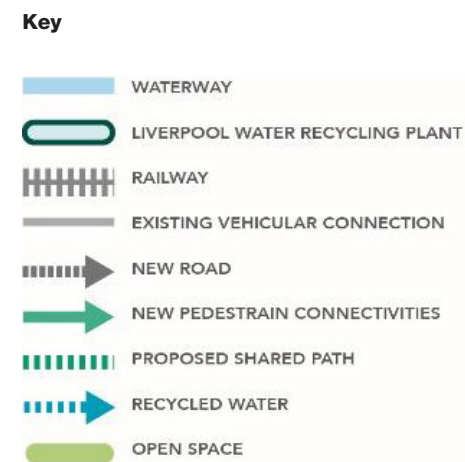


Figure 7: Ecology and accessibility Ideas for the Liverpool Collaboration Area (Courtesy of CRC Water Sensitive Cities)



2.0 Planning Context

Liverpool Local Strategic Planning Statement (LSPS)

In 2018, the DPIE introduced a new requirement for local councils in NSW to prepare an LSPS, which sets out a 20-year land use vision to manage future growth and realise the regional / district plans. The LSPS will also inform the changes to the local level plans including the Local Environmental Plan (LEP) and Development Control Plan (DCP). The LSPS will need to be endorsed by the DPIE or the relevant planning authority (e.g. the Greater Sydney Commission).

Liverpool City Council endorsed the Liverpool LSPS - Connected Liverpool 2040 in December 2019. The Greater Sydney Commission (GSC) has accepted the Liverpool LSPS through its assurance review process. The Liverpool LSPS provides a 20-year vision for the Liverpool Local Government Area (LGA) to facilitate the continuous growth of the area. It identifies 16 priorities across connectivity, livability, productivity and sustainability to realise the vision:

'A vibrant place for people that is community focused, walkable, public transport-oriented, sustainable, resilient and connected to its landscape. A place that celebrates local diversity and history, and is connected to other Sydney centres. A jobs-rich city that harnesses health, research, education, innovation and growth opportunities to establish an inclusive and fair place for all.'

Warwick Farm is identified as a Town Centre. The overall Structure Plan and Action 10.2 identifies the necessity of preparing a Structure Plan and Planning Proposal to rezone the land to a mix of uses, including B4 Mixed Use (Figure 8).

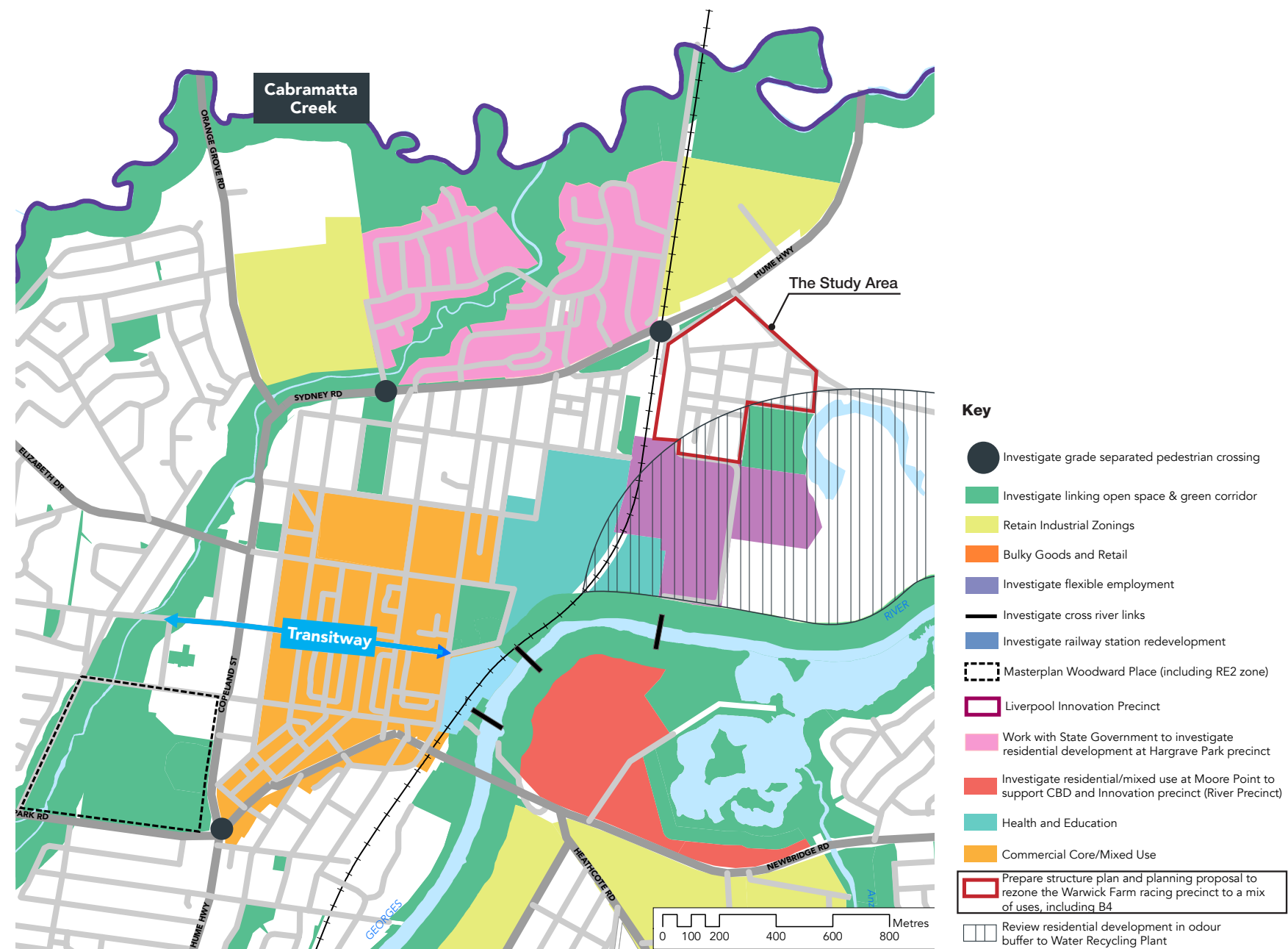


Figure 8: Liverpool LSPS



2.0 Planning Context

2.2 Liverpool Local Environmental Plan 2008 (LLEP 2008)

Land Zoning

The current zoning that applies to the precinct is illustrated in Figure 9. The majority of the precinct is zoned low to medium density residential. Rosedale Oval is zoned RE1 Public Recreation, providing a recreational facility to the general public. The triangular land along Governor Macquarie Drive is zoned B5 Business Development, in which warehouse-type businesses are permitted. RE2 Private Recreation zoning can be found along Governor Macquarie Drive close to the Warwick Farm Racecourse.

There is a parcel of land along Rosedale Oval zoned SP2 Infrastructure - Sewage System. SP2 Infrastructure zoning can also be found along the Hume Highway and the railway corridor.

A General Industrial area (zoned IN1) is situated immediately to the south of the precinct.

LEGEND

- Study Area
- B1 Neighbourhood Centre
- B5 Business Development
- IN1 General Industrial
- R2 Low Density Residential
- R3 Medium Density Residential
- R4 High Density Residential
- RE1 Public Recreation
- RE2 Private Recreation
- SP2 Infrastructure

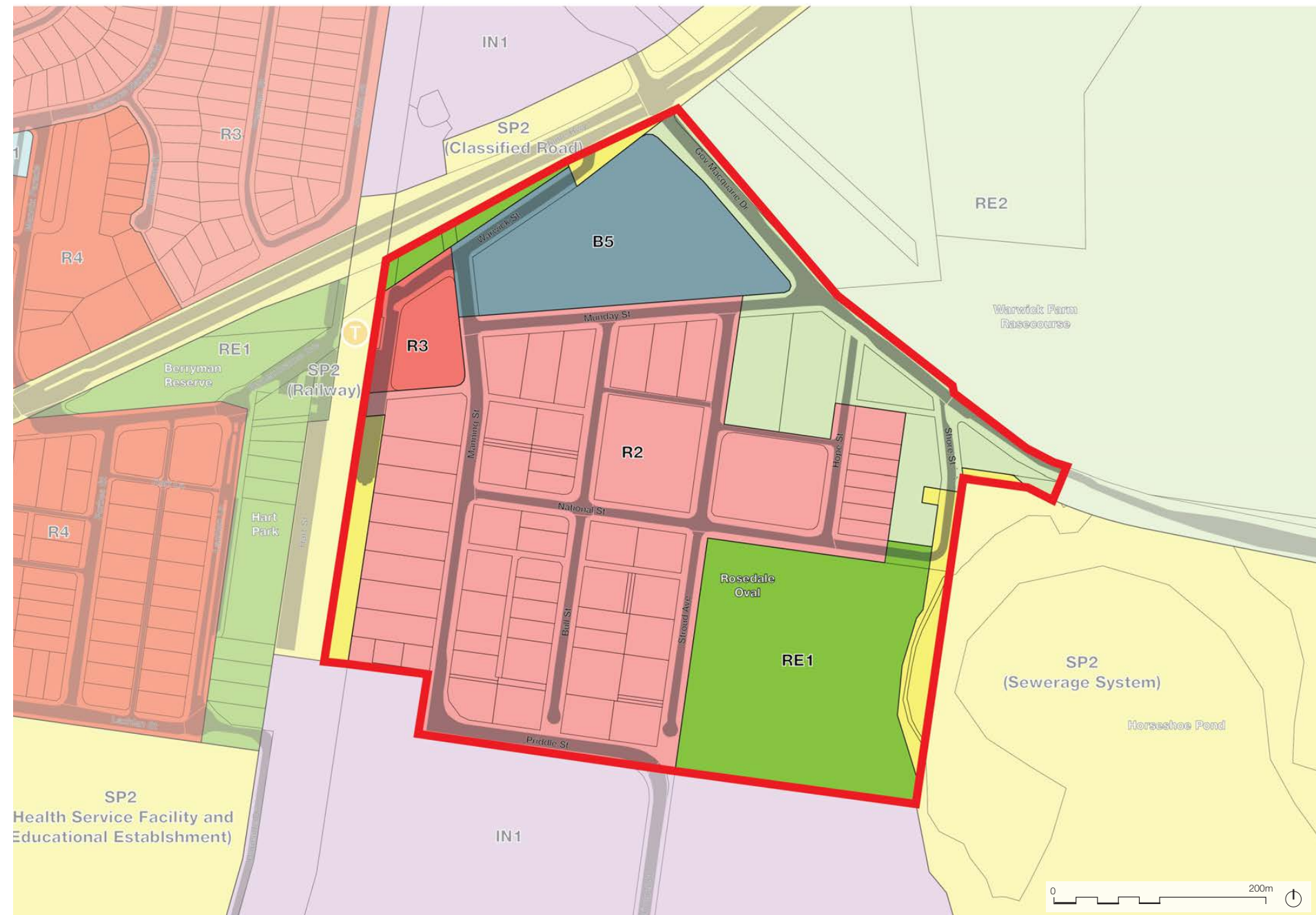


Figure 9: Existing zoning map

CM⁺

2.0 Planning Context

Building Height

The majority of the precinct has a maximum building height of 8.5m (2.5 storeys), with the triangular site along Governor Macquarie Drive with a maximum allowable height of 15m (4 storeys).

The general industrial area to the south has a height control of 15m (4 storeys). The Warwick Farm Racecourse adjacent to the precinct has a height limit of 30m, equivalent to about 9 storeys. The land to the west of the railway corridor has a height limit of 35m which is about 10 to 11 storeys.

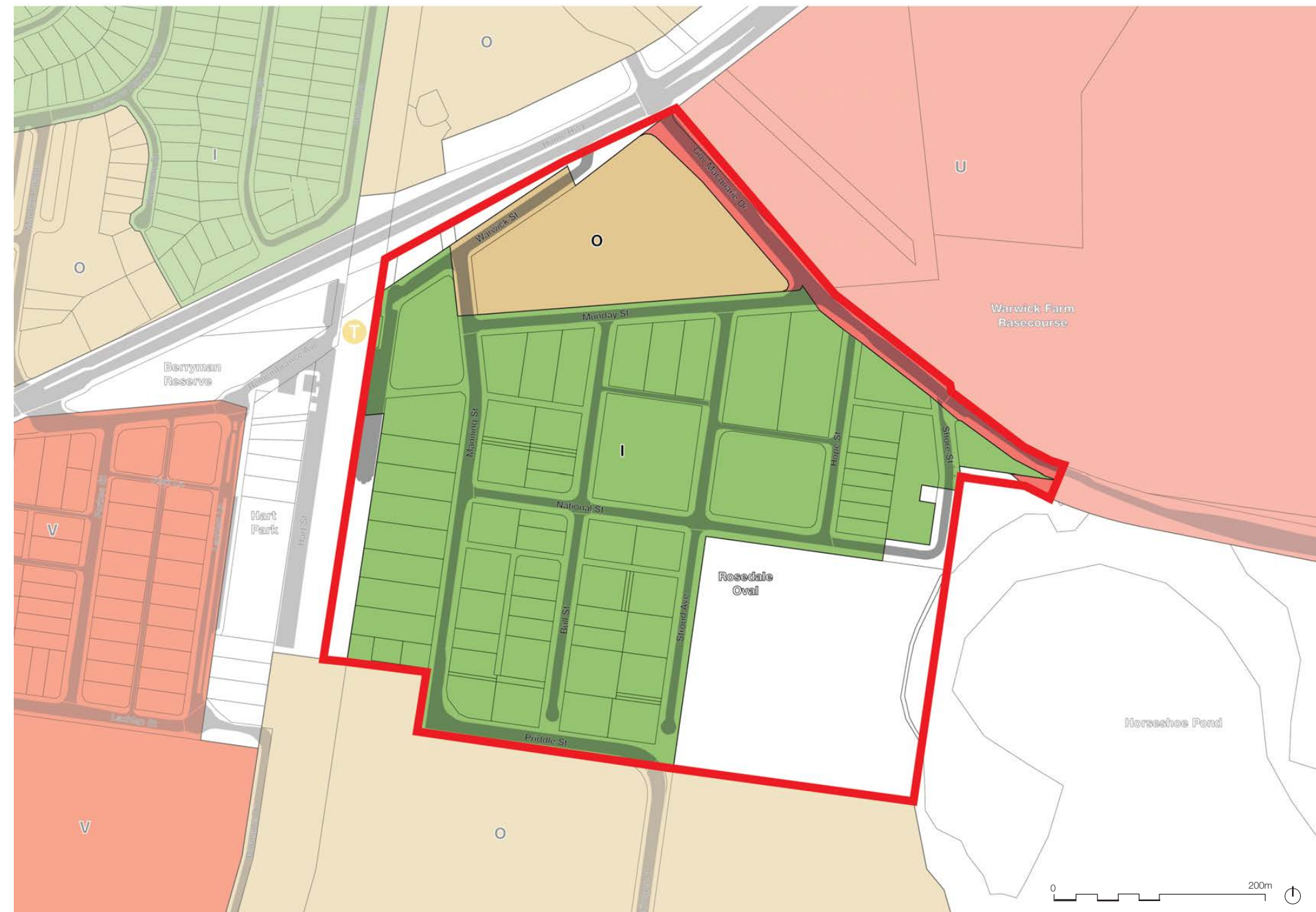


Figure 10: Existing building height map

CM⁺

2.0 Planning Context

Floor Space Ratio (FSR)

The precinct is relatively low in density. FSR 0.5:1 applies to the majority of the land, with the highest FSR of 0.75:1 applicable to the triangular site along Governor Macquarie Drive.

The area to the west, across the railway corridor enjoys a higher FSR, ranging from 2.0:1 to 2.5:1. There is no FSR control for the industrial land to the south of the precinct.

LEGEND

- Study Area
- 0.25:1
- 0.5:1
- 0.75:1
- 1.5:1
- 2:1
- 2.5:1

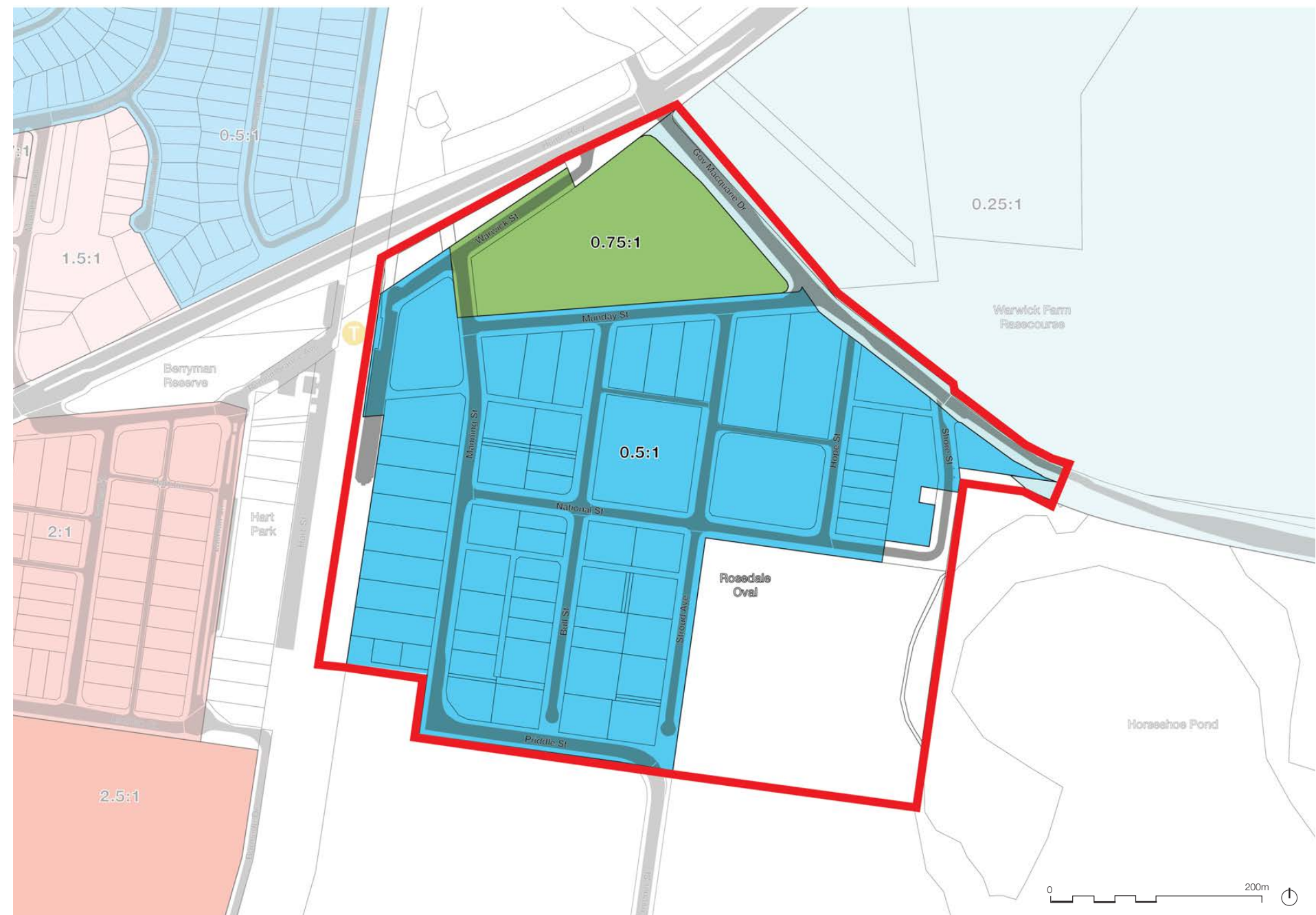


Figure 11: Existing FSR map

CM⁺

2.0 Planning Context

Heritage Item

There is no heritage item or Heritage Conservation Area (HCA) within the precinct. Warwick Farm Racecourse, which is across Governor Macquarie Drive to the northeast of the precinct, is identified as a heritage item with State level significance.

Berryman Reserve along the Hume Highway has a local landscape heritage. The grid of streets to the west of the railway corridor are identified in LLEP 2008 as local heritage, which represent the early Liverpool Town Centre layout which dates back to the 1800s.

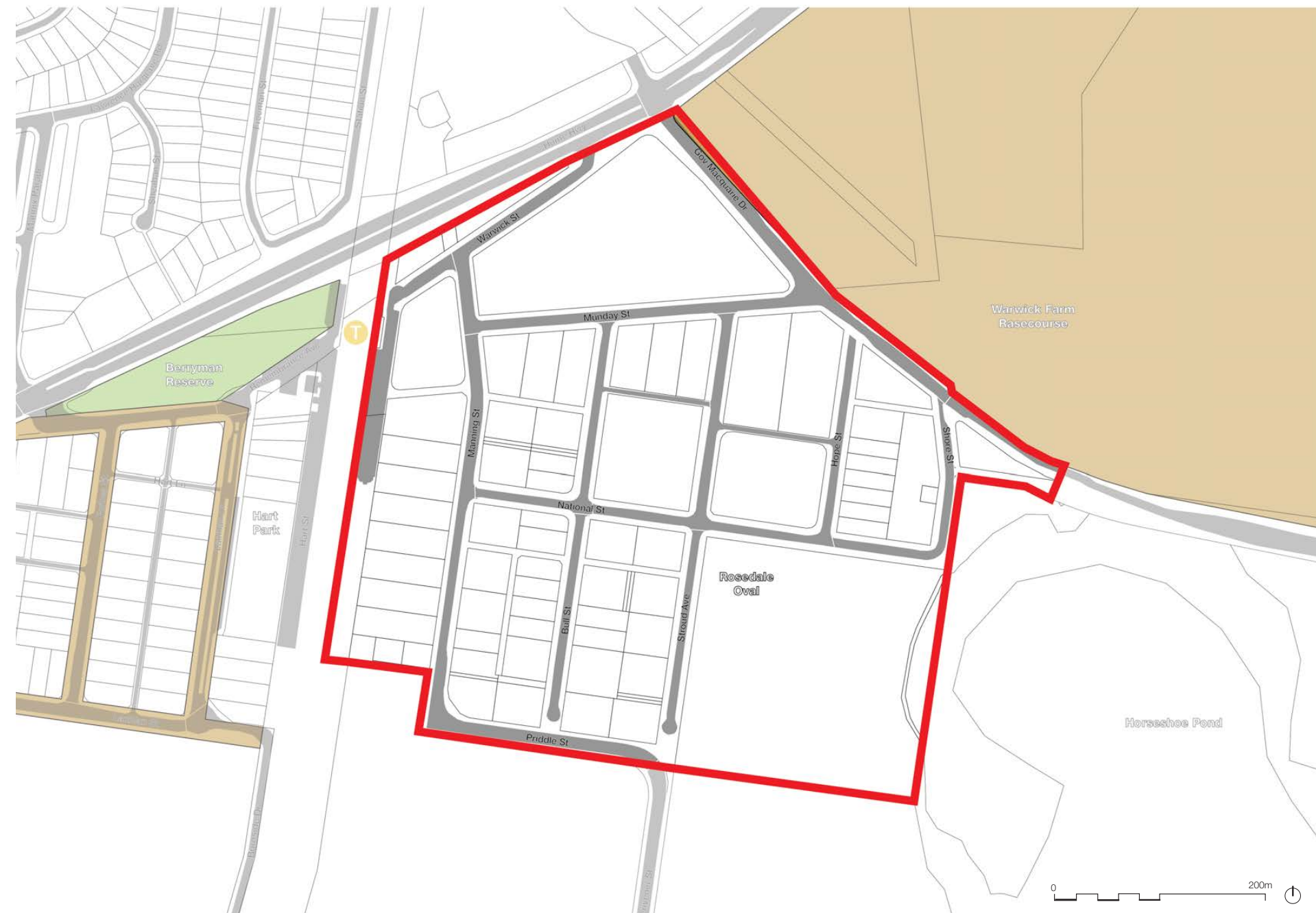


Figure 12: Heritage map

LEGEND

- Item - General
- Item - Landscape

CM⁺

2.0 Planning Context

Minimum Lot Size

The minimum lot size controls ensure that subdivisions and associated developments promote the desired future character of the neighbourhood through consistent lot size, shape, orientation and housing density. The minimum lot size controls within the precinct vary. The land within the R2 Low Density Residential Zone are set at 600m². The site adjacent to Warwick Farm Station, which is zoned R3 Medium Density Residential has a minimum lot size of 450m². Larger lot sizes apply to the sites zoned B5 and RE2, with minimum lot sizes of 2ha and 1ha respectively.

LEGEND

- Study Area
- 300m²
- 450m²
- 600m²
- 1000m²
- 2000m²
- 1ha
- 2ha

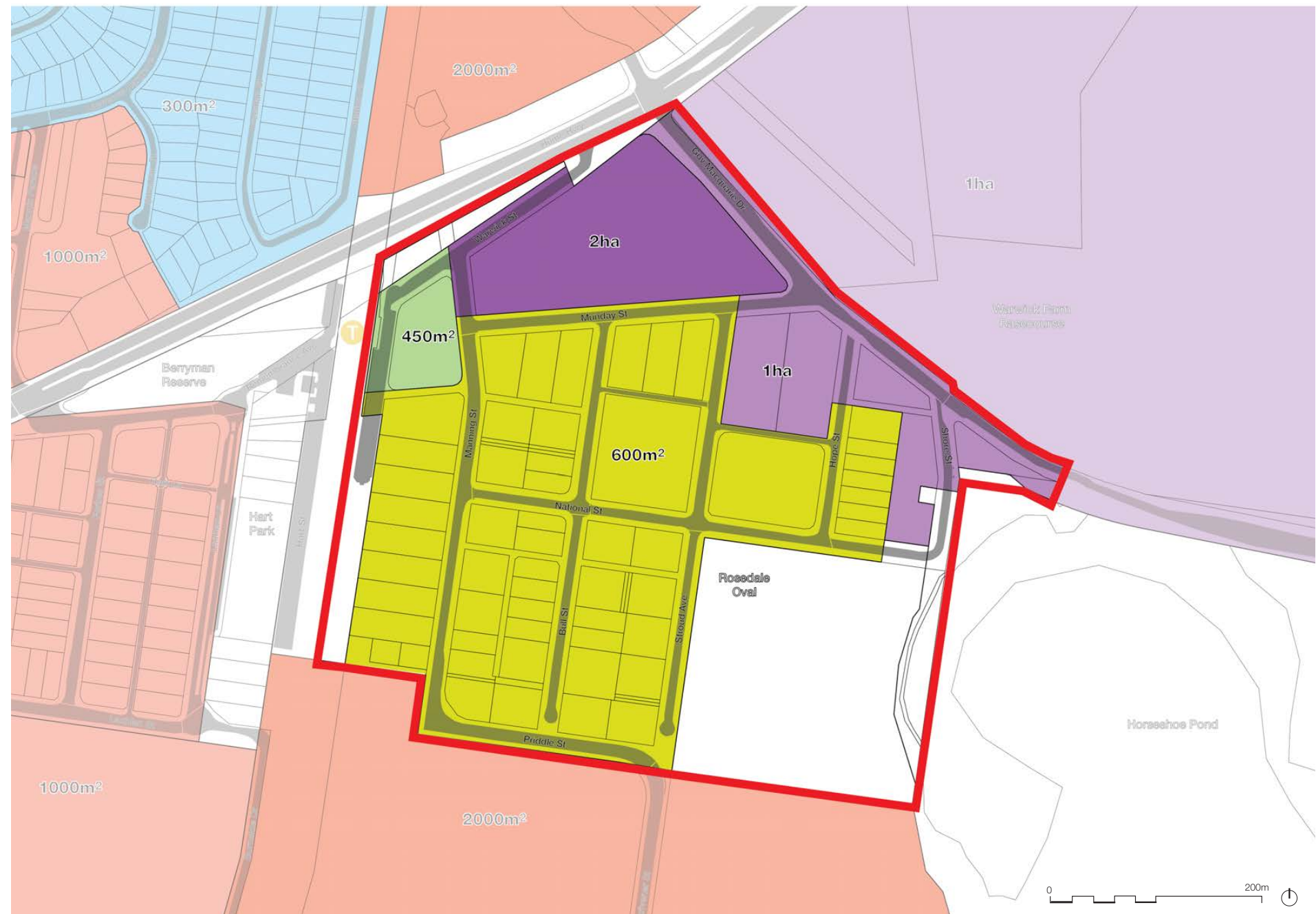


Figure 13: Existing minimum lot size map



Dense mature trees along the edge of Rosedale Oval

CM⁺

3.0 Local Context

3.1 Local Context

The Warwick Farm Precinct is located within the Liverpool Metropolitan Cluster identified in the Western City District Plan. The precinct is close to the Liverpool CBD (about 1.5km), which has a mixed use character, providing civic, educational and recreational facilities as well as retail, commercial and residential uses.

The precinct is well connected to the surrounding areas via public transport and main roads. Warwick Farm Station provides frequent services to Liverpool, Leppington and other major centres including Sydney CBD and Parramatta. The Hume Highway links the precinct to the M5 Motorway. Governor Macquarie Drive provides a crossing point of the Georges River and links the Hume Highway and Newbridge Road, which is another east-west state route providing access to Central River City and Eastern Harbour City. It is envisaged that the whole stretch of Governor Macquarie Drive will be widened to accommodate four-lane traffic, which will further improve the precinct's connectivity and traffic capacity.

Educational facilities, including Warwick Farm Public School, Liverpool Girls High School and Liverpool Public School are within 2km of the precinct to the west of the railway corridor. The precinct is well serviced by sport and recreational facilities. Rosedale Oval and Warwick Farm Racecourse provide sport facilities for both local residents and the broader community. Public open spaces along the Georges River foreshore, Chipping Norton Lake and Cabramatta Creek provide regional level open spaces. Liverpool Hospital and associated medical facilities provide the precinct easy access to public health facilities.

The future public domain improvement projects, including the development of the Georges River Parklands and Chipping Norton Lake Masterplan and Liverpool Water Treatment Facility Masterplan (LCC is currently working with Sydney Water to deliver this masterplan), coupled with the proposed additional bridges across Georges River (refer to Liverpool LSPS) will further improve the precinct's access to surrounding open space. The proposed new bridges will also provide easy access from the Liverpool CBD and the precinct to the future masterplan area - Moore Point Mixed Use Development.

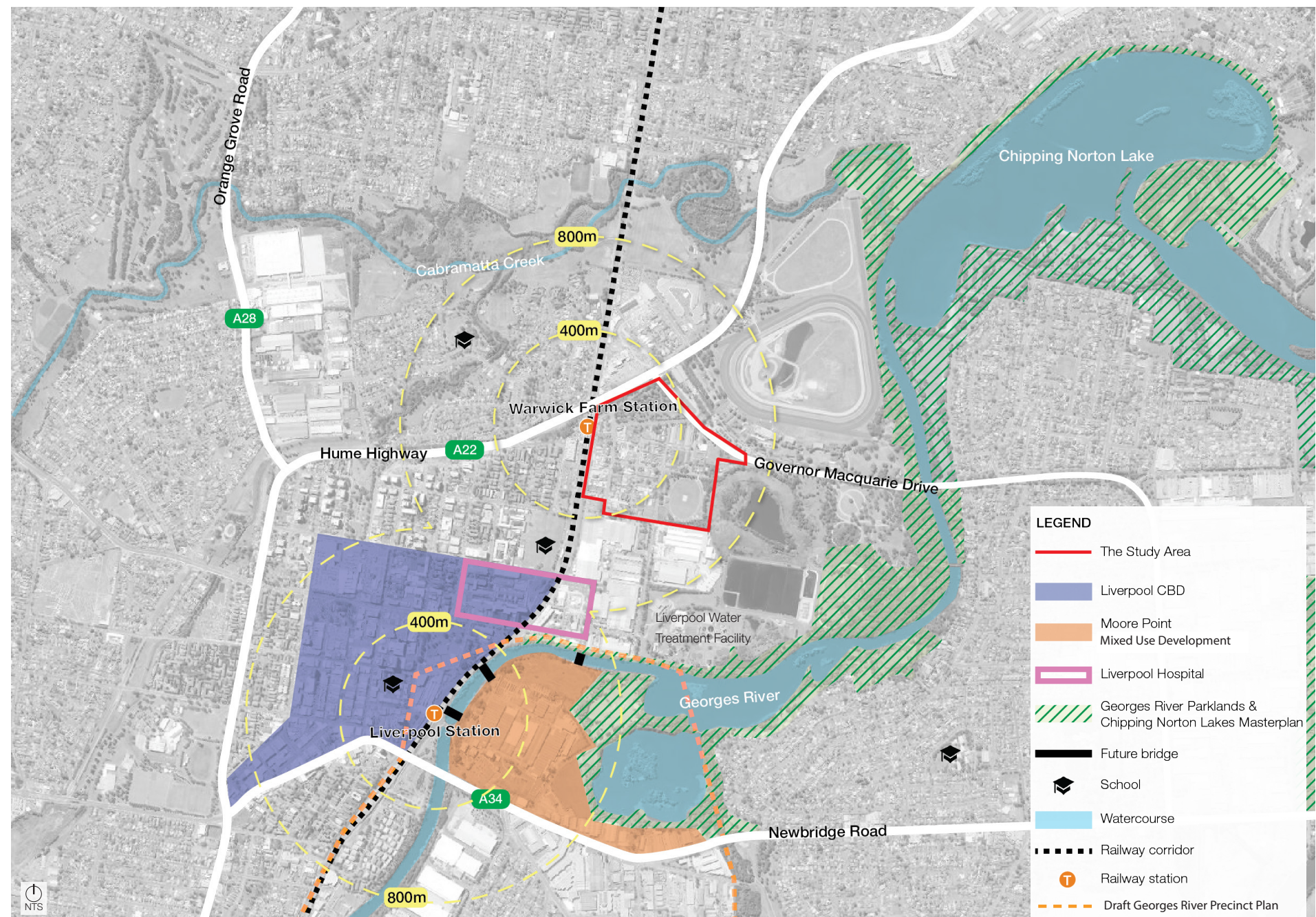


Figure 14: The study area and its context



3.0 Local Context

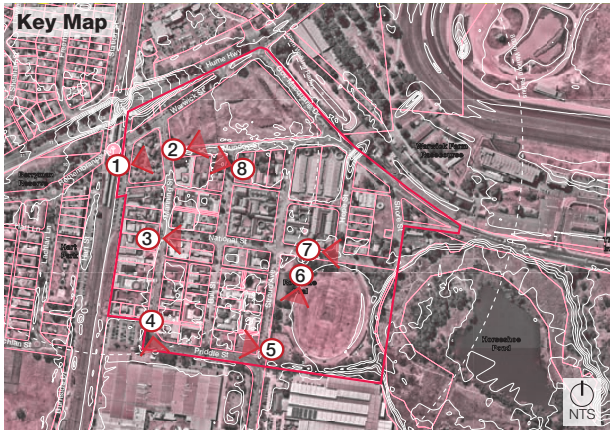
3.2 Existing Site Conditions

The Warwick Farm Precinct is predominantly occupied by equine related facilities (View 5). However, there is a mixture of character and built form within the precinct.

The precinct has a low scale character, with buildings ranging between one to two storeys in height. Low density residential houses spread throughout the precinct and are generally associated with horse training facilities. Poorly maintained houses also exist in the precinct, which contribute negatively to the streetscape character (View 8). Medium density residential dwellings are scattered along Manning Street close to Warwick Farm Station (View 1 and 3).

The industrial area to the south of Priddle Street generates heavy vehicle traffic in the precinct (View 4), as Priddle - Manning - Munday Street provide the only access to Governor Macquarie Drive and the Hume Highway from the industrial area. Conflict of uses among light and heavy vehicles, and pedestrian and horse movement is a major issue (View 2, 4 and 7).

Rosedale Oval (View 6) is the major open space within the precinct, which provides sport facilities and a children's playground. Dense mature Eucalyptus trees define the edge of the oval to its south and east.



CM⁺

4.0 Urban Design Analysis

4.1 Introduction

CM⁺ has conducted a thorough Urban Design Analysis, informed by the site visit, and a background document review. The Urban Design Analysis assesses the existing conditions of the Warwick Farm Precinct, identifies the constraints and opportunities and establishes the future vision and Urban Design principles to guide the redevelopment of the precinct.

4.2 Topography

The precinct is relatively flat with most of the area at RL 8m Australian Height Datum (AHD). Rosedale Oval is lower than the rest of the precinct and sits at RL 7m AHD.

The Hume Highway is higher than the precinct. It rises up gradually towards the railway corridor, and reaches its highest point at RL 15m AHD above the railway line

The land to the west of the railway corridor is higher than the precinct, and sits at RL 9m AHD and above.

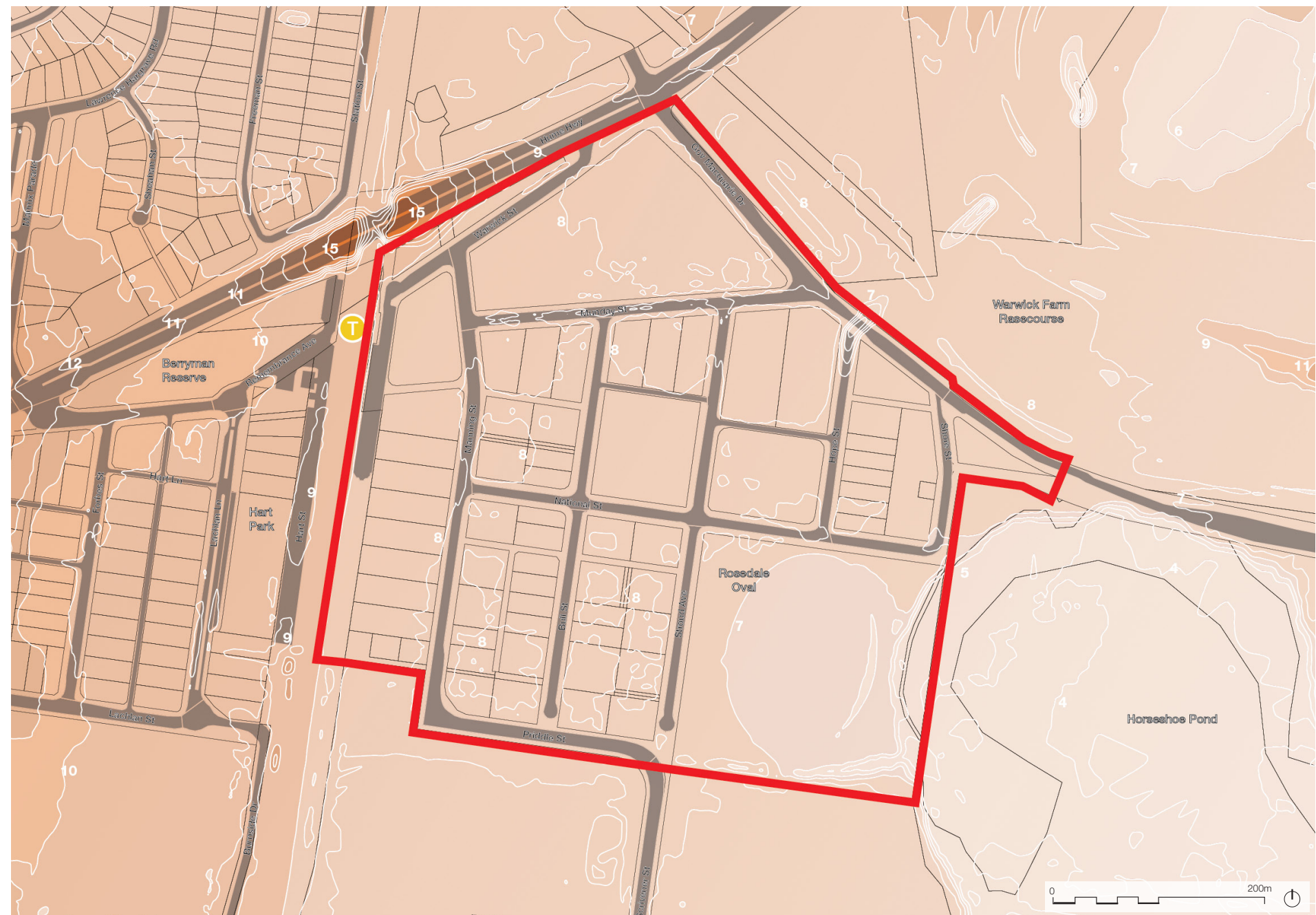


Figure 15: Existing topography



4.0 Urban Design Analysis

4.3 Flooding

The existing peak flood depths and extents within the study area are derived from the 2004 Georges River Floodplain Risk Management Study and Plan and are shown in Figures 16 and 17, and are summarised below:

- 1. 1% Annual Exceedance Probability (AEP) is 8.5m AHD
- 2. Probable Maximum Flood (PMF) is 10.8m AHD

A key issue with this development is the evacuation of residents during a flood. Shelter in place is not appropriate and therefore there must be appropriate access from every building in events larger than a 1% AEP. The key features of the evacuation approach are:

- 1. All floors to be at or above 9m AHD (1% AEP + 0.5m).
- 2. All floors must be at least 0.3m above the surrounding ground / road to allow for local drainage.
- 3. All internal roads to be at or above 8.5m AHD (1 % AEP).
- 4. All roads or pedestrian access used for evacuation must rise to the PMF.
- 5. There must be either pedestrian or vehicle access from all floors that is always at or above 8.5m AHD (1 % AEP) to above the PMF.

Another important factor is the need to ensure the new development proposed will not result in net loss of the flood storage at 1% AEP namely RL 8.5m AHD. Therefore, balancing the cut and fill in the precinct is critical in the development of the structure plan.

Refer to Warwick Farm Flooding Assessment Report by WMA Water.

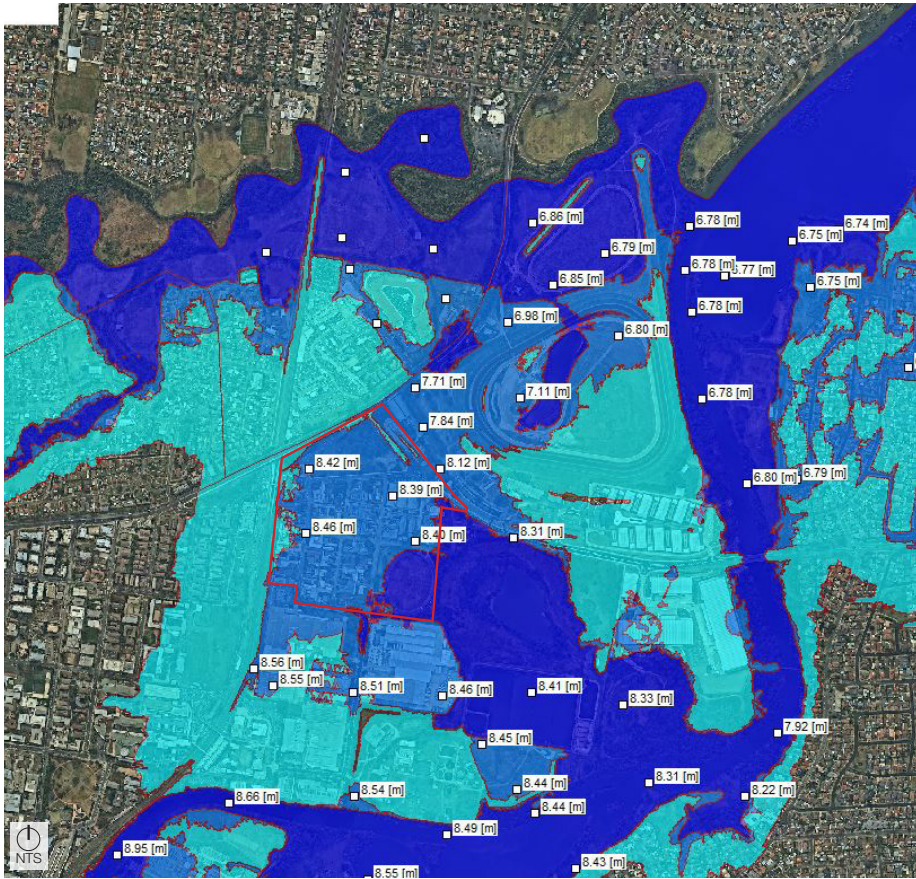


Figure 16: 1 in 100 flood level (Source: MIKE-11 model)

Note in both diagrams: Light blue = PMF extent, mid blue = 1% AEP extent

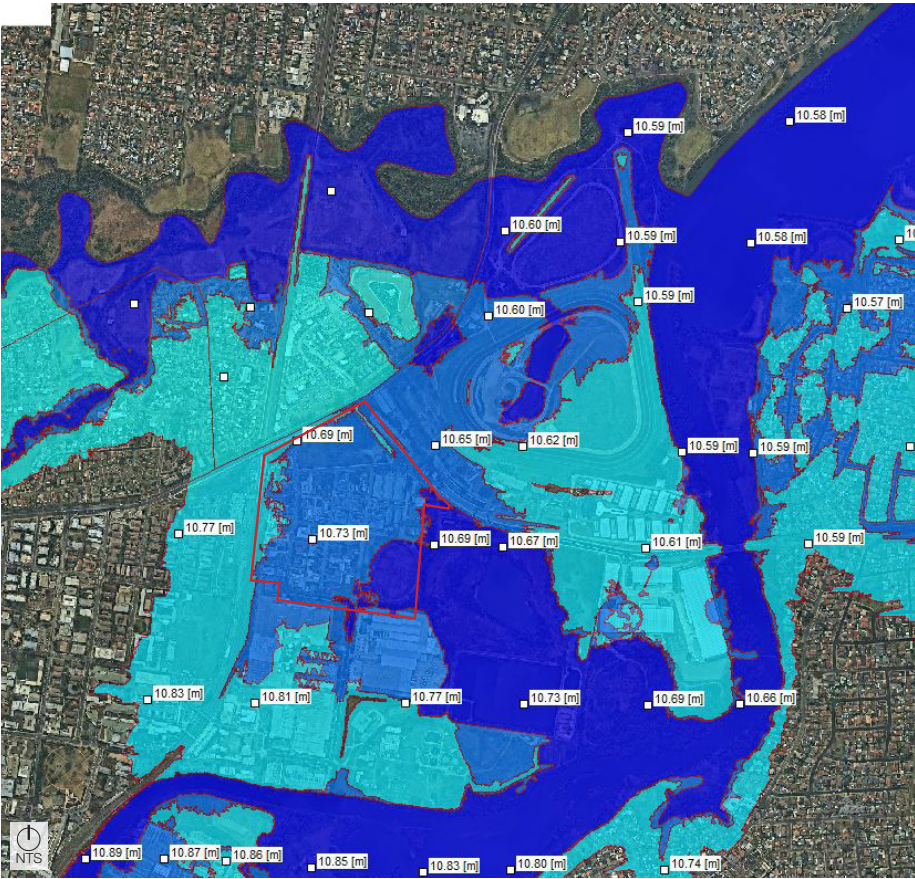


Figure 17: PMF level map (Source: MIKE-11 model)

CM⁺

4.0 Urban Design Analysis

4.4 Community Facility, Open Space Benchmark and Significant Landscaping

Social infrastructure and open space have significant impacts on the wellbeing of the local community, as they provide community services, places for social gathering and recreational uses. Landscaping plays an important role shaping the character of the precinct and has significant impacts on the visual and residential amenity.

There are no multipurpose or hireable community facilities within the precinct. The closest one - Warwick Farm Community Hub is about 800m to the northwest of the precinct; however, it is ageing and is not available for general community hire.

Rosedale Oval, which is approximately 5ha in size, is a major open space within the precinct providing recreational uses and a children's playground. There are no local parks within the precinct; however, smaller parks, including Hart Park and Berryman Reserve are immediately to the west of the precinct.

The open space benchmark is very important to guide the planning of the precinct. It requires the future development to comply with the nominated benchmark to deliver adequate open spaces. The benchmark applied to the precinct when the exhibited Structure Plan was made was 2ha per a thousand population. However, this benchmark is revised by the latest Open Space Needs Analysis for the Liverpool Collaboration Area to 1.5ha per 1,000 residents. Refer to Section 7.2 of this report for more information.

A cluster of dense mature Eucalyptus trees are located within Rosedale Oval, especially along its southern and eastern boundaries. Munday Street and National Street present some consistency in street tree planting. However, the trees cover within the precinct is generally low.

LEGEND

- The Study Area
- Major open space recreational facility
- Tree canopy
- Surrounding Parks



Figure 18: Existing tree canopies and open space



4.0 Urban Design Analysis

4.5 Traffic and Transport

Road Network

The characteristics of the roads surrounding the subject precinct are:

- Hume Highway is a primary road connecting Liverpool to Sydney's Inner West. It is a state road (A22) and has three lanes in each direction. In the vicinity of the precinct, there is a footpath on the northern side and a shared pedestrian/cycle path on the southern side. Pedestrian crossings are provided at the intersection of Hume Highway / Governor Macquarie Drive (except on the east side) and an underpass is available to the west of Warwick Farm Station to connect Warwick Farm to the south of Hume Highway with Station Street to the north of Hume Highway.
- Governor Macquarie Drive is a distributor road. It intersects with Hume Highway to the north and Newbridge Road to the south. The road has only one lane in each direction between Munday Street and the signalised access to Warwick Farm Racecourse. The road has recently been upgraded to two lanes in each direction plus turning lanes between the Warwick Farm Racecourse and Georges River. The section of the road between Georges River and Newbridge Road remains one lane in each direction, with future plans to be upgraded to two lanes in each direction. Footpaths are not provided on the west side in the vicinity of No. 240 Governor Macquarie Drive. Pedestrian crossings are present on all approaches of the Munday Street intersection.
- Warwick Street is a local road that connects Warwick Farm Station and Manning Street with Hume Highway. It has one lane in each direction. Except for the recently completed shared path on the south side of the road close to the station, there is no footpath on either side of the road, making it unattractive for walking.
- Munday Street / Manning Street / Priddle Street is the local collector road that connects Governor Macquarie Drive with the industrial area to the south of the Warwick Farm precinct. It has one traffic lane and one parking lane in each direction. A recently completed shared path is provided on the northern side.
- Shore Street is a one way (northbound) one lane local road that mainly services the residences and visitors of the Rosedale Oval and nearby racecourse. It currently terminates at a left-out only intersection with Governor Macquarie Drive.

Active Transport

Shared pedestrian / cycle paths are provided on the southern side of Hume Highway, on the northern side of Munday Street, and a small section of Manning Street and Warwick Street connecting to the station. A shared path crossing of Hume Highway is provided via an underpass located to the west of the Warwick Farm Station, although the underpass is in poor condition. There is an extended shared path network to the southwest of the precinct to connect to Liverpool CBD, providing potential opportunity to promote cycle use in the local area.

Footpaths are provided on some internal streets within the precinct in various qualities. Along Governor Macquarie Drive, there is no footpath on the western side between Munday Street and Hume Highway and on the eastern side between Munday Street and Shore Street.

Refer to Traffic and Transport Impact Assessment by SCT for more information.

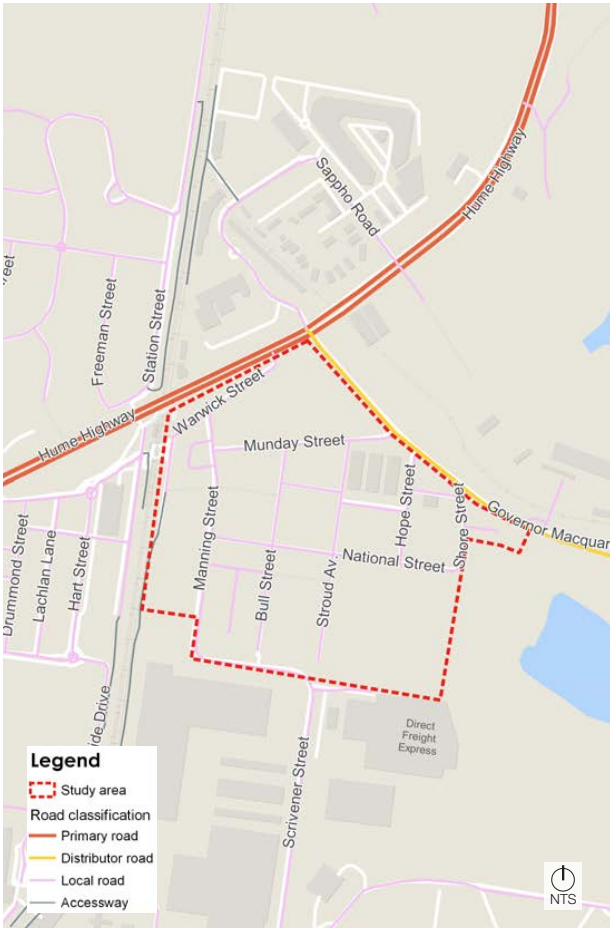


Figure 19: Road network (Source: SCT Consulting)

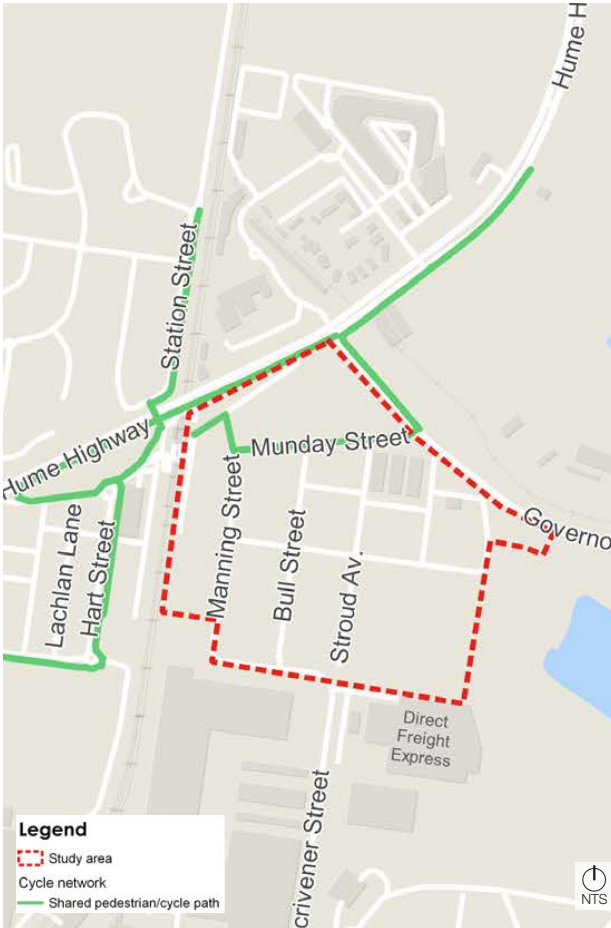


Figure 20: Existing shared pedestrian / cycle path (Source: SCT Consulting)

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4.0 Urban Design Analysis

4.6 Bankstown Airport Obstacle Limitation Surface (OLS)

The Warwick Farm Precinct is in an area affected by the operational requirements for Bankstown Airport, which is located approximately 9.5km to the east of the precinct. Obstacle Limitation Surface is used to define the airspace that is protected from obstacles to ensure the safety of aircraft during takeoff and landing phases.

The nominated Bankstown Airport OLS ranges between RL 51m AHD and RL 70m AHD. Considering the existing ground level height of RL 8m AHD, the Bankstown Airport OLS limits the building height within the precinct to a maximum of 62m (about 20 storeys) close to Warwick Farm Station.

LEGEND

- The Study Area
- Bankstown Airport Obstacle Limitation Surface Contours (m AHD)

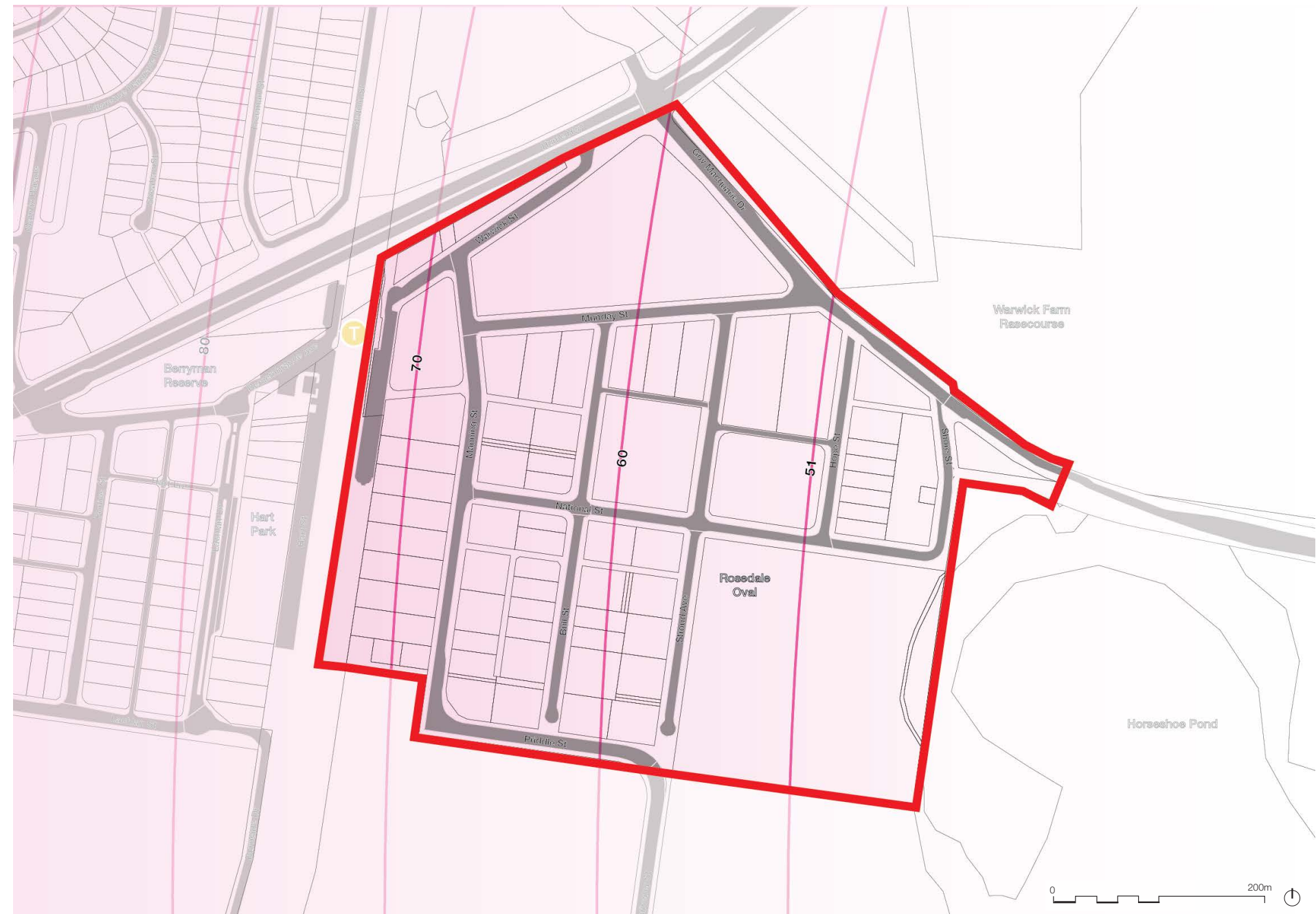


Figure 21: Bankstown Airport OLS contours

CM⁺

4.0 Urban Design Analysis

4.7 Odour Buffer

Liverpool Sewage Treatment Plant is situated adjacent to the Warwick Farm Precinct and generates odour that impacts surrounding areas. The odour buffer zone provided by Sydney Water indicates that the southeast portion of the site is within the odour buffer zone, including Rosedale Oval.

The LSPS and Sydney Water Guidelines seek to avoid residential development within the odour buffer. A reduction of the odour buffer size may be achievable as a result of upgrading the Sewage Plant facilities. The exhibited Structure Plan adopts the odour buffer outlined in Figure 22. For the latest information on this odour buffer, Refer to the Section 7.2 of this report.

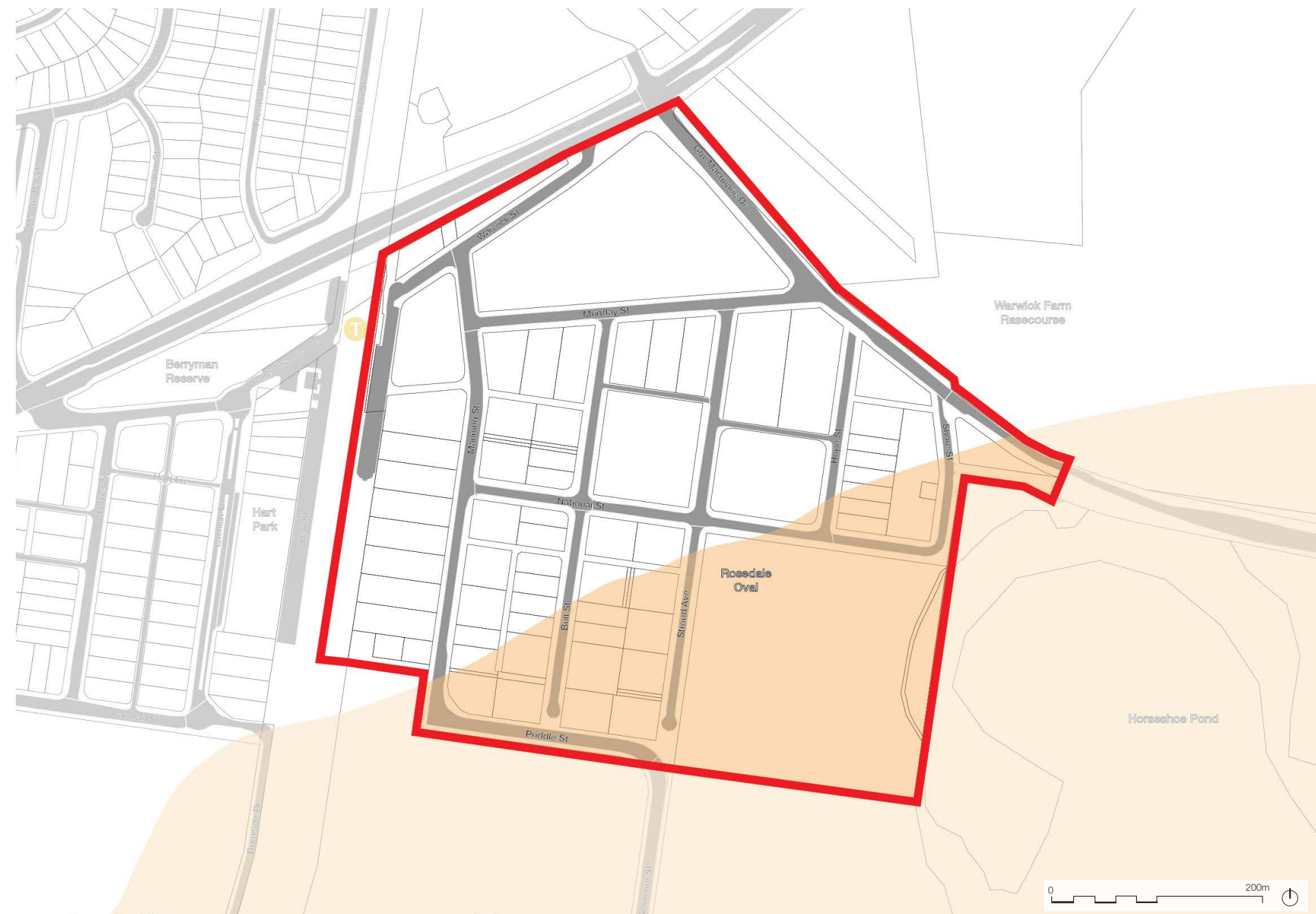


Figure 22: Sydney Water Treatment Facility odour buffer

LEGEND

- The Study Area
- Sydney Water Treatment Facility odour buffer area



4.0 Urban Design Analysis

4.8 Planning Proposal and Development Applications

The study has identified sites that are subject to a Planning Proposal or an approved Development Application (DA). The Planning Proposal site is:

- 1. 240 Governor Macquarie Drive
(refer to Figures 24-26) - this proposal has been rejected by the DPIE at the Gateway determination)

Recently approved DAs include:

- 2. 12 Munday Street
- 3. 2 Stroud Avenue
- 4. 6 Manning Street
- 5. 8 Manning Street
- 6. 13 Bull Street
- 7. 21C Manning Street
- 8. 1 Stroud Avenue
- 9. 11 Manning Street
- 10. 7 Bull Street
- 11. 9A Bull Street
- 12. 11A Bull Street
- 13. 10 Stroud Avenue
- 14. 14 Manning Street
- 15. 12 Bull Street
- 16. 17 Stroud Avenue
- 17. 14 Bull Street

The majority of the DAs listed above are in relation to horse training facilities and alteration and additions to existing residential dwellings.

LEGEND

- The Study Area
- Planning Proposal
- Development Application



Figure 23: Currently Planning Proposal and Development Applicatons

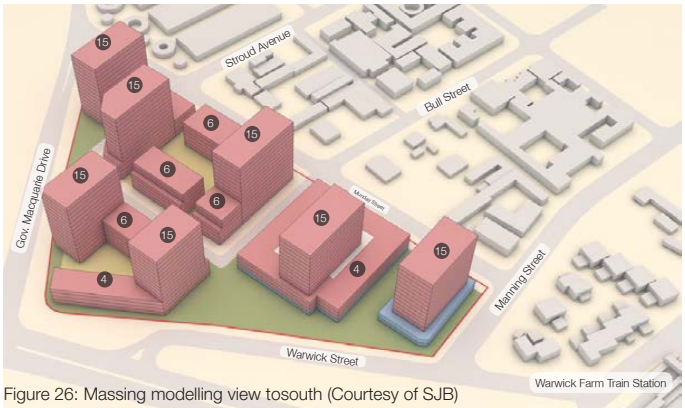
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4.0 Urban Design Analysis

240 Governor Macquarie Drive (GMD)

This Planning Proposal was endorsed by Liverpool City Council and submitted to the DPIE for Gateway determination on 25 February 2020. The Planning Proposal was under assessment by the DPIE when the exhibited Structure Plan was developed. Thereby, the exhibited Structure Plan adopted the built form and height strategy outlined in this Planning Proposal. However, the Planning Proposal was rejected at Gateway by the DPIE on 21 September 2020. Refer to Section 7.2 of this report for the implication of the Gateway determination.

Note that the plan and 3D views on this page illustrates the built form and height strategy for No.240 Governor Macquarie Drive that are rejected by the DPIE for reference purposes.





4.0 Urban Design Analysis

4.9 Ownership Pattern

The Warwick Farm Precinct has a relatively fragmented ownership, with some large land holdings in the precinct.

Rosedale Oval and a strip of land along the Hume Highway are Council owned land. There are some small land parcels close to Warwick Farm Station that are owned by Transport for NSW (TfNSW). Sydney Water owns a piece of land adjacent to Rosedale Oval, which is known as Liverpool Sewage Treatment Plant. Another Sydney Water facility is located along Shore Street.

The large vacant site at No. 240 Governor Macquarie Drive is under one ownership. The Australian Turf Club (ATC) owns several properties along Governor Macquarie Drive, which are currently occupied by horse training facilities.

Darley is another private landowner within the precinct. It owns two large lots along National Street, close to Rosedale Oval, which are also occupied by equine related uses.

The land opposite Warwick Farm Station is strata constrained, which has over 20 separate owners. Land with strata constraints presents less opportunity to be redeveloped in the short to medium term; however, there are precedents in the Metropolitan Sydney area where strata titled land has been consolidated and redeveloped.

LEGEND

- The Study Area
- Sydney Water owned land
- Transport for NSW owned land
- Liverpool City Council owned land
- Australian Turf Club owned land
- Darley owned land
- Land under one ownership
- Land under one ownership
- Other private owned land
- Strata constrained land
- 240 Governor Macquaire Drive Site

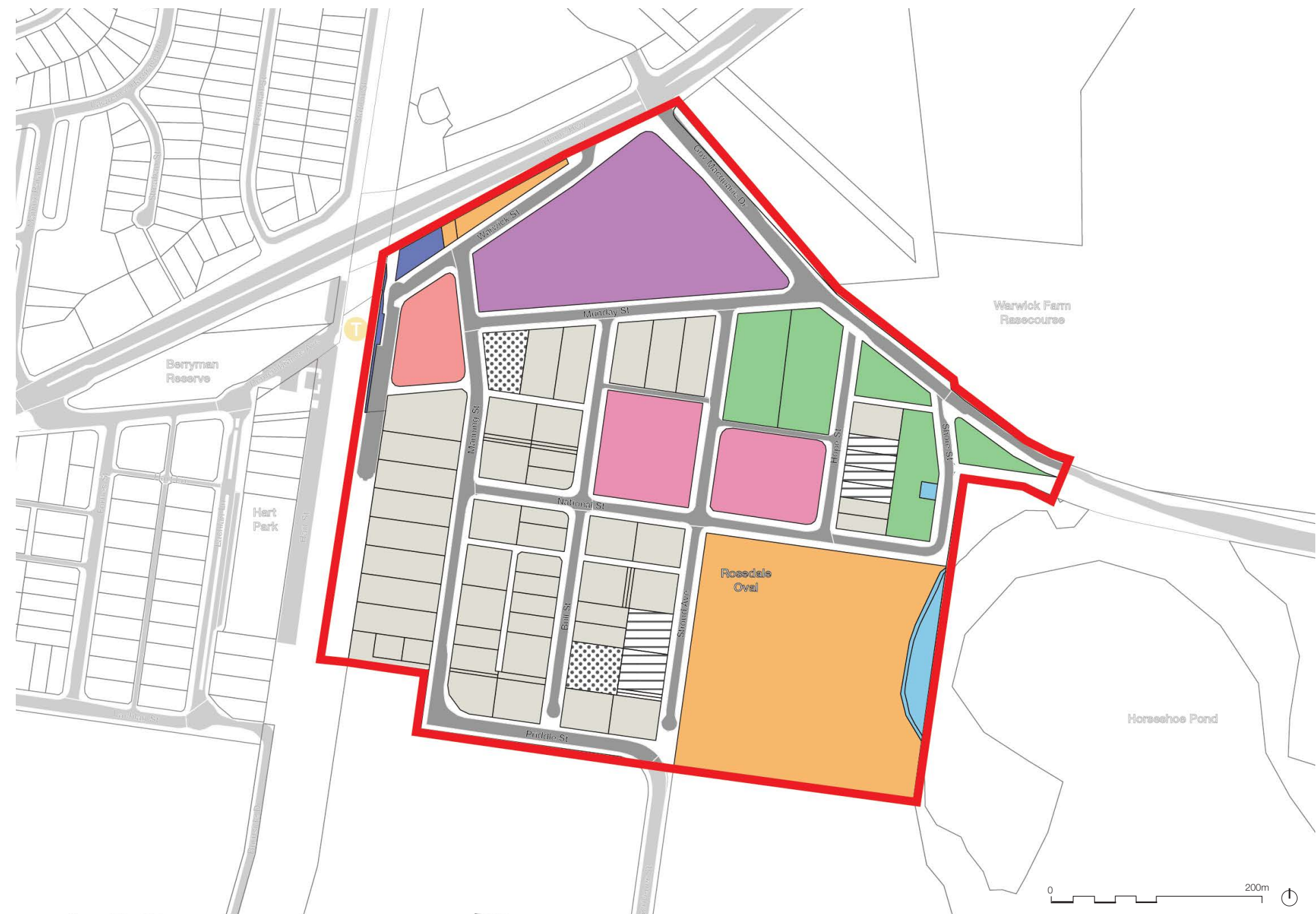


Figure 27: Current landownership pattern



The existing child playground near Rosedale Oval



5.0 The Exhibited Structure Plan

5.1 Executive Summary

The exhibited Structure Plan was developed informed by the comprehensive Urban Design analysis and the information / studies available at that time. In developing the original Structure Plan, CM+ and the consultant team had tested several options and conducted strengths and weakness analysis for each option. This chapter of the report extracts the key information from the exhibited Structure Plan. Council's website provides additional information about the exhibited Structure Plan.

The exhibited Structure Plan presents a maximum building height of 15 storeys (near Warwick Farm Station), and overall density (FSR) of approximately 0.8:1. Approximately 2,295 dwellings (including No. 240 Governor Macquarie Drive) and 4.7ha of additional open space is proposed.

The precinct is subject to flooding issues. The exhibited Structure Plan has carefully considered the floodplain water displacement by balancing the associated cut and fill. The tables on the next page provide a high level summary of the yield proposed in the exhibited Structure Plan. Note that the cut and fill calculation in the yield table is based on the data available at the time the exhibited Structure Plan was developed.

The draft Structure Plan, associated yield and studies were put on public exhibition between September and October 2020. A virtual community session was held on 22 September 2020. A total number of 20 submissions were received during the public exhibition period. Refer to the next chapter of this report for the high-level summary of the submissions.

Notes:

- 1. The built forms at No. 240 Governor Macquarie Drive correlate with the Council endorsed Planning Proposal (Planning Proposal No. 81, by Liverpool City Council, dated 25 February 2020)
- 2. New stormwater pipelines will be introduced to the future Local Sport Venue open spaces to drain the areas during a flood event. It is acknowledged that detailed measures in regard to hazard reduction and hydraulic engineering design will need to be undertaken in the detailed design stage.

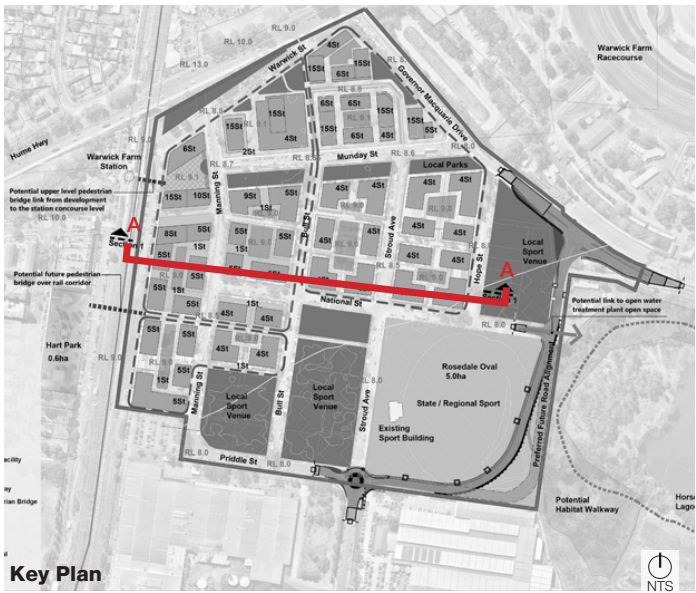
* The location of the proposed community facility shown on the plan is indicative only. The final form and location will be determined in the detailed design stage



Figure 28: Exhibited Structure Plan

CM⁺

5.0 The Exhibited Structure Plan



Exhibited Structure Plan - Long Section



Figure 29: Exhibited Structure Plan - Section A



5.0 The Exhibited Structure Plan

Exhibited Structure Plan - Yield Summary

240 Governor Macquarie Drive (GMD)*					
Residential GFA		82,300 m ²			
Commercial GFA		5,000 m ²			
Total GFA		87,300 m ²			
Site Area		29,307 m ²			
No. of Dwellings		830			
FSR		3.0:1			
Development Parameters (Excl. 240 GMD)					
	Total GBA (m ²)	Efficiency	Total GFA (m ²)	Dwelling Size (m ²)	No. of Dwellings
Residential	166,047	75%	124,535	85*	1,465
Commercial (GF)	25,425	70%	17,798	N/A	
Commercial (1st Floor)	2,601	85%	2,211	N/A	
Total GFA			144,544		
Site Area			254,735		
Overall FSR			0.56:1		
Overall Development Parameters (Incl. 240 GMD)					
Residential GFA		206,835 m ²			
Commercial GFA		25,008 m ²			
Total GFA		231,843m ²			
Site Area		284,042m ²			
No. of Dwellings		2,295			
FSR		0.82:1			

Open Space Calculation	
Open Space 1 (OS1)	2,490 m ²
Open Space 2 (OS2)	4,948 m ²
Open Space 3 (OS3)	13,507 m ²
Open Space 4 (OS4)	26,887 m ²
Total Proposed Local Open Space**	47,832 m ² (16.8% of the site area)
Rosedale Oval	49,927 m ²
Total Open Space Area	97,759 m ² (34% of the site area)

Floodplain Displacement Calculation (approximate only)	
Existing Building Footprint (EBF)	50,000 m ²
Proposed Developed area (PDA)	137,000 m ²
FILL**	43,500 m ³
CUT (in OS3 & OS4)***	44,300 m ³

+ The yield is extracted from the approved Planning Proposal Urban Design Report by SJB dated 27/06/2018.

+ + This does not include Hart Park, which has an area of approximately 0.66ha. The total local open space percentage will be approximately 18.8%.

* The average dwelling size does not apply to 240 GMD.

** The volume of fill = (PDA-EBF) X 0.5m

***The volume of cut = OS3 Cut Volume + OS4 Cut Volume

Note: 0.5m is an average depth calculated based on the level difference between 1%AEP (RL8.5) and average existing level of the site (RL8.0). Detailed floodplain displacement will need to be undertaken in the detailed design stage.

Key Plan





Rosedale Oval



6.0 Public Exhibition Feedback Summary

6.1 Public Exhibition Overview and Summary

The draft Structure Plan, associated yield and studies were put on public exhibition between September and October 2020. Council used a number of means to make people aware of the opportunities to comment on the Structure Plan on exhibition. A Community Session was also held on 22 September 2020.

The community provided the comments via 'Have Your Say' website, emails and letters between 14 September and 12 October 2020. The exhibited Structure Plan and the associated studies were also forwarded to the DPIE, the Greater Sydney Commission (GSC), Transport for NSW (TfNSW) and Sydney Water for feedback. A total of 20 submissions were received, including submissions from Sydney Water and TfNSW. However, the DPIE and GSC declined to provide submissions at this stage of planning process.

They key themes raised in the submission are summarised by Council in Figure 30. Refer to Chapter 7 of this report for the responses to the community feedback.

In summary, the key issues can be categorised into:

- Flooding:
 - flooding was no longer an issue.
 - land should be found elsewhere to compensate for the loss of flood storage.
- Odour buffer zone:
 - odour buffer zone should be ignored.
 - Warwick Farm sewage treatment facility would inevitably be upgraded therefore would reduce the odour buffer over time.
 - Sydney Water objects to the original structure plan as there is some development shown within the confines of the current odour buffer zone.
- Open space:
 - concerns over the quantum of open space provided.
 - proposed open space is not evenly distributed and concentrated in the vicinity of the least-dense residential areas.
- Feasibility:
 - the proposed development standards are not feasible to encourage redevelopment.
 - question regarding how future development can practicably proceed.
- Traffic:
 - concerns relating to an increase in traffic congestion that would occur from increased density within the area.
- 240 Governor Macquarie Drive:
 - support the redevelopment of the site.
 - concerns over the proposed built form outcome and unequitable distribution of dwellings in the precinct.
 - employment uses are preferred to be located on this site.

Refer to Council's Community Engagement Report for the detailed summary of the submissions received.

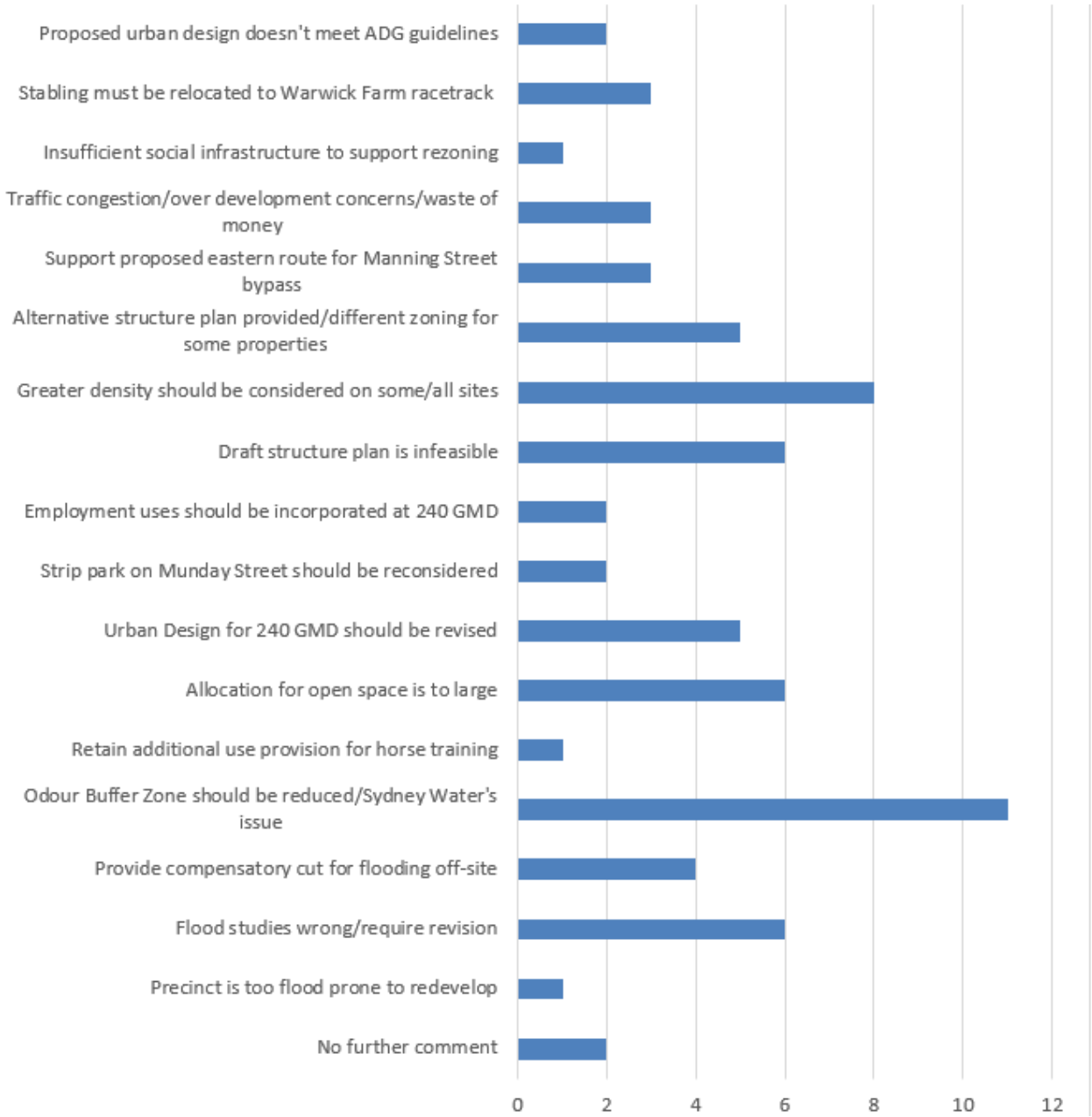


Figure 30: Public Exhibition Submission Summary (Source: Liverpool City Council)



Manning Street Streetscape



7.0 Revised Structure Plan

7.1 Executive Summary

Council at its meeting on 28 April 2021 resolved to refine the exhibited Warwick Farm Structure Plan to reflect more detailed information and the community feedback received during the public exhibition in 2020. In amending the exhibited Structure Plan, the project team has carefully considered this information and its implications, including:

- Department of Planning, Industry and Environment (DPIE) gateway refusal on 240 Governor Macquarie Drive - 240 Governor Macquarie Drive has been incorporated into the overall structure plan.
- Community feedback - All the feedback are reviewed and assessed. The revised structure plan has considered and incorporated some of the feedback where appropriate. Section 6.1 of the report provides a brief summary of the key community engagement outcomes. Refer to Section 7.7 of this report and Council's Community Engagement Report for the responses to the submissions.
- Atlas Urban's Feasibility Testing Report - The revised structure plan has incorporated the suggestions by reducing the overall non-residential GFA, contributions cost and rerun the testing for three typical sites to ensure they are financially viable. Refer to Section 7.2 on this page for more information on the implication of this study.
- New regional studies including Liverpool Collaboration Area Open Space Needs Assessment, Liverpool Collaboration Area Strategic Transport Infrastructure Assessment and Liverpool Collaboration Area Regional Flood Evacuation Strategy - The consultant team reviewed the new regional studies and their implications. The revised Structure Plan reflects the outcomes from the regional studies.
- Bypass Road - Two options have been identified by Council: one to the south and east of Rosedale Oval and the other utilising the existing road network. The final design of this bypass road is yet to be determined.

A detailed assessment of the potential flood impacts and the proposed floodplain displacement has also been conducted to minimise the potential risks and to comply with the relevant guidelines and Council strategies. A staged approach has also been adopted to realise the redevelopment of the precinct in a coordinated and feasible way.

7.2 Implications of the New Information

Economic Feasibility Testing

In October 2020, Atlas Urban Economics conducted an economic feasibility study against the exhibited Structure Plan. The study determined that the planning controls proposed in the exhibited Structure Plan were not financially viable. It also suggested ways to reduce the contributions rates associated with new infrastructure and to decrease the non-residential GFA to 5% to 10% of the overall floor space in the mixed use zone.

An iterative approach has been adopted in developing the revised Structure Plan. Economic feasibility testing of three typical blocks was conducted to ensure that the proposed planning controls will make the most of the blocks financially feasible. The financial feasibility tipping points of 3.35:1 for B4 Mixed Use zone and 2.2:1 for R4 High Density Residential zone were identified. The economic feasibility testing did not test every single block within the precinct. Instead, the findings on the typical blocks were extrapolated to the larger precinct and a generic approach was taken to test the typical blocks.

Open Space Benchmark

An Open Space Needs Analysis for the Liverpool Collaboration Area was prepared by Council to set a more appropriate open space benchmark for the urban renewal areas, including the Warwick Farm precinct. The study nominates a regional level open space benchmark of 1.5 hectares per 1,000 residents compared with the previous Council metric of 2.0 hectares per 1,000 residents. The revised Structure Plan considers the nominated open space benchmark.

Odour Buffer

Council has been liaising with Sydney Water regarding their plan to upgrade the facilities. However, no updated information is available at this time. Therefore, the revised Structure Plan adopts the current odour buffer information available and complies with the relevant guidelines in regard to residential development within an odour buffer.

240 Governor Macquarie Drive Planning Proposal

This Planning Proposal was rejected at Gateway by the DPIE on 21 September 2020. One of the recommendations from the DPIE is to consider the regional level technical studies and incorporate the site into the development of the Warwick Farm Structure Plan. Council resolves in its meeting on 28 April 2021 that:

The consultant is to consider the site's relationship to the entire precinct in terms of distribution of density, proposed zoning and SEPP 65 concerns, while also addressing the reasons for DPIE's Gateway refusal.

The revised Structure Plan therefore reconsiders the development potential on No. 240 GMD and its relationship with the rest of the precinct.

The Bypass Road Options

The Manning Street Bypass road was identified by Council in 2019 as a priority project to redirect heavy vehicles from entering the core of the precinct, therefore facilitating the redevelopment of the precinct to mix of uses, including B4 Mixed Use zone.

Two design options are being considered by Council:

1. Construct a new bypass road to the south and east of Rosedale Oval connecting Scrivener and Shore Streets with Governor Macquarie Drive.
2. Upgrade the existing road network to construct a new bypass road through Scrivener Street - Stroud Avenue - National Street - Shore Street.

The Manning Street Bypass design is a separate project to the Warwick Farm Structure Plan project and it is at the preliminary stage. Therefore, both of the options are shown in the revised structure plan.

Detailed information regarding the proposed Manning Street Bypass will be made available to the public once the design is finalised.

7.3 Flood Related Information

It is Council's direction at its April 28 Meeting to conduct a detailed flood impact assessment against the revised Structure Plan. It recommends that:

The completion of a detailed flood impact assessment to better understand land required for flood mitigation and alternative flood mitigation options.

Subsequently, Council has provided the TUFLOW hydraulic model used in the Draft January 2020 Georges River Flood Study to the consultant team to undertake the flood impact assessment.

It is important to note that the TUFLOW hydraulic model from the Draft January 2020 Georges River Flood Study is provided to the proponents for flood assessments; however, Council still adopts the design flood levels from the 2004 Georges River Floodplain Risk Management Study and Plan.

The 2004 Georges River Floodplain Risk Management Study and Plan uses a Mike-11 hydraulic model to determine design flood levels rather than TUFLOW hydraulic model. Therefore the nominated 1% Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) design flood levels in Section 4.3 of this report are used in the revised structure plan. Refer to the Flood Assessment Report by WMA Water for more information.



7.0 Revised Structure Plan

7.4 Constraints and Opportunities

The Urban Design Analysis of the Warwick Farm Precinct in terms of its strategic, local and planning context and existing conditions, has identified a suite of constraints and opportunities. New information, coupled with the community feedback received, has further informed the understanding of the constraints and opportunities for the precinct.

Constraints

The constraints include:

- The precinct is prone to flood. The majority of the land is identified as having medium flood risk. Rosedale Oval has high flood risk. Flooding issues would affect the design of buildings, places, land uses and earth works. The two key flood related issues are the evacuation route in a flood event and balancing cut and fill to avoid net loss of flood storage.
- Residential development within the Liverpool Sewage Treatment Plant odour buffer zone is to be avoided.
- The only through site vehicular access (Priddle Sreet - Manning Street - Munday Street) linking the industrial area to the south of the precinct to the Hume Highway limits the area's permeability. It also creates conflicts of uses among pedestrian, light and heavy vehicles.
- The Warwick Farm Station concourse provides the only east-west cross railway corridor access for pedestrians and cyclists, which limits the precinct's access to surrounding recreational, educational, and health facilities as well as the Liverpool CBD.
- The Hume Highway underpass adjacent to the precinct is narrow and lacks maintenance, which provides an unsafe environment for pedestrians and cyclists.
- The vehicular traffic along the Hume Highway and the railway corridor generate noise to the precinct, which affects the area's acoustic amenity.
- Bankstown Airport OLS contours limit the maximum building height within the precinct.
- The industrial area immediately to the south of the precinct could potentially affect the area's residential amenity.

- The lots in the precinct are in fragmented ownership. It may be challenging to achieve amalgamation.
- The strata constrained land opposite Warwick Farm Station would potentially retain its current form in the short to medium term.
- Governor Macquarie Drive is currently at capacity. Future development within the precinct needs to assess and address the potential traffic impacts to Governor Macquarie Drive.
- There are no multipurpose or hireable community facilities within the precinct. The closest one - Warwick Farm Community Hub, is 800m away from the precinct and is ageing.
- Tree coverage along the main streets is minimal.

Refer to Figure 31

Opportunities

The precinct presents the following opportunities:

- To provide a high quality mixed-use, Transport Oriented Development (TOD) close to Warwick Farm Station.
- To incorporate No. 240 Governor Macquarie Drive into the overall precinct planning.
- To create an urban centre close to Warwick Farm Station, providing a mix of uses and community facilities.
- To activate the main streets close to the urban centre by providing a mixed-use building typology with ground floor retail / commercial uses fronting the streets.
- To concentrate height and density close to Warwick Farm Station and transitioning down towards Rosedale Oval.
- To enable the redevelopment of the precinct by moving horse training facilities and stables to the Warwick Farm Racecourse (subject to agreement with ATC).
- To facilitate the future growth of the precinct by improving the capacity of Governor Macquarie Drive.
- To provide a bypass road redirecting heavy vehicles from entering the heart of the precinct.
- To improve the pedestrian amenity and streetscape along Priddle Street - Manning Street - Munday Street and reduce use conflicts in light of the reduced through site heavy vehicle traffic.
- To promote active transport (walking and cycling) within and around the precinct.
- To improve east-west cross railway corridor connection by improving the station concourse and providing a new link.
- To upgrade the Hume Highway underpass improving the precinct's access to Warwick Farm northwest and Cabramatta Creek.

- To provide future pedestrian and cyclist accesses to Georges River Foreshore via Governor Macquarie Drive and Horseshoe Pond.
- To improve access to Liverpool Boys High School, and the surrounding open spaces via existing and new links.
- To create 'green links' connecting east and west of the precinct.
- To protect the existing mature trees and improve the precinct's tree coverage by planting additional street trees along main streets.
- To provide flood escape route from the precinct to the flood free area along the Hume Highway.

Refer to Figure 32.

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7.0 Revised Structure Plan

Constraints Diagram

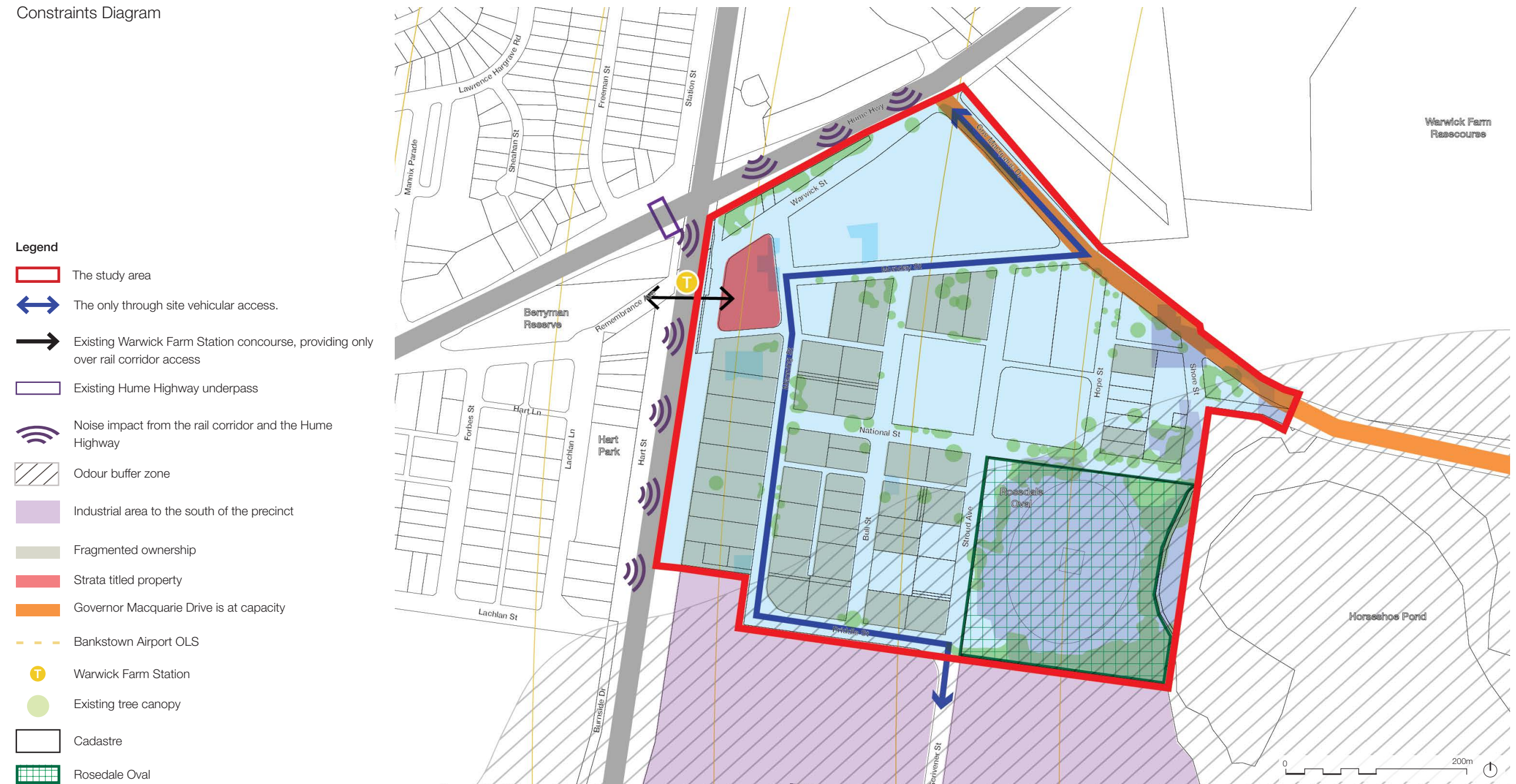


Figure 31: Constraints

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7.0 Revised Structure Plan

Opportunities Diagram





7.0 Revised Structure Plan

7.5 Urban Design Vision Statement

The Urban Design Study, the input received from Council, public submissions and the consultant team in regard to flooding, traffic and social infrastructure requirements as well as the latest regional studies have informed the development and amendments to the Urban Design Vision and the structure plan for the precinct.

Urban Design Vision

The Warwick Farm Precinct will be a new mixed-used community, providing living and employment close to Warwick Farm Station. It will be a precinct that addresses the community needs by leveraging the surrounding natural and built assets as well as delivering new high quality urban spaces. Its rural character will be transferred to a vibrant and multifunctional community that facilitates urban living.

Its character will be defined by diverse built forms and uses; and further strengthened by the precinct's rich history. Leafy streets and prime open spaces will complement the high quality urban living and distinct the precinct from the surrounding suburbs.

A new urban centre will be formed close to Warwick Farm Station, facilitating greater density and height. The new urban centre will become a 'community heart' providing high quality urban spaces and community facilities for the precinct and the suburb of Warwick Farm.

Mixed-use buildings will provide active street frontages and living and working opportunities in convenient proximity. The urban environment will gradually transition down in height towards Rosedale Oval providing a sensitive approach interfacing with the public domain.

The pedestrian and vehicular accessibility of the precinct will be improved. Governor Macquarie Drive will be widened to facilitate the future growth of the area. The proposed bypass road, which is Council's priority project, will provide an alternative route to access to the industrial area, thereby improving the road amenity and streetscapes in the heart of the Warwick Farm Precinct. The east-west connectivity across the railway corridor will be improved via upgrading the existing station concourse and additional crossing.

Active transport, including walking and cycling, will be encouraged, connecting the precinct to the surrounding suburbs, facilities and open spaces. Tree line streets together with active street frontages will improve public domain amenity and passive surveillance.

The precinct's amenity and appearance will be further improved by the proposed local parks, which will be provided within walking distance from any medium to high density development. Local parks coupled with tree-line streets will form 'green grids' linking the precinct to the surrounding regional and local open space networks.

The access to the regional parks will be enhanced. Rosedale Oval will continue to accommodate recreational uses for different age groups. The future pedestrian and cycle link to Horseshoe Pond and Georges River foreshore, through the Sydney Water site, will provide the community with additional access to the picturesque natural assets of the region.

Flooding issues that impact the precinct will be carefully dealt with through managing cut and fill and adopting Water Sensitive Urban Design (WSUD). The proposed open space network will also play an important role, facilitating flood water runoff and water storage.



Rouse Hill Town Centre

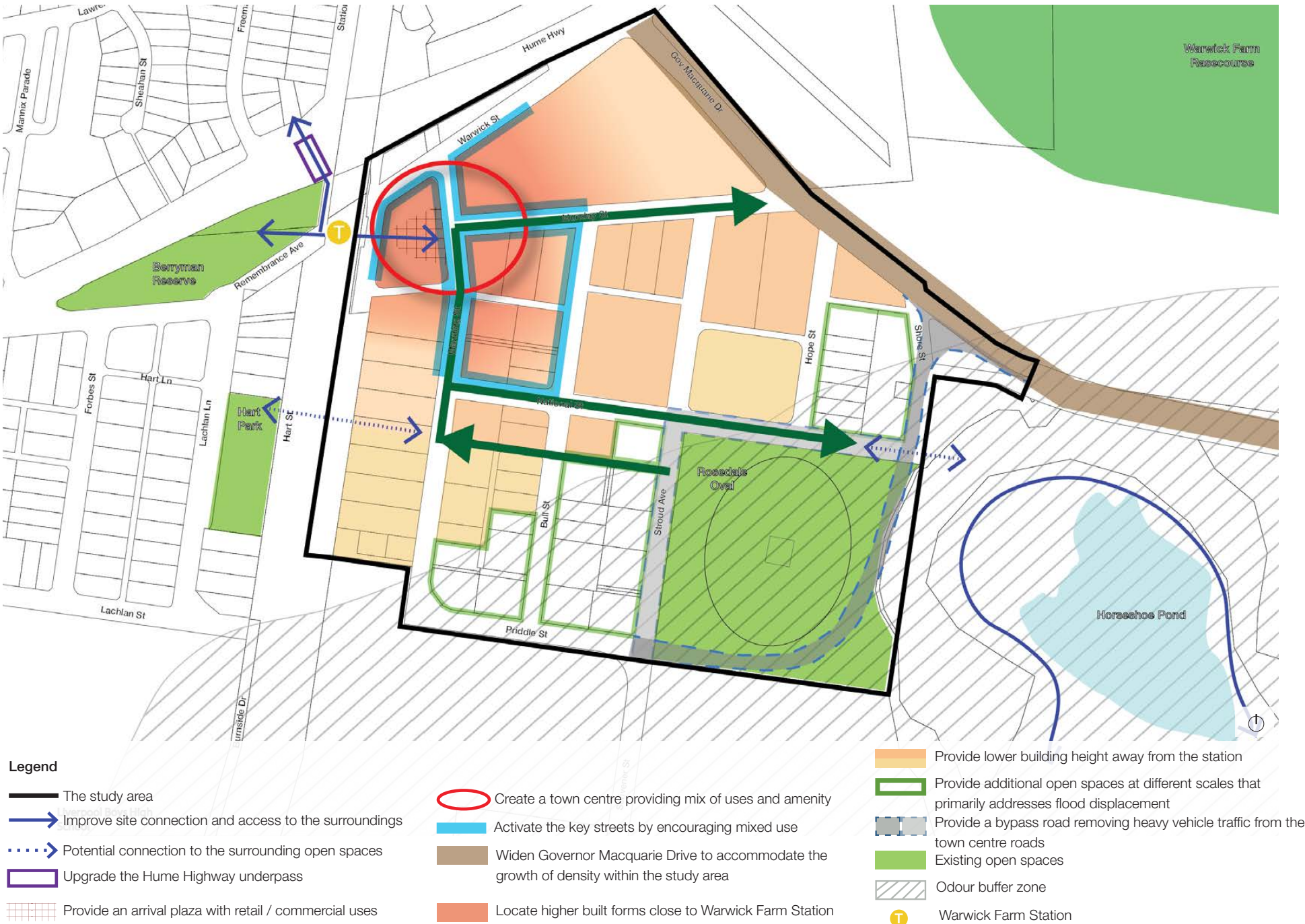


7.0 Revised Structure Plan

7.6 Urban Design Framework

The Urban Design framework identified below has formed the basic structure and principles to guide the redevelopment of the precinct, as well as fulfilling the Urban Design Vision outlined in Section 7.5.

1. Create a high quality, lively 'community hub' near Warwick Farm Station, comprising new community infrastructure and a mix of uses.
2. Concentrate higher built form and density around the future town centre and transition the height / density down to the lower lying areas to the southeast
3. Create a mixed use town centre in close proximity to Warwick Farm Station providing living and job opportunities.
4. Promote high quality residential living in the precinct, utilising the existing and proposed parks and natural resources.
5. Recognise Rosedale Oval as a valuable asset to the broader community as well as to future residents in the precinct.
6. Deliver new local open spaces throughout the precinct, providing amenity to the future community and to primarily address flood water displacement.
7. Create 'green links' and tree lined boulevards, utilising streets, laneways, existing and future open spaces.
8. Improve cross rail corridor accessibility via upgrading the old connection and exploring a new link.
9. Explore opportunities to harness the natural assets of the area, in particular Horseshoe Pond and the Georges River foreshore, to enable the general public access to picturesque areas.
10. Upgrade the road infrastructure in the precinct to prevent heavy vehicles from entering the precinct, whilst promoting active transport and local traffic within the precinct.
11. Improve streetscapes within the precinct via tree planting, footpath upgrades and ground floor activation.
12. Mitigate the flood impact through design and management and implementing Water Sensitive Urban Design (WSUD) measures.
13. Ensure the proposed flood storage open spaces are functional for recreational purposes and are safe for all in any flood event.
14. Manage the potential amenity impacts of the Sydney Water treatment facility by locating built form beyond the current odour buffer zone.



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7.0 Revised Structure Plan

Precedent Images

Projects across Australia have been studied to identify the most appropriate examples the nominated vision, framework and development standard for the Warwick Farm Precinct. The examples also facilitate the visualisation of the proposed changes.

The precedent images on this page illustrate the desired quality for the future public domain, including local parks, urban plaza, streets, and built form.

Examples of the large recreational open spaces while also serving floodwater storage / drainage can be found overleaf. The success of these places in Zetland demonstrate that it is possible to balance recreational uses whilst providing flood storage / drainage through thoughtful design. The precedents also illustrate the intended design outcome for these future open spaces.



Hassett Park, Campbell ACT



World Square Plaza, Sydney



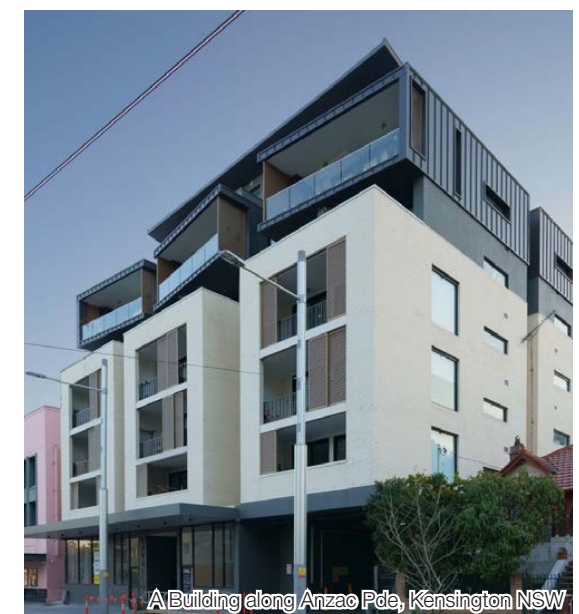
Main Street, Rouse Hill NSW



Main Street, Rouse Hill NSW



Rouse Hill Town Square, Rouse Hill NSW

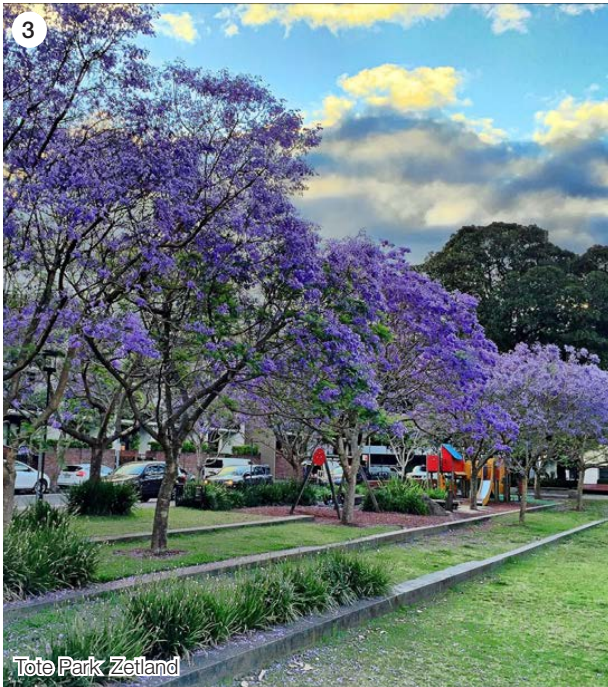
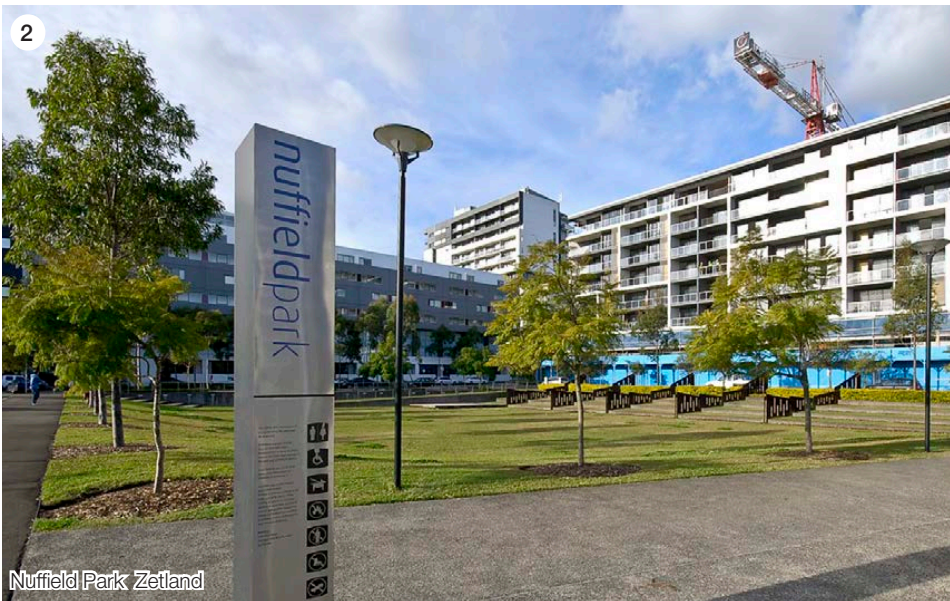
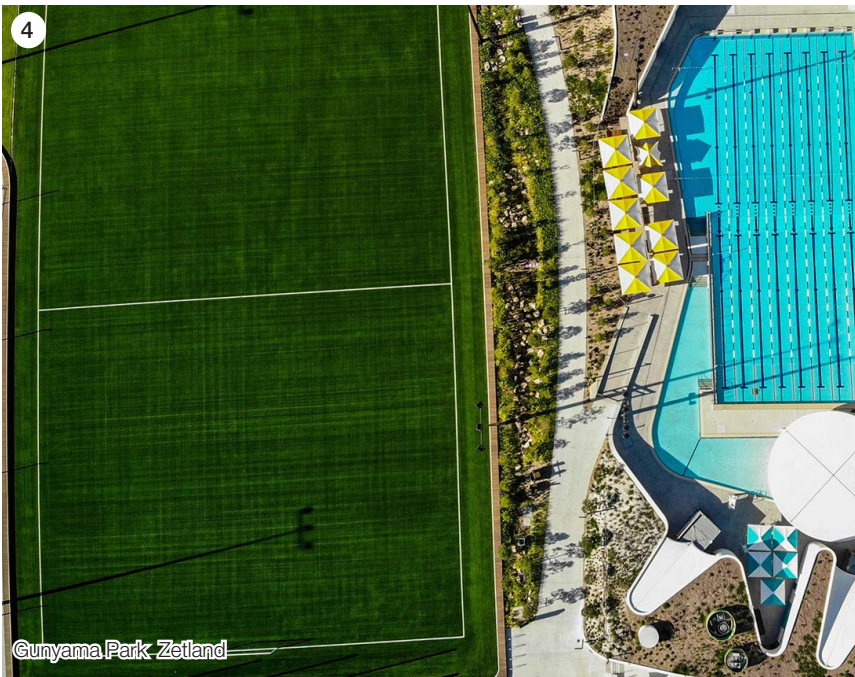
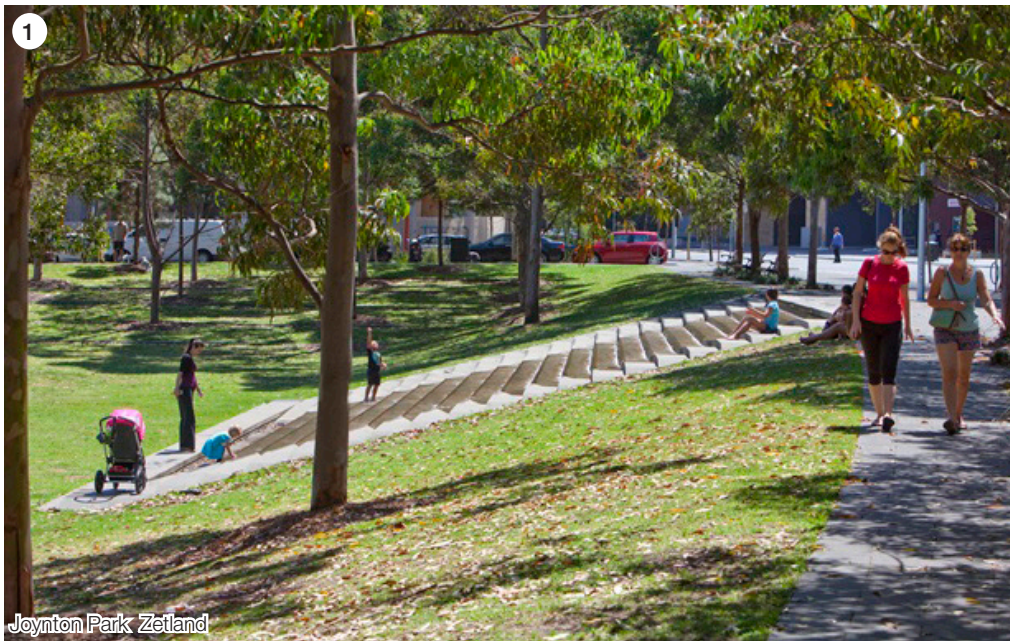


A Building along Anzac Pde, Kensington NSW

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7.0 Revised Structure Plan

Precedent Images - Water Parks





7.0 Revised Structure Plan

7.7 Revised Structure Plan

The revised Structure Plan was informed by the urban design vision and framework, community feedback, economic feasibility study, latest regional studies, and feedback from the DPIE regarding the 240 Governor Macquarie Drive Planning Proposal.

The revised Structure Plan considers the economic feasibility input to ensure each development block can achieve the nominated tipping points for different zoning (refer to Section 7.2 of this report for more information). It presents a maximum building height of 15 storeys (near Warwick Farm Station), and overall density (FSR) of approximately 1.04:1. Approximately 3,224 dwellings (including No. 240 Governor Macquarie Drive) and 3.9 ha of additional open space is proposed. Refer to Section 8.2.4 of this report for the yield summary.

The revised Structure Plan has carefully considered flood evacuation and floodplain water displacement by balancing the associated cut and fill. The volume of cut will be accommodated in the nominated proposed open spaces only (refer to Section 7.7.3 Floodplain Displacement).

The buildings illustrated on the revised structure plan are envelopes only. No articulations or architectural treatments are introduced. The building envelopes illustrated present the potential maximum building outlines projected onto each block. It is anticipated that building widths will vary between 18-22m.

Notes:

Appropriate drainage system will be developed for the future Local Sport Venue open spaces to drain the areas during and after a flood event. Detailed measures in regard to hazard reduction, warning signs and hydraulic engineering design will need to be undertaken in the later design stage.

The detailed design of the open spaces in the later stages will need to comply with the relevant requirements, provide appropriate edge transitions to mitigate the changes in levels and ensure easy access. Flood warning signs and other hazard reduction measures are to be facilitated in the detailed design stage.

* The location of proposed community facility shown on the plan is indicative only. The final form and location will be determined in detailed design stages.



Figure 33: Revised Structure Plan



7.0 Revised Structure Plan

7.7.0 Plan Comparison

The revised Structure Plan preserves various Urban Design initiatives developed from the exhibited Structure Plan, including road network, precinct accessibility and height transition. However, it also adopts a suite of changes to reflect the new information. The key changes are:

- 240 Governor Macquarie Drive - This land has been incorporated into the overall structure plan. The proposed built forms and height distribution now aligns with the overall Urban Design strategy and presents a more contextual fit.
- Open space configuration - The configuration of the open spaces has been changed reflecting the increased overall development areas, latest open space benchmark and the

floodplain displacement needs. The larger open spaces close to Rosedale Oval also align more closely to the odour buffer zone.

- Munday Street Linear Parks - The linear parks are removed. Instead building setbacks are proposed along Munday Street to form Munday Street boulevard. Several publicly accessible open spaces in different sizes are nominated on No. 240 Governor Macquarie Drive. These open spaces will have improved amenity, be more useful and contribute to the proposed residential and non-residential uses.
- Building height and massing - Refined built form height and massing are proposed to reflect the financial feasibility study and the latest regional level studies including the new open

space benchmark. The revised building height and massing also reflect the redistribution of height and density on 240 Governor Macquarie Drive.

Refer to the following sections of this report for the detailed information regarding the revised Structure Plan.



Exhibited Structure Plan



Revised Structure Plan



7.0 Revised Structure Plan

7.7.1 Response to Community Feedback

The revised Structure Plan has been developed with consideration of the community feedback received. The table on this page highlights how community commentary has influenced the ongoing development of the Structure Plan. The topics in the table have been taken from the summary of key concerns provided in Chapter 6 of this report.

Key Areas of Concerns and Responses	
Key Topics	Responses
Topic 1 - Flooding	
Flooding was no longer an issue.	The precinct is constrained by flooding issues. The Structure Plan needs to consider two key issues related to flooding. One is the evacuation of residents during a flood event. The other issue is the need to ensure the new development proposed will not result in net loss of the flood storage, within the site, at 1% AEP namely RL 8.5m AHD. Refer to Warwick Farm Flooding Assessment Report by WMA Water.
Land should be found elsewhere to compensate for the loss of flood storage.	The floodplain displacement is proposed to be located within the Warwick Farm Precinct. Refer to the relevant Council policies and Warwick Farm Flooding Assessment Report by WMA Water.
Topic 2 - Odour buffer zone	
Odour buffer zone should be ignored.	Council has been liaising with Sydney Water regarding their plan to upgrade the facilities. However, no updated information is available at this time. Therefore, the revised Structure Plan adopts the current odour buffer information available and complies with the relevant guidelines in regard to residential development within an odour buffer.
Warwick Farm sewage treatment facility would inevitably be upgraded therefore would reduce the odour buffer over time.	
Sydney Water objects to the original structure plan as there is some development shown within the confines of the current odour buffer zone.	The revised Structure Plan has removed all the proposed residential development within the current odour buffer zone.
Topic 3 - Open space	
Concerns over the quantum of open space provided.	The quantum of open spaces proposed is to comply with the required open space benchmark for the future population and also to facilitate floodplain displacement. The revised Structure Plan has reduced the amount of the proposed open spaces reflecting the latest open space benchmark for the area and the floodplain displacement modelling.
Proposed open space is not evenly distributed and concentrated in the vicinity of the least-dense residential areas.	The larger open spaces have been located to facilitate floodplain displacement and as a response to the need to avoid development within the odour buffer zone. The revised Structure Plan provides a more usable approach to the configuration of the smaller sized local open spaces.
Topic 4 - Feasibility	
The proposed development standards are not feasible to encourage redevelopment	The revised Structure Plan has reviewed and considered the previous economic feasibility study for the exhibited Structure Plan. An iterative approach has also been adopted in developing the revised Structure Plan. Economic feasibility testing of three typical blocks was conducted to ensure that the proposed planning controls will make the most of the blocks financially feasible. Refer to Section 7.2 of this report.
Question regarding how future development can practicably proceed.	An indicative staging plan is provided. Refer to Section 8.5 of this report.
Topic 5 - Traffic	
Concerns relating to an increase in traffic congestion that would occur from increased density within the area.	The revised Structure Plan has considered the potential traffic impact. No major concern is identified. Refer to SCT Consulting's high level commentary against the revised Structure Plan.
Topic 6 - 240 Governor Macquarie Drive	
Support the redevelopment of the site.	Noted.
Concerns over the proposed built form outcome and unequitable distribution of dwellings in the precinct.	The revised Structure Plan has reconsidered the configuration of development on No. 240 GMD and its relationship with the rest of the precinct. The proposed building envelopes and heights on No. 240 GMD have been revised to reflect the overarching Urban Design vision and principles for the precinct and provide a more contextual fit.
Employment uses are preferred to be located on this site.	Employment uses (non-residential uses) are proposed on the land close to Warwick Farm Station, including No. 240 GMD.

7.0 Revised Structure Plan

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7.0 Revised Structure Plan

7.7.3 3D View - Preferred Built Form



Figure 35: Revised Structure Plan Bird's Eye View

Note: This is an indicative building envelope diagram only and does not include detailed articulation, or topography.
The model anticipates that built forms will be between 18m to 22m wide.



7.0 Revised Structure Plan

7.7.4 Floodplain Displacement

The precinct is constrained by flooding issues. One of the important flood considerations is to ensure that the new development will not result in net loss of the flood storage at 1% Annual Exceedance Probability (AEP) namely RL 8.5m AHD. Therefore, it is critical to balance the cut and fill within the precinct. Three open spaces, Open Spaces 1, 2 and 4 in Figure 36, are identified as the places to accommodate the required excavation. Other open spaces will not provide compensatory excavation. Rosedale Oval currently is at RL 7m. No excavation is proposed to Rosedale Oval. The proposed cuts are summarised as follows:

- Open Space 1 - 2.0m cut from the existing level (RL 8m).
- Open Space 2 - 2.0m cut from the existing level (RL 8m).
- Open Space 4 - 2.1m cut from the existing level (RL 8m).

An average of 1:4 slope to the edges is proposed to the above open spaces to facilitate edge transitions. This will enable universal access compliance and mitigate the changes in levels in detailed design stages.

Appropriate drainage systems will be developed to the future Local Sport Venue open spaces to drain the areas during and after a flood event. It is acknowledged that detailed measures in regard to hazard reduction, warning signs and hydraulic engineering design will need to be undertaken in the detailed design stage.

A detailed flood impact assessment has also been conducted through TUFLOW hydraulic model to determine the change in 1% AEP flood level with the structure plan fully implemented.

The results are shown in Figure 37 and indicate no increase in flood level outside the Structure Plan area. There is a slight reduction in peak level (generally less than 0.05m) downstream towards the Warwick Farm Racecourse due to the restriction in flow caused by the proposed development (increase in building density and raised roads). The table below Figure 37 summarises the floodplain displacement data from the TUFLOW hydraulic model, which indicates the volume of cut and fill is 99.93% balanced. Considering the structure plan is a high level strategy, the variation is therefore within the acceptable tolerance level. The revised Structure Plan indicates its capability of balancing cut and fill in the detailed design stage.

Refer to Warwick Farm Flood Assessment Report by WMA Water for more information.

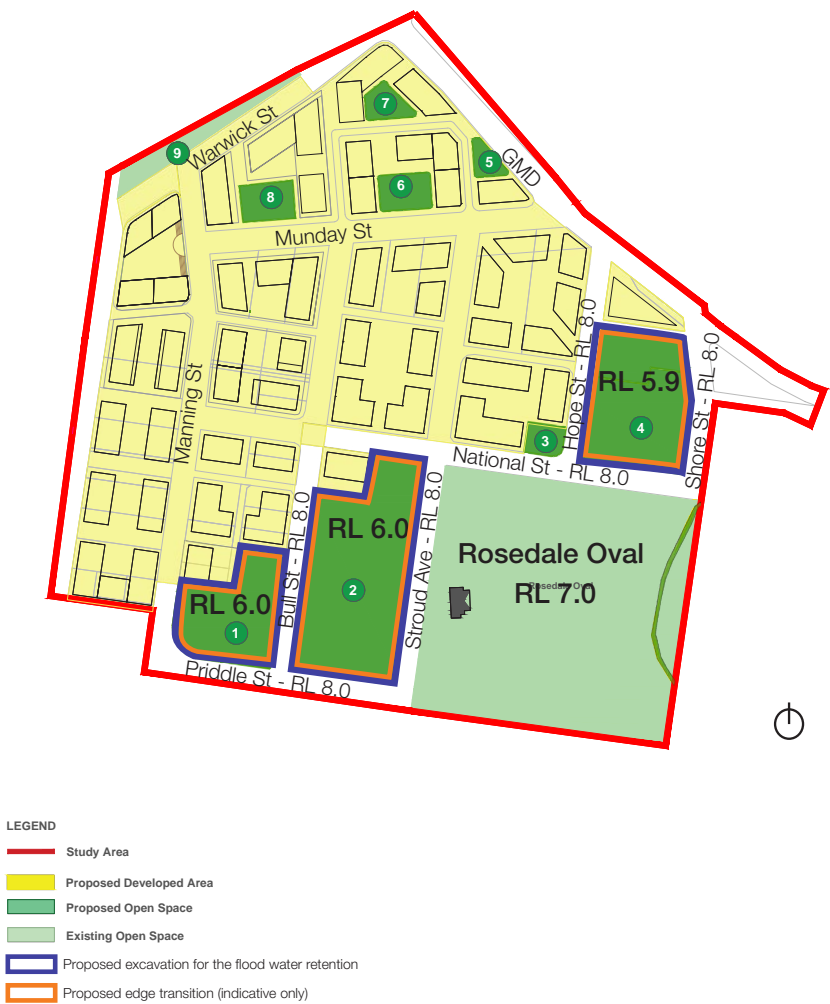
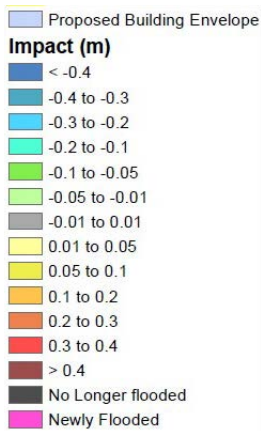
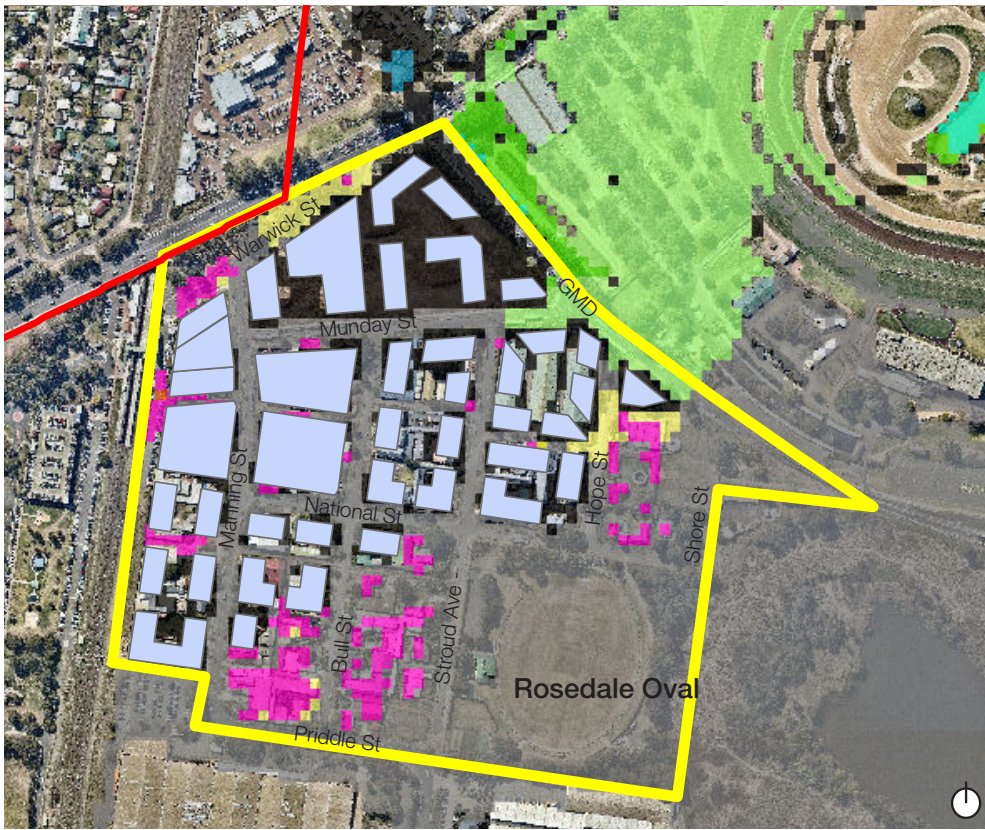


Figure 36: Proposed Areas of Excavation for Floodwater Displacement



Floodplain Displacement Calculation	
Existing Building Footprint (EBF)	50,000 m ²
Proposed Developed area (PDA)	143,860 m ²
Existing Volume at RL8.5*	209,384.3 m ³
Proposed Cut Volume at RL8.5*	209,236.1 m ³

* The data is from the detailed TUFLOW modelling based on the revised structure plan conducted by WMA Water.

Note:
The proposed excavation for the flood water retention only applies to Open Spaces 1,2 and 4.

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8.0 Proposed Controls

8.1 Key Strategies in Developing the Controls

The revised Structure Plan illustrates the desired Urban Design outcome for the Warwick Farm Precinct. The nominated building footprints present the maximum envelopes the future development can fulfil. Building articulations and architecture details will need to be introduced in the detailed design stage. Therefore, it is important to introduce the right suite of controls which is easy to reference to and enables the delivery of the proposed structure plan whilst providing a certain level of flexibility.

A two-step approach is adopted in developing and rationalising the floor space ratio (FSR) control:

1. Calculate the development yield based on the revised preferred structure plan building envelopes - the resultant FSR for each block fluctuates slightly; however the FSRs are all above the tipping points.
2. Determine a consistent zoning and density (FSR) approach - this is to rationalise the proposed planning controls to avoid having multiple density controls over different blocks within a same zoning that is based on both the model and the feasibility tipping points and building width between 18m and 22m.

A generic approach is also introduced to the building height control. It nominates the maximum height within a block to form the building height map. The building height control coupled with the Urban Design Control - height in storeys will further define the desired height distribution across the entire precinct.

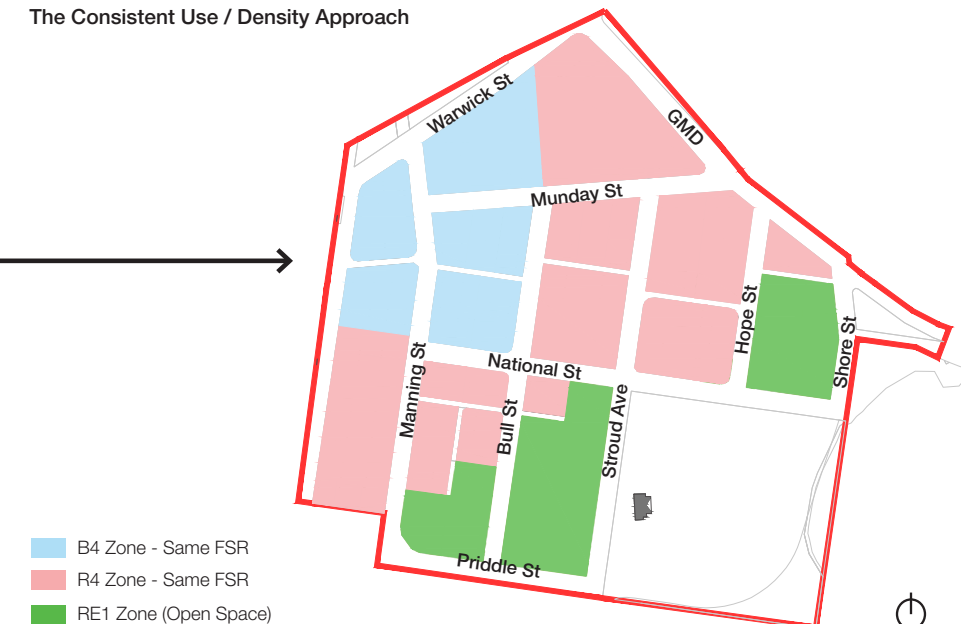
3D Building Envelopes from the Revised Structure Plan



Note:

This is an indicative building envelope diagram only and does not include detailed articulation, or topography. The model anticipates that built forms will be between 18m to 22m wide.

The Consistent Use / Density Approach



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8.0 Proposed Controls

8.2 Proposed Planning Controls

8.2.1 Proposed Zoning

Proposed changes to zoning controls to facilitate implementation of the revised Structure Plan includes:

1. B4 Mixed Use Zone - In close proximity to Warwick Farm Station and the future town centre.
2. R4 High Density Residential Zone - Adjacent to the proposed B4 Mixed Use zone to its east and south.
3. RE1 Public Recreation Zone - Adjacent to Rosedale Oval.

The revised Structure Plan also identifies a number of smaller sized local open spaces along Munday and National Streets, namely Open Spaces 3, 5, 6, 7 and 8 (refer to the diagram below). The proposed zoning does not intend to zone these local open spaces to RE1 zone, which means that the abovementioned open spaces will be under private ownership. Open Spaces 3, 5, 6, 7 and 8 form important parts to the proposed open space network. They are also critical to fulfil the local open space requirement identified in the Community Needs Assessment by Cred Consulting. Therefore these privately owned open spaces are required to provide the general public access. The Planning Proposal Report by GLN Planning provides more detailed information on the mechanism of achieving this arrangement.



The nominated Open Spaces in the revised Structure Plan

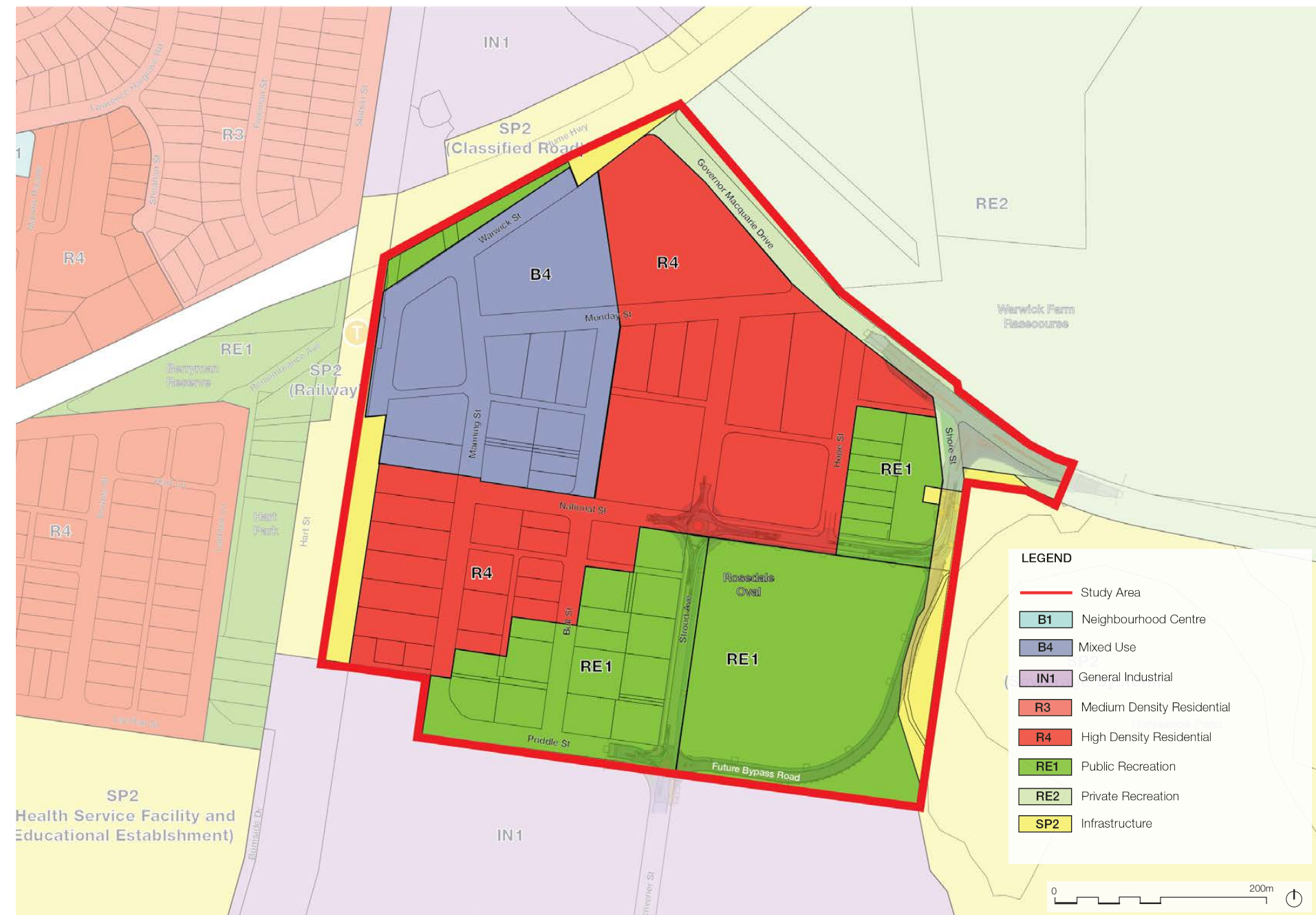


Figure 38: Proposed Zoning Map

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8.0 Proposed Controls

8.2.2 Proposed Density Control - Floor Space Ratio (FSR)

The revised Structure Plan introduces a generic approach to the proposed FSR. The nominated FSR on this page is developed based on the approach nominated in Section 8.1 of this report:

1. B4 Mixed Use zone enjoys a maximum of 3.35:1 FSR.
2. R4 High Density Residential zone has a maximum FSR control of 2.20:1.

Non-residential floor space in the B4 mixed use zone is required to provide employment opportunities and facilitate the proposed street activation (refer to Section 8.3.2).

LEGEND

- Study Area
- 3.35:1
- 2.20:1

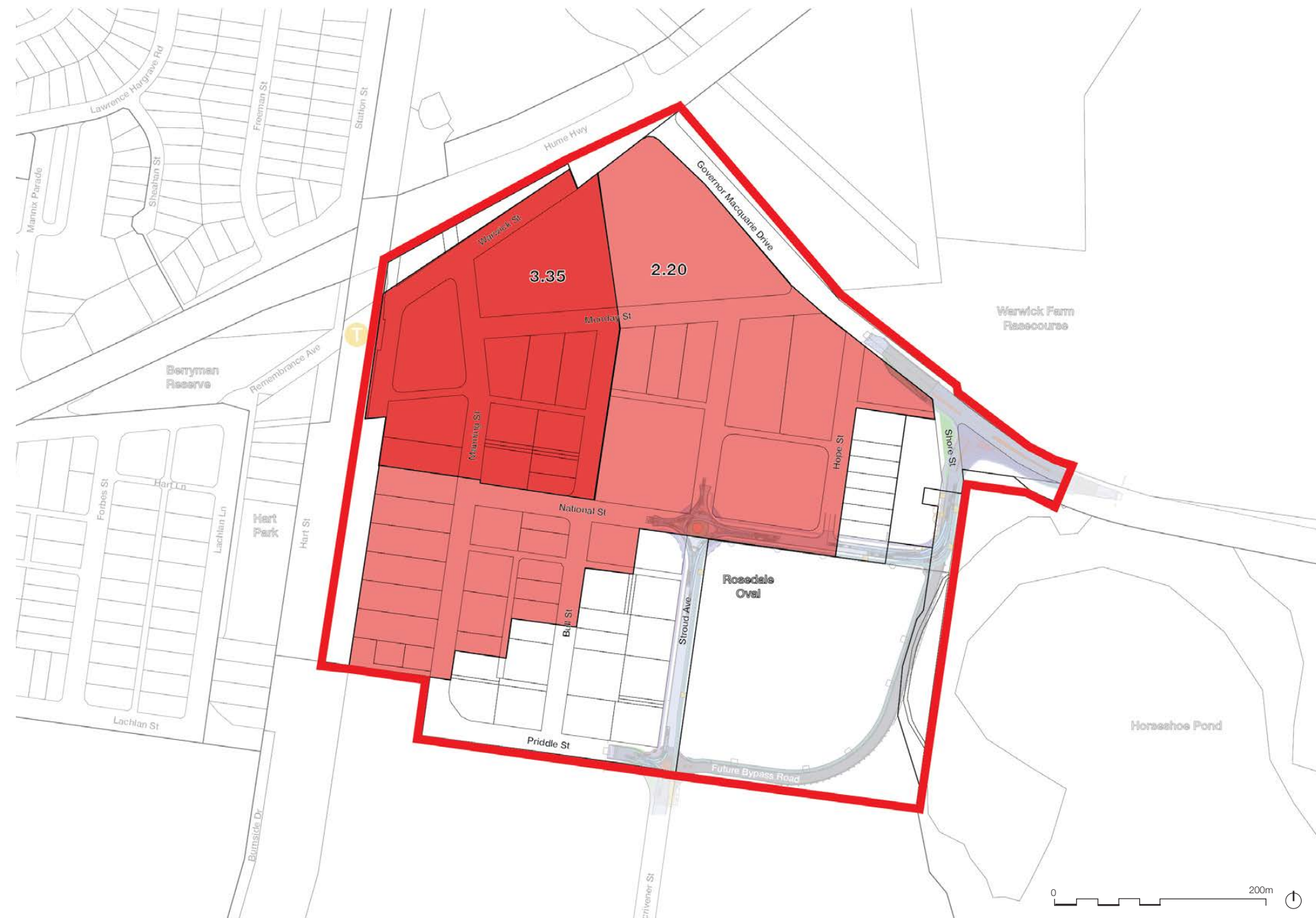


Figure 39: Proposed FSR Map

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8.0 Proposed Controls

8.2.3 Proposed Building Height Control

An increase in building height is proposed in the precinct. The revised Structure Plan proposes building height ranges from 6 storeys up to 15 storeys in the future town centre, close to Warwick Farm Station.

The proposed height transitions down from 50m (approximately 15 storeys) near the transport node (Warwick Farm Station) to 21m (6 storeys) towards the edge of the precinct, which provides a sensitive built form transition towards Rosedale Oval as well as the future open spaces.

The recommended maximum building height control (in metre) is illustrated in Figure 40. The maximum achievable height for any built form on any given site will also be determined by impacts with respect to overshadowing, privacy or other loss of urban amenity.

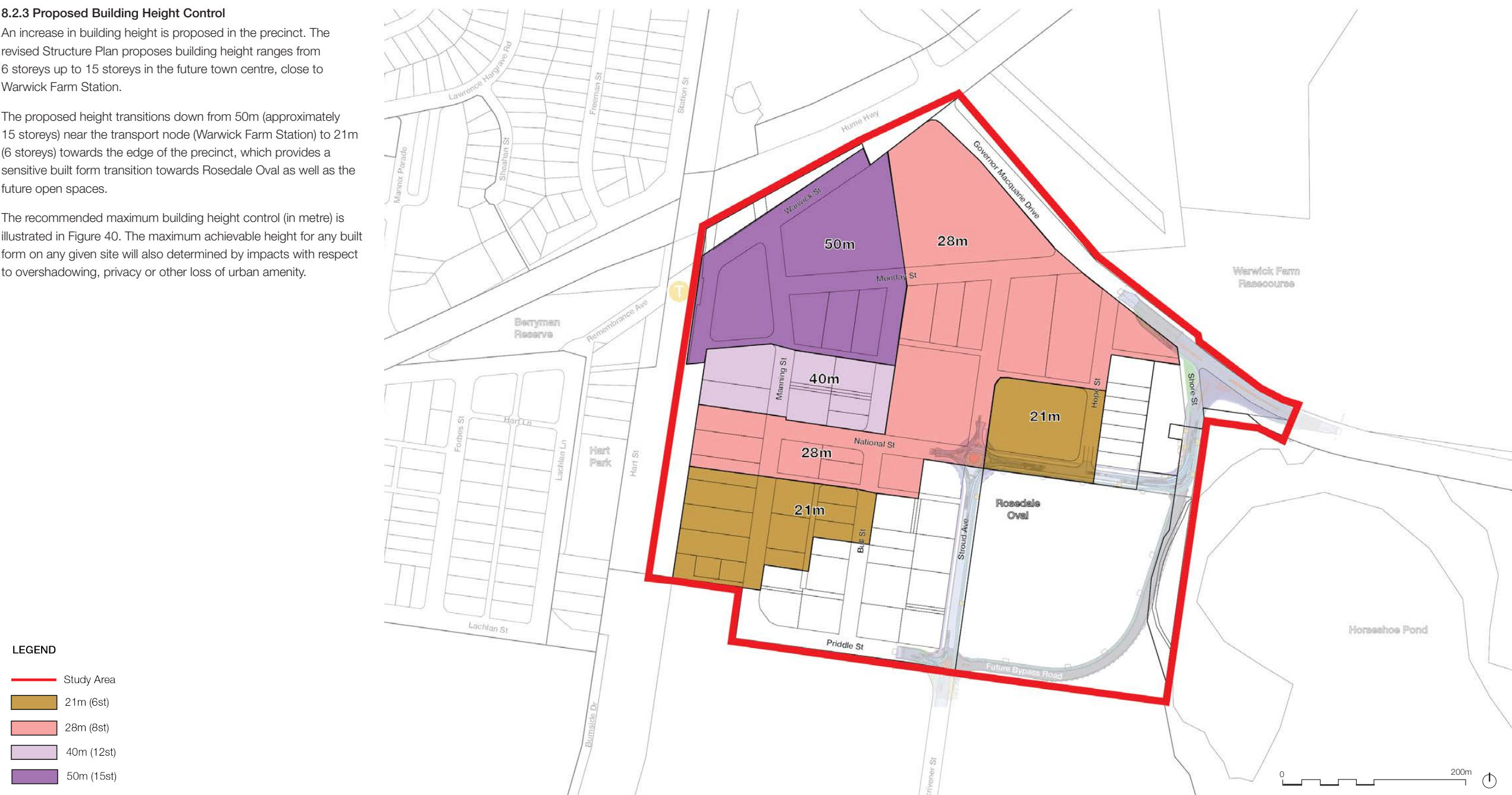


Figure 40: Proposed Building Height Control



8.0 Proposed Controls

8.2.4 Proposed Yield Summary

The following yield summary is based on the nominated planning controls.

Overall Development Parameters (Incl. 240 GMD)	
Residential GFA	274,053 m ²
Non-Residential GFA	20,109 m ²
Total GFA	294,162 m ²
Site Area	284,042 m ²
No. of Dwellings *	3,224
Population Projection**	7,383
FSR	1.04:1
% Non-Resi	7%

240 Governor Macquarie Drive (GMD)	
Residential GFA	69,781 m ²
Non-Residential GFA	7,260 m ²
Total GFA	77,401 m ²
Site Area	29,307 m ²
No. of Dwellings*	821
FSR	2.64:1

Notes:
Gross Building Area (GBA) is the entire building footprint.

Gross Floor Area (GFA) means the sum of the floor area of each floor of a building measured from the internal face of external walls, or from the internal face of walls separating the building from any other building, measured at a height of 1.4 metres above the floor, excludes common vertical articulation, car parking, services and voids. Refer to the Liverpool LEP 2008 for the detailed definition.

GFA is used to calculate FSR.

Open Space Calculation	
Open Space 1 (OS1) (Proposed RE1)	7,200 m ²
Open Space 2 (OS2) (Proposed RE1)	16,360m ²
Open Space 3 (OS3)**	910 m ²
Open Space 4 (OS4) (Proposed RE1)	10,374m ²
Open Space 5 (OS5)**	690 m ²
Open Space 6 (OS6)**	1,480 m ²
Open Space 7 (OS7)**	1,014 m ²
Open Space 8 (OS8)**	1,575 m ²
Total Proposed Local Open Space*	39,603m ² (14% of the site area)
Open Space 9 (OS9)	2,678 m ²
Rosedale Oval	49,927 m ²
Total Existing Open Space Area	52,605 m ²
Total Open Space Area	92,208 m ² (32% of the site area)
The Resultant Open Space Benchmark	
1.25ha / 1,000 residents	

- * The average dwelling size used in the calculation is 85sqm.
- ** Private owned publicly accessible open space.
- + This does not include Hart Park, which has an area of approximately 0.66ha.
- ++ A household size of 2.29 has been used to forecast the future population.
- The GBA to GFA efficiency rate used for residential uses is 75%.
 - The GBA to GFA efficiency rate used for ground floor non-residential uses is 50% and 85% for the 1st floor.



Figure 41: Key Plan for the Yield Calculation

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8.0 Proposed Controls

8.3 Urban Design Controls

The following Urban Design controls are proposed. The Urban Design Controls will dovetail with the proposed planning controls to realise the vision for the Warwick Farm Precinct.

8.3.1 Proposed Building Height in Storey

The nominated height in storeys will comfortably sit within the proposed building height controls.

15-storey built forms are concentrated to the future town centre in the B4 Mixed Use zone, close to Warwick Farm Station. The building height cascades down to six storeys in the periphery of the precinct fronting Rosedale Oval and the future open spaces.

The recommended building height in storeys is illustrated in Figure 42.

LEGEND

- Study Area
- 1 Storey
- 2 Storey
- 4 Storey
- 5 Storey
- 6 Storey
- 8 Storey
- 9 Storey
- 10 Storey
- 12 Storey
- 15 Storey
- Plaza



Figure 42: Proposed Building Height in Storey

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8.0 Proposed Controls

8.3.2 Active Street Frontages

Streets play an important role in shaping the amenity and character of an area. Active street frontages, in the form of retail and commercial uses define the streets, and bring vibrancy to the area, provide passive surveillance and create an attractive town centre. Refer to Figure 43 for the nominated active street frontages. The general principles are:

1. Active street frontages are required along the local streets within the future town centre (B4 Mixed Use Zone).
2. Active street frontages along laneways and internal roads are desired.
3. Active uses, including retail, commercial shop front, civic uses, display windows and the like should define the active frontages.
4. High quality pedestrian environment along active street frontages should be provided through improving footpath condition, tree planting and awnings all support this street activity.
5. Reduce long sections (i.e. greater than 40m) of blank walls, building services (i.e. substation) and minimise vehicular access points and width along active frontages to improve pedestrian safety and footpath continuity. Buildings that require to have active street frontages should have a minimum 85% of their ground floor building length activated.

LEGEND

- Study Area
- Active Street Frontages - Required
- Active Street Frontages - Preferred



Figure 43: Active Street Frontages Plan

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8.0 Proposed Controls

8.3.3 Street Wall Height

Street wall height defines the character of an urban space. It forms and shapes the urban experience from the street level. A proper street wall height will assist creating a human-scale streetscape and provide a consistent urban setting. Figure 44 illustrates the desired street wall height. The key principles are:

1. Provide one to two storey street wall height within B4 Mixed Use zone.
2. Promote human scale through a well proportioned, consistent street wall height.
3. Make the upper levels distinct from the street wall height.
4. Include active and employment generating uses within the building podium level(s) to activate the street and to provide local employment.



Figure 44: Street Wall Height Map

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8.0 Proposed Controls

8.3.4 Open Space Network and Benchmark

The open space network is based on the proposed open spaces in the revised Structure Plan, which identifies the locations of the additional RE1 Recreational zone as well as private owned publicly accessible open spaces along Munday and National Streets. The proposed network provides a structure for the future public domain improvements. It also adjoins the adjacent existing / proposed open spaces and forms a part of Liverpool's green network.

Future residential development will benefit from the proposed large and small size local open spaces within walking distance from the door step, providing amenities and views.

Green links along Munday Street, National Street and laneways will improve the precinct's permeability. They will provide east-west spines linking the community to the west of the railway corridor to the future habitat walkway in Horseshoe Pond (subject to the collaboration with Sydney Water) through the heart of the precinct.

Tree-lined streets within the precinct coupled with Munday Street boulevard will provide shades to pedestrian and cyclists and improve the overall streetscape.

The future open spaces will provide multi-purpose sport facilities (in the larger open spaces close to Rosedale Oval), playground, natural based discovery facilities, BBQ and picnic areas.

It is noted that the proposed overall open space metric of 1.25 ha per 1,000 residents is slightly lower than 1.5 ha identified in the Open Space Needs Analysis for the Liverpool Collaboration Area. Considering the proposed open space network will improve the precinct's connection to Hart Park and Horseshoe Pond, the amount of the open spaces proposed is considered acceptable to Council.

LEGEND

- Study Area
- Proposed Main Green Corridor
- - - Potential to Extend the Green Corridor to the Surrounding Open Space
- - - Potential Habitat Walkway
- Proposed Open Space
- Existing Open Space
- Plaza
- Street Tree
- Landscaping Tree



Figure 45: Open Space Network Map



8.0 Proposed Controls

8.3.5 Active Transport

Active transport, which priorities walking and cycling, will improve the quality of the public domain as well as the wellbeing of residents.

The precinct currently has a shared path (pedestrian and cyclists) along Warwick Street, Manning Street, Munday Street and Governor Macquarie Drive, linking Warwick Farm Station to the Hume Highway (refer to Figure 46). The walking and cycling environment will be further strengthened via improved existing footpaths / through site laneways and new footpath / shared way.

The over railway corridor connections are indicative only and will be improved via additional pedestrian / cyclists over bridge and updated station concourse. The proposed active transport network in the precinct will also link to the Chipping Norton Cycleway, which provides access to the Georges River foreshore. The potential link to Horseshoe Pond will provide a habitat walkway through the scenic area and create another access to the Georges River foreshore.

LEGEND

- Study Area
- Existing Shared Path (Pedestrian / Cycle)
- Chipping Norton Cycleway (Liverpool Bike Plan 2018-2023)
- Local Road - One Side of Pedestrian Footpaths + One Side of Shared Path
- Local Road - Pedestrian Footpaths on both sides
- Improved Through Site Laneway - Shared Zone
- Potential Pedestrian Bridge Over Rail Corridor
- Potential Pedestrian Link to Open Water Treatment Plant Open Space
- Potential Habitat Walkway
- Bus Stop



Figure 46: Active Transport Map



8.0 Proposed Controls

8.4 Evacuation Route

The precinct is subject to flooding issues. A key issue with the proposed development is the evacuation of residents during a flood. Shelter in place is not appropriate and therefore there must be appropriate access from every building in events larger than a 1% Annual Exceedance Probability (AEP). The key features of the evacuation approach are:

- 1. All floors to be at or above 9m AHD (1% AEP + 0.5m).
- 2. All floors must be at least 0.3m above the surrounding ground / road to allow for local drainage.
- 3. All internal roads to be at or above 8.5m AHD (1 % AEP).
- 4. All roads or pedestrian access used for evacuation must rise to the Probable Maximum Flood (PMF).
- 5. There must be either pedestrian or vehicle access from all floors that is always at or above 8.5m AHD (1 % AEP) to above to the PMF.

The proposed evacuation route fulfils the abovementioned requirements by providing a continuously rising route from 8.5m AHD to 10.8m AHD (PMF) and above along the Hume Highway. The proposed evacuation route will be detailed later in the Development Application (DA) stage. Refer to Warwick Farm Flooding Assessment Report by WMA Water.

LEGEND

- Study Area
- Evacuation Route



Figure 47: Evacuation Route Plan



8.0 Proposed Controls

8.5 Indicative Staging Plan

Staging is important in delivering the revised Structure Plan. The delivery of the required infrastructure, including open spaces, flood storage excavation, raising roads for flood evacuation and the building of the bypass road etc., is critical, however expensive. A high level staging plan has been developed to facilitate the realisation of the structure plan in a coordinated and feasible way. The staging strategy on this page is of high level. A detailed implementation plan will be needed in later stages to further test and refine the proposed staging boundaries and the associated infrastructure.

In general, three stages are proposed:

- Stage 1 - The land parcels close to Warwick Farm Station along Munday Street.
- Stage 2 - The properties to the north of National Street.
- Stage 3 - The remainder of the precinct.

To ensure the proposed staging will not result in net loss of the flood storage, the three large open spaces nominated for accommodating compensatory cut are also designated to each development stage:

- Open Space 2 is to be delivered in Stage 1 - It has an area of roughly 16,360 m² to compensate the amount of fill by Stage 1.
- Open Space 4 is to be delivered in Stage 2 - It has an area of roughly 10,374 m² to compensate the amount of fill by Stage 2.
- Open Space 1 is to be delivered in Stage 3 - It has an area of roughly 7,200 m² to compensate the amount of fill by Stage 3.

The table on this page summarises the yield for each stage.

Stage 1 Yield	
Dwelling Number	1,360
Population Projection	3,114
Open Space 2 Area	16,360m ²
Fill Volume	23,632m ³
Cut Volume	29,448m ³
Cut Depth (on Open Space 2 only)	2m
Stage 2 Yield	
Dwelling Number	1,193
Population Projection	2,733
Open Space 4 Area	10,374m ²
Fill Volume	17,206m ³
Cut Volume	19,607m ³
Cut Depth (on Open Space 4 only)	2.1m
Stage 3 Yield	
Dwelling Number	671
Population Projection	1,536
Open Space 1 Area	7,200m ²
Fill Volume	6,593m ³
Cut Volume	12,960m ³
Cut Depth (on Open Space 1 only)	2m
Total Dwelling Number	3,224
Total Population Projection	7,383

- Notes:
- The average dwelling size used in the calculation is 85sqm.
 - A household size of 2.29 has been used to forecast the future population.
 - The cut and fill volumes are of high level.



Figure 48: Indicative Staging Plan



8.0 Proposed Controls

8.6 Conclusion

The exhibited Structure Plan has been updated to respond to:

- Department of Planning, Industry and Environment gateway refusal on 240 Governor Macquarie Drive .
- Community feedback.
- Financial Feasibility Testing results.
- New regional studies including Liverpool Collaboration Area Open Space Needs Assessment, Liverpool Collaboration Area Strategic Transport Infrastructure Assessment and Liverpool Collaboration Area Regional Flood Evacuation Strategy.
- The latest flood model.

The revised Structure Plan presents the following key changes:

- 240 Governor Macquarie Drive - This land has been incorporated into the overall structure plan. The proposed built forms and height distribution now aligns with the overall Urban Design strategy and presents a more contextual fit.
- Open space configuration - The configuration of the open spaces has been changed reflecting the increased overall development areas, latest open space benchmark and the floodplain displacement needs. The larger open spaces close to Rosedale Oval also align more closely to the odour buffer zone.
- Munday Street Linear Parks - The linear parks are removed. Instead building setbacks are proposed along Munday Street to form Munday Street boulevard. Several publicly accessible open spaces in different sizes are nominated on No. 240 Governor Macquarie Drive. These open spaces will have improved solar amenity, be more useful and contribute to the proposed residential and non-residential uses.
- Building height and massing - Refined built form height and massing are proposed to reflect the financial feasibility study and the latest regional level studies including the new open space benchmark. The revised building height and massing also reflect the redistribution of height and density on 240 Governor Macquarie Drive.

The revised Structure Plan has provided a blueprint for the redevelopment of the Warwick Farm Precinct. The structure plan envisions incremental changes to the precinct over the coming years. The Warwick Farm Precinct will gradually change from the low density suburb characterised by its equine related facilities to a mixed use higher density area providing housing choice and local employment opportunities.



Figure 49: Revised Structure Plan Bird's Eye View

Note: This is an indicative building envelope diagram only and does not include detailed articulation, or topography. The model anticipates that built forms will be between 18m to 22m wide.

MOLINO STEWART

ENVIRONMENT & NATURAL HAZARDS



LIVERPOOL
CITY
COUNCIL

Georges River Evacuation Modelling
Flood Evacuation Analysis
Final



Georges River Evacuation Modelling

Flood Evacuation Analysis

Final

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Document Approval

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Executive Summary

Context

Flooding has been identified as a major constraint to achieving future growth in Liverpool LGA under the Greater Sydney Commission's Liverpool Collaboration Area Place Strategy ([LCA Place Strategy](#)). Action 24 of the Strategy states that there is a need to "prepare floodplain constraint categorisation study and a flood evacuation study." However, flood evacuation of the Collaboration Area would occur at the same time as other parts of the Georges River floodplain. Molino Stewart was already investigating evacuation capacity for planning proposals in Moorebank East. Accordingly, Council commissioned Molino Stewart to investigate flood evacuation challenges across the floodplain to investigate evacuation capacity for future development in the Moorebank Peninsula and the Liverpool Collaboration Area.

The NSW SES is the lead agency for flood emergency response in NSW and it is currently updating its *Georges River and Woronora River Valley Flood Emergency Sub Plan* (NSW SES 2018). During the preparation of this study there was extensive consultation with NSW SES which made it clear that its preferred primary flood emergency response for the Georges River floodplain is evacuation. The modelling has therefore assumed that all premises threatened by flooding will need to evacuate when ordered to by NSW SES. As such, it is effectively modelling road transport capacity to see if Liverpool's entire floodplain can evacuate within the available flood warning time, given a 100% evacuation compliance rate.

Model Construction

This study uses an agent-based model (Life Safety Model) to investigate the road transport capacity of Liverpool LGA to evacuate from the Georges River Probable Maximum Flood (PMF). The model simulates warning dissemination, evacuee response, traffic flows and flood rise and spread. It can visually and dynamically show the progress of evacuation, the build-up and dissipation of traffic queues and the overtaking of vehicles by floodwaters. The model results in this report are presented as map extracts and tables but videos of each model run from start to finish are also available.

It is emphasised that the modelling is only as good as the model's inputs and assumptions. To formulate these, extensive consultation was undertaken with Liverpool Council, NSW State Emergency Service (NSW SES), Infrastructure NSW, Transport for NSW, Department of Planning and Environment (DPE) and others to provide local knowledge and ensure the modelling was in line with the most up to date information on future urban development and road upgrades, and NSW SES's approach to managing a flood emergency in the area.

Table i lists the key parameters and studies utilised in the model assumptions.

Table i. Summary of model parameters and incorporated studies

Parameter	Description	Source
Flood Study	For flood behaviour and flood impact probabilities	Georges River Flood Study 2020 2D TufLOW model
Design Flood	Georges River Probable Maximum Flood (PMF) used to set evacuation triggers and model flood impacts	Georges River Flood Study 2020 2D TufLOW model
Warning Lead Time	12 hours prior to flooding	Warning time available for floods on both the Liverpool and Milperra Bridge Gauges (NSW SES, 2019)
Road Cuts	Evacuation routes would not be cut by local creek or Georges River flooding in events more frequent than a 0.2% (1 in 500) Annual Exceedance Probability (AEP) flood	Georges River Flood Study's 2D TufLOW model (BMT, 2020) Anzac Creek Flood Study (Bewsher Consulting, 2005) Cabramatta Creek Flood Study and Basin Strategy Review (Bewsher Consulting (2011)
Time Required between Evacuation Order and Departure	<ul style="list-style-type: none"> One hour Warning Acceptance Factor, plus One hour Warning Lag Factor (see Section 4.2.1) 	NSW SES Timeline Evacuation Model (TEM) (Oppen et al, 2009)
Road Capacity/ Travel Time Required	<ul style="list-style-type: none"> Assumed road capacity of 600 vehicles per hour per lane This has been applied to all scenarios, except in Scenario B where the two on ramps from the Hume Highway and M5 onto the M7 will have their capacity increased to 900 vehicles per lane per hour as per TfNSW advice. 	NSW SES Timeline Evacuation Model (TEM) (Oppen et al, 2009)
Traffic Safety Factor (TSF)	Calculated and accounted for based on the elapsed time that vehicles are traveling on the road, as per TEM table. Subsectors were identified where accounting for the TSF meant that additional vehicles would be trapped by floodwaters or on the road.	NSW SES Timeline Evacuation Model (TEM) (Oppen et al, 2009)

The study assumed that evacuation would occur by subsector as triggered by forecast flood impacts. Each subsector would evacuate either progressively from areas with a rising road access or all at once where the evacuation route would be cut before properties were flooded.

Specific assumptions regarding residential and non-residential vehicle numbers and other details for each scenario are summarised in Table ii.

Modelled Scenarios

Multiple Georges River flood evacuation scenarios were defined and modelled in this study to demonstrate how various assumptions will alter the evacuation process. The following scenarios are discussed and presented in this report:

- **Scenario 1** is the base case scenario based on 2016 Census (ABS, 2016) population and vehicle data and 2011 Journey to Work (Transport for NSW, 2011) data¹
- **Scenario 2** is a future scenario with intensified development under existing zoning, accounting for residential and non-residential infill and planned road upgrades
- **Scenario 3** is a future scenario with rezoning and development from planning proposals currently under investigation, as advised by Council
- **Scenario A** is Scenario 2 with multiple non-residential vehicle evacuation destinations depending on the origin of the workers
- **Scenario B** is a modified Scenario 3 with updated planning proposals, adjusted vehicle yields for new development, upgrades to roads and capacities, and multiple non-residential vehicle evacuation destinations.

These are summarised in Table ii.

Key Findings

Existing and Infill Development

The modelling suggests that there are some existing flood evacuation issues which need to be addressed. In particular:

- Parts of the commercial development along Orange Grove Road and residential development in Hargrave Park may not be able to evacuate on public roads because of local creek flooding. Provision of a flood emergency evacuation route through private property would alleviate this problem.
- There are numerous low flood islands where occupants may get trapped and overwhelmed by floodwaters if they don't leave promptly. Emergency services may need to focus resources on these areas to ensure timely evacuation.
- Nuwarra Road is an evacuation bottle neck which may prevent the timely evacuation of parts of Chipping Norton. The provision of an additional southbound lane from Brickmakers Road to Heathcote Road and the utilisation of Brickmakers Road and Anzac Road for some of the Chipping Norton evacuation traffic may alleviate this problem
- In the most extreme flood events the M5 will flood at the Moorebank Avenue underpass and, because its drainage is only designed for local rainfall, could be closed for several days due to ponded water. This could prevent some evacuees from leaving the peninsula and would disrupt through traffic for weeks. The planned additional westbound lanes crossing the Georges River at this location could be constructed in such a way to ensure access to Moorebank Peninsula in even the most extreme floods.

¹ The 2011 Journey to Work data was used since more recent 2016 Journey to Work data with the associated spatial data is not publicly available.

Table ii: Summary of modelled scenarios

	Scenario 1: Base case ¹	Scenario 2: Intensified development under existing zoning ²	Scenario 3: Proposals currently under investigation ³	Scenario A: Modified Scenario 2 ⁴	Scenario B: Modified Scenario 3 ⁵
Description	The "present" or current status scenario	Residential and non-residential infill development under existing zonings and currently planned road capacity upgrades	Residential and non-residential infill development under existing zonings plus development associated with planning proposals currently under investigation and currently planned road capacity upgrades	Scenario 2 but with four non-residential vehicle destinations depending on the origin of the workers	Scenario 3 with updated planning proposals, adjusted vehicle yields for new development, changes to roads and capacities, and multiple non-residential vehicle evacuation destinations as per Scenario A
Timing	2016	2036	>20 years in future	2036	>20 years in future
Destinations	M7 northbound (single destination)	M7 northbound (single destination)	M7 northbound (single destination)	M7 northbound for all residential. Four non-residential destinations depending on origin of workers: 1) M7 northbound; 2) Hume Motorway southbound; 3) Camden Valley Way westbound and 4) M5 eastbound	M7 northbound for all residential. Four non-residential destinations depending on origin of workers: 1) M7 northbound; 2) Hume Motorway southbound; 3) Camden Valley Way westbound and 4) M5 eastbound
Road Capacity	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour except for the two on ramps from the Hume Highway and M5 onto the M7 will have their capacity increased to 900 vehicles/ lane/ hour
Road Network	As current	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound, and additional third lane northbound on the M7 and improvements to M7 on ramp capacities through ramp metering
Dwelling Numbers⁶	Based on 2016 census data and Google Maps visual assessment: ~8,500 dwellings or ~27,000 people in evacuation study area	Additional dwellings based on existing zoning-dependent infill potential in Warwick Farm, Chipping Norton and Moorebank as estimated by Council (370 additional dwellings compared to Scenario 1)	Additional dwellings based on existing zoning-dependent infill potential in Warwick Farm, Chipping Norton and Moorebank as estimated by Council (370 additional dwellings compared to Scenario 2)	Same as Scenario 2	Modified dwelling numbers compared to Scenario 3, as per updated Planning Proposals numbers from Council
Vehicles per Dwelling	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate but with a rate of one vehicle per dwelling for new apartments
Non-Residential Vehicles	Based on 2011 Journey to Work data for vehicle drivers commuting from outside of the study area (no double counting of those both living and working in the study area)	As per Scenario 1 with additional vehicles added to Liverpool Hospital location only (discounted to include only vehicle drivers originating from outside of the study area)	As per Scenario 2 with additional vehicles associated with additional jobs from original Planning Proposals numbers from Council (discounted to include only vehicle drivers originating from outside of the study area)	Same as Scenario 2	Modified commercial development areas and associated vehicle numbers compared to Scenario 3, as per updated Planning Proposals numbers from Council
Vehicles⁶	Base case: ~27,500 total	1,541 additional evacuating vehicles compared to Scenario 1	61,671 additional evacuating vehicles compared to Scenario 2	1,541 additional evacuating vehicles compared to Scenario 1	40,097 additional evacuating vehicles compared to Scenario 2, minus existing development in the locations of new development.

1-See Section 5.5.1 for details; 2-See Section 5.5.2 for details; 3-See Section 5.5.3 for details; 4-See Section 5.5.4 for details; 5-See Section 5.5.5 for details; 6-Excluding creek-only impacted subareas I10, R21 and R22

- It would appear that no matter how the additional lanes are provided on the M5 they would alleviate the existing evacuation risks for Chipping Norton and allow some infill development to take place on floodprone R3 and R4 zoned land in Chipping Norton and Moorebank.
- While the NSW SES evacuation planning for the Georges River relies upon motor vehicle evacuation, there are currently thousands of people within the floodplain that do not have access to a vehicle (over 30% of dwellings in some areas). It is recognised that both rail and pedestrian evacuation have their limitations and may not be able to be relied upon. Furthermore, they are generally not supported by the NSW SES.
- Failing to evacuate or deliberately Sheltering in Place in the Georges River floodplain is particularly risky considering buildings can be isolated and inaccessible to emergency services for more than 24 hours in the PMF.

Planning Proposals

The capacity for the expected augmented road network to accommodate development associated with future planning proposals is mixed.

Table iii summarises the key challenges for future development in the study area.

Table iii. Constraints on Future Development

Development	Challenge
The Grove	Requires a flood free evacuation route connection between Homepride Avenue and Orange Grove Road
Shepherd Street	May require an emergency level crossing of the railway line at Atkinson Street
Warwick Farm Structure Plan	Insufficient road capacity to cater for the evacuation of the planning proposals
Moore Point	Insufficient road capacity to cater for the evacuation of the planning proposals
Moorebank East	Approved and proposed development in Moorebank East would be able to evacuate in time but proposed development blocks the evacuation of Chipping Norton

"Spare" evacuation capacity has been investigated at a high level for some of the large planning proposals included in Scenario B. However, it is stressed that this is only a high-level calculation, and the capacity would have to be modelled in order to test the impact of a reduction in vehicles from certain developments. Also note that the vehicles which escape the floodwaters but are trapped on the Moorebank Peninsula have not been accounted for in those calculations.

The Grove

The Grove development should be able to evacuate if an emergency evacuation route through private property is provided to deal with existing evacuation problems.

33 Shepherd Street

The capacity to evacuate 33 Shepherd St by vehicle will depend on how much of the evacuation capacity has been taken up by approved neighbouring developments. Shepherd Street gets cut by frequent floods at the railway underpass which is a threat to both existing development and that being



considered in the planning proposal. An emergency level crossing at Atkinson Street would significantly reduce risks to existing and proposed development. It might be possible for 33 Shepherd St to shelter in place because it is generally above the PMF level or subject to shorter duration flooding in the PMF. The provision of the emergency level crossing would make this more viable.

Warwick Farm Structure Plan

Development proposed for the Warwick Farm structure plan would appear to exceed the evacuation capacity of the area because many surrounding areas need to share the same evacuation routes at the same time. Scenario B suggests that the road network could have capacity for 850 evacuating vehicles from Warwick Farm in Scenario B, accounting for the road upgrades included in Scenario B.

Other than reducing the scale of the proposed development, there is not a lot which can be done to mitigate the above challenges. Providing two exit lanes on Warwick Street might assist if it does not create capacity issues on the Hume Highway. Sheltering within buildings is not advisable as the area is surrounded by hazardous floodwaters in the PMF for more than 24 hours and for up to 8 hours in a 0.2% AEP flood.

The precinct is not a flood island and rises gently towards the Hume Highway which then rises rapidly as it crosses the rail line to higher ground west of the railway. Therefore, walking out ahead of rising flood waters should vehicular evacuation fail would be an option.

Moore Point

The planning proposals for Moore Point far exceed the capacity of the road network to cater for their evacuation during a flood. Together they would result in nearly 32,000 vehicles having to evacuate in advance of a flood under the current settings and the modelling suggests that more than 26,000 of them would not be able to evacuate by vehicle in time. The problem is caused because there are only two lanes of Newbridge Road on which it can evacuate and the road gets cut in a 2% (1 in 50) AEP flood. Scenario B suggests that the road network may have capacity for approximately 5,500 evacuating vehicles from Moore Point, accounting for the road upgrades included in Scenario B.

Alternatives to vehicular evacuation such as pedestrian evacuation or sheltering in place present their own challenges because tens of thousands of people are involved and the development can be surrounded by high hazard floodwaters for more than 24 hours in the most extreme floods.

Moorebank East

The modelling suggests that while planning proposals for Moorebank East would have sufficient time to evacuate, they would take up road capacity currently used by Chipping Norton evacuees and thousands would be caught by floodwaters who would otherwise have time to escape. Modelling suggests that the road network could have capacity for approximately 700 evacuating vehicles from Moorebank East, accounting for the road upgrades included in Scenario B. It is noted that the model included over 360 vehicles for Site C, which is already approved and under construction. This only leaves capacity for 340 additional vehicles. The suggested widening of Nuwarra Road and use of additional roads for evacuation may facilitate some further modest development at Moorebank East without compromising the safety of those already living and working in Chipping Norton.

Recommendations

A. Current Flood Evacuation Challenges

- Ensure that the proposed additional lanes on the M5 across the Georges River are configured to reduce the probability of flooding isolating the Moorebank Peninsula

- Investigate the provision of an additional southbound lane on Nuwarra Road between Brickmakers Drive and Heathcote Road to reduce the queuing that severely limits the evacuation of Chipping Norton onto the M5
- Investigate an emergency level crossing at Atkinson Street to improve the evacuation capability of current developments on Shepherd Street and Riverpark Drive
- Investigate an emergency flood evacuation route through private property between Homepride Avenue and Orange Grove Road (Figure 25 is one possibility) to ensure a flood-free evacuation route for the existing commercial, industrial and residential developments in the areas
- Investigate development of a comprehensive flood forecasting and warning system in the Georges River Catchment to increase the warning time for evacuation
- Investigate the benefits of an intelligent traffic system (ITS) to see whether this could increase evacuation route capacities at route bottlenecks
- Investigate whether contraflow arrangements are likely to increase flood evacuation capacity
- Use data and consider outcomes from this study to inform preparation of Volume 2 and 3 of the Georges River and Woronora River Valley Flood Emergency Sub Plan
- Identify means of safely managing the thousands of people on the floodplain who do not have access to private motor vehicles, many of whom may have mobility challenges. This might include pedestrian evacuation, mass transport or sheltering in place.

B. Planning Proposals

- Many of the above listed recommendations to deal with “current” challenges may also facilitate evacuation capacity improvements for future planning proposals
- Development at Moorebank East should be restricted, considering it is estimated that half of the potential evacuation capacity is taken up by the already-approved Site C development. An additional lane on Nuwarra Road should be investigated to see whether it would provide sufficient additional evacuation capacity to enable further development at Moorebank East without compromising the safe evacuation of existing development in Chipping Norton
- Development at Shepherd Street has a relatively low flood evacuation risk and is unlikely to compromise the evacuation of nearby developments. Emergency access in the area could be improved through the provision of an emergency level crossing at Atkinson Street
- The Grove in Warwick Farm should only be approved if a flood free emergency evacuation route can be created between Homepride Avenue and Orange Grove Road
- The planning proposals for Moore Point and the Warwick Farm Structure Plan either need to be substantially scaled back or:
 - more time to evacuate is provided through an improved warning system
 - improved evacuation route capacity is provided through road upgrades, contraflow traffic arrangement and/or an ITS
 - alternatives to private motor vehicle evacuation is catered for through mass transport, pedestrian evacuation or sheltering in place.

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1 | Introduction

1.1 Background

In October 2019, Molino Stewart prepared a report for Liverpool City Council (Council) on flood evacuation potential in the Moorebank Peninsula in Liverpool LGA. This was specifically for the potential development of five sites in the Moorebank East precinct (Figure 1) which was previously used for extractive industry and commercial purposes. The whole precinct is at risk of flooding from the Georges River and, to a lesser extent, from local creek flooding.

The highest part of the area was rezoned for residential development in 2008 (Site C) and a development application was submitted in 2017 for low density residential development on that site. A condition of the planning approval for Site C was that a road bridge be constructed to connect the development to Brickmakers Drive to facilitate evacuation in advance of an extreme flood in the Georges River. More recently, development approval was granted for a marina at Site D with approval conditional on the availability of Site C's road infrastructure. It is noted that a separate planning proposal is also being pursued by the landowner of Site D for additional residential development, this planning proposal has yet to receive a Gateway determination.

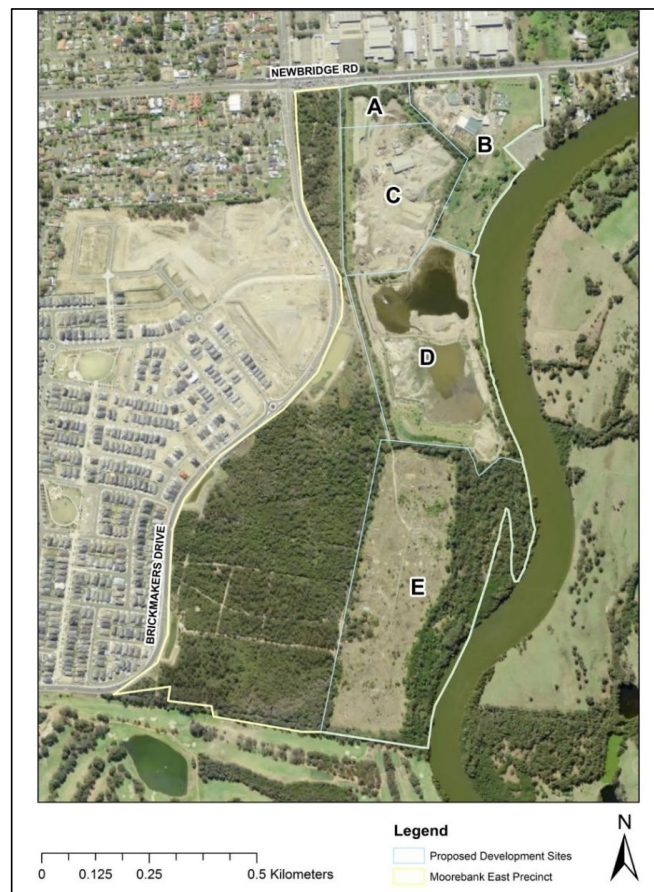


Figure 1. Moorebank East Development Precinct, the scope for the 2019 Molino Stewart report



Since then, additional planning proposals for residential and commercial development on the floodplain have been submitted to Council. While sheltering in place (SIP) above the reach of the Probable Maximum Flood (PMF) level may be physically possible on some of these sites if evacuation from these properties is not achievable, the NSW State Emergency Service (SES) has advised that SIP is not an appropriate primary flood emergency response for new developments. An important consideration in this advice from the NSW SES is that in the most extreme floods most sites on the floodplain can be isolated by hazardous flood waters for nearly two days. This means the developments must allow for vehicular evacuation ahead of flooding, with pedestrian evacuation being an essential secondary response should vehicular evacuation fail for any reason.

Application of the NSW SES Timeline Evacuation Model in the Molino Stewart 2019 study showed that there is sufficient time to evacuate all of the proposed residential and non-residential vehicles in the Moorebank East precinct onto Brickmakers Drive. However, where traffic converges onto a single lane at the intersection of Brickmakers Drive and Nuwarra Road, there is insufficient road capacity for timely evacuation. Therefore, for evacuation to be possible, either Nuwarra Road would need to be widened or the number of evacuating vehicles would need to be reduced. The study also recognised that accounting for the evacuation of existing development in Moorebank and Chipping Norton along with the proposed developments would further constrain the development capacity of the Moorebank East Precinct.

However, it was beyond the scope of that report to assess the constraints which may be imposed by the evacuation of existing development in Moorebank and Chipping Norton, which may take up some, or all, of the local road capacity. Additionally, Liverpool has been flagged as a centre for future growth under the Greater Sydney Commission's Collaboration Area Place Strategy, which aims to find opportunities for growth including housing developments within the collaboration area.

According to the Greater Sydney Commission (2018), the population of the Western Sydney Region is set to grow from 740,000 in 2016 to 1.1 M by 2036, and to over 1.5 M by 2056. The majority of this growth is projected to occur around the existing hub of Liverpool, which has established transportation, residential areas, employment opportunities and educational centres. While significant growth is anticipated for the area, flooding has been identified as a major constraint to achieving the vision of the Strategy, which has identified the need to "prepare floodplain constraint categorisation study and a flood evacuation study" as per action no. 24 of the Strategy.

Accordingly, Council commissioned Molino Stewart to investigate flood evacuation challenges for both the Moorebank Peninsula and the Liverpool Collaboration Area.

1.2 Study Area

1.2.1 Moorebank Peninsula

The Moorebank Peninsula encompasses the suburbs of Chipping Norton and Moorebank. The Georges River bounds the peninsula from the west to the east, and Anzac Creek flows into the Georges River through the southwest of this area. This area includes the Moorebank East Precinct (Figure 1), which sits south of Newbridge Road between Brickmakers Drive and the Georges River. The Precinct is flagged for potential development and divided up into five sites, which are referred to as:

- Site A – Benedict Sands
- Site B – Flower Power
- Site C – Moorebank Cove
- Site D – Georges Cove Marina
- Site E – EQ Riverside

1.2.2 Liverpool Collaboration Area

The Liverpool Collaboration Area was co-designed by the Greater Sydney Commission and the Liverpool Collaboration Area Stakeholder Group and was approved in 2018. The extent of the Liverpool Collaboration Area is shown in Figure 2 and encompasses the area between Cabramatta Creek and the Georges River, as well as a section of the Moorebank Peninsula between the Georges River and Anzac Creek. It includes the Liverpool CBD, the health and education precinct, the Warwick Farm precinct, and nearby residential and industrial lands. It therefore partially overlaps with the above study area for the Moorebank Peninsula.

As the Moorebank Peninsula will be evacuating at the same time as the Liverpool Collaboration Area, it is necessary to cover the extents of both areas within a single evacuation model. The combined area is shown in Figure 3 along with the PMF extent of the Georges River, Cabramatta Creek and Anzac Creek which must all be taken into consideration in the evacuation modelling.

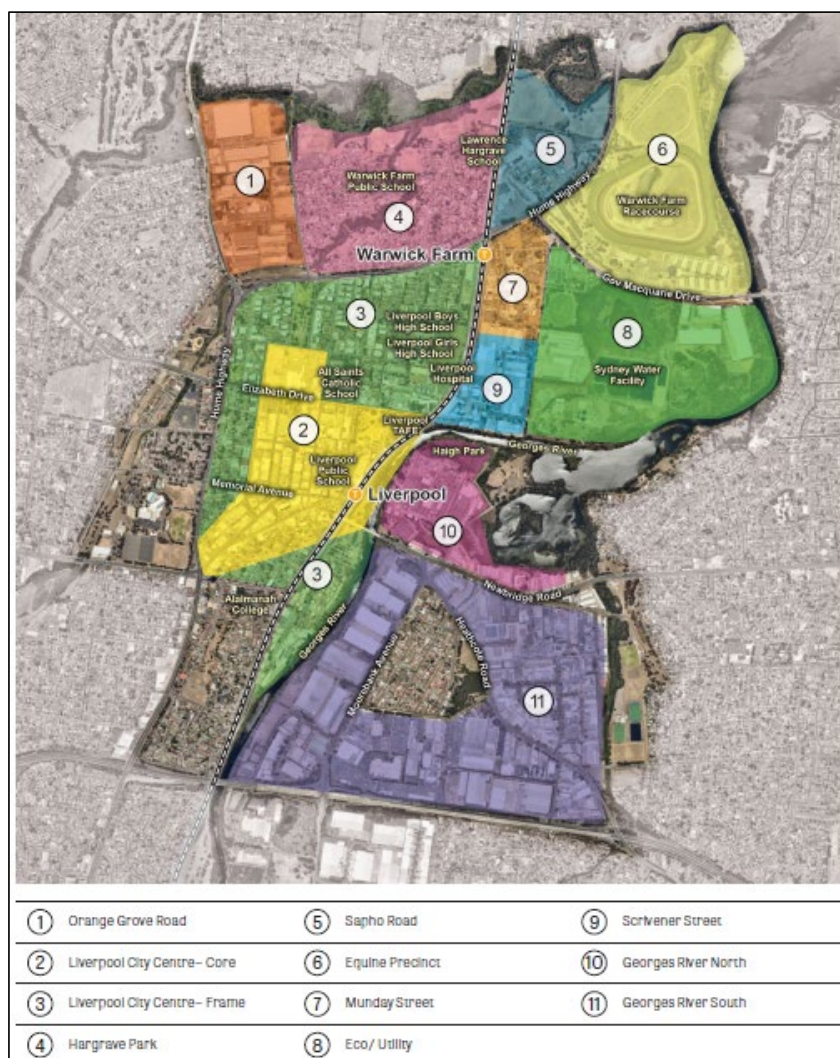


Figure 2. Extent of the Liverpool Collaboration Area

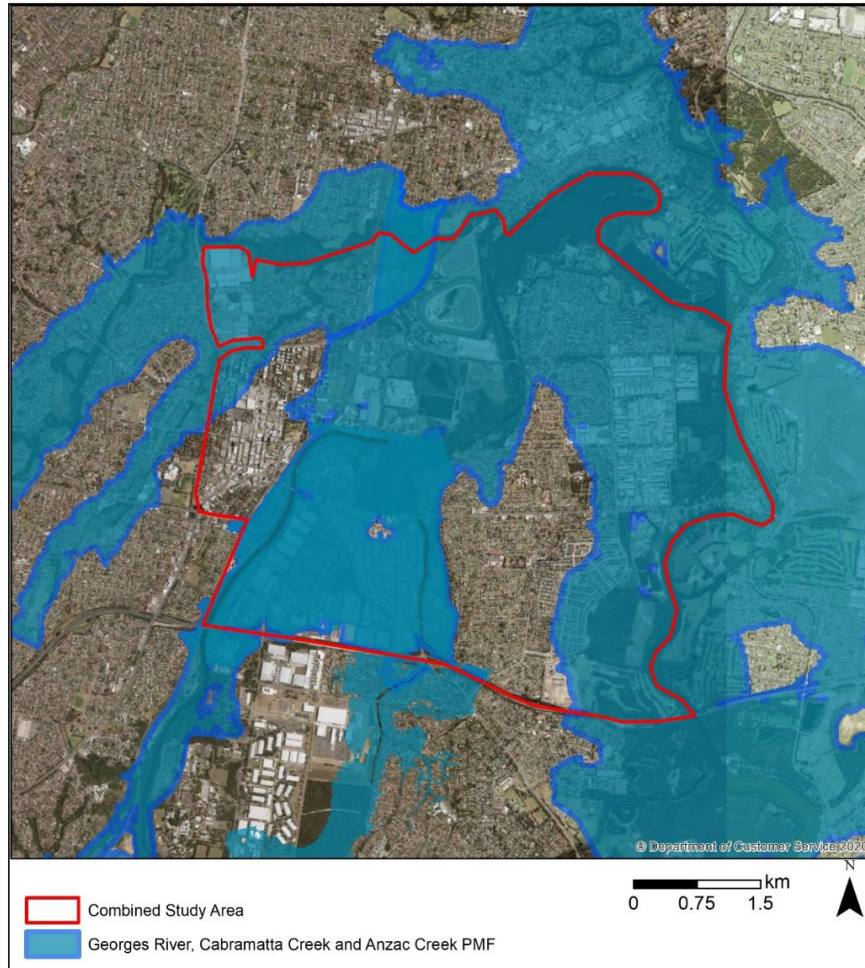


Figure 3. Extent of the combined study area

1.2.3 Extended Study Area

While Figure 3 shows the extent of the primary study area for evacuation modelling, an extended study area was also identified which takes into account additional areas which may need to evacuate at the same time. The extended area includes:

- Areas affected by the modelled Probable Maximum Flood (PMF) from the Georges River which are outside of the primary study area but which will share evacuation routes with the primary study area and contribute to traffic congestion.
- Areas flooded by nearby creeks which are likely to be experiencing some degree of flooding when the Georges River is flooding but are unlikely to receive flood warnings or evacuation orders. While not the focus of this study, these additional areas may place additional loads on the road network if people undertake self-directed evacuation to escape rising flood waters and were included for potential sensitivity analysis to

understand the possible impact of simultaneous flooding of the Georges River and the local creeks.

Figure 4 shows the extent of the extended study area that is affected by the PMFs from the Georges River, Cabramatta Creek, Brickmakers Creek, or Anzac Creek and that will need to utilise the same regional evacuation routes when flooding. Therefore, some of the areas are affected only by creek flooding, some only by the Georges River and some by the creeks and the Georges River.

The suburbs within the entire modelled area include Liverpool, Chipping Norton, Moorebank, Hammondville, Voyager Point, Casula, Prestons, Lurnea, Cartwright, Wattle Grove, and Holsworthy.

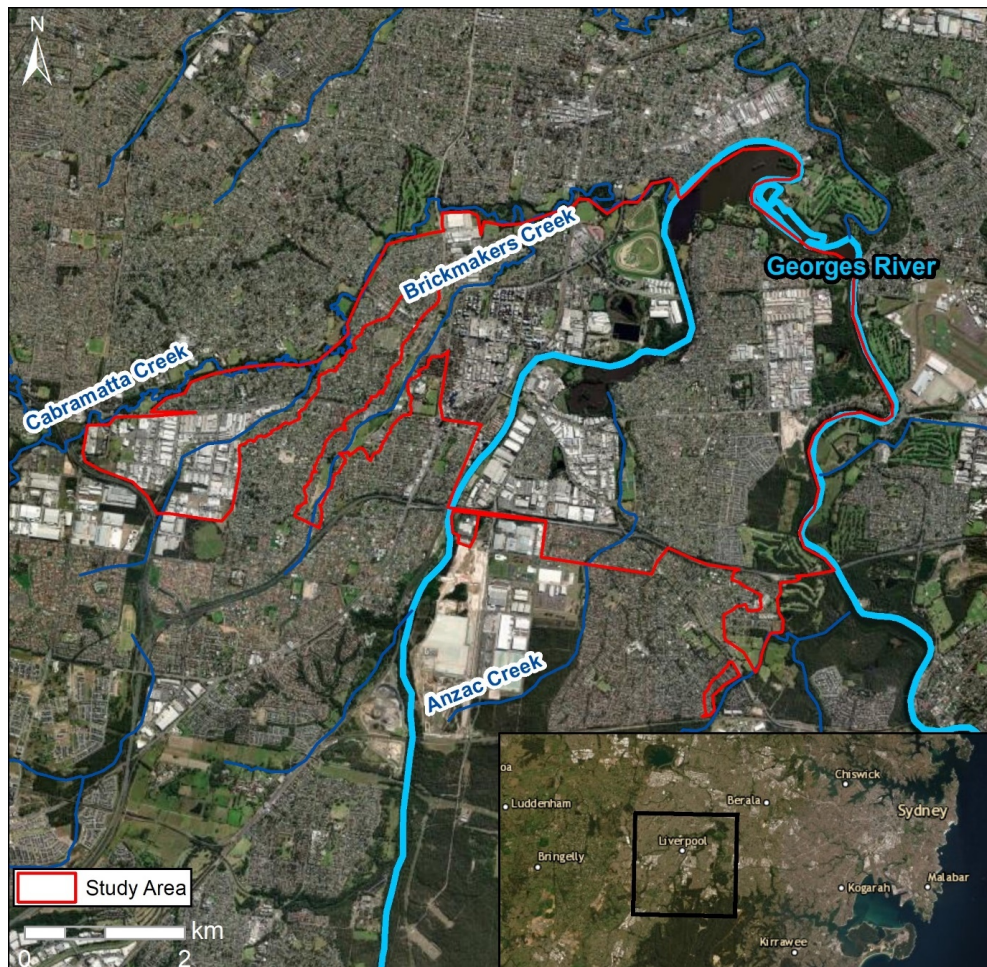


Figure 4. Study area

1.3 Scope of Work

This report is a single comprehensive document describing the study context, the model construction, assumptions, inputs and outputs and a discussion of the results. The primary components covered in this report are:

- Urban Development Context
- Local Flooding Context
- Emergency Planning Context
- Life Safety Model Inputs and Outputs
- Implications for Evacuation Planning
- Conclusions and Recommendations

1.4 Modelled Scenarios

Over the course of this study, multiple Georges River flood evacuation scenarios were defined and modelled to demonstrate how various assumptions will alter the evacuation process. The following scenarios are discussed and presented in this report:

- **Scenario 1** is the base case scenario based on 2016 Census (ABS, 2016) population and vehicle data and 2011 Journey to Work (Transport for NSW, 2011) data²
- **Scenario 2** is a future scenario with intensified development under existing zoning, accounting for residential and non-residential infill and planned road upgrades
- **Scenario 3** is a future scenario with rezoning and development from planning proposals currently under investigation, as advised by Council
- **Scenario A** is Scenario 2 with multiple non-residential vehicle evacuation destinations depending on the origin of the workers
- **Scenario B** is a modified Scenario 3 with updated planning proposals, adjusted vehicle yields for new development, changes to roads and capacities, and multiple non-residential vehicle evacuation destinations.

These are summarised in Table 1.

² The 2011 Journey to Work data was used since more recent 2016 Journey to Work data with the associated spatial data is not publicly available.

Table 1. Summary of modelled scenarios

	Scenario 1: Base case ¹	Scenario 2: Intensified development under existing zoning ²	Scenario 3: Proposals currently under investigation ³	Scenario A: Modified Scenario 2 ⁴	Scenario B: Modified Scenario 3 ⁵
Description	The "present" or current status scenario	Residential and non-residential infill development under existing zonings and currently planned road capacity upgrades	Residential and non-residential infill development under existing zonings plus proposals currently under investigation and currently planned road capacity upgrades	Scenario 2 but with four non-residential vehicle destinations depending on the origin of the workers	Scenario 3 with updated planning proposals, adjusted vehicle yields for new development, changes to roads and capacities, and multiple non-residential vehicle evacuation destinations as per Scenario A
Timing	2016	2036	>20 years in future	2036	>20 years in future
Destinations	M7 northbound (single destination)	M7 northbound (single destination)	M7 northbound (single destination)	M7 northbound for all residential. Four non-residential destinations depending on origin of workers: 1) M7 northbound; 2) Hume Motorway southbound; 3) Camden Valley Way westbound and 4) M5 eastbound	M7 northbound for all residential. Four non-residential destinations depending on origin of workers: 1) M7 northbound; 2) Hume Motorway southbound; 3) Camden Valley Way westbound and 4) M5 eastbound
Road Capacity	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour	600 vehicles/ lane/ hour except for the two on ramps from the Hume Highway and M5 onto the M7 will have their capacity increased to 900 vehicles/ lane/ hour
Road Network	As current	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound	Additional planned road upgrades to Governor Macquarie Drive and M5 westbound, and additional third lane northbound on the M7 and improvements to M7 on ramp capacities through ramp metering
Dwelling Numbers⁶	Based on 2016 census data and Google Maps visual assessment: ~8,500 dwellings or ~27,000 people in evacuation study area	Additional dwellings based on existing zoning-dependent infill potential in Warwick Farm, Chipping Norton and Moorebank as estimated by Council (370 additional dwellings compared to Scenario 1)	Additional dwellings based on existing zoning-dependent infill potential in Warwick Farm, Chipping Norton and Moorebank as estimated by Council (370 additional dwellings compared to Scenario 1)	Same as Scenario 2	Modified dwelling numbers compared to Scenario 3, as per updated Planning Proposals numbers from Council
Vehicles per Dwelling	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate	Based on 2016 census vehicle ownership rate but with a rate of one vehicle per dwelling for new apartments
Non-Residential Vehicles	Based on 2011 Journey to Work data for vehicle drivers commuting from outside of the study area (no double counting of those both living and working in the study area)	As per Scenario 1 with additional vehicles added to Liverpool Hospital location only (discounted to include only vehicle drivers originating from outside of the study area)	As per Scenario 2 with additional vehicles associated with additional jobs from original Planning Proposals numbers from Council (discounted to include only vehicle drivers originating from outside of the study area)	Same as Scenario 2	Modified commercial development areas and associated vehicle numbers compared to Scenario 3, as per updated Planning Proposals numbers from Council
Vehicles⁶	Base case: ~27,500 total	1,541 additional evacuating vehicles compared to Scenario 1	61,671 additional evacuating vehicles compared to Scenario 2	1,541 additional evacuating vehicles compared to Scenario 1	40,097 additional evacuating vehicles compared to Scenario 2, minus existing development in the locations of new development.

1-See Section 5.5.1 for details; 2-See Section 5.5.2 for details; 3-See Section 5.5.3 for details; 4-See Section 5.5.4 for details; 5-See Section 5.5.5 for details; 6-Excluding creek-only impacted subareas I10, R21 and R22

2 | Urban Development Context

2.1 Existing Land Uses

2.1.1 Existing Development

The study area currently encompasses a range of land use zonings according to the Liverpool Local Environmental Plan (LEP) 2008 (Figure 5). The lands directly adjacent to the Georges River and creeks in the study area are generally zoned as open space for private or public recreation, as these flood prone lands are unsuitable for habitable buildings. The majority of the study area is zoned as either residential or industrial. The equestrian precinct of Warwick Farm is also included in this study area. These three generalised zones are shown in Figure 6.

There are 15 major industrial subareas, including in the east of Chipping Norton, west Moorebank, Liverpool CBD, Warwick Farm, and Prestons. There are 27 residential subareas, which are located along the Georges River in Chipping Norton, Moorebank, and Hammondville; along the Anzac Creek in Moorebank and Wattle Grove; and along Cabramatta Creek and Brickmakers Creek in Casula, Lurnea, Cartwright, and Liverpool. There are scattered business zonings such as local shops across these generalised zones.

There is a strip of properties along Newbridge Road in the east of Moorebank along the Georges River which have long had houses on them but due to their flood risk are subject to a voluntary purchase scheme by Council (the Moorebank Voluntary Acquisition Scheme), which is currently operational. As houses are acquired by Council in this area the land is rezoned from residential to recreational.

Under the LEP, residential lots are zoned as either R1 General Residential, R2 Low Density Residential, R3 Medium Density Residential, or R4 High Density Residential. Based on these current categories, different numbers of residential dwellings are allowed on each lot without any change to zoning. This means that there is potential for densification of residential dwellings within the study area without any amendments to the LEP and current zoning. A summary of the zones is as follows:

- **R1 General Residential:** There is only one area with this zoning in the study area, which is in Moorebank and is filled with recently constructed dwellings.
- **R2 Low Density Residential:** Over half of the residential lots in the study area, or approximately 4,500 lots, fall under R2 zoning. There is currently an average of 1.11 dwellings per lot as of the 2016 census.
- **R3 Medium Density Residential:** There are 17 R3 zones within the study area, which contain over 2,300 lots with a current average density of 1.29 dwellings per lot as of the 2016 census.
- **R4 High Density Residential:** There are 12 R4 zones within the study area, within which almost one third of the dwellings in the study area are located. There is currently an average density of 4.65 dwellings per lot as of the 2016 census. There is currently a maximum of 144 dwellings on a single lot, as well as a large number with only one dwelling per lot.

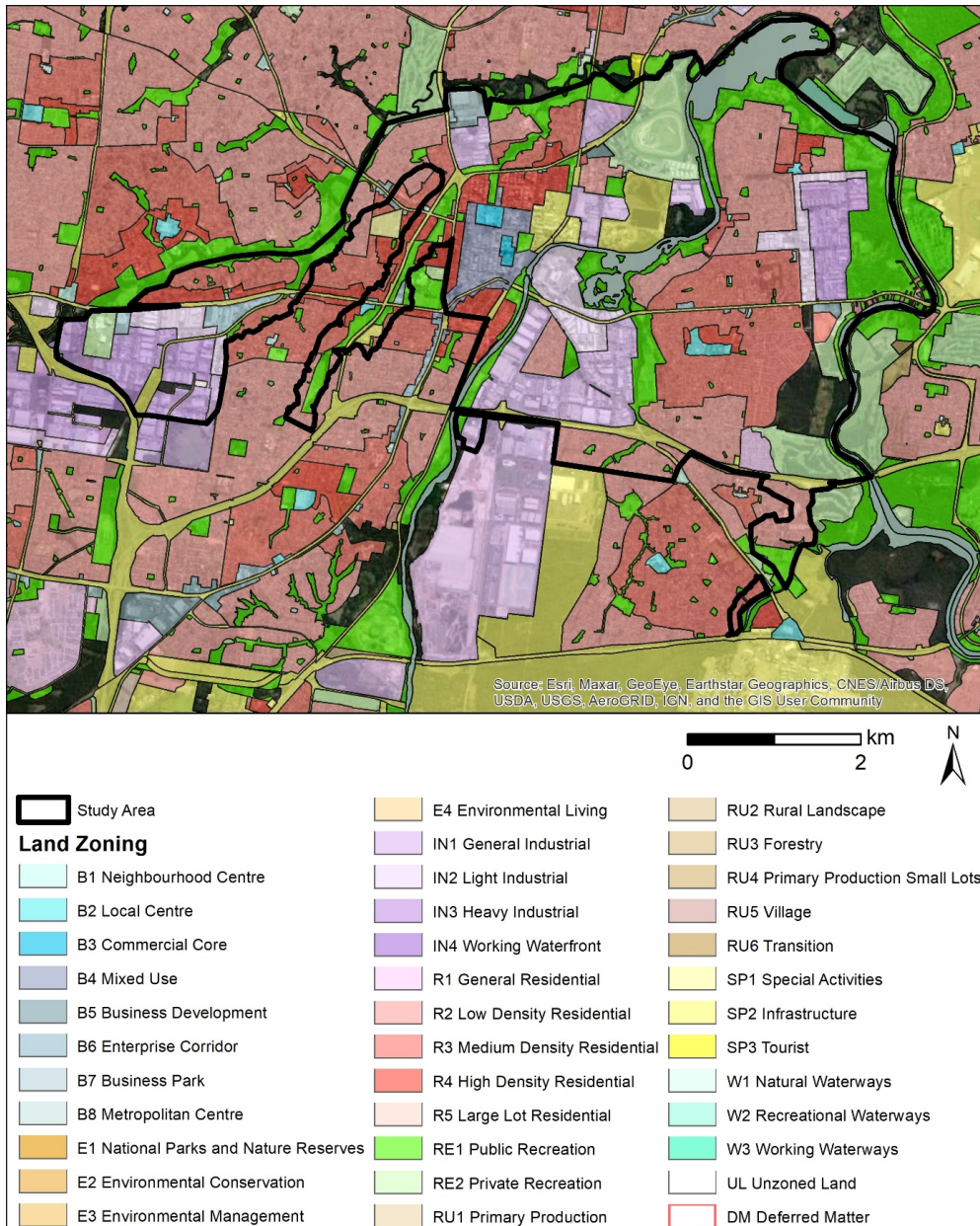


Figure 5. Liverpool City Council land use planning in the extended study area

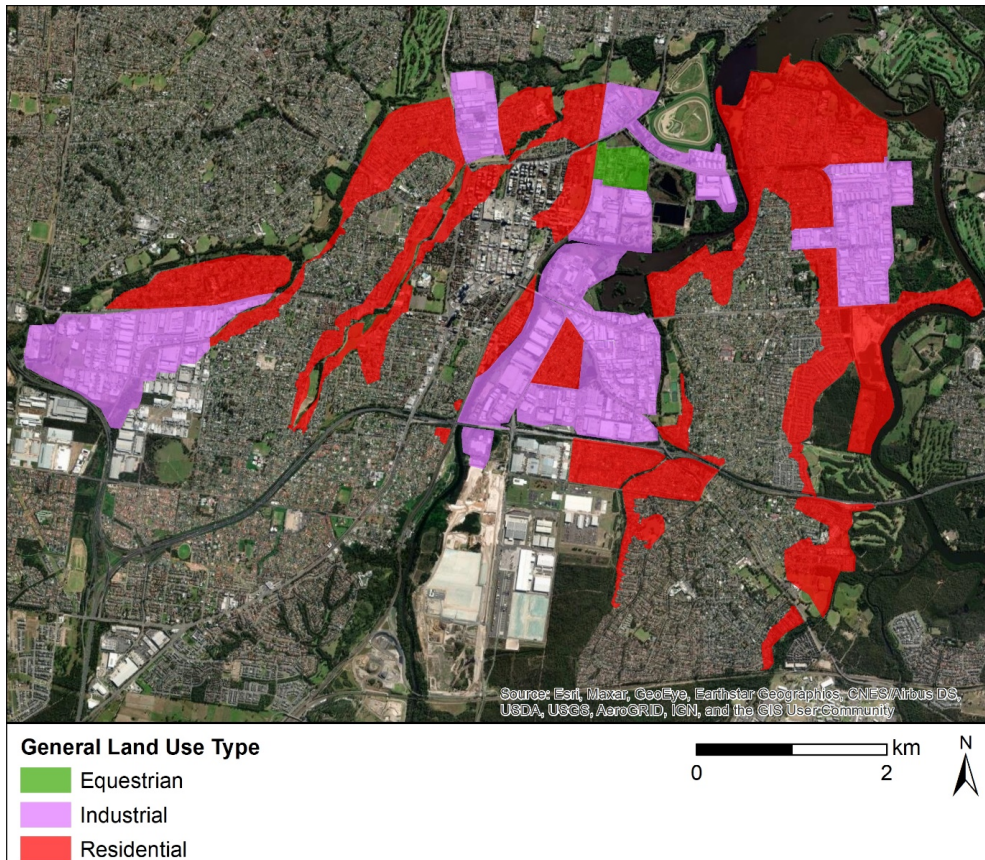


Figure 6. General land use type by evacuation subareas in the extended study area

2.1.2 Residential Infill Development Potential

Without any rezoning, there is the potential for the residential density to increase within the study area. There may be potential for infill, redevelopment and intensification to take place within R2, R3 and R4 residential zones. This can range from replacing small houses with larger houses with more people and more cars, adding granny flats to existing dwellings, replacing single dwellings with duplexes, building townhouse developments and erecting residential apartment buildings. The potential for lots to increase their number of dwellings depends on their zoning and size, as well as a number of other factors specified in Liverpool's Development Control Plans. Therefore, not every lot meeting the zoning and size requirement would be able to increase its number of dwellings, but there is potential for more dwellings than currently present in these areas.

Evacuation modelling scenarios have accounted for assumptions regarding future infill under existing zoning, as explained in Section 5.5.2. This includes assumptions regarding how much infill development and intensification is likely to take place in R1, R2, R3 and R4 zoned areas over the next 20 years.

2.2 Planning and Development Proposals

Liverpool is a rapidly growing local government area (LGA), experiencing substantial growth through both urban release areas and redevelopment of existing areas. Both Liverpool City Council and the NSW Government are involved in the planning of several major land release areas in the LGA, including the South West Priority Growth Area, the Western Sydney Employment Area, and the Western Sydney Aerotropolis. While not all impacting the specific study area of this assessment, it is evident that Liverpool LGA is rapidly growing as a southwest Greater Sydney Central Business District. Development proposals relevant to the study area are discussed below, and specific assumptions integrated into evacuation modelling are discussed in Section 5.5.3.

2.2.1 Moorebank East

As discussed in Section 1.1, the Moorebank East Precinct is flagged for potential development within the five sites shown in Figure 1. Table 2 summarises the current data for each development or planning proposal, as provided by Council in 2021.

Table 2. Proposed Moorebank East Developments

Site	Development Type	Commercial Space (ha)	Employees	Dwellings	
				Houses	Apartments
Site A: Benedict Sands	Mixed use	0.89	857	0	126
Site B: Flower Power	Mixed use and commercial strip	2.32	361	0	602
Site C: Moorebank Cove	Low density residential	0	N/A	179	0
Site D: Georges Cove Marina	Apartments	0	N/A*	21	374
Site E: EQ Riverside	Apartments and commercial/retail	0.18	207	0	1,500

*there are an estimated 45 employees under Site D's existing deferred commencement consent for a Marina, however the modelling considered the residential planning proposal for the site.

2.2.2 Liverpool Collaboration Area

The Liverpool Collaboration Area is an action in the Greater Sydney Regional Plan and is one of the locations identified as a place of metropolitan significance with potential to grow into a larger centre. The Liverpool Collaboration Area Place Strategy was developed between 2017 and 2018 by the Greater Sydney Commission and the Liverpool Collaboration Stakeholder Group. The vision of the strategy is that, by 2036, Liverpool is a rejuvenated city with diverse and growing residential and employment opportunities. It aims to have major health, education and retail precincts along with open spaces and parklands along the Georges River bringing employees, residents and recreational users to Liverpool.

Part of its mission will be to service the new Western Sydney International Airport through upgraded public transport. A key goal for the area is to improve public spaces, including connections to the Georges River. The four immediate imperatives from the Liverpool Place Strategy (Greater Sydney Commission, 2018) are to:

1. *Develop an integrated transport strategy that applies movement and place and addresses the transport challenges associated with delivering the vision, shared objectives and growth profile (led by Transport for NSW/Roads and Maritime Services).*
2. *Update and complete the Georges River, Brickmakers Creek and Liverpool CBD Overland Flood Studies and prepare floodplain risk management plans.*
3. *Prepare a floodplain constraints categorisation study (led by Liverpool City Council) and a flood evacuation study (led by State Emergency Service).*
4. *Establish an enduring Collaboration Area Partnership that facilitates the implementation of stakeholder actions and builds on existing governance structures (led by Liverpool City Council and the Greater Sydney Commission).*

With flooding recognised as a major factor that could potentially limit growth in the area, the flood studies and floodplain risk management plan have already been completed by Liverpool City Council. The Floodplain Constraints Categorisation Study has also been completed (FloodMit, 2020) but due to resource constraints the NSW SES was not able to commence the flood evacuation study. To expedite this aspect Liverpool City Council commissioned Molino Stewart to undertake the flood evacuation study.

The Liverpool Place Strategy states that one challenge is that market interest in new residential development significantly exceeds the NSW Government forecasts. Planning proposals have been assessed by Liverpool City Council that equate to more than 30,000 dwellings, compared to the 2036 Government forecast of 7,800 dwellings. The Collaboration Area aims to provide a mix of housing densities, including affordable housing and high-density housing close to public transport.

As shown in Figure 2, there are 11 places that make up the Liverpool Collaboration Areas, which are:

- **Orange Grove Road:** an employment precinct outside Liverpool City Centre;
- **Liverpool City Centre – Core:** Liverpool’s primary commercial centre for Liverpool, including a mixed use central business district with commercial offices, retail, government services, educational services, and residential apartments;
- **Liverpool City Centre – Frame:** a mixed-use area including the Liverpool Hospital, educational centres, and high-density residential dwellings;
- **Hargrave Park:** a low-density residential area with a large proportion of Land and Housing Corporation dwellings and some educational services;
- **Sappho Road:** an urban employment precinct;
- **Equine Precinct:** the Australian Turf Club racecourse and the Inglis Hotel;
- **Munday Street:** predominantly low-density residential development with horse stables;
- **Eco/Utility:** the Sydney Water Liverpool Water Recycling Facility;
- **Scrivener Street:** industrial precinct with some hospital facilities and offices;
- **Georges River North:** industrial precinct;
- **Georges River South:** predominantly industrial precinct surrounding a low-density residential neighbourhood.

Stakeholders have assessed potential growth profiles prepared by Liverpool City Council meant to guide a coordinated response to development. The preferred “Metropolitan City” growth profile anticipates that the Collaboration Area could potentially host up to 16,200 new jobs, have capacity for up to 18,800 new dwellings by 2036, and host up to 15,000 tertiary students.

As discussed in the FloodMit (2020) study, recent planning proposals assessed by council equate to more than 30,000 new dwellings, including high density residential development proposed within:

- Liverpool City Centre Frame;
- Hargrave Park Area;
- Munday Street Area;

- Georges River North Area; and
- Georges River South Area.

This includes the area covered by the Warwick Farm Structure Plan and Moore Point Planning Proposal, which both aim to contribute significant residential and non-residential precincts to the area. Table 3 shows the proposed development yields for significant developments planned in the Collaboration Area.

Table 3. Liverpool Collaboration Area development yields

Site	Additional Dwellings	Additional Jobs
Moore Point (JLG) in Moorebank	12,200	16,648
Moore Point (Rose Group) in Moorebank	1,854	6,352
The Grove in Warwick Farm	--	600
Warwick Farm Structure Plan including 240 Gov Macquarie Drive	3,224	925
33 Shepherd Street, Liverpool*	1,200	--

*This Planning Proposal is already gazetted with some developments approved and constructed and others pending approval.

2.2.3 Liverpool Hospital

Liverpool Hospital is undergoing a planned expansion which is due for completion by 2026. This includes the construction of the Liverpool Health and Academic Precinct with a new education and research hub. The redevelopment will include additional clinical services and public spaces. The recently approved concept plan included provision for an additional approximately 900 car parking spaces across the hospital campus, including a multi-storey car park, amounting to a total of 2,400 spaces.

2.2.4 Floodplain Constraints

While there is significant growth projected for the study area, flooding has been identified as a constraint on the development potential for the area. Liverpool City Council commissioned FloodMit (2020) to prepare a study considering the flood constraints that apply to the Liverpool Collaboration Area Place Strategy. This study looks at how the following legislative and flood policy requirements may have an impact on planning proposals and future development in the area:

- Directions by the Minister (formerly Section 117 Directions);
- NSW Floodplain Development Manual;
- Floodplain Management Studies and Plans;
- Liverpool LEP 2008;
- Liverpool DCP 2008.

A summary of the regional flood constraints that apply to the study area are outlined in Table 4 as set out in the FloodMit report.

Table 4. Regional Flood Constraints for the Liverpool Collaboration Area (based on FloodMit, 2020)

Constraints	Details
Flood Planning Area (FPA)	This is the area within which developments may be subject to flood related development controls. Approximately 56% of the Liverpool Collaboration Area is included in the Flood Planning Area.
Flood Planning Level (FPL)	This is a level used to set flood planning controls. It is calculated from a designated flood event plus an allowance for freeboard. It is the height used to set floor levels for property development in flood prone areas. In Liverpool LGA the FPL for habitable floor levels in residential, commercial and industrial properties affected by riverine flooding is the 1% AEP flood level plus 0.5m freeboard.
Flood Risk Management Areas	Approximately 20% of the Liverpool Collaboration Area is within High Flood Risk areas, which are subject to significant development restrictions.
Floodway Area	There are floodways in the Georges River and Cabramatta Creek that need to be kept clear of all development.
Riparian Corridors	A riparian corridor is required to act as a buffer between the area's waterway banks and future development.
Vulnerable Development	Vulnerable existing development has been identified throughout the study area, and future development must not exacerbate the existing flood problems.
Potential Climate Change Impacts	The climate change impacts of sea-level rise and increased rainfall intensities need to be considered, although not expected to have a large impact compared to the presently adopted models.
Emergency Management and Evacuation Considerations	The availability of suitable evacuation routes must be assessed considering both the existing and future population of the area.
Controls on Future Development	Future development in land below the flood planning area will be restricted by controls such as those relating to minimum floor levels, building components, structural stability, car parking, driveway access, evacuation and others.
On-Site Detention (OSD) and Water Harvesting	OSD in the Liverpool Collaboration Area is not likely to be effective, and runoff retention for all new development is likely to be a more appropriate response.

Some specific flood risks for the following areas were examined in the report (Figure 7):

- **Orange Grove Road Place Area** which is affected by both Cabramatta Creek and Brickmakers Creek;
- **Shepherd Street/Riverpark Drive** in Liverpool City Centre, where the only site access is via a railway underpass at Shepherd Street that is inundated in a 20 year flood, prior to flooding of the homes in this area;
- **Hargrave Park Place Area**, where 56% of the area is below the residential flood planning level;
- **Sappho Road Place Area**, which is approximately 82% below the residential flood planning level, and consideration of flood free access is needed for future development;
- **Equine Precinct Place Area**, which is approximately 78% below the residential flood planning level, with considerable high flood risk areas in the north of the site and potential issues surrounding flood free site access;
- **Munday Street Place Area**, which is entirely below the residential flood planning level, is within a flood storage area, and has low spots on local road restricting flood free access;
- **Scrivener Street Place Area**, which has a limited evacuation route across the railway bridge towards the Liverpool CBD;



- **Georges River North Place Area**, which is 92% below the residential flood planning level, has areas of vulnerable development including along Newbridge Road, and requires considerations of flood free site access;
- **Georges River South Place Area**, which is 70% below the flood planning level, at risk in flood greater than a 1% AEP flood, and contains industrial and residential areas vulnerable to flooding.



Figure 7. Liverpool Collaboration Place Areas from the Floodplain Constraints Study (FloodMit, 2020)

3 | Local Flooding Context

3.1 Topography and Drainage

The Georges River has a catchment area of 960 km² and is heavily urbanised in its northern half and in a natural state in its southern half with some rural residential areas in its western parts which are gradually being urbanised as Sydney expands. The major tributaries for the middle reaches of the Georges River, relevant to the study area, include:

- Anzac Creek – which flows from the site of the Moorebank Intermodal Terminal south west of Wattle Grove and runs under the M5 and flows north through the western part of the study area before joining the river at Lake Moore;
- Cabramatta Creek – which drains western parts of the catchment and flows into the upstream end of the Chipping Norton Lake on the Georges River to the north of the study area;
- Brickmakers Creek – which is a major tributary of Cabramatta Creek and runs roughly parallel to Cabramatta Creek and the Georges River flowing north east between the two before joining Cabramatta Creek upstream of its confluence with the Georges River
- Prospect Creek – which drains the north western parts of the catchment and has several tributaries before entering the downstream end of Chipping Norton Lake on the Georges River north of the study area;
- Harris Creek – which flows north towards the south western part of the site in Holsworthy, where it meets with Williams Creek and joins the Georges River.

The Georges River wraps through the study area around the Moorebank Peninsula to the east, north and western boundaries. There are low lying floodplains all along most of this reach of the Georges River on both sides of the river. Within Moorebank, there is a ridge that runs north to south roughly along Nuwarra Road. On either side of this there is land which is above the reach of any flooding.

Part of the study area, mostly west of Stockton Avenue in Moorebank, generally flows into Anzac Creek via the local piped drainage network and overland flow paths. Between Stockton Avenue and Nuwarra Road the drainage and overland flow paths generally lead to a major trunk drain and an overland drainage pathway heading north roughly along what would have been the original route of Cunningham Creek, the northern most section of which leads into the Georges River. East of Nuwarra Road and north of Alfred Road there are pipes and some open canals which direct rainfall into the Georges River as well as there being overland flow paths leading directly to the river.

South of Alfred Road in Chipping Norton there is a drainage pathway running south just to the east Governor Macquarie Drive which intercepts piped and overland flows east of Nuwarra Road and directs them into the north-western corner of the Moorebank East Development Precinct. From here stormwater runoff flows south along the eastern side of Brickmakers Drive. Pipes through the developments between Nuwarra Road and Brickmakers Drive also discharge into this drainage swale which then drains east into the Georges River along a drainage pathway in Moorebank East.

In addition to the Georges River, Cabramatta and Brickmakers Creeks influence drainage in the western section of the study area, in the Liverpool Collaboration Area. Cabramatta Creek is a major tributary of the Georges River, with a 74 km² catchment (Bewsher, 2004) from the suburb of Denham Court to Liverpool. Brickmakers Creek flows from Casula to meet Cabramatta Creek approximately 1.7 km upstream of where it flows into the Georges River.

3.2 Flood History

There are several river height gauges within the catchment and along the Georges River for which the Bureau of Meteorology reports river levels. Before the establishment of the current gauging system flood levels were recorded at various locations along the river during significant floods. Three points have long records, with one going back to early colonial history. These points correspond to the current gauges operating at:

- Liverpool Weir, south of Newbridge Road between Liverpool and Moorebank;
- Lansdowne Bridge, which sits north of the study area where the Hume Highway crosses Prospect Creek;
- Milperra Bridge which sits where Newbridge Road becomes Milperra Road to the east of the study area.

These give some insight into the history of flooding on the Georges River as seen in Table 5.

Table 5. Historic Flooding Events

Date	Level (m AHD)		
	Liverpool Weir	Lansdowne Bridge	Milperra Bridge
May 1809		8.2	
Apr 1860		7.5	
Feb 1873	10.5	8.0	
Apr 1887	9.2		
May 1889	9.7	7.2	
1892	6.3		
Jan 1895	7.1		
Feb 1898	9.0	5.5	
July 1900	7.3		
Mar 1914	7.4		
1927	6.7		
1943	7.0		
Jun 1949	7.6		
Jun 1950	7.4	5.3	3.5
Feb 1956	8.3	5.7	4.8
Nov 1961	7.1	4.6	3.8
Dec 1962	5.6		
Aug 1963	6.7		3.3
Jun 1964	7.1		3.6
Apr 1967	5.9		
Mar 1978	5.8	3.7	2.9
April 1981	3.8		
Apr 1982			3.0
Aug 1986	7.2	5.1	4.4
Oct 1987	6.0		2.4
Apr 1988	7.4	5.8	4.9
Jul 1988			2.9
Feb 1990	5.1	3.1	2.9
Aug 1990			2.4
Jun 1991	6.6	4.7	3.8
Aug 1996	5.8	2.4	2.0
Feb 2008			2.1
Mar 2012			2.2
Apr 2015			2.8
Feb 2020	5.4	3.6	4.6

Source: George River Floodplain Risk Management Study and Plan (Bewsher, 2004), MHL Historical Gauge Data (1982-2019) and correspondence from the Bureau of Meteorology (2020)



The largest recorded flood occurred in February 1873 and is estimated to be well above the 1% annual exceedance probability (AEP) event (Maruf Hossain pers. comm.). The April 1860, April 1887 and the May 1889 floods were estimated to be similar in magnitude to a 1% (1 in 100) AEP flood (Bewsher Consulting, 2004).

It is noted that there is now a new Milperra gauge just downstream of the bridge which has replaced the gauge located on the bridge. It has a gauge zero of zero metres AHD.

3.3 Flood Behaviour

3.3.1 Georges River

a) Flood Model

Although the NSW Government's guidance is that planning controls for residential development should be based on the 1% AEP flood level plus 0.5 m of freeboard, the NSW Floodplain Development Manual (DIPNR, 2005) requires consideration of the consequences of the full range of floods up to the Probable Maximum Flood (PMF) when assessing the merits of planning and development proposals.

For this work, Liverpool City Council provided outputs of the 2020 Georges River Flood Study 2D TUFLOW hydraulic model (BMT, 2020) which covered the entire study area and some of the Georges River upstream and downstream floodplains. This is the latest flood model available for the Georges River and was jointly developed by Canterbury-Bankstown and Liverpool City Council under the State Floodplain Management Program funded by OEH and councils.

The primary objective of the 2020 Georges River Flood Study was to develop a 2D model and assess flooding behaviour in the local catchment and to identify significant inundation patterns, flow paths and flooding locations within the study area for a range of design flood events up to the Probable Maximum Flood (PMF). Council's objectives are to evaluate the impact of flooding on existing and future developments within the study area and assess floodplain management options in subsequent floodplain management and planning studies. The flood model went through extensive calibration and validation against all historical floods including August 1986, April 1988, April 2015 and June 2016 events.

Output files were provided for the following events:

- 20% AEP
- 10% AEP
- 5% AEP
- 2% AEP
- 1% AEP
- 0.5% AEP
- 0.2% AEP
- Probable Maximum Flood (PMF)

This model uses LiDAR data to define the existing ground levels throughout the study area. Because it is looking at a large section of the Georges River, a 10 m grid size was used for the flood modelling to make computing run times manageable. The model runs for 50 hours after the commencement of rainfall.

Note that there is an older Georges River Flood Study (Bewsher, 2004) which is a 1D Mike 11 flood model that is adopted by Council. Council uses the adopted flood levels of the MIKE 11 flood model for development controls.



b) Spatial Extension of Georges River Flood Model

The 2020 Georges River 2D TUFLOW hydraulic model (BMT, 2020) extent is truncated where Cabramatta Creek and Harris Creek enter the river. Cabramatta Creek has its own separate TUFLOW model, which is discussed below. However, if these tributaries are not flooding, but the Georges River is, the riverine flooding would extend up these creeks and affect residential areas that would also be required to evacuate. This is important because even though the same rainfall event would cause flooding in all watercourses, the specific spatial and temporal distribution of the rainfall will mean that the timeline of flooding of the tributaries are independent of the flooding of the river.

In order to account for Georges River flooding in the northwest of the study area, the additional area that would be flooded was mapped by extrapolating the flood levels at the Georges River model extent along the contours using the digital elevation model (DEM). This allowed for the identification of additional areas around Cabramatta Creek and Harris Creek that are lower than the Georges River flood levels, and therefore would be inundated during river flooding. This flood extent is shown in Figure 8 for the PMF.

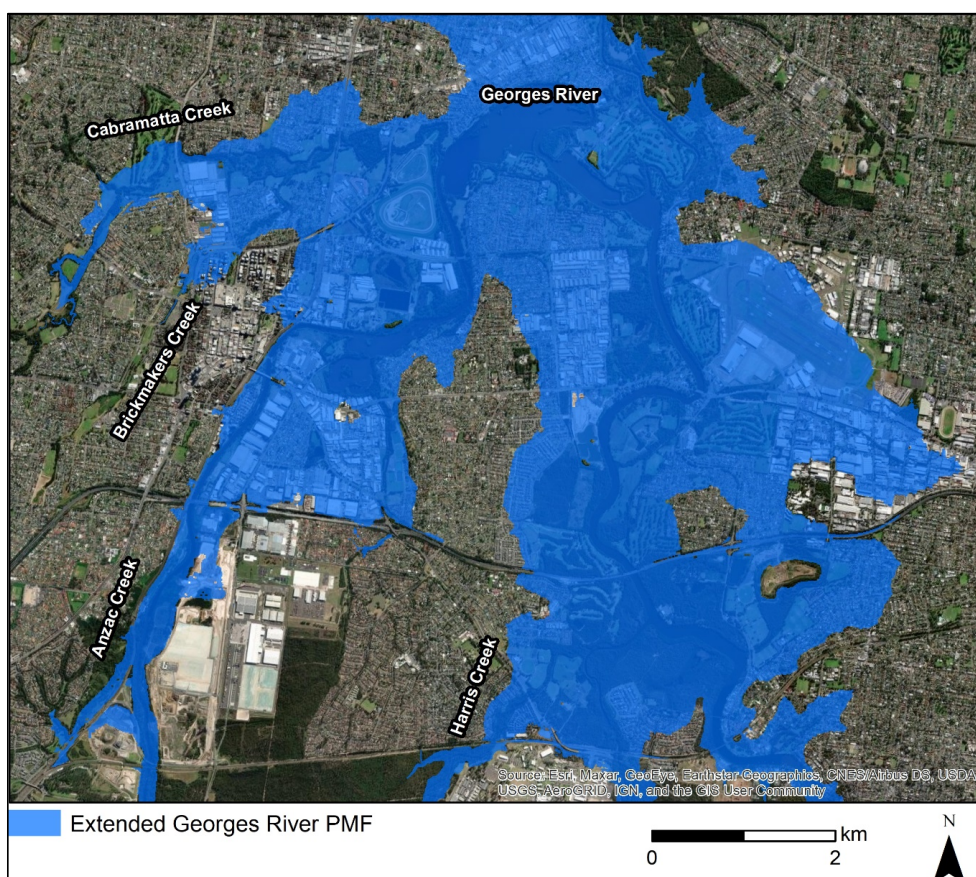


Figure 8. Extent of the Georges River modelled PMF extended up Cabramatta and Harris Creeks

c) Georges River Modelled Flood Levels

Figure 9 shows the modelled Georges River PMF levels across the study area. There is a considerable change in water level across the study area, as the river goes from the Liverpool side of the peninsula

to the Milperra side. Flood levels are 12.4 m AHD where the M5 crosses the Georges River to the west of Moorebank. Levels decrease to 11.7 m AHD where the M5 cross the eastern reach of the Georges River by Milperra.

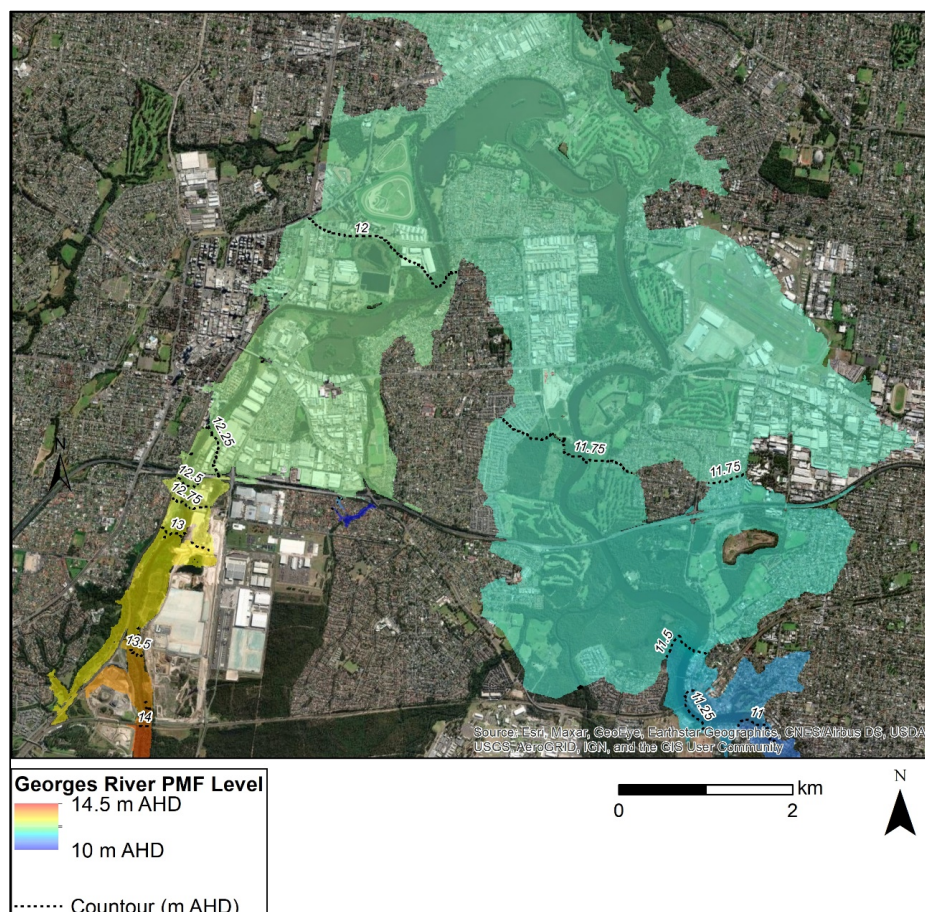


Figure 9. Georges River modelled PMF levels (BMT, 2020)

d) Impacts on road network

Floodwaters from the Georges River can inundate and cut roads within the study area, including:

- The Hume Highway to the north, where it crosses Cabramatta Creek, can flood by backwater from the Georges River up the creek in the Georges River 5% AEP flood.
- Backwater flooding from the Georges River PMF up Cabramatta Creek can also flood the Cumberland Highway/ Orange Grove Road and Elizabeth Drive.
- Governor Macquarie Drive can flood in the vicinity of Warwick Farm Race Course in the 2% AEP flood.
- The western end of Newbridge Road does not flood where it crosses the Georges River to the west, even in the PMF. However, Newbridge Road does flood between the Georges River and Anzac Creek (i.e. by the intersection with Heathcote Road) in events as frequent as the 2% AEP flood making the bridge over the river inaccessible.

- The eastern end of Newbridge Road is cut at multiple points between Governor Macquarie Drive and the Georges River in events as frequent as the 20% AEP flood.
- Junction Road can be cut near its intersection with Heathcote Road in a 5% AEP flood on the Georges River, where backwater flows up Anzac Creek. Flooding can also cut the intersection of Junction Road and Heathcote Road in the Georges River 2% AEP flood.
- East of the bridge over the Georges River the M5 can be cut by flooding in the 0.2% AEP flood in the vicinity of the UWS Campus.
- The M5 can flood in the Georges River PMF west of Heathcote Road as well as where it goes under Moorebank Avenue.

These critical locations are shown in Figure 10.

3.3.2 Anzac Creek

It is important to understand flooding in the study area's creeks as well as the Georges River, as the same rainfall event is likely to cause flooding in both at the same time, impacting evacuation routes and required evacuation areas. Anzac Creek has been modelled separately by Council and the TUFLOW model results were provided for this investigation.

Anzac Creek can flood independently of the Georges River with floodwaters coming from the upper reaches of its catchment and flowing under the M5 Motorway towards the River. Figure 11 shows the extent of the 1% AEP and PMF floods on Anzac Creek, along with the other creeks and the Georges River. The 1% AEP cuts Junction Road but not Heathcote Road, Nuwarra Road or the M5 Motorway on ramps. The PMF overtops Heathcote Road just southeast of the M5 Motorway on ramps but a bridge on Anzac Road appears to be above the PMF flood level and this provides an alternative route to the M5 Motorway via Anzac Road and Moorebank Avenue. These are shown in Figure 10.

3.3.3 Cabramatta Creek

Cabramatta Creek is a major tributary of the Georges River, with a catchment area of 74 km². It has five major subcatchments, including the Upper Cabramatta Creek, Hinchinbrook Creek, Lower Cabramatta Creek, Maxwells Creek and Brickmakers Creek.

The majority of the catchment is located within the Liverpool LGA, and it is bound by the Hume Highway in the east, where it flows into the Georges River. Brickmakers Creek joins Cabramatta Creek near the downstream end of the catchment. Compared to the Georges River, Cabramatta Creek generally experiences rapidly rising waters and short-duration flooding, and also a history of flooding. It has been modelled separately to the Georges River (Bewsher, 2011) for the 1%, 0.5% and 0.2% AEP events as well as the PMF. Figure 11 shows the extent of the 1% AEP and PMF floods along with the other creeks and the Georges River.

Cabramatta Creek flooding can cut several roads in the study area. The 1% AEP Cabramatta Creek flood cuts many local roads in Prestons and Jedda Road is cut by Maxwell Creek. This event also cuts Camden Valley Way. It is possible that these roads are cut in more frequent events. In the PMF, it cuts Hoxton Park Road and Camden Valley Way by the M7 entrance. Cabramatta Creek and its tributaries do not cut the M7 and its on ramps from the Hume Highway and the M5. These are shown in Figure 10.

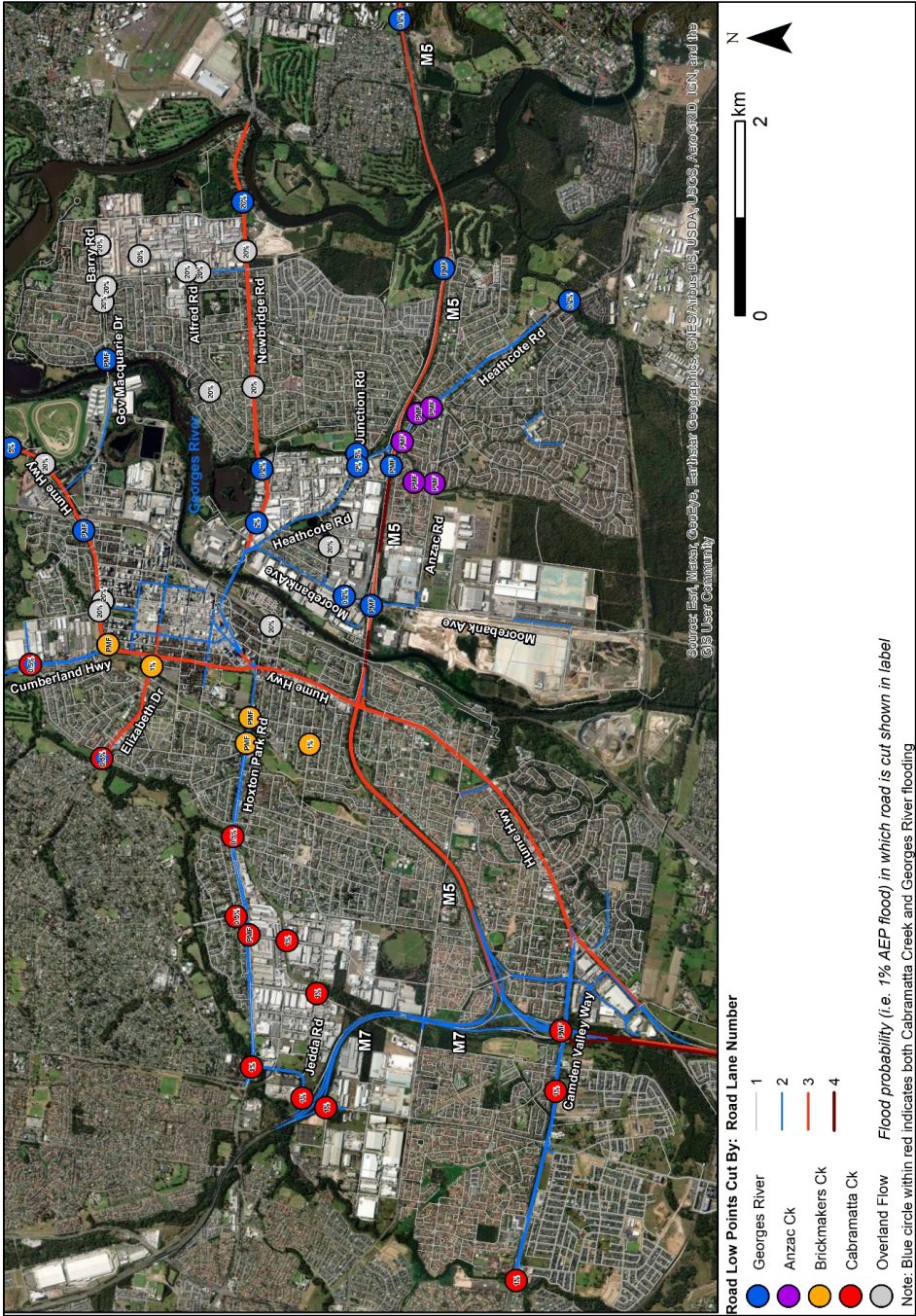


Figure 10. Location of road low points inundated by the Georges River, creek and overland flow flooding

3.3.4 Brickmakers Creek

Although it is a subcatchment of Cabramatta Creek, Council has had Brickmakers Creek modelled separately for the 1% AEP flood and the PMF. The creek starts in Casula and flows north to the west of the Liverpool CBD and flows into Cabramatta Creek. Figure 11 shows the extent of the 1% AEP and PMF floods along with the other creeks and the Georges River.

Brickmakers Creek 1% AEP flooding can cut many local roads in Liverpool and Lurnea as well as Elizabeth Drive. Orange Grove Road, the Hume Highway and Hoxton Park Road are inundated in the PMF. These are shown in Figure 10.

3.3.5 Harris Creek

Flood modelling was not available for Harris Creek, however, backwater flooding from the Georges River cuts Heathcote Road where it crosses Harris Creek in the 1% AEP event. It was therefore assumed that no evacuation traffic from the study area would head south along Heathcote Road.

3.3.6 Local Overland Flows

Modelling of the Liverpool City Centre Overland flow has also been completed, which defines local flood behaviour throughout the heavily urbanised city centre catchment. This includes the analysis of flows within the underground pipe drainage network and surface runoff across the catchment. The catchment drains into the Georges River to the east and Brickmakers Creek to the west. There is no flood warning for local overlands flows, but they have the potential to inundate local roads with relatively short duration flooding.

Overland flows can cut roads throughout Liverpool and Moorebank in floods as frequent as the 20% AEP. This includes inundation of Governor Macquarie Drive, Newbridge Road, Alfred Road, and Barry Road in Chipping Norton, the Hume Highway by the Warwick Farm race course and by Brickmakers Creek, and Shepherd Street and Macquarie Street in Liverpool. These are shown in Figure 10.

Figure 11 shows the combined peak 1% AEP and PMF extents of the creeks and Georges River. The critical duration of the 1% AEP and the PMF in the Georges River would be different from the 1% AEP and PMF events in the creeks and the probability of a PMF occurring at the same time on the river and all major creeks would be extremely low. The figure is included to show the potential extent of impacts from flooding from any of these watercourses.

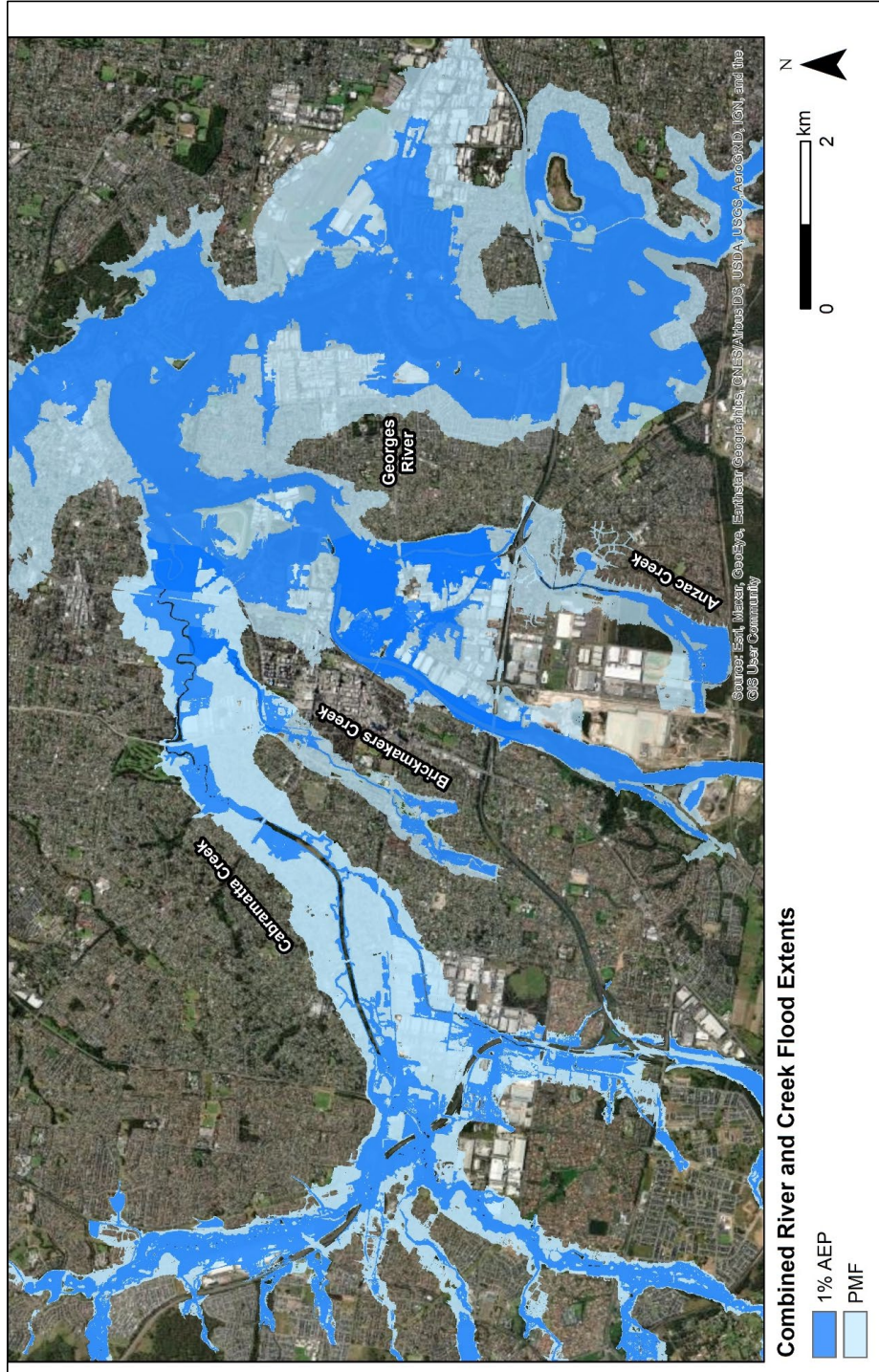


Figure 11. Combined 1% AEP and PMF extents for Georges River, Cabramatta Creek and Brickmakers Creek

4 | Emergency Planning Context

4.1 Georges River Flood Plan

The NSW SES is the designated combat agency for floods, and has roles in prevention, preparedness, response and recovery. This includes protecting dangers to people, protecting property from destruction or damage, and preparing for the eventuality of severe to extreme floods in the Georges River. The NSW SES Metro Zone is the unit dealing with Georges River flooding.

The NSW SES has developed the *Georges River and Woronora River Valley Flood Emergency Sub Plan* (NSW SES 2018) which is a Sub Plan of the *Sydney Metropolitan and South West Metropolitan Regional Emergency Management Plans* (EMPLAN) and a sub plan to the *NSW SES State Flood Plan*. This is the most up-to-date document relevant to Georges River flooding. This sets out the responsibilities for all organisations involved in flood planning, as well as preparation, response and recovery measures in place. The purpose of this document is to outline roles and responsibilities of support agencies specific to cross boundary arrangements during the Prevention, Preparedness, Response and Recovery (PPRR) phases.

Volume 1 of the *Georges River and Woronora River Valley Flood Emergency Sub Plan* (NSW SES 2018) is currently available, which maps out the emergency management arrangements. The NSW SES advises that Volume 2 is in preparation, which will detail hazards and risks. It will describe flood behaviour and consequences across the river system using current flood studies and reports, and will include information generated from the Floodplain Risk Management review and Liverpool evacuation modelling. Volume 3 is in the preliminary stages of drafting. This volume articulates the triggers and emergency response arrangements based on Volume 2 and other data and analysis. Volume 2 and 3 are prepared by the NSW SES for informing the relevant Emergency Management Committees, rather than for endorsement. Note that Volume 1 will be revised when Volumes 2 and 3 are developed, to align with the HN Flood Plan which uses the SEMC recommended format for State level plans.

The following are relevant excerpts from Volume 1:

1.4 Out of Scope

1.4.1 This plan is based on existing information publicly available at the time of writing. Planned and future development beyond current levels are not covered by this plan. Consultation with the NSW SES and modification to this plan will be required to account for future population increases and development within the area.

2.9 Community Members Within the Georges River Valley

2.9.1 Prepare now, know how to respond appropriately and recover effectively to help your community become more resilient, including:

Preparedness

2.9.2 Know your risk: Understand the potential risks and impact of flooding at home, work and places you visit. The flood risk is so severe in parts of the Georges River that in a major flood, evacuation will be the only safe option for people in these areas.

2.9.3 Know where to go: Including which evacuation route you will take and where you will stay in case you are flood affected.

2.9.4 Get your home ready: Prepare homes and property to reduce the impact of flooding. Have an emergency kit and essential supplies.



2.9.5 Plan for what you will do: Develop home emergency plans to identify who to contact, what to do, where to go and when. Share plans and practice them with family, friends, pets and neighbours.

2.9.6 Businesses develop continuity plans to prepare, minimise losses and reinstate essential services as soon as possible after a flood.

2.9.7 Be informed: Know where to find risk information, understand warnings, triggers and the safest actions to take in a flood.

2.9.8 Be involved: Work with local Emergency Services, local leaders, councils and other stakeholders to anticipate and manage the flood emergencies that could affect your community.

Response

2.9.9 Be aware: Monitor emergency warnings and broadcasts, and follow the advice of emergency services.

2.9.10 Never drive, ride or walk through floodwater: The major cause of death during floods is due to people entering floodwater.

2.9.11 Look out for each other: Share information with family, friends and neighbours and help those that may need assistance.

2.9.12 Leave flood affected areas early: If you are at risk of flooding or are advised by emergency services to evacuate.

Recovery

2.9.13 Stay clear of flood affected areas: Until you are advised by emergency services that it is safe to enter.

2.9.14 Ensure your home is safe before entering: Check for structural damage and potential risk of electrocution.

2.9.15 Manage ongoing health, safety and hygiene: Ensure personal items, food and water in contact with floodwater are not consumed and protective clothing is worn while cleaning.

2.9.16 Understand where and how to get support and assistance with your recovery.

2.9.17 Check the NSW SES website for further information on what to do before, during and after a flood.

5.3 Operational Strategies

5.3.1 The main response strategies for NSW SES flood operations are:

- a. Provision of timely, relevant, accurate and tailored information to the community regarding the potential impacts of a flood and what actions to undertake to support and encourage proactive measures to be taken.*
- b. Evacuate people pre-emptively from dangerous or potentially dangerous places created by the flood hazard to safe locations away from the hazard.*
- c. Rescue people and domestic animals from floods in accordance with the NSW Flood Rescue Policy including where evacuation operations have not been successfully completed.*
- d. Coordinate the protection of property of residents, businesses and essential infrastructure at risk of flood damage where feasible.*
- e. Resupply properties, towns and villages which have become isolated as a consequence of flooding to minimise disruption of the community.*

f. Manage the transition from response operations to recovery.

5.3.3 The NSW SES Incident Controller will select the appropriate mix of response strategies to deal with the expected impact of floods and set operational objectives.

5.11 Warnings and Information

5.11.13 NSW SES Evacuation Warnings and Evacuation Orders. These are usually issued to the media by the NSW SES Operations Controller on behalf of the NSW SES Incident Controller. Evacuation warnings are a message advising the community to prepare for likely evacuation. The warning advises people what to do and what to take with them. Evacuation orders communicate the need for a community (or parts of a community) to evacuate within a specified time frame in response to an imminent threat. It also advises where people should go and may advise which evacuation route to take.

5.29 DECISION TO EVACUATE

5.29.1 The decision to evacuate rests with the NSW SES Incident Controller who exercises his/her authority as an emergency officer in accordance with Section 22(1) of The State Emergency Service Act 1989. The decision to evacuate will usually be made after consultation with the NSW SES Operations Controller and the Local Emergency Operations Controller.

5.29.2 In events that require large scale evacuations, the decision to evacuate will remain with the Incident Controller with the approval of evacuation warnings and orders required from State Duty Operations Controller/NSW SES Commissioner.

5.29.3 Some people will make their own decision to evacuate earlier and move to alternate accommodation, using their own transport. This is referred to as self-managed evacuation (5).

5.29.4 Evacuations will take place when there is a risk to public safety. Circumstances may include:

- a. Evacuation of people when their homes or businesses are likely to flood.*
- b. Evacuation of people who are unsuited to living in isolated circumstances, due to flood water closing access.*
- c. Evacuation of people where essential energy and utility services have failed or are likely to fail where buildings have been or may be made uninhabitable. Evacuation is the primary response strategy as isolated properties can lose power, water, phone lines, sewerage services, become a refuge for spiders, snakes and other animals and are at risk of the consequences secondary emergencies without assistance.*

5.31 Evacuation Warning and Order Delivery

5.31.12 Refusal to evacuate. Field teams should not waste time dealing with people who are reluctant or refuse to comply with any Evacuation Order. These cases are to be referred to the NSW Police Force.

5.32 Withdrawal

5.32.3 The most effective means of evacuation is via road, using private vehicles and public buses for those who do not have or unable to use their own vehicles. This allows residents more control over their own evacuation. However, other means of evacuation may also be used if available and as necessary (e.g. by foot, rail, air).

5.32.4 Evacuees who require emergency accommodation or disaster welfare assistance will be directed to designated evacuation centres. Evacuees who have made their own accommodation arrangements will not be directed to evacuation centres. It is not possible to determine in advance how many will fall into this category.

5.32.5 Evacuees will:

- a. Move under local traffic arrangements from the relevant sectors to the evacuation route entry point.
- b. Move under traffic management arrangements to the evacuation route exit points.
- c. Continue along the road network to allocated evacuation centres.

5.32.6 On major evacuation routes there may be one lane set aside for emergency vehicle traffic into and out of the Sectors. These include:

- a. Utility service provider vehicles to disconnect services and make safe utility assets.
- b. Waste service vehicles to make final collections and make safe waste assets.
- c. Vehicle breakdown repair and towing vehicles.
- d. Road maintenance repair crews.
- e. Road barricade and traffic signage crews.

5.33 All Clear and Return

5.33.1 Evacuation Centres: Evacuees will be advised to go to friends or relatives, or else be taken to the nearest accessible evacuation centre, which may initially be established at the direction of the NSW SES Incident Controller, but managed as soon as possible by Welfare Services.

The currently available Volume 1 of the plan does not include information regarding the evacuation triggers, proposed evacuation routes, local evacuation centres or the scale of evacuation operations required for the existing population. This information is expected to be included in Volume 3.

Accordingly, the NSW SES has been closely liaised with over the course of this project. This has included multiple meetings during 2020 and 2021 to ensure that the approaches and assumptions are applicable to the study area and in line with NSW SES methodologies. This includes:

- The NSW SES requires modelling of the “worst case scenario” evacuation, which includes all residential and non-residential premises evacuating at the same time although only the non-residential vehicles which originate from outside of the floodplain are counted in the evacuating traffic.
- Determining the methodology for estimating non-residential vehicles based on Infrastructure NSW’s approach in the Hawkesbury-Nepean Valley;
- Vehicles in the study area would primarily be evacuating south on the Hume Highway or west on the M5 and then northwest onto the M7 out of the floodplain in advance of a flood which would trigger evacuation of the precinct, as per the NSW SES provision;
- There would be 12 hours warning time of flooding reaching the level which would trigger evacuation as per the Provision of and Requirements for Flood Warning (NSW SES, 2019);
- The NSW SES would have mobilised in advance of it being necessary to issue an evacuation order and the whole of the warning time would be available for occupants of the precinct to respond to the evacuation order;
- Evacuation would occur on a subsector by subsector basis, and the subsectors used in the modelling are modifications of original subsector boundaries provided by NSW SES by adjusted to account to roads being cut by flooding. The adjusted boundaries were sent to the NSW SES in order to be transparent in the methodology and to seek any feedback, although none was received at time of writing.

The above list is not exhaustive, and the NSW SES has confirmed in meetings that all assumptions adopted in the various model runs are in line with its approach for flood evacuation in the Georges River.

It is reiterated that the preferred primary response of the NSW SES to a flood emergency in the Georges River is evacuation, rather than Shelter in Place. The NSW SES does not support Shelter in Place for any new development where that is relied upon as the primary means of flood emergency response.

4.2 NSW SES Flood Evacuation Planning

4.2.1 SES Timeline Evacuation Model

The NSW SES has developed the Timeline Evacuation Model (TEM) as an empirical tool for consistently estimating the ability of people to safely evacuate by motor vehicle from floodplains (Oppen et al, 2009). It takes into account the time people take to accept a warning, act upon the warning and travel along an evacuation route which may face delays due to incidents along the route. It then compares this estimated "Time Required" with the estimated "Time Available". The Time Available is derived from information about warning times, flood travel times and flood rates of rise.

The TEM was born out of the 1997 Hawkesbury-Nepean Floodplain Management Strategy, where the NSW SES applied conventional timeline project management to the flood evacuation problem. It became apparent that this approach provided a clear and concise method for examining the evacuation process. Since that time, the approach has been refined into a model that can be easily applied to different developments. The TEM has been used widely within NSW by both the NSW SES and consultants in evacuation planning, with the scale of the model ranging from small subdivisions to towns of tens of thousands of people.

The primary goal of the TEM is to compare the time required for evacuation with the time available for evacuation. This can be represented by the equation:

$$\text{Surplus Time (ST)} = \text{Time Available (TA)} - \text{Time Required (TR)}$$

Where the Time Available exceeds the Time Required there can be greater confidence that a community can evacuate safely by motor vehicle. Where the Time Required exceeds the Time Available it is unlikely that everyone will be able to evacuate safely by motor vehicle in all floods.

The Time Required (TR) is the sum of the following four components:

- **Warning Acceptance Factor (WAF)** accounts for the delay between receiving an evacuation order and acting upon it. The NSW SES recommends a value of one hour.
- **Warning Lag Factor (WLF)** is an allowance for the time taken by occupants to prepare for evacuation. The NSW SES recommends a value of one hour.
- **Travel Time (TT)** is defined as the number of hours taken for all of the evacuating vehicles to pass a point given the road capacity. The NSW SES recommends an assumed road capacity of 600 vehicles per hour per lane. Therefore, if an evacuation generates 1,200 vehicles and the evacuation route has one lane, then the travel time is two hours. If there are two lanes the travel time is reduced to one hour.
- **Traffic Safety Factor (TSF)** is added to the travel time to account for any delays that occur along the evacuation route. This includes potential for incidents such as vehicle accidents or breakdowns, fallen trees or power lines or water across the road. The NSW SES has developed a table of traffic safety factors, where the safety factor is proportional to the travel time, ranging from one hour to three and a half hours (Table 6).

This is summarised in Figure 12.

The time needed to disseminate an evacuation order also needs to be considered. Generally, the NSW SES will broadcast the order by several means but will also initiate doorknocking of the target

premises. The model assumes that the evacuation order is not received at a property until it is doorknocked and that at any one time there will be properties at different stages of the evacuation sequence.

However, this is only true if the number of door-knocking teams available is equal to the number that would produce enough traffic to keep the evacuation route at full capacity. Should the number of door knocking teams available be less than this optimal number, then the travel time must be modified to account for this. If more door knockers are provided than the optimal number, then the rate of traffic generation will exceed the road capacity and traffic queues will form until no more premises evacuate.

Table 6. Traffic Safety Factors

Travel Time (TT) (hrs)	Traffic Safety Factor (TSF) (hrs)
0 to 3	1.0
>3 to 6	1.5
>6 to 9	2.0
>9 to 12	2.5
>12 to 15	3.0
>15	3.5

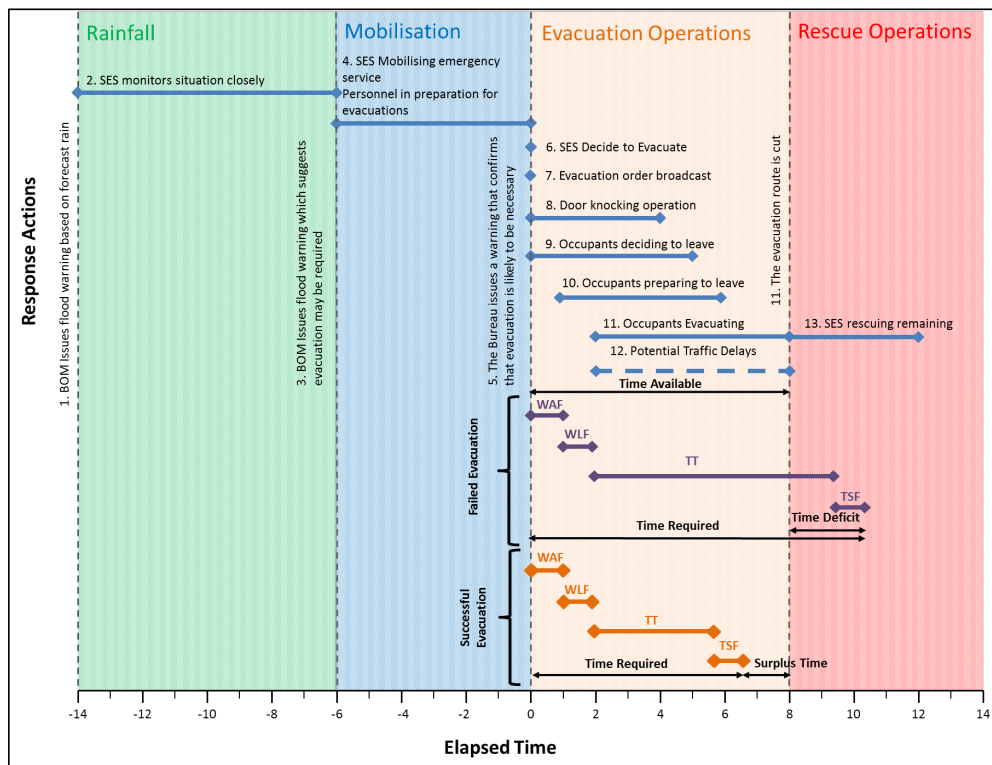


Figure 12. Timeline Evacuation Model summary

The Time Available (TA) is usually the time from when an Evacuation Order is issued by the NSW SES to when the lowest point on the evacuation route is cut by floodwaters. The ability to estimate this time for use in the TEM will be very dependent on the quality of available flood data and the type of warning products which the Bureau of Meteorology (BoM) is able to provide.

When determining the Time Available, consideration also needs to be given to the relative position of where the warning is provided for, compared to the location where the road will be cut. This requires accounting for the flood travel time from the gauge to the road cut location in estimating the available warning time.

4.2.2 NSW SES Evacuation Subsectors

The NSW SES manages flood response on a sector by sector basis, and has divided the Georges River floodplain into 46 draft subsectors. They have provided their draft Georges River evacuation subsectors for this study, which have informed the identification of evacuation subsectors for this study. It is noted that the NSW SES subsectors extend beyond the scope of this study (i.e. into Fairfield City Council). Many of the NSW SES evacuation subsectors were further subdivided in this study in order to assess evacuation in the study area at a higher resolution, particularly where it became clear from a detailed analysis of flood modelling results that flooding would sever key road connections within a subsector.

4.3 Other Flood Evacuation Considerations

4.3.1 Availability of Safe Refuge

While vehicular evacuation is the preferred primary response to a major flood on the Georges River and pedestrian evacuation a critical secondary response should vehicular evacuation fail, it is also important to consider where safe refuges are available to building occupants in the full range of flood events should evacuation fail. For such refuge to be considered suitable there must be sufficient, accessible and appropriate shelter above the peak PMF level, including for those with limited mobility, those on lower levels of multi-floor buildings or people in buildings which do not have their own refuge above the PMF level. The building in which shelter is to take place must be able to remain structurally sound during a PMF and withstand the hydrostatic, hydrodynamic, buoyancy and debris loads of the flood. It must be of suitable size and have adequate amenities for the number of people likely to use it.

Taking refuge as a final response should both vehicular and pedestrian evacuation fail is quite different from planned Sheltering in Place as a primary flood emergency response. Where evacuation is planned and there is sufficient time and road capacity for it to occur, there should be a low probability of people needing to take refuge and only a small proportion of the population which needs to do so. The space and facilities provided can arguably be minimal.

On the other hand, where Sheltering in Place is the proposed primary response, adequate provisions need to be made for the entire population for the full range of events in which sheltering is to take place. The potential for secondary emergencies or inappropriate behaviour by individuals which can place lives at risk needs to be considered. The longer the duration of isolation by flooding the higher the likelihood of such things occurring.

The NSW SES does not support shelter in place for future development. It considers that such an approach is only suitable to allow existing dwellings that are currently at risk to reduce their risk, without increasing the number of people subject to the flood risk.

4.3.2 Human Behaviour

According to Haynes et al. (2009), most of flood-related death and injuries in Australia have occurred to people voluntarily entering floodwaters, usually trying to walk or drive through them. For this reason, avoiding direct contact with floodwaters is the main aim of every flood emergency policy in Australia and overseas.

All the NSW Councils that have a risk to life policy in place recommend evacuation as the preferred emergency response for new development only if enough time is available to safely reach a flood free area. If this is not possible, avoiding the risk of direct contact with floodwaters by sheltering in place becomes the preferred emergency response strategy.

Whether the preferred flood emergency response is evacuation or sheltering in place, the success of the response is highly dependent on people responding appropriately. It requires those that need to evacuate evacuating in a timely manner and those that need to shelter, doing so until the flood hazard has gone.

In recent years there have been floods in Australia where evacuation orders have been given with sufficient time to evacuate but many residents have failed to do so. Some research shows that less than 25% of people evacuate when told to do so (Oppen et al., 2006; Strahan Research, 2011). However, in the June 2007 Hunter Valley floods, 76% of people in Maitland said they evacuated when ordered to do so (Molino Stewart, 2008). Yeo et al. (2018) found that compliance with Evacuation Orders in the Murrumbidgee region in March 2012 was frequently greater than 80%, although rates were as low as less than 5% in other areas. About 10-20% of people say they will not evacuate under any circumstances. On 27th January 2013 a voluntary mass evacuation of north and east Bundaberg was called in advance of forecast flooding. On 28th January this was escalated to a mandatory evacuation. Although 7,000 people were provided with sufficient advanced warning to leave, 850 people had to be rescued by 24 Blackhawk helicopters in the largest air evacuation in Australia's history (Honor and Regan, 2014).

The safety of sheltering in place is also highly dependent on appropriate human behaviour. This can be illustrated by two examples.

The June 2007 Hunter Valley floods resulted in flash flooding in the Newcastle CBD at about 5pm on the Friday of the June long weekend. Office workers who saw the flooding in the streets contacted the NSW SES who told them to stay within their buildings until the flooding had subsided which would occur within a couple of hours. Within an hour, the NSW SES was rescuing those same people as they had tried to drive out through the floodwaters (Greg Perry, NSW SES, pers. comm.).

During the 2017 Lismore floods, many residents of North Lismore elected not to evacuate when ordered to do so because their homes were elevated on piers and they believed they could sit out the flood with stocks of food and drinking water. Many of those people regretted that decision when they lost power and the flooding continued for more than 24 hours. They were left in the dark with no communication to the outside world and refrigerated food was spoiling. Some had medical emergencies. Some traversed hazardous floodwaters to escape their homes or to get help (BNHCRC, 2017).

These examples illustrate that when people are sheltering in a building that is isolated by floodwaters, they might decide to take actions which increase the risks to their lives and the lives of others. The longer they are isolated the more likely they are to want to leave the premises and the more time they have available to make poor decisions.

The viability of evacuation plans or plans to shelter in place will be very dependent on the relationship people have with the buildings. Typically, workers will want to leave the flood threatened building to be able to get home even if the flood duration is only a couple of hours. On the other hand, residents will tend to remain in their dwellings for several hours or more even if they are without services such



as electricity but will then want to leave if they are isolated for longer durations. Residents who are outside of the floodplain when the building isolation occurs are very likely to try to reach their homes, risking travelling through hazardous floodwaters in the process.

4.3.3 Secondary Emergencies

A secondary emergency is where a non-flood related emergency, such as a building fire or medical emergency, occurs during a flood. In many cases the flood and secondary emergency will be two unrelated events, however there is potential for floodwaters to damage the electrical system and cause fires or for occupants to use improvised lighting (candles), cooking and heating with naked flames that may also cause fires. The flood could also cause elevated stress levels in occupants that could aggravate pre-existing medical conditions leading to more medical emergencies.

While the probability of a fire in a building during a flood is likely to be small, the consequences, should a fire occur, could be significant if people are unable to evacuate the building because they are surrounded by hazardous floodwaters and firefighters are not able to reach the building to undertake rescues and extinguish the fire. Ambulance emergencies are more likely to occur than a fire while areas are isolated by flooding, particularly if the stress of flooding aggravates pre-existing medical conditions.

While a secondary emergency has a relatively low chance of occurring during a flood, it is important to recognise the potential and understand the potential consequences. Buildings can be designed to be accessed by boat or helicopter for rescue during floods but there are practical difficulties due to the river and weather conditions which prevail during a flood that may prevent emergency access.

4.3.4 Flood Duration

An important consideration in assessing the risks associated with isolation from floodwaters is the duration of the isolation. There are several aspects of risk associated with isolation. Firstly, the shorter the duration of the isolation, the lower the probability that a secondary incident such as a fire or a medical episode is likely to occur. Secondly, the shorter the duration of the isolation, the less likely that building occupants will be frustrated by being isolated and therefore they are less likely to be motivated to traverse floodwaters to leave the building. Finally, the shorter the isolation duration the less opportunity people will have to traverse the floodwaters.

For example, the NSW SES Timeline Evacuation Model suggest that on average it takes about two hours people to make an evacuation decision and get ready to evacuate (Oppen et al, 2009). The probability of people traversing floodwaters when isolated for two hours or less is therefore expected to be quite low. An isolation of up to eight hours might be considered to be another key threshold as it is about the average time that people sleep or are in a workplace and isolation up to this duration might not be considered particularly inconvenient. Research has also shown that even people who have decided not to evacuate and to shelter within a building they know will be surrounded by floodwaters can change their minds after 24 hours (Tofa et al., 2018). This therefore would appear to be another key threshold for isolation risk analysis.

Based on an analysis by Molino Stewart for this study of the 2020 Georges River 2D TUFLOW hydraulic model data (BMT, 2020), the vast majority of the area inundated by the Georges River PMF experiences high hazard flooding (i.e. Hazard level 3 (H3) according to the Australian Rainfall and Runoff 2019 hazard classification which is described as, "unsafe for vehicles, children and the elderly") for over 24 hours, in many places for in excess of 40 hours (Figure 13). Therefore, failing to evacuate or deliberately sheltering in place in the Georges River floodplain is particularly risky considering buildings can be isolated and inaccessible to emergency services for more than 24 hours.



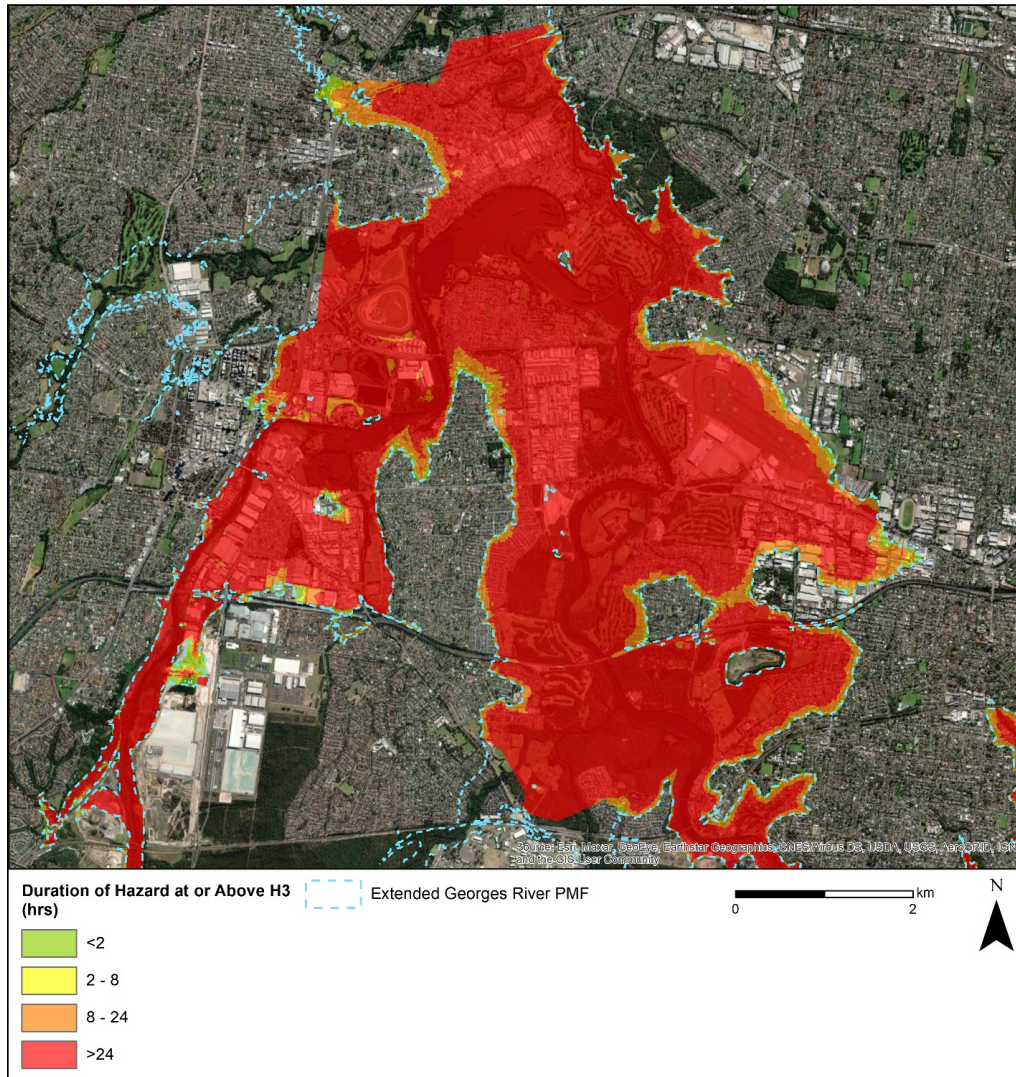


Figure 13. Duration of high flood hazard during the PMF for the modelled extent of Georges River flooding

4.3.5 Warning Systems

There are two gauges on the Georges River within the study area that have quantitative flood warnings provided by the Bureau of Meteorology. The key gauges, defined as “key location for downstream predictions, critical for the provision of a quantitative flood forecasting service” in the study area are the Liverpool Gauge and the Milperra Gauge. Table 7 shows the information for these gauges, as per *The Provision and Requirements for Flood Warning in New South Wales* (NSWSES, 2019) and the *Bureau of Meteorology Service Level Specification for Flood Forecasting and Warning Services for New South Wales and the Australian Capital Territory* (BoM, 2013).

Table 7. Service Level Specification for Flood Forecasting and Warning Services for New South Wales (BoM, 2013)

Bureau number	AWRC number	Forecast location	Station owner	Gauge type	Gauge datum	Flood classification (m)			Prediction type	Target warning lead time		70% of peak forecasts within	Priority
						Minor	Moderate	Major		Time (hrs)	Trigger height (m)		
213 – Georges River and Sydney Coast													
566054	213400	Liverpool	Sutherland Shire Council NSW OEH	Automatic	Local	2.0	3.0	4.5	Quantitative	6 hrs 12hrs	>2.0 m >4.0 m	+/- 0.3 m	High
66168	213405	Milperra	MHL*	Automatic	AHD	2.0	3.3	4.2	Quantitative	6 hrs 12hrs	>2.0 m >4.0 m	+/- 0.3 m	High

* Updated from the referenced document which has the station owner as Sutherland Shire Council and NSW OEH.

It is noted that a reading of 0 m on the gauges does not necessarily equal 0 m AHD. The Milperra Gauge has a gauge zero of 0 AHD but the Liverpool gauge has a gauge zero of 2.8 m AHD.

Table 8 shows the impacts of various flood and gauge levels in the study area.

Table 8. Georges River flood levels and impacts

Georges River Flood Classification	Liverpool Weir Gauge Level (m)	Liverpool Weir Flood Level (m AHD)	Milperra Gauge and Flood Level (m AHD)	Impacts for the Study Area
Minor ¹	2	4.8	2.0	No significant impacts
Moderate ¹	3	5.8	3.3	Flooding of low-lying areas in Moorebank East, along eastern Newbridge Road, and along Cabramatta Creek in Warwick Farm.
Major (about a 1 in 15) ¹	4.5	7.3	4.2	Flooding along eastern Newbridge Road, Barry Road in Chipping Norton, the Hume Highway by Cabramatta Creek, and Junction Road by Anzac Creek.
2% AEP ²	6.5	9.3 (8.7)	5.6 (5.5)	Flooding throughout western and eastern Moorebank, eastern Chipping Norton, and Warwick Farm, cutting many roads and inundating properties.
1% AEP ²	6.8	9.6 (9.0)	5.8 (5.9)	High flood islands form in east Moorebank, extensive flooding through Liverpool, Warwick Farm and western Moorebank, cutting many roads and inundating properties.
0.5% AEP ³	6.9	9.7	5.9	As above, with additional flooding throughout and in Chipping Norton.
0.2% AEP ³	7.2	10	6.2	As above, with additional flooding throughout entire study area.
PMF ²	9.4	12.2 (11.6)	11.8 (10.4)	Study area inundated except for the high ridge in the Moorebank peninsula and higher terrain in western Liverpool.

1. Levels from Bureau of Meteorology flood gauge information

2. Levels from Georges River Flood Study Report (BMT, 2020)

3. Levels extracted from Georges River Flood Study model results

() bracketed values are corresponding levels currently adopted by Council

Based on the above information, there should also be at least 12 hours warning that a precinct's evacuation route will be cut or that the precinct will start flooding.

While the time for floodwaters to travel from the gauges to the evacuation subsectors can theoretically be accounted for as additional effective warning time, the distances between the gauges and the subsectors in the study area are such that such travel times are short and can be discounted for practical purposes.

It is noted that flood warning systems are not failsafe. During the floods in Victoria between September 2010 and February 2011, about 50% of the warning systems experienced some type of failure (Molino Stewart, 2011). This included mechanical and electrical failures in gauges, gauges being damaged by flood debris or erosion, communication failures between the gauges and the receivers or human error in the interpretation of the data. The more extreme the flood event, the more likely it is that the gauging hardware will be damaged by the flooding.

Forecasts made for future flood levels at the Liverpool and Milperra gauges are based on rainfall gauge readings in the catchment and stream gauges readings upstream on the Georges River and its tributaries as well as current water levels at Liverpool and Milperra. Damage to the Liverpool or Milperra gauges could compromise the ability to gain accurate information on current flood levels at those locations. Damage to upstream gauges could compromise the ability to accurately forecast future flood levels at Liverpool and Milperra.

4.4 Emergency Response Classification

In this study, areas have been spatially defined according to emergency response classification of communities in accordance with Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIRD, 2017). This is a classification in regard to isolation and access considerations. The four classes of land that are flooded in the PMF include:

- **Flooded Isolated and Submerged (FIS)**, also known as low flood islands, where the area is first isolated from flood-free land and then completely inundated as flood waters continue to rise. This is the most dangerous scenario.
- **Flooded Isolated Elevated (FIE)**, also known as high flood islands, which are similar to FIS areas but a portion of the site remains flood free in the PMF, providing a refuge for those who do not evacuate before the loss of access.
- **Flooded with an Exit Route via Rising Road (FER)**, where the area is flooded but there is a continuously rising flood evacuation exit route by road out of the floodplain.
- **Flooded Overland Escape (FOE)** where the area is flooded but there is a continuously rising overland exit route out of the floodplain rather than by road.

In addition, there are two classes of not flood affected areas outside of the PMF, including:

- Indirect Consequence (NIC), which are areas not flooded but may lose access to services such as electricity, gas, water, and telecommunication.
- Flood free areas that do not experience any indirect consequences of flooding.

The above emergency response classification thus differentiates between buildings where occupants can evacuate by driving (FER) or walking (FOE) from rising floodwaters, and buildings where occupants would get trapped by floodwaters before they are affected themselves (FIS and FIE). This provides the framework for gauging the nature, severity and scale of inundation and isolation risk across the floodplain.

5 | Georges River Flood Evacuation Model

5.1 Limitations of Timeline Evacuation Model

In the earlier Moorebank East evacuation analysis, the NSW SES Timeline Evacuation Model (TEM) was used to estimate the time needed to evacuate each sector in the Moorebank Peninsula, which was compared to the time available based on expected warning times published by the NSW SES. Based on this, sectors were identified where there was insufficient time or road capacity to evacuate.

Traffic was then converged from each sector according to their relative evacuation trigger timings based on a flood rising as fast as the modelled PMF. It was then assessed whether the converged traffic would have sufficient time to evacuate in the time available using TEM. This was based on the assumption that all sectors would evacuate onto the M5 Motorway, but once on the Motorway, would have free flow to evacuate east or west to an area outside of the Peninsula which is above the PMF extent. As there were only two roads leading onto the Motorway in this study, and each sector fed onto one of these two roads, the modelling was sufficiently straightforward that the Timeline Evacuation Model could be used in this instance.

The NSW SES recognises that evacuation of a development may not necessarily occur in isolation as other nearby developments may also have to evacuate at the same time. The TEM makes provision for estimating how converging evacuation traffic may impact on the ability of developments to evacuate simultaneously. However, the TEM is not set up to consider more than two converging traffic streams such as when there are multiple subsectors evacuating onto shared evacuation routes. This means that more sophisticated modelling that accounts for traffic convergence in more detail is required for larger scale studies. This would allow consideration on what impact other existing evacuating traffic from Moorebank and Liverpool would have on the safe evacuation of new development.

Furthermore, the TEM is coarse in that it analyses towns, precincts, subsectors or sectors as a single block and provides no sense of what is happening to evacuation traffic on the roads within the spatial unit which is evacuating.

Nevertheless, the fundamental principles and assumptions of the TEM including warning lead times, delays in evacuation response, evacuation route capacities and potential for traffic delays need to be incorporated in any flood evacuation model.

5.2 Life Safety Model

In recent years more sophisticated models for the estimation of loss of life in any flood event have been created. One of the most advanced of these was developed by British Columbia Hydro in Canada and commercialised as the Life Safety Model (LSM) by HR Wallingford in the UK.

HR Wallingford, under licence from British Columbia Hydro, has developed the LSM into a dynamic model that represents the:

- Rise and spread of floodwaters;
- Receipt of warning messages;
- Response of occupants to the warning;
- Evacuation traffic flow;
- Fate of those who fail to evacuate before the arrival of floodwaters.



It models the evacuation and fate of each individual household based on their exact spatial location and the available road network over time. Time series output from the model can be viewed as animations as well as in tables.

In the LSM, each individual and vehicle is represented as an autonomous entity within the model. The behaviour of each entity is individually governed by a set of rules that control its interactions with other entities and with the flood hazard. The traffic model is a simplified traffic model that is appropriate for traffic that is constrained by flow rate limits and congestion (the high vehicle density associated with mass evacuation). The traffic model uses the Greenshields relationship between traffic density and speed to control the movement rate of vehicles, with additional rules to:

- Account for the movement across junctions;
- The interaction with other vehicles (it is assumed that vehicles can't pass one another on a single lane);
- Once a queue is formed, the length of each vehicle is used to determine the position of the next vehicle back of the queue.

The LSM has previously been compared with a full traffic model (Omnitran) and produced similar results for large scale evacuation (Tagg et al., 2012; 2016).

The inputs required for the LSM are:

- **Buildings:** The physical location of occupied buildings to provide a start location for the population groups and vehicles.
- **Population Data:** Census or other data to define household groups and distribute them to a physical building location.
- **Number of Vehicles:** The number of vehicles evacuating from each property. These are distributed to the building locations.
- **Road network:** A simplified, digitised road network containing the evacuation routes and minor roads leading to it. The number of lanes and free flow speed limits are required.
- **Hydrodynamic data:** A two-dimensional flood modelling of depths, water levels, velocity for a number of time intervals covering the flood event. The time interval depends on the duration and rate of rise of the flood event.

The advantages that the LSM has over the TEM are that it:

- fully integrates with two-dimensional flood models;
- can model different warning dissemination mechanisms;
- can model vehicular and pedestrian evacuation;
- models individual buildings and vehicles with spatial accuracy;
- can replicate NSW SES TEM warning, departure and travel assumptions;
- models the entire road network including networks internal to evacuation nodes;
- models traffic convergence within and outside of evacuation nodes;
- shows results dynamically and visually in a way which helps communicate convergence, queuing and evacuation failure;
- can undertake sensitivity analysis quickly.

LSM is also able to estimate the movement of pedestrians leaving buildings or leaving vehicles which are no longer able to travel on the traffic network. In addition, it can estimate the fate of people who are caught by floodwaters by using information about their situation (in a building, in a vehicle or on foot), the water conditions (depth, velocity, temperature) and their exposure (duration).

The fully featured model has been calibrated/verified against the Malpasset dam failure in Italy (Johnstone et al., 2003; 2005) and the storm surge on Canvey Island (Di Mauro et al., 2008; Lumbroso et al., 2011).

5.3 Applying the Life Safety Model to the Georges River

In this project, the Life Safety Model (LSM) was used to model vehicular evacuation from the study area. The pedestrian evacuation and the fate features of the model were not used but they can be switched on in the model if these issues are to be explored in the future.

Council's 2020 Georges River 2D TUFLOW hydraulic Probable Maximum Flood (PMF) model (BMT, 2020) was used in the model to represent the maximum flood extent and fastest rising flood which evacuees would need to respond to. While it is recognised that this is an extremely rare event, more frequent events could rise this quickly and if vehicular evacuation can be achieved in this event then it should be possible to achieve it in events which rise more slowly or which have a lower peak.

The NSW cadastral lot layer, together with satellite imagery, was used to identify each individual premises from which evacuating vehicles would originate. The number of vehicles at each premises was assigned using census data for existing residential premises and journey to work data for existing non-residential premises. Vehicles numbers for potential future development were informed by the census data and journey to work data as well as other considerations about the nature of the development.

The floodplain was divided into subsectors based on preliminary subsector boundaries provided by NSW SES. The boundaries were refined through detailed analysis of the TUFLOW model times series outputs and where and when roads would be cut. It was assumed that each subsector would receive an evacuation order 12 hours in advance or either its evacuation route being cut or premises being flooded by the PMF. It was assumed that the evacuation order would be disseminated at a rate which would generate a maximum of 600 vehicles per hour from each subsector with each premises receiving their evacuation order in order of the ground elevation from lowest to highest.

In the LSM it was assumed that those receiving the evacuation order would take one hour to accept the order and a further hour to be ready to leave. Therefore, there was a two hour delay between order delivery and evacuation commencement which is the same as the TEM.

The NSW road network GIS layer was used to represent the road network with some modifications where roads are gated at railway crossings or where local flood modelling suggested that roads may be closed by local flooding during and evacuation. Generally, it was assumed that each evacuating lane would have a capacity of 600 vehicles per hour per lane as recommended by the NSW SES in its TEM and there would be no contraflow lanes available for evacuation.

To account for the traffic safety factors (TSF) recommended by NSW SES, the LSM model outputs were interrogated to determine the duration of evacuation from a particular subsector or along a particular length of road. The NSW SES TSF was then applied to that location and the number of vehicles remaining in the subsector or still on a section of road at the earlier time was extract from the model.

The details of how these model assumptions and inputs were derived and applied is elaborated upon in Section 5.4.

Over the course of this study, multiple different Georges River flood evacuation scenarios were defined and modelled to demonstrate how various assumptions will alter the evacuation process. The following scenarios are discussed and presented in this report:

- **Scenario 1** is the base case scenario based on 2016 Census (ABS, 2016) population and vehicle data and 2011 Journey to Work (Transport for NSW, 2011) data
- **Scenario 2** is a future scenario with intensified development under existing zoning, accounting for residential and non-residential infill and planned road upgrades
- **Scenario 3** is a future scenario with rezoning and development from planning proposals currently under investigation, as advised by Council

Subsequently, two of the above scenarios were run with modified assumptions. These are:

- **Scenario A** is Scenario 2 with multiple non-residential vehicle evacuation destinations depending on the origin of the workers being:
 - M7 north (i.e., the single destination of all vehicles in Scenarios 1, 2 and 3),
 - Hume Motorway south,
 - Camden Valley Way west, or
 - M5 east
- **Scenario B** is a modified Scenario 3 with the following modifications:
 - updated numbers of vehicles from proposed residential and non-residential areas for all developments, including a decrease in the number of vehicles per dwelling for new planning proposal apartments,
 - non-residential vehicle traffic will evacuate to multiple destinations depending on the origin of the workers as per Scenario A (i.e. M7 north, Hume Motorway south, Camden Valley Way west or M5 east),
 - the two on ramps from the Hume Highway and M5 will have their capacity increased to 900v/h/lane,
 - there will be a third lane heading north on the M7

The above scenarios are referred to in the discussion and presentation of results.

5.4 Model Inputs and Assumptions

5.4.1 Warning Times

According to the *Provision and Requirements for Flood Warning in New South Wales* (NSWSES, 2019), the Bureau of Meteorology has a target minimum warning lead time of 12 hours for floods greater than 4.0 m, and 6 hours for floods greater than 2.0 m for both the Liverpool and Milperra Bridge Gauges.

As evacuation from the Georges River floodplain is only necessary in floods exceeding 4.0 m at these gauges, there will be at least 12 hours warning available. Therefore, in all five of the modelled scenarios, a warning time of 12 hours was utilised.

5.4.2 Time Required to Evacuate

All modelled scenarios utilised the assumptions from the NSW Timeline Evacuation Model (TEM) as explained in Section 4.2.1. This included:

- Vehicles leave two hours after being notified of evacuation order (one hour Warning Acceptance Factor plus one hour Warning Lag Factor).
- The travel time is based on an assumed road capacity of 600 vehicles per hour per lane. This has been applied to all scenarios, except in Scenario B where the two on ramps from the Hume Highway and M5 onto the M7 will have their capacity increased to 900 vehicles per lane per hour.
- Traffic Safety Factors (TSF) were calculated and accounted for based on the elapsed time that vehicles are traveling on the road. Subsectors were identified where accounting for the TSF meant that additional vehicles would be trapped by floodwaters or on the road.

5.4.3 Evacuation Subsectors and Trigger Levels

As shown in Figure 14, there are 43 evacuation subsectors in the study area that are impacted by the PMF from the Georges River and the study area's creeks. These have been identified based on an analysis of the flood model time series and the NSWSES published warning times for the Georges River. The evacuation subsectors have been informed by the draft NSW SES subsectors that were provided, but are not identical. The NSW SES was provided with the subsectors identified in this study for its approval.

The subsectors used in all modelled scenarios were refined by selecting areas with shared evacuation routes and flood risks, and thus would need to respond to specific trigger level(s). They were classified based on the emergency response classification of communities in accordance with DPIE guidelines to identify the flood islands within the study area and those which have rising road access and overland escape routes. Of these subsectors, 15 are primarily industrial, 26 are primarily residential, one is both industrial and residential, and one was classed as an equestrian area.

Subsectors R13, R14, R20, R22, I10 and I11 are only affected by local creek flooding and their evacuation was not included in the modelled scenarios.

The trigger levels at the Liverpool and Milperra gauges which would cut off the flood islands or start to flood areas with rising road access were identified. The timing of these trigger levels were identified by timestep on the PMF design flood hydrograph in Liverpool Council's TUFLOW model of the Georges River. The standard warning dissemination, warning acceptance, evacuee response and road capacity assumptions as per the NSW Timeline Evacuation Model were utilised.

A database of both initial and progressive evacuation triggers for each subsector was developed. The staging of evacuation of each subsector was based on the following three possible scenarios:

- Areas where everyone is told to evacuate based on a single trigger level ("all"). This was generally where the subsector is a flood island and the trigger for evacuation is the level at which the evacuation route is cut although it also applied to subsectors where there is little change in level across the subsector. The model assumed that evacuees would be warned at a rate which would generate a maximum of 600 vehicles per hour evacuating from the subsector and that the evacuation order would be issued to the premises in order of ascending ground level;
- Areas where they will progressively evacuate by ground level based on revised flood forecasts, as per SES staging of subsector evacuations ("by level"). These are subsectors with rising road access or overland escape routes and a significant change in level across the subsector. Only those parts of the subsector which are expected to flood would be evacuated based on current forecasts. As forecasts are revised upwards more elevated parts of the subsector would be ordered to evacuate;
- Areas where there will initially be a staged evacuation, until the evacuation route gets cut, at which point everyone will need to evacuate ("by level until..."). This used a combination of the above two approaches.

Appendix A shows the triggers that have been identified for each subsector.

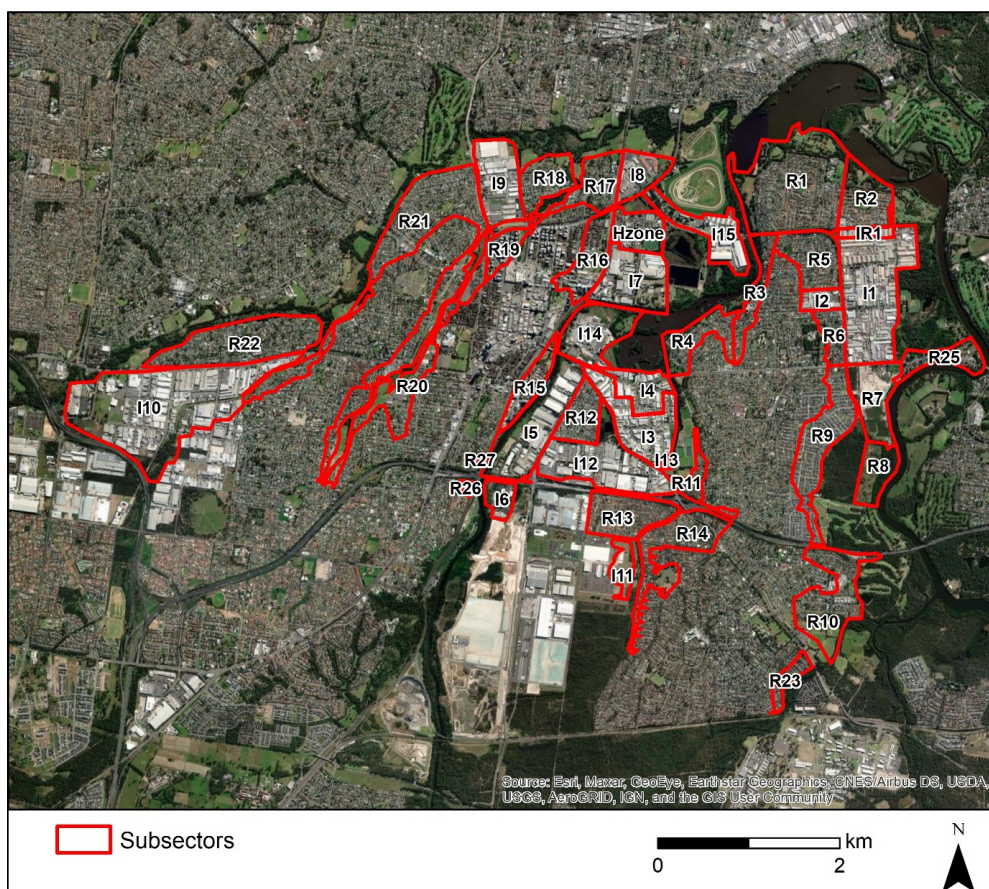


Figure 14. Subsectors identified and used in this study

5.4.4 Existing and Future Road Network

The existing road network was input into the modelled base case (Scenario 1), with modifications made in the future scenarios (Scenarios 2, 3, A and B) based on advice from Council.

As advised by the NSW SES, all traffic is expected to be directed to evacuate west to the M7 and north from there. Therefore, to force traffic in this direction in the model, Newbridge Road and the M5 were cut at the eastern extent of the study area where they cross the Georges River in scenarios 1, 2, and 3. In Scenarios A and B where some vehicles need to evacuate to the east, the M5 crossing of the Georges River was opened.

To account for the very real possibility of local creek flooding during an evacuation from the Georges River flooding, every road that crosses Anzac Creek, Brickmakers Creek, Cabramatta Creek and Maxwell's Creek was cut in the model if it was flooded by a 1 in 500 annual exceedance probability (AEP) flood or more frequent events (Figure 15) according to the local flood modelling. It was assumed that wherever overland flooding would cross roads it would be of a short enough duration and low enough hazard that it would be accounted for in the delays allowed for the in the TSF within the modelling.

There were three locations where the road network layer suggested roads cross the railway line but investigation showed that these crossings are all gated, so they were closed in the model. These locations are also shown in Figure 15.

In the model each road was assigned a number of evacuation lanes based on the number of lanes available in the direction of evacuation. This was groundtruthed using GoogleMaps aerial imagery and is also shown in Figure 15.

For scenarios 2, 3, A and B, committed road upgrades in Moorebank, Chipping Norton and Warwick Farm, as advised by Council, were incorporated into the evacuation models. These are shown in Figure 16 and include:

- Governor Macquarie Drive widening to two lanes in each direction between Newbridge Rd and Alfred Rd, between Alfred Rd and Childs Rd, and between Munday St to the racecourse access.
- an upgrade to the M5 Motorway westbound that will add two additional lanes connecting between east of the Moorebank Avenue and the intersection with the Hume Highway.

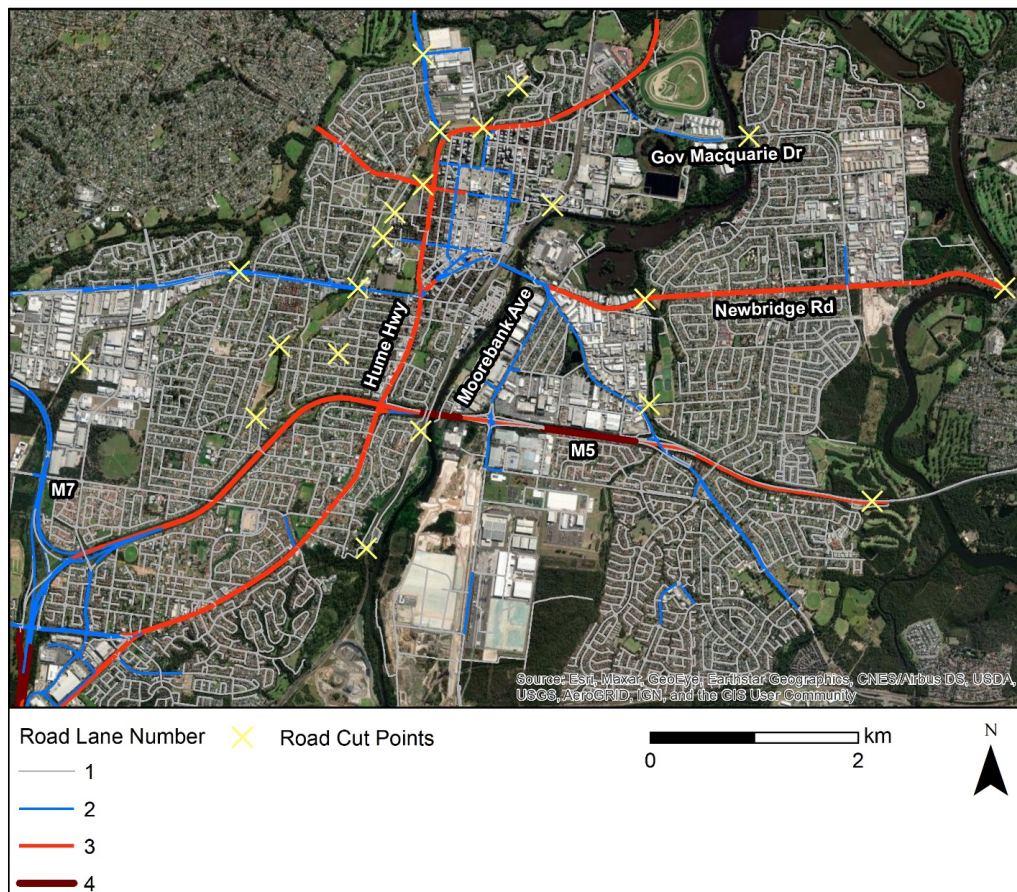


Figure 15. Road cut locations

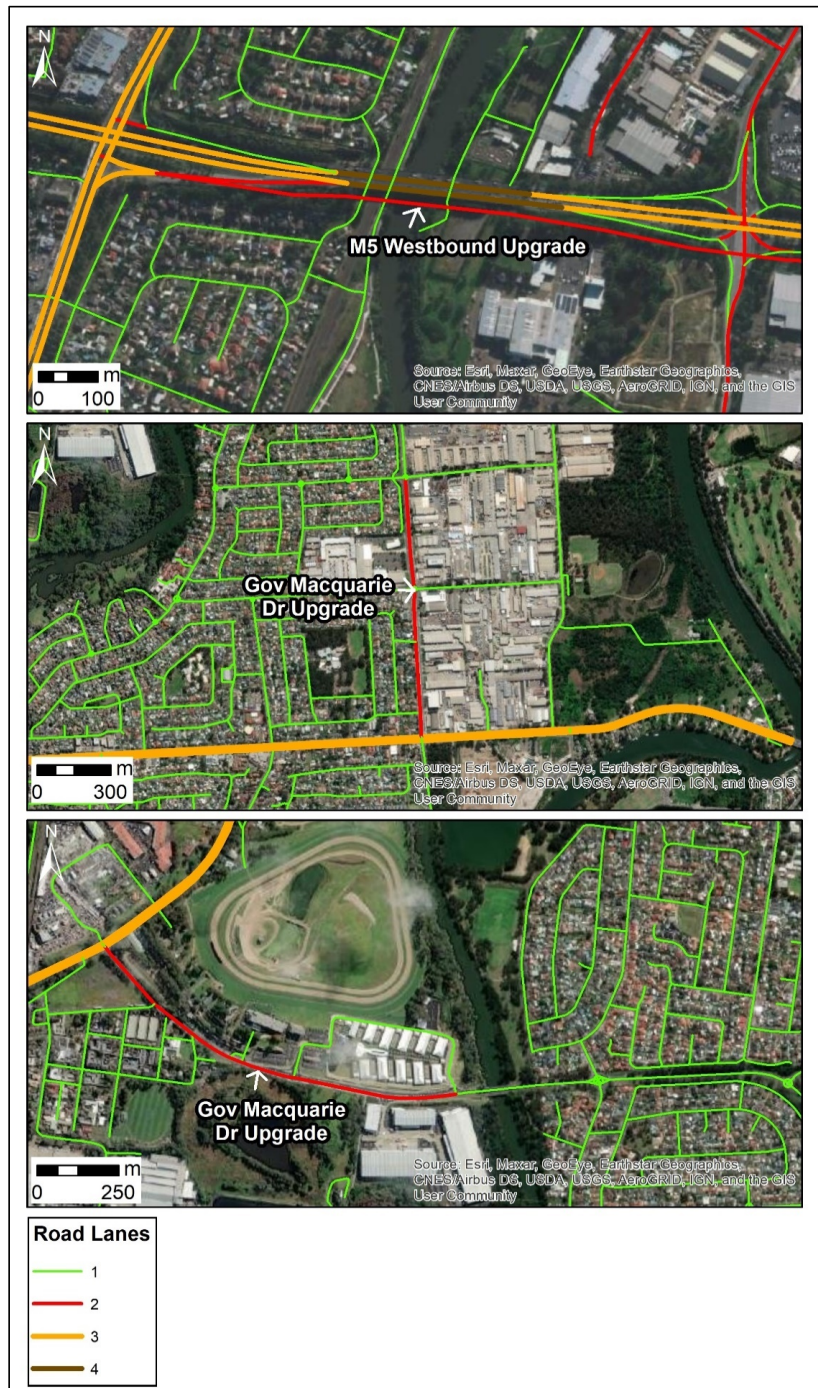


Figure 16. Road upgrades for the future scenarios including additional two lanes of M5 westbound traffic (top), and widening of Governor Macquarie Drive to two lanes in Chipping Norton (middle) and Warwick Farm (bottom)

5.4.5 Evacuating Vehicles

As advised by NSW SES, all of the modelled scenarios assume that all of the residential and non-residential premises in the lots that fall under the extent of the Georges River design PMF will need to be evacuated in the same event. The methodology ensured that those who both live and work within the study area were not double counted (i.e. only non-residential traffic originating from outside of the area was counted as the non-residential traffic originating within the floodplain was assumed to be counted in the residential traffic).

Each of the five modelled scenarios used different assumptions and inputs for the numbers of residential and non-residential vehicles distributed across the subsectors that require evacuation from the Georges River PMF. This is summarised in Table 1. Section 5.5 details the five modelled scenarios and the current and future residential and non-residential vehicle model inputs.

It was assumed that each evacuating vehicle would occupy 6 m of road for the purposes of representing traffic queueing in the model. The exception is that vehicles originating from the equestrian area in Warwick Farm were assigned a 15 m vehicle length to account for trailers being towed.

5.5 Modelled Scenarios

5.5.1 Scenario 1: Base Case

Existing building and vehicle numbers were used to develop the scenario 1 Base Case.

a) Residential

Molino Stewart developed a methodology using an integration of the flood model data, 2016 Australian Bureau of Statistics Census data, cadastre data, and Google Maps imagery to estimate the number of vehicles that would need to evacuate from existing residential developments in the study area.

The total number of dwellings based on the 2016 Census at the Mesh Block spatial scale (the smallest geographical area available) was distributed as whole integer numbers among the cadastre lots containing residential buildings that were affected by the Georges River PMF. Where the value of dwellings was higher than the number of lots within the Mesh Block, visual assessment using Google Maps Street View was used to determine which lots contained multi-dwelling residences (i.e. apartment blocks, or houses with granny flats) and the number of dwellings on the lots (i.e. using number of post boxes). Where the number of dwellings was slightly fewer than the number of lots, visual assessment in Google Maps was used to determine if any lots did not contain a unique dwelling (i.e. if there were single dwelling houses occupying two lots). Where the number of dwellings based on the 2016 census was clearly less than observed visual assessment in Google Maps, it was assumed that development had happened since 2016 resulting in additional dwellings. For example, there had been recent development in southwestern Moorebank (south of Brickmakers Drive) and Hammondville (i.e. the HammondCare development that is partially affected by the Georges River PMF). The majority of the newer development is relatively dense and on smaller lots, so typically only has one dwelling per lot. These lots were thus assigned a number of dwellings based on the Google Maps and Google Street View assessment (i.e. counting the number of mailboxes in a new subdivision).³

³ Note that it has been determined that the number of vehicles requiring evacuation from Shepherd Street has likely been underestimated due to recent apartment developments (i.e., post-2016 census) that were not accounted for in the base case nor picked up as infill development but are included in the planning proposal.

Data on average residential vehicle ownership for each suburb (the lowest spatial resolution this data was available in) was calculated based on 2016 census data. This is shown in Table 9. Each residential lot containing at least one dwelling was assigned the average value of vehicles for its suburb, which was multiplied by the number of dwellings to result in a whole integer number of vehicles per lot. The remainder or excess of vehicles per suburb that resulted from whole-integer rounding was calculated. The remaining number of unassigned or excess vehicles were added or removed from lots to achieve the more accurate total number within the suburbs by either: 1) subtracting where necessary from multi-dwelling lots (i.e. apartment buildings) particularly close to public transport, or 2) adding to single-dwelling lots in suburban areas further from public transport.

Table 9. Current vehicle ownership rate (based on 2016 census)

Areas	Vehicles per Dwelling
Liverpool	1.31
Chipping Norton and Moorebank	2.03
Holsworthy, Wattle Grove, Hammondville,	2.00
Lurnea and Cartwright	1.63
Warwick Farm	1.14
Casula	1.95
Prestons – Edmondson Park	2.19

b) Non-Residential

Molino Stewart consulted with NSW SES and Infrastructure NSW (INSW) regarding a method for estimating the number of cars which might evacuate from the industrial and commercial areas, and the proportion of these which might need to evacuate at the same time as the residential areas. INSW provided guidance based on its government-endorsed methodology established as a part of the Hawkesbury-Nepean Valley Flood Risk Management Strategy (2016-2021) to inform evacuation modelling.

The base data used is Journey to Work Data (Transport for NSW, 2011) released by Transport Performance and Analytics (TPA), which is based on the 2011 Census of Population and Housing. It provides data at the Travel Zone geographical scale and includes data on the Origin Travel Zones (OTZ), Destination Travel Zones (DTZ) and mode of transport for every employee across NSW. Data was extracted from *Table 19: Origin TZ x Destination TZ x Mode9*, to calculate the number of employees who travel to work as the driver of a vehicle within the study area. This process entailed:

1. Determining the total number of vehicles entering each Travel Zone within the flood affected study area from outside of the study area;
2. Distributing the calculated number vehicles across the non-residential lots within each Travel Zone based on the lot's size.

Only vehicles that originated from outside of the study area and entered the study area's Travel Zones were included to avoid double counting vehicles already accounted for in the residential vehicle count. This approach means that the non-residential vehicle count does not include those that both live and work inside the study area (even in they live and work in different travel zones within the study area).

Additionally, only vehicle drivers were counted in assigning non-residential vehicles to lots.

The project managers for Australian Turf Club (ATC) (Mostyn Copper) were also consulted to understand the operating procedures and seek information to estimate the number of vehicles and horse floats which may need to evacuate from the equestrian zone and Warwick Farm Race Course

(in subsector Hzone). This helped ensure our approach and assumptions are consistent with the typical operations of the race course and the nearby stables.

The ATC advised that while the race course operates every day of the year, there are only one to two events a year that would bring more than 1,000 people to the site. There are also 20 to 25 race days per year on the race course that would have fewer than 1,000 attendees. ATC also advised that in rainy weather, races would be cancelled (i.e. events cancelled due to poor weather in February 2020). There is a hotel located adjacent to the track available for people to stay in and patronage of the hotel is not always linked to race meetings.

Approximately 700 horses train daily at the track in the morning. They said that the majority of racehorses (500 to 600) stable “on course” within the equestrian area on the southern side of Governor Macquarie Drive and use an underground tunnel to travel between the stables and track. They advised that horse floats that may be present on site can transport up to 25 horses at a time. However, they could not advise how many horse floats are kept on site, or how many would be required for evacuation. Despite follow up, we did not receive specific data on the number of horse floats that would be required in the event of an evacuation.

Future development plans were also discussed, including plans to create a new stabling area on the northern side of Governor Macquarie Drive, as the current stabling area is flagged for future rezoning and redevelopment.

To account for this area in the model, we used the number of residential and non-residential for this area as per the above methodology (a total of 211) but allowed 15 m for the vehicle length (as opposed to the standard 6 m vehicle length) for all vehicles coming from this area to account for trailers being towed. Additionally, 245 vehicles were assigned to subsector I15, which encompasses the ATC track and adjacent hotel, accounting for the current parking capacity for visitors and hotel guests.

5.5.2 Scenario 2: Infill

All future scenarios modelled built on the existing base case Scenario 1. Scenario 2 accounted for increased residential and non-residential infill or intensified development and planned road works without any changes to zoning. This was based on data supplied by Council regarding forecasts of the likely dwelling and population growth to 2036. Council utilises Forecast .id data (Profile .id, 2021) as the preferred forecasting tool for demographics.

The data provided by Council was collated to match the study area as best as practically possible as informed by a Forecast .id representative. The Forecast .id data was reduced to match the Travel Zones that sit within the study area by:

- taking the dwelling count from 2016 for each small area and splitting that count by the proportion of the catchment that intersects with the area.
- using the growth profile of the small areas in the forecast data to apportion the growth into the appropriate catchments.

As summarised in Table 10 there may be potential for infill within R2, R3 and R4 residential zones. The potential for lots to increase their number of dwellings depends on their size, as well as a number of other factors specified in Liverpool’s Development Control Plans. Therefore, not every lot meeting the size requirement would be able to increase its number of dwellings, but there is potential for more dwellings than currently present in these areas.

It was assumed that in the single R1 General Residential zone within the study area, there is no potential for an increased number of dwellings, although secondary dwellings may be permitted with consent. This is because these lots have recently been developed, and it was assumed this development has maximised the number of permissible dwellings per lot.

In R2 Low Density Residential, only lots that are greater than 400m² would have the potential to increase the number of dwellings from one to two per lot. As almost 80% of the R2 lots are larger than 400 sqm and have only one dwelling, there is high potential for an additional secondary dwelling within this zone.

R3 Medium Density additionally has high potential for infill development. Approximately one third of R3 lots are between 400 and 600 m² and only have one dwelling. These lots may be permitted to have a secondary dwelling. In addition, under the new NSW Government's Low Rise Housing Diversity Code, manor houses with four dwellings may be permitted on lots larger than 600 m². Approximately 43% of the R3 lots are greater than 600 m² and have fewer than four dwellings. Once again, there is high potential for these lots to increase their numbers of dwellings under these planning regulations.

R4 High Density Residential also would have a high potential for infill development. While the number of potential dwellings on lots is dependent on a number of factors, approximately half of the lots currently zoned R4 have only one dwelling and are larger than 400 m². Approximately 10% of the R4 lots currently have 10 or more dwellings. This alone implies that there is potential for a significant increase in number of dwellings without any changes to the current residential zoning.

Table 10. Current residential zoning and infill potential

Zoning	Lots	Current Dwellings	Current Dwellings per Lot	Potential for Infill
R1 General Residential	77	77	1	It is assumed that these lots have already been recently filled with their maximum permissible number of dwellings.
R2 Low Density Residential	4,524	5,025	1.11	Lots >400 m ² may have two dwellings, which may apply to the approximately 80% of lots this size which only have one dwelling.
R3 Medium Density Residential	2,373	3,057	1.29	Lots between 400 and 600 m ² may have two dwellings, which may apply to the approximately one third of lots this size which only have one dwelling. Lots >600 m ² may have four dwellings (i.e. manor house), which may apply to the approximately 43% of lots this size which have fewer than four dwellings.
R4 High Density Residential	818	3,806	4.65	High potential for infill.

In addition to the infill potential, there are 38 residential dwellings along Newbridge Road currently included within the evacuation area that are subject to the above-mentioned voluntary purchase scheme by Council due to their flood risk from the Georges River. It is expected that these lots will eventually be rezoned from residential to recreational, therefore decreasing the number of dwellings to zero in this area.

The infill scenario primarily included additional residential vehicles, but also accounted for the planned expansion from the Liverpool Hospital, which was the only non-residential addition. All other planned non-residential development locations were outside of the floodplain.

Based on information supplied by Council planners and projections published by Profile .id, the intensified development under existing zoning scenario incorporated 1,541 additional evacuating vehicles in the following locations within the study area⁴. These are shown in Figure 17. This includes:

- 821 non-residential vehicles added to the Liverpool Hospital location. This is based on a planned increase of 900 parking spaces to Liverpool Hospital (added to the existing car parking area west of the railway) and adjusted based on the current distribution of commuters between study area residents and non-residents (91.2% of workers in this travel zone come from outside of the study area travel zones)
- 720 residential vehicles were added to flood-affected residential lots in the study based on location-specific increases in dwelling density within R3 and R4 zoned areas, utilising the existing vehicle ownership rate, including:
 - 52 residential vehicles added to 6 Drummond St, Warwick Farm (which is a development proposal which was before Council)
 - 93 residential vehicles added to R3 and R4 zones in Chipping Norton
 - 575 residential vehicles added to R3 and R4 zones in Moorebank

It was decided to exclude the Moorebank Intermodal terminal from the evacuation analysis due to the fact that the majority of the developed part of the site is not directly impacted by the Georges River PMF, and additional land filling associated with this development is expected to occur. The site will only be isolated by the PMF. There should be sufficient opportunity to stop people from going into work, so it is not expected that this large number of workers will be evacuating at the same time as the rest of the study area.

5.5.1 Scenario 3: Planning Proposals

Council also advised of the details for planning proposals that are in progress or have been recently finalised within the study area (Table 11). It included approved development under construction at Site C in Moorebank East which gained approval after model set up had begun. Also, rezoning is already gazetted in Shepherd Street with several developments approved and constructed and others not yet approved. The values for additional evacuating vehicles were added to those from Scenario 2. The numbers of vehicles were calculated based on the provided numbers of new dwellings and jobs. Vehicle ownership rates as per the 2016 census were applied (Table 9).

Note that Scenario 2 evacuation also utilised planned road upgrades as discussed in Section 5.4.4.

Commercial and retail floor space and associated job estimates were supplied by Council. The number of vehicles per job were estimated from the Journey to Work data and multiplied by the number of jobs to estimate the number of cars on site. This value was then adjusted to only account for vehicle drivers coming from outside of the study area based on the ratios calculated from Journey to Work 2011 data for each relevant Travel Zone. For example, the number of jobs created in Moorebank East was multiplied by 0.77 to account for vehicle drivers only, and then multiplied by 0.69 to account for only vehicles coming from outside of the study area. This avoided double counting between residential and non-residential evacuating vehicles.

⁴ It is recognized that this may be an underestimate due to potential redevelopment and intensification of residential areas where there are currently public housing estates within the floodplain (e.g. Hargrave Park). NSW Land and Housing Corporation (LAHC) currently has 1,298 dwellings in the study area across both Warwick Farm and Cartwright (only subject to creek flooding) with an average occupancy of 2 people per dwelling. LAHC has also informed this study that their development projection for the study area over the next 20 years is 481 additional dwellings, with 45% of the additional dwellings in Warwick Farm and 55% in Cartwright.



Figure 17. Locations where vehicles were added in scenario 2, showing potential for intensified development

There was a total of 61,671 vehicles added to the study area in the sites specified in Table 11 and shown in Figure 18.

It was assumed that Sites A, B, C and D at Moorebank east would share an exit via a new bridge onto Brickmakers Road from site C. The trigger level for the evacuation of these subsectors was level of a low Point on Brickmakers Road just south of this bridge.

In the case of Site E it was assumed that it would be constructed with an access road which rose continuously from the site to Brickmakers Road. The evacuation trigger for this site was therefore the 1% AEP flood level which was assumed to be the lowest flood level which would impact the habitable parts of the site.

It was acknowledged that development of Moore Point would involve filling habitable parts of the site to above the 1% AEP flood level. However, the evacuation trigger for this subsector is set by its evacuation route. For the modelling it was assumed that evacuation would be triggered when it was forecast that flooding would exceed 7.5m AHD.

For all other planning proposals the evacuation trigger was the same as it was for that cadastral lot in scenarios 1 and 2.

Scenario 3 evacuation also utilised planned road upgrades as discussed in Section 5.4.4.

Table 11. Additional vehicles in Scenario 3: Planning Proposals

Site	New Dwellings	Additional Population ¹	New Residential Vehicles ¹	New Jobs	New Non-Residential Vehicles	Total New Vehicles
Site A	126	391	255	857	459	714
Site B	602	1,866	1,219	361	193	1,412
Site C	179	555	363	--	--	363
Site D	374	1,159	758	-- ²	--	758
Site E	2,000	6,200	4,052	207	111	4,163
Site F: Moore Point JLG	14,783	45,827	29,950	23,617	18,282	48,232
Site G: Moore Point Rose Group	536	1,662	1,086	91	70	1,156
Site H: The Grove			--	600	462	462
Site I: 240 Gov Macquarie Dr	500	1,200	571	125	80	651
Site J: Warwick Farm Structure Place	1,465	3,516	1,673	800	509	2,182
Site K: 33 Shepherd Street ³	1,200	3,360	1,578	--	--	1,578
Total	21,765	65,736	41,505	26,658	20,166	61,671

1. Based on respective suburb's average people and vehicles per dwelling rates from the 2016 census.

2. There are an estimated 45 employees under Site D's existing deferred commencement consent for a Marina, however the modelling considered the residential planning proposal for the site.

3. This Planning Proposal is already gazetted with some developments approved and constructed and others pending approval.

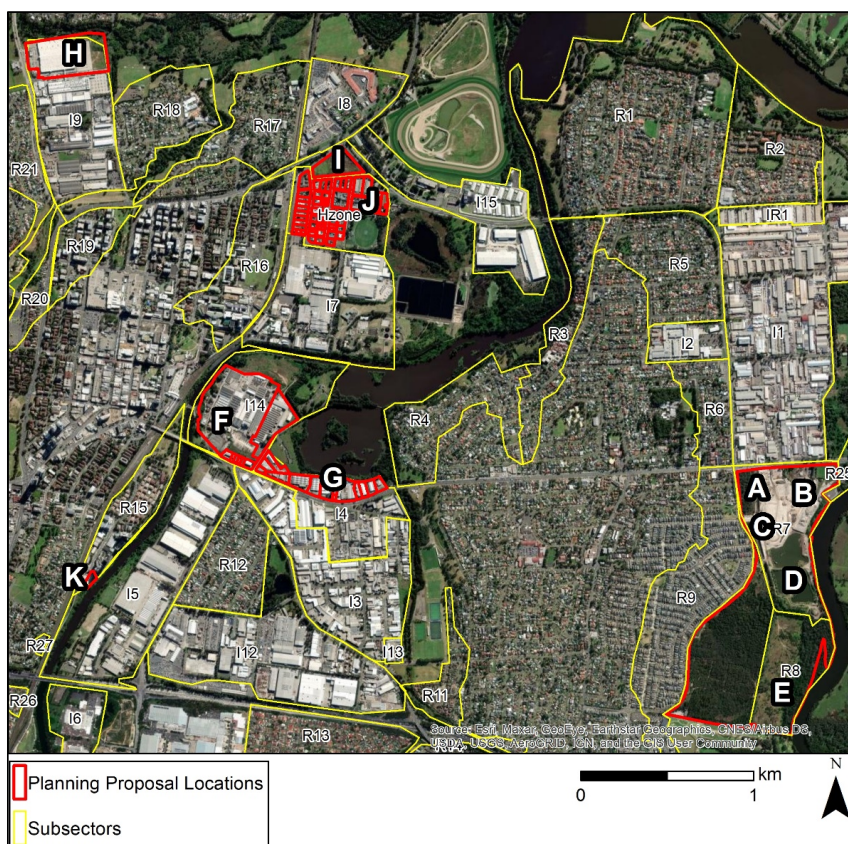


Figure 18. Location of additional planning proposal locations (letters refer to labels in Table 11)

5.5.2 Scenario A: Modified Infill

Following discussions with Council, Scenario 2 was modified and run as Scenario A. It is the same as Scenario 2 but with multiple non-residential vehicle evacuation destinations depending on the origin of the workers. These are:

- M7 north (i.e., the single destination of all vehicles in Scenarios 1, 2 and 3),
- Hume Motorway south,
- Camden Valley Way west, or
- M5 east

Workers' origins were determined from the 2011 Journey to Work data⁵, as used in Scenarios 1, 2 and 3. Based on this data, drivers of vehicles working in the study area but not living in the study area come from:

- 30% come from north of the study area
- 30% come from the east of the study area

⁵ The 2011 Journey to Work data was used since more recent 2016 Journey to Work data with the associated spatial data is not publicly available.

- 20% come from the south of the study area
- 20% come from the west of the study area

Therefore, from each subsector, the above proportions of non-residential evacuees were sent to the respective destinations.

In the case of those heading North, while many may have arrived at work via the Hume Highway or the Cumberland Highway, these roads cannot be relied upon as flood evacuation routes because of their risk of being cut by either Georges River or Cabramatta Creek flooding. Accordingly, the M7 heading north was the only northbound evacuation route in the model.

Furthermore, the M5 heading East is cut but flooding before all of the vehicles with this destination are able to evacuate. Therefore, vehicles with an eastern evacuation destination had their destination changed to North after $t = 7$ in the Georges River PMF timing, as they can no longer travel East. The M7 heading North is their only route to roads travelling east.

Non-residential vehicles from each subsector were each sequentially sent north, east, south and west based on the order in which they would leave.

Consideration was also given to the fact that not all residential evacuees would wish to head north on the M7 with many seeking alternative accommodation with family or friends or at commercial accommodation to the west, south or east or even within flood free areas of the study area. As there was no way to estimate in which direction these would head it was conservatively assumed they would all head north.

Where a planning proposal involved a mixed use development it was assumed that the non-residential traffic would leave first which is likely to be the case in a real evacuation with people more willing to leave their work places than their homes.

Note that Scenario A evacuation also utilised planned road upgrades as discussed in Section 5.4.4. The following evacuation route assumptions were made:

- Arrangements would be made to create a flood emergency access route between Homepride Avenue and Orange Grove Road using existing private accessways
- Camden Valley Way would have two lanes each of 600 vehicles per hour capacity and the vehicle destination is west of the M7 on ramp;
- The Hume Highway south of Camden Valley Way would continue south as three lanes (Campbelltown Road) each with a 600 vehicles per hour capacity, which narrows to two lanes and then a single lane before it merges with the M5;
- The M5 after its M7 offramp would continue south as two lanes each of 600 vehicles per hour capacity until it merges with the Hume Highway;
- Once the Hume Highway and the M5 merge they become the Hume Motorway which continues south as a four lane road;
- While the M5 heading east has three lanes, to account for other traffic streams entering it from elsewhere, the model has assumed that it only has a single lane available for traffic coming from the study area. The evacuation destination is east of the University of Western Sydney Campus (past a low point west of that which can be inundated).

It was recognised that Camden Valley Way can be cut by local flooding in the 1% AEP flood and possibly more frequent events where it crosses Cabramatta Creek and theoretically it does not satisfy NSW SES requirements as a regional flood evacuation route. However, it gets cut for about 2 hours or less in the 0.2% AEP Cabramatta Creek flood. However, there is considerable flood free land in Prestons between the M7 and Cabramatta Creek where evacuating vehicles could wait if required. About 500 vehicles can queue on the two west bound lanes of Camden Valley way between Cabramatta Creek and one of its tributaries to the east. In Scenario A, there are 2,710 non-residential vehicles with a West destination.

5.5.3 Scenario B: Modified Planning Proposals

Following discussions with Council, Scenario 3 was modified and run as Scenario B. This included the following modifications:

- Updated numbers of vehicles from proposed residential and non-residential areas for all developments as per Table 12. This included an assumption that there would only be one vehicle for each new residential apartment building;
- Non-residential vehicle traffic evacuates to multiple destinations depending on the origin of the workers as per the ratios and description in Scenario A (i.e. M7 north, Hume Motorway south, Camden Valley Way west or M5 east) and as per the road modifications in Scenario A;
- The two on ramps from the Hume Highway and M5 would have their capacity increased to 900 vehicles per lane per hour through upgrades as advised by TfNSW;
- An added third lane heading north on the M7 as advised by TfNSW.

Note that Scenario B evacuation also utilised planned road upgrades as discussed in Section 5.4.4.

Table 12. Scenario B assumptions and vehicle numbers

Site	New Dwellings	Additional Population ¹	Vehicles per New Dwelling	New Jobs	New Non-Residential Vehicles	Total New Vehicles
Site A	126	391	1	857	459	585
Site B	602	1,866	1	361	193	795
Site C	179	555	2.03	--	--	363
Site D	374	1,159	1	-- ²	--	374
Site E	1,500	4,650	1	207	111	1,611
Site F: Moore Point JLG	12,200	37,820	1	16,648	12,888	25,088
Site G: Moore Point Rose Group	1,854	5,747	1	6,352	4,917	6,771
Site H: The Grove	--	--	--	600	462	462
Site I and J: Warwick Farm Structure Plan including 240 Gov Macquarie Dr	3,224	7,738	1	925	485	3,709
Site K: 33 Shepherd St ³	1,200	3,360	1	--	--	1,200
Total	21,259	63,286		25,950	19,515	40,958

1. Based on respective suburb's average people per dwelling rate from the 2016 census

2. There are an estimated 45 employees under Site D's existing deferred commencement consent for a Marina, however the modelling considered the residential planning proposal for the site.

3. This Planning Proposal is already gazetted with some developments approved and constructed and others pending approval

In these specific locations, it was assumed that all existing development would be removed before the new development occurred, and so these values were not added to the Scenario 1 or Scenario 2 values within these lots.

6 | Life Safety Model Outputs

6.1 Interpretation of Results

Outputs from the LSM can be presented in a number of ways including interactive animations, videos, graphs and tables. For the purposes of this discussion, screen shots from the animation of the evacuating vehicles have generally been used to illustrate particular points. An AVI files of the model animations have been provided separately so that the outputs can be viewed in more detail than can be conveyed in the static images in this report.

The key to interpreting the screen shots is that:

- Shades of blue represent the extent of the Georges River PMF at a particular time step with deeper shades indicating greater water depth.
- The fine grey lines represent the road network which has been included in the model. This has been edited to block access down inaccessible sections of road which are either permanently closed by a locked gate or are unlikely to be reliable during a flood evacuation because they could be cut by local creek flooding.
- Dark purple squares represent the locations of vehicles at properties which have not yet been ordered to evacuate. Where there are multiple vehicles at a property only one square is visible but in the model there are many vehicles allocated to that location.
- Mauve squares represent vehicles on properties where the occupants have been made aware of the need to evacuate but have not yet evacuated.
- Yellow squares are evacuating vehicles at the location they would be found at the associated time step.
- Red squares are vehicles (or clusters of vehicles) which have been caught by floodwaters
- The time code is shown in the top right corner and displays the hours and minutes relative to the start of flooding in the Georges River PMF design flood event.

As explained in Section 5.4.1, it has been assumed that the evacuation order for each subsector will be given 12 hours prior to its trigger level being reached as this is the anticipated minimum warning time which will be available for flooding exceeding 4.0 m at Liverpool and Milperra Gauges. This means that most subsectors would receive evacuation orders prior to time step 0 in the PMF design flood event.

There are buildings in the model which do not need to be evacuated in the Georges River PMF, which have been included in order to run possible later sensitivity testing taking into account evacuation from local creek flooding while evacuation from the Georges River is also taking place. These remain dark purple for the entire model run.

As advised by the NSW SES, the primary final destination for all evacuation vehicles in the model is traveling north on the M7, although multiple destinations are included for non-residential vehicles in Scenarios A and B. As shown in the screen shots, the majority of traffic evacuates onto the M7 either via the M5 traveling westbound or from the Hume Highway via Camden Valley Way.

6.2 Scenario 1 Results

6.2.1 Raw Results

Appendix B Figures B1 to B6 show excerpts of the Scenario 1 base case LSM at key time steps, which are:

- T = -5:25 hours (Figure B1): The first evacuation wave occurs of vehicles leaving from R25 on Newbridge Road in the east of the study area. These have to evacuate very early before the Georges River cuts Newbridge Road at the western end of the subsector.
- T = -2:55 hours (Figure B2): The next wave of evacuation occurs with vehicles leaving predominantly industrial subareas in west Moorebank (e.g. I3, I5 and I13). Their primary evacuation route is south on Moorebank Avenue to the M5. There are also some low lying homes west of the river (R26) which evacuate onto the Hume Highway at this time.
- T = 0 hours (Figure B3): As the modelled PMF begins to rise, evacuation is underway across the study area. Almost all of Chipping Norton is preparing to evacuate or is already evacuating south onto the M5 via Nuwarra Road and Heathcote Road. The industrial and residential areas in west Moorebank are all preparing to evacuate, evacuating or have already evacuated onto the M5 via Moorebank Avenue. Subsectors in Warwick Farm are preparing or starting to evacuate via the Hume Highway. Lanes of traffic from the M5 and from Camden Valley Way via the Hume Highway are entering the M7 to travel northwest out of the study area. There is significant traffic queueing throughout the Moorebank Peninsula while evacuation traffic on the Hume Highway is travelling more freely.
- T = 5 hours (Figure B4): Floodwater approaches properties on the Moorebank peninsula, including in Chipping Norton. All properties that have not yet evacuated on the Moorebank peninsula are prepared to evacuate, however there is extensive queueing to get onto the M5 via Nuwarra Road and Heathcote Road. The remaining vehicles from subareas in west Moorebank are evacuating. Vehicles from Warwick Farm subsectors I9 and R18 are starting to evacuate but have no evacuation routes on public roads which do not cross a low point on a local creek and so in the model are trapped within their subsectors due to road cuts. Traffic continues to merge onto the M7 from the M5 and from Camden Valley Way/ Hume Highway but with six lanes merging into two there is queueing on the Hume Highway and even longer queues on the M5. Nuwarra Road is at capacity with queued vehicles and other roads leading into it are also experiencing queueing.
- T = 12 hours (Figure B5): Traffic traveling to the M7 is queued on the M5 over the Georges River, and on the Hume Highway. Access onto the M5 from Moorebank Avenue is cut by floodwaters at t = 11 and the M5 itself is cut nearby at t = 12.5. At this latter point the Moorebank peninsula becomes a high flood island. Some vehicles from I1, R1, R2 and IR1 in Chipping Norton have been caught by floodwaters.
- T = 28:30 hours (Figure B6): At the end of modelled PMF, the number of vehicles that are caught by the flood water (red cells) at the end of the model are:
 - I1 (Chipping Norton): 94 vehicles
 - IR1 (Chipping Norton): 6 vehicles
 - R1(Chipping Norton): 11 vehicles
 - R2(Chipping Norton): 22 vehicles
 - **Total: 133 vehicles**

The subsectors that are trapped due to a lack of flood free road access are:

- I9 (Warwick Farm): 258 vehicles
- R18(Warwick Farm): 237 vehicles
- **Total: 495 vehicles**

The primary evacuation routes utilised in the model are:

- The primary route for Chipping Norton and Moorebank East onto the M5 is via Nuwarra Road and the Heathcote Road on ramp. This route has extensive queueing throughout the model.
- Moorebank West enters the M5 via the Moorebank Avenue on ramp.
- Traffic from the Hume Highway which is a primary route for vehicles from Warwick Farm and Liverpool CBD, enters the M7 via Camden Valley Way.

6.2.2 Applying the Traffic Safety Factor

The modelling results presented in the preceding discussion represent evacuee and evacuation traffic behaviour based on assumptions set out by the NSW SES in its Timeline Evacuation Model. However, LSM does not account for the NSW SES recommended Traffic Safety Factor (TSF). This is normally added to the time taken to evacuate an area to account for the potential for incidents such as vehicle accidents or breakdowns, fallen trees or power lines or water across the road.

Appendix C shows the TSF calculated for each subsector based on the elapsed time that there are vehicles travelling out of the subsector (time on road (TOR)). The difference between the Required Time (which equals TSF + Warning Acceptance Factor + Warning Lag Factor+ TOR) and the Available Time, the subsectors that do not have enough time to evacuate (i.e. a negative Surplus Time) have been identified.

Based on initial calculations, these subsectors are: R18, I9, R17, R27, R11, I1, R1, R2, I2, R16, R5, and R3. However, a more detailed analysis accounting for the time it takes for floodwaters to rise within each subsector with rising road access showed that several of these subsectors are likely do have enough time to evacuate because vehicles will be able to evacuate before flood waters reach them even accounting to the TSF.

The remaining subsectors that would have a problem directly when accounting for TSF are:

- R18 (Warwick Farm)
- I9 (Warwick Farm)
- I1 (Chipping Norton)
- R1 (Chipping Norton)
- R2 (Chipping Norton)
- IR1 (Chipping Norton)

R18 and R9 are a special case because they do not have any evacuation route on a public road which does not involve a low level creek crossing. Thus, these subsectors cannot evacuate irrespective of whether the TSF is taken into account.

Subsectors I1, R1, R2 and IR1, which are all in Chipping Norton, are low flood islands which will all have less time to get past the evacuation route low point before it is cut by floodwaters when the TSF is taken into account. However, because the traffic is queued back into these subsectors and not moving for a few hours before their evacuation routes are cut, accounting for the traffic safety factor makes no difference to the number of trapped vehicles here.

Vehicles that do not make it west of the low point on the M5 located at the Moorebank Avenue underpass would become trapped on the Moorebank peninsula. This includes all vehicles queued in Chipping Norton and Moorebank, and queued on the M5 to the east of this point. As mentioned previously, this point gets cut at $t=12.5$ in the model. However, to account for a 3 hr TSF, the number of vehicles east of this point were counted in the model at $t = 9.5$ (Figure 19). A total of 2,367 vehicles,

originating from the following subsectors, would be trapped within the Moorebank Peninsula. Note that these numbers include those that are eventually overtaken by floodwaters.

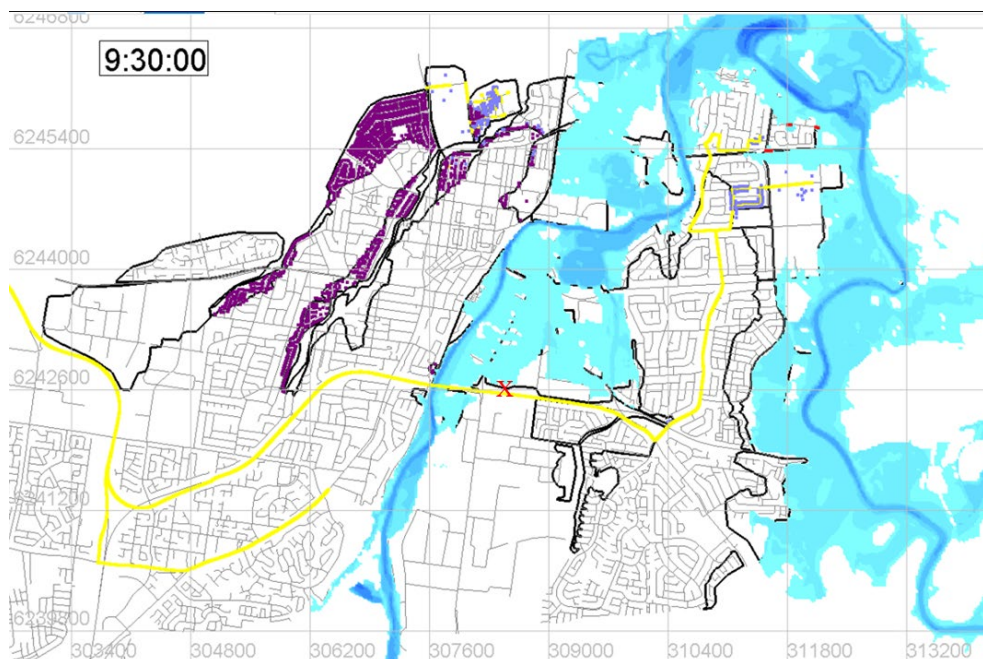


Figure 19. Georges River PMF timestep 9.5 with X at road cut location on the M5 (Scenario 1: Base Case)

6.2.3 Scenario 1 Summary

The results of Scenario 1: Base Case are summarised in Table 13 and Figure 20. To assist in interpreting the table:

- Vehicles on a road (driving or queuing) when the road is inundated by floodwaters are referred to as “caught” by floodwaters.
- Vehicles that do not have a possible evacuation route on public roads (that do not cross a low point on a local creek/ flooded road) are “trapped due to a lack of flood free access” and cannot evacuate from their subsectors.
- It is estimated that the model accounts for, on average, less than two people per vehicle (an average of between 1.5 to 2 people per residential vehicle and one person per non-residential vehicle).

Table 13. Scenario 1: Base Case (2016) Results

Caught by flood waters	Trapped due to a lack of flood free road access	Trapped on the Moorebank Peninsula ¹
I1 (Chipping Norton): 94 vehicles	I9 (Warwick Farm): 258 vehicles	I1(Chipping Norton): 695 vehicles
IR1 (Chipping Norton): 6 vehicles	R18 (Warwick Farm): 237 vehicles	I2(Chipping Norton): 88 vehicles
R1 (Chipping Norton): 11 vehicles		IR1 (Chipping Norton): 1 vehicle
R2(Chipping Norton): 22 vehicles		R1 (Chipping Norton): 469 vehicles
		R2 (Chipping Norton): 368 vehicles
		R3 (Chipping Norton): 16 vehicles
		R5 (Chipping Norton): 674 vehicles
		R6 (Chipping Norton): 50 vehicles
		R11 (Moorebank): 6 vehicles
Total: 133 vehicles	Total: 495 vehicles	Total: 2,367 vehicles

1. These numbers include those that are eventually overtaken by floodwaters in Chipping Norton.

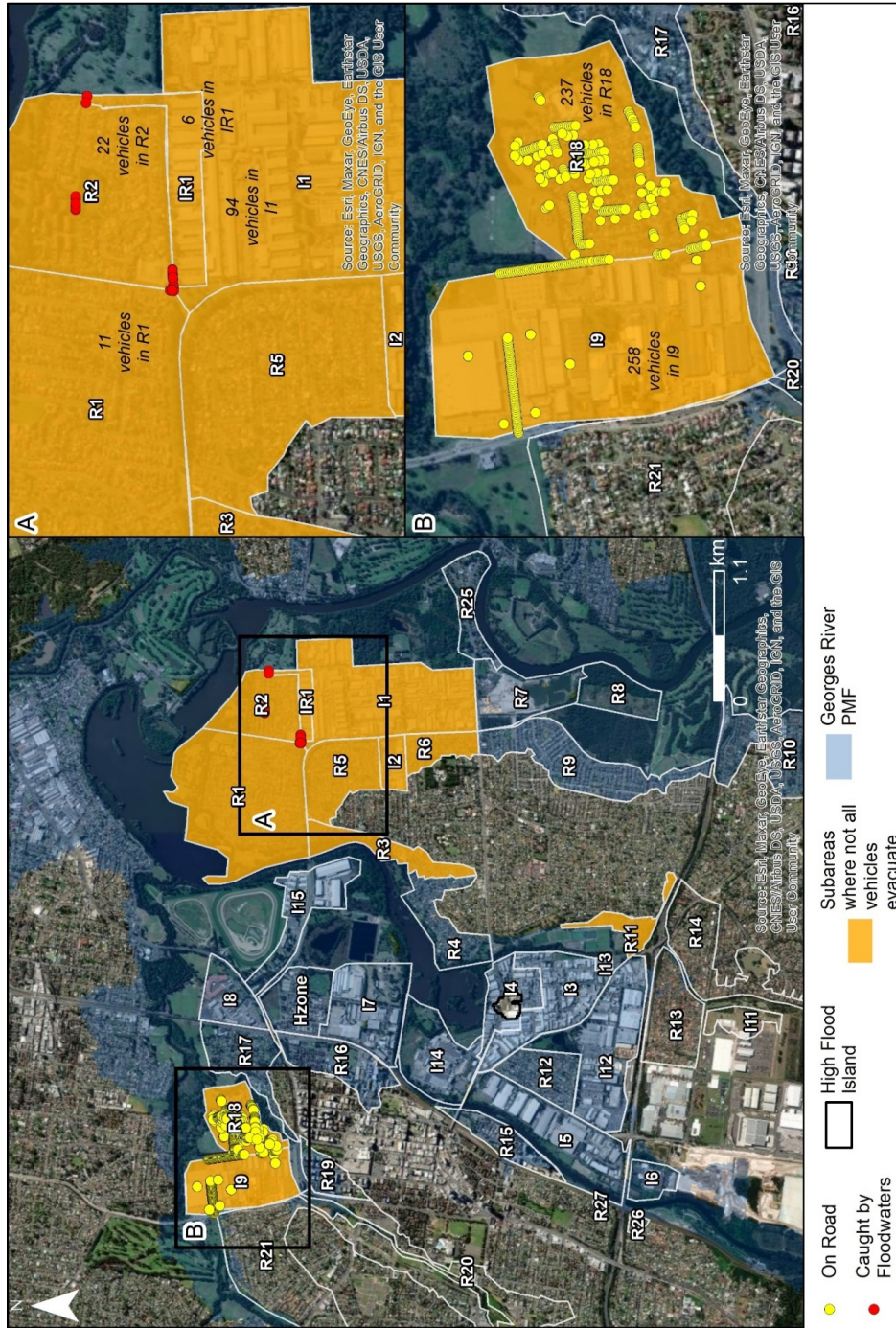
These results indicate that 2,862 vehicles (with one to two people per vehicle), or about 10% of the approximately 27,500 total modelled vehicles, do not successfully evacuate and are affected by flooding in Scenario 1.

6.3 Scenario 2 Results

While Scenario 2 includes 1,541 additional vehicles compared to the base case, evacuation benefits from additional road capacity. In particular, the planned two-lane addition to the M5 over the Georges River (included based on advice from Council) improves evacuation capacity from Moorebank and Chipping Norton because some of the traffic from the M5 goes onto the Hume Highway and utilises spare capacity on that road and its on-ramp to the M7 which was not being fully utilised in the base case.

Appendix B Figures B7 to B9 show excerpts of the Scenario 2 at key time steps where they differ from the base case. These are:

- T = 5 hours (Figure B7): As in the base case, there is still some queueing to get onto the M5 via Nuwarra Road, however this is reduced due to the additional two westbound M5 lanes. There is additional queueing on the Hume Highway to get onto the M7 via the Camden Valley Way compared to the base case because some M5 traffic has been diverted onto the Hume Highway.
- T = 12 hours (Figure B8): By the time the M5 westbound is cut by floodwaters, more vehicles have been able to evacuate from the Moorebank peninsula compared to the base case (i.e. no vehicles from R1 are caught by floodwaters, and 20 fewer vehicles from R2 are caught by floodwaters). There is significant queueing on the Hume Highway, which is back up to Liverpool, slowing evacuation from Warwick Farm and Liverpool CBD. This did not happen in the base case and has been caused by traffic from the M5 taking up capacity on the Hume Highway
- T = 28.5 hours (Figure B9): At the end of the modelled PMF, accounting for the TSF, 155 vehicles are caught by flood waters (red cells)



This is 22 vehicles more than in the base case, and the vehicles are from different subsectors. Whereas the base case had a total of 133 vehicles from northern Chipping Norton caught by floodwaters, in Scenario 2, this is reduced to 106 vehicles. The remaining 49 vehicles caught by flood waters are from R16, which is the subarea including Liverpool Hospital. It is noted that the model sends vehicles along the shortest route to the M7 and where these vehicles are trapped in Liverpool there are other flood free routes above the PMF which are available, so they are not likely to actually get trapped.

The subsectors that are trapped due to a lack of flood free road access are the same as in the base case:

- I9 (Warwick Farm): 258 vehicles
- R18 (Warwick Farm): 237 vehicles
- **Total: 495 vehicles**

A total of 399 vehicles are trapped on the Moorebank peninsula when the M5 gets cut at t = 9.5. Note that these numbers include those that are eventually overtaken by floodwaters.

The primary evacuation routes utilised in the model are:

- Chipping Norton and Moorebank East use the M5 via Nuwarra Road and the Heathcote Road on ramp. The traffic moves more quickly on the M5 westbound due to the additional M5 lanes diverting of some of that traffic onto the Hume Highway.
- Moorebank West enters the M5 via the Moorebank Avenue on ramp, which has less queueing compared to the base case due to the additional M5 lanes diverting of some of that traffic onto the Hume Highway.
- Scenario 2 has more queueing on the Hume Highway than the base case, as vehicles travel to the M7 via Camden Valley Way. This is the primary route for vehicles from Warwick Farm and Liverpool CBD. This additional queueing is because some of the M5 traffic is diverted onto the Hume Highway.

The results of Scenario 2: Infill are summarised in Table 14 and Figure 21.

Table 14. Scenario 2: Future Infill with Existing Zoning Results

Caught by flood waters	Trapped due to a lack of flood free road access	Trapped on the Moorebank Peninsula ¹
I1 (Chipping Norton): 94 vehicles	I9 (Warwick Farm): 258 vehicles	I1 (Chipping Norton): 57 vehicles
IR1 (Chipping Norton): 10 vehicles	R18 (Warwick Farm): 237 vehicles	I2 (Chipping Norton): 21 vehicles
R2 (Chipping Norton): 2 vehicles		IR1 (Chipping Norton): 1 vehicle
R16 (Liverpool): 49 vehicles		R1 (Chipping Norton): 125 vehicles
		R2 (Chipping Norton): 83 vehicles
		R5 (Chipping Norton): 106 vehicles
		R11 (Moorebank): 6 vehicles
Total: 155 vehicles	Total: 495 vehicles	Total: 399 vehicles

¹Note that these numbers include those that are eventually overtaken by floodwaters in Chipping Norton.

These results indicate that 943 vehicles (with one to two people per vehicle), or about 3% of the approximately 29,000 total modelled vehicles, do not successfully evacuate and are affected by flooding in Scenario 2.

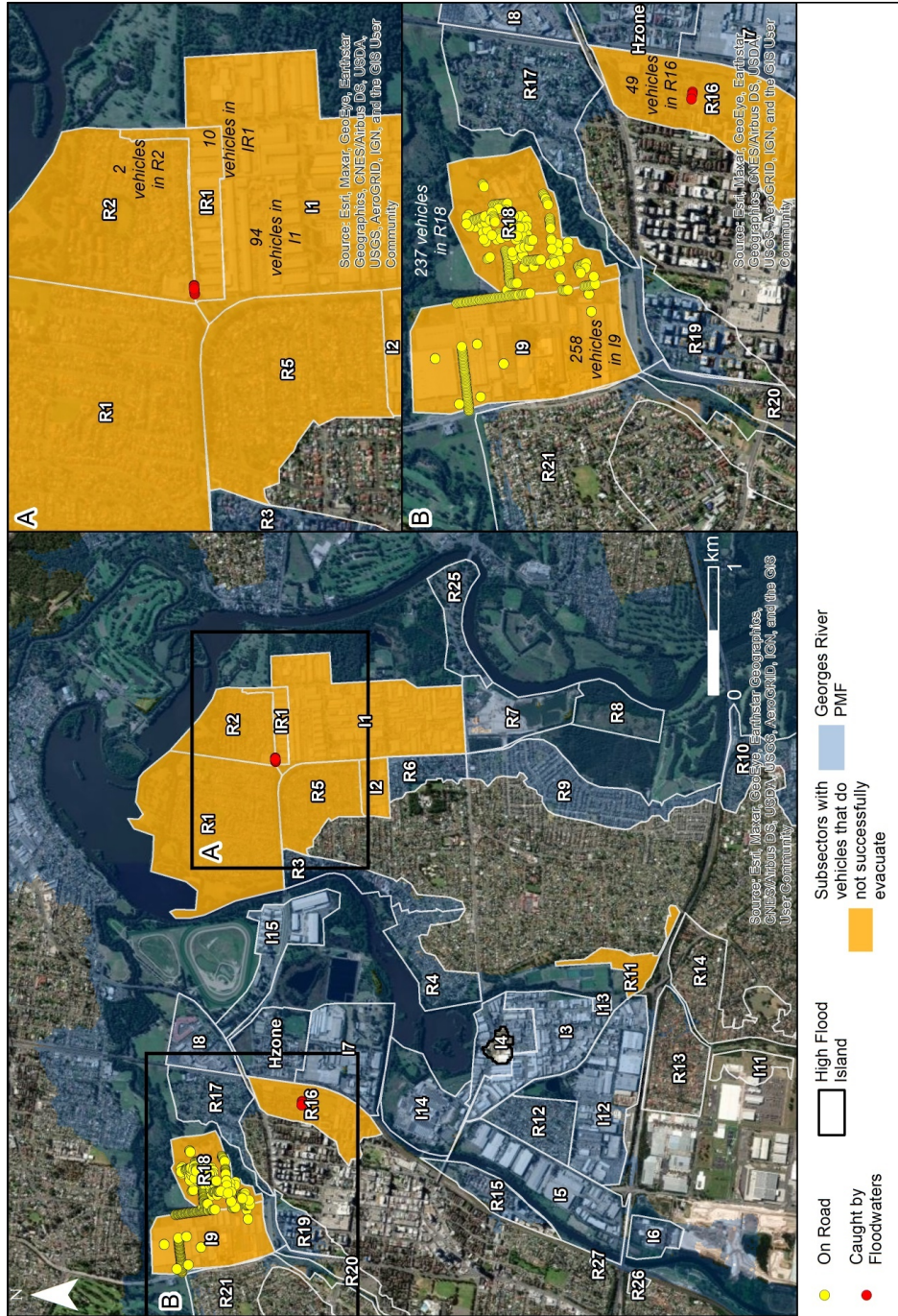


Figure 21. End results of Scenario 2 showing subsectors where vehicles do not successfully evacuate, and vehicles trapped on the road or caught by floodwaters.

6.4 Scenario 3 Results

Scenario 3 includes the addition of 61,671 vehicles in the study area. Appendix B Figures B10 to B14 show excerpts of Scenario 3 LSM at key time steps where they differ from the base case. These are:

- T = -2:55 hours (Figure B10): Due to the large number of additional vehicles, there is immediately queuing as soon as evacuation starts in western Moorebank. There is a bottleneck as traffic enters the M5 westbound via Moorebank Avenue.
- T = 0 hours (Figure B11): Compared to the base case, there is more queueing throughout the entire study area. While there is road capacity still available on the M5 due to the addition of the two additional westbound lanes, there are bottlenecks at the M5 on ramps at Moorebank Avenue and Heathcote Road which are both single lane. There is also significant queuing on the Hume Highway and Camden Valley Way to get onto the M7 from Liverpool and Warwick Farm.
- T = 5 hours (Figure B12): Despite the additional westbound M5 road capacity compared to the base case, there are traffic bottlenecks at the M5 on ramps at both Moorebank Avenue and Heathcote Road. Compared to the base case, there are many more vehicles remaining on properties ready to evacuate in Moorebank (i.e. I4 and R12) where they cannot yet leave, as the roads are too full to accommodate additional vehicles. In addition, there is significant queuing to get onto the M7 via the Hume Highway. In Warwick Farm, there are also many vehicles ready to evacuate that cannot leave due to lack of road capacity, while in the base case, vehicles in this area had already been evacuated.
- T = 12 hours (Figure B13): There remains extensive queuing on all primary evacuation routes, as vehicles have been caught by flood waters throughout the study area in Chipping Norton, Moorebank, Warwick Farm and Liverpool. There are vehicles stranded on the roads and on the properties on a high flood island that forms in I4 in west Moorebank, that reduces in size as PMF flood waters continue to rise. There are still vehicles that are ready to evacuate but cannot due to lack of road capacity in Chipping Norton, Warwick Farm and Moorebank.
- T = 28:30 hours (Figure B14): At the end of the modelled PMF, accounting for TSF, 51,199 vehicles are caught by flood waters (red cells)

As opposed to Scenarios 1 and 2 where only four subareas had vehicles caught by flood waters, Scenario 3 results in vehicles trapped in flood waters throughout the entire study area, in Moorebank, Chipping Norton, Liverpool and Warwick Farm.

The subsectors that are trapped due to a lack of flood free road access are the same as in the base case, however there are more vehicles that have been unable to evacuate from I9 because there are more vehicles in that area due to the planning proposal:

- I9 (Warwick Farm): 720 vehicles
- R18 (Warwick Farm): 237 vehicles
- **Total: 957 vehicles**

A total of 8,679 vehicles (including those that are eventually overtaken by floodwaters) are trapped on the Moorebank peninsula when the M5 gets cut. There are 9,673 vehicles also trapped on the roads in I4 in western Moorebank, where a small high flood island remains.

The results of Scenario 3: Planning Proposals are summarised in Table 15 and Figure 22.

Table 15. Scenario 3: Future Planning Proposals

Caught by flood waters		Trapped due to a lack of flood free road access	Trapped on roads/ Moorebank Peninsula
R1 (Chipping Norton): 956	R2 (Chipping Norton): 647	I9 (Warwick Farm): 720	I4 (Moorebank): 9,673 vehicles trapped on the high flood island
I1 (Chipping Norton): 1,514	R5 (Chipping Norton): 35	R18 (Warwick Farm): 237	8,579 vehicles trapped on the Moorebank Peninsula ¹
IR1 (Chipping Norton): 104	R6 (Chipping Norton): 258		
I14 (Moorebank): 38,171	R7 (Moorebank): 996		
I4 (Moorebank): 891	R8 (Moorebank): 1,353		
I5 (Moorebank): 33	R9 (Moorebank): 956		
R12 (Moorebank): 122	R15 (Liverpool): 510		
I12 (Moorebank): 659	I7 (Liverpool): 782		
R16 (Liverpool): 1,421	R17 (Warwick Farm): 74		
Hzone (Warwick Farm): 1,717			
Total: 51,199 vehicles		Total: 957 vehicles	Total: 18,252 vehicles

¹Note that these numbers include those that are eventually overtaken by floodwaters in Chipping Norton and Moorebank.

These results indicate that at least 61,829 vehicles (with one to two people per vehicle), or about 69% of the approximately 89,200 total modelled vehicles, do not successfully evacuate and are affected by flooding in Scenario 3 (note that, to avoid double counting, this estimate does not include the count of additional vehicles trapped on the Moorebank Peninsula but not caught by floodwaters in Table 15).

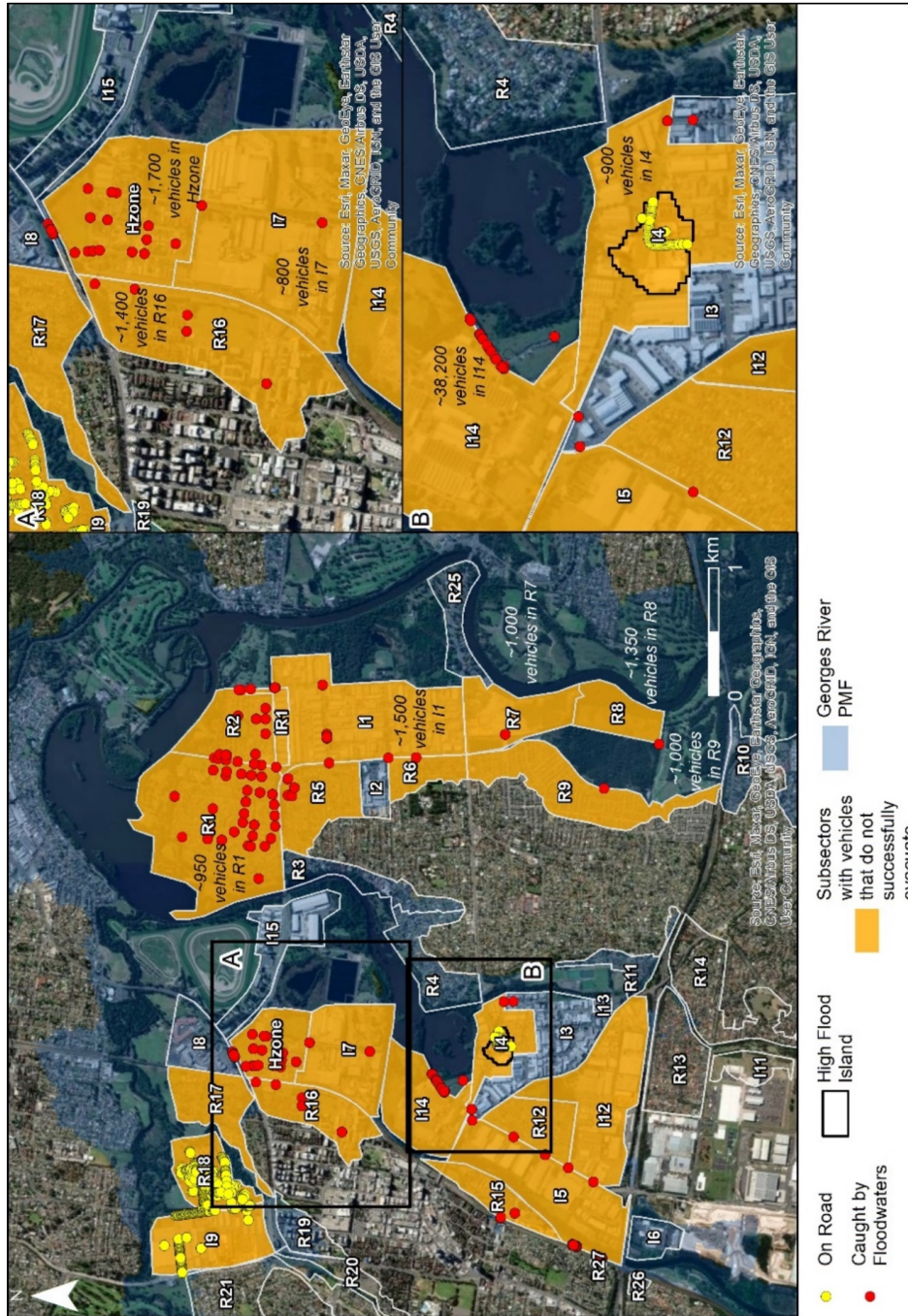


Figure 22. End results of Scenario 3 showing subsectors where vehicles do not successfully evacuate, and vehicles trapped on the road or caught by floodwaters.

6.5 Scenario A Results

Scenario A represents an improvement from Scenario 2, as non-residential traffic has additional evacuation destinations and a private evacuation route has been included to account for I9 and R18 evacuation. There are slightly fewer vehicles trapped in total compared to Scenario 2. These vehicles come from the same subsectors as Scenario 2, however slightly more vehicles are trapped from some subsectors and slightly fewer from other subsectors. This is likely due to the random merging of vehicles in the model. Appendix B Figures B15 through B18 show excerpts of the Scenario A model run at key time steps. These are:

- T = -2:55 hours (Figure B15): Vehicles leave predominantly industrial subareas in west Moorebank (e.g. I3, I5 and I13). The primary evacuation routes are south on Moorebank Avenue to the M5, or on the Hume Highway for vehicles originating from west of the river (e.g. R26). Non-residential vehicles also travel east on the M5. Vehicles whose destinations are west or south are travelling west on Newbridge Road to the Hume Highway.
- T = 5 hours (Figure B16): As in the previous scenarios, there is still some queueing to get onto the M5 via Nuwarra Road, however this is reduced compared to previous scenarios. Evacuation of western Moorebank is occurring more quickly compared to Scenario 2. There is less queueing on the Hume Highway to get onto the M7 via the Camden Valley Way compared to Scenario 2.
- T = 8:35 hours (Figure B17): At this time, the first vehicles are overtaken by floodwaters in Chipping Norton (IR1). This is because of the amount of queueing on Nuwarra Road, preventing all of northern Chipping Norton from evacuating before the roads flood. It is also noted that vehicles are able to evacuate from I9 and R18 due to the provision of flood-free road access through subsector I9.
- T = 28.5 hrs (Figure B18): At the end of the modelled PMF, accounting for TSF, there are 97 vehicles caught by floodwaters (red cells).
- When the Moorebank Peninsula is cut off by floodwaters, accounting for TSF, there are 227 vehicles trapped on the Moorebank peninsula accounting for TSF. The above vehicles caught by floodwaters are included in the numbers below, but all of these vehicles do not necessarily get overtaken by floodwaters as they rise, as there is some queueing capacity on the roads above the floodwaters.

The detailed results of Scenario A are summarised in Table 16 and Figure 23.

Table 16. Scenario A: Modified Future Infill Results

Caught by flood waters	Trapped on the Moorebank Peninsula ¹	Trapped due to a lack of flood free road access
I1 (Chipping Norton): 93 vehicles	I1 (Chipping Norton): 19 vehicles	
IR1 (Chipping Norton): 4 vehicles	I2 (Chipping Norton): 21 vehicles	
	IR1 (Chipping Norton): 7 vehicles	
	R1 (Chipping Norton): 64 vehicles	
	R2 (Chipping Norton): 4 vehicles	
	R5 (Chipping Norton): 106 vehicles	
	R11 (Moorebank): 6 vehicles	
Total: 97 vehicles	Total: 227 vehicles	None

¹Note that these numbers include those that are eventually overtaken by floodwaters in Chipping Norton.

These results indicate that 227 vehicles (with one to two people per vehicle), or less than 1% of the approximately 29,000 total modelled vehicles, do not successfully evacuate and are affected by flooding in Scenario A.

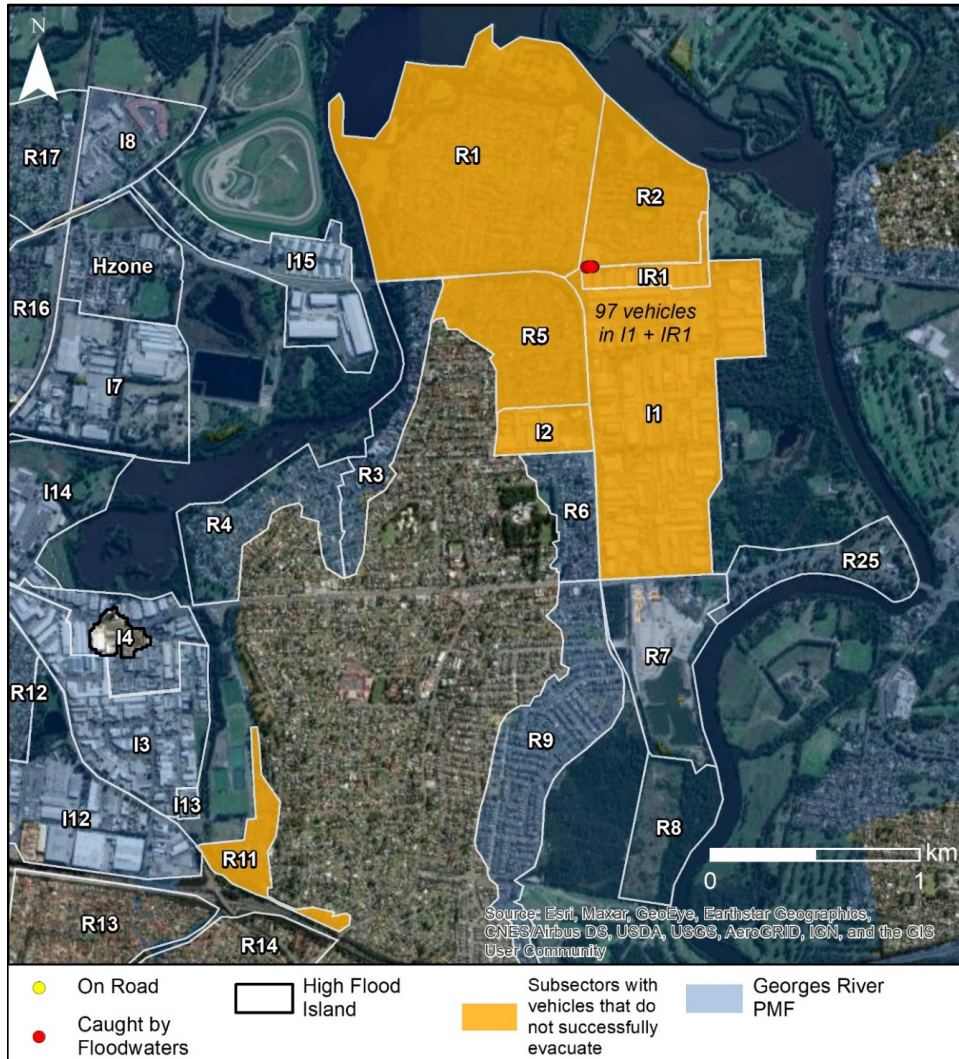


Figure 23. End results of Scenario A showing subsectors where vehicles do not successfully evacuate, and vehicles trapped on the road or caught by floodwaters.

6.6 Scenario B Results

Scenario B represents an improvement from Scenario 3, as there are fewer evacuating vehicles and non-residential traffic have additional evacuation destinations. Appendix B Figures B19 to B23 show excerpts of the Scenario B model run at key time steps. These are:

- T = -2:55 hours (Figure B19): Vehicles leave industrial and residential subareas in west Moorebank (e.g. I3, I5 and I13). The primary evacuation routes are south on Moorebank

Avenue to the M5, or on the Hume Highway for vehicles originating from west of the river (e.g. R26). Non-residential vehicles also travel east on the M5.

- T = 0 hours (Figure B20): By this point, there is queueing throughout the study area. There is queueing throughout Chipping Norton and Moorebank to get on the M5 via Nuwarra Road, in Moorebank west to get on the M5 via Moorebank Avenue, and in Warwick Farm on the Hume Highway to get onto the M7 via the Camden Valley Way. Non-residential vehicles are also still travelling east on the M5.
- T = 5:00 hours (Figure B21): There is extensive queueing throughout the study area, including in Moorebank, Chipping Norton, Liverpool and Warwick Farm. Many vehicles throughout these areas are not able to enter the roads yet since they are at capacity.
- T = 8:05 hours (Figure B22): The first vehicles are overtaken by floodwaters in I3 as floodwater rise in western Moorebank. Floodwaters approach houses in Chipping Norton, Warwick Farm and Moorebank East, which have not yet fully evacuated. It is also noted that vehicles are able to evacuate from I9 and R18 due to the provision of flood-free road access through subsector I9.
- T = 28:30 hours (Figure B23): At the end of the modelled PMF, accounting for TSF, there are 32,178 vehicles caught by floodwaters (red or orange cells).
- When the Moorebank Peninsula is cut off by floodwaters, accounting for TSF, there are 8,040 vehicles trapped on the Moorebank peninsula accounting for TSF. The above vehicles caught by floodwaters are included in the numbers below.

The results of Scenario B are summarised in Table 17 and Figure 24.

Table 17. Scenario B: Modified Future Planning Proposals Results

Caught by flood waters	Trapped on the Moorebank Peninsula ¹	Trapped due to a lack of flood free road access
R1 (Chipping Norton): 955 vehicles	R1 (Chipping Norton): 1,134 vehicles	
R2 (Chipping Norton): 635 vehicles	R2 (Chipping Norton): 868 vehicles	
R5 (Chipping Norton): 36 vehicles	R3 (Chipping Norton): 314 vehicles	
IR1 (Chipping Norton): 102 vehicles	R5 (Chipping Norton): 722 vehicles	
I1 (Chipping Norton): 1,311 vehicles	R6 (Chipping Norton): 322 vehicles	
R16 (Liverpool): 53 vehicles	IR1 (Chipping Norton): 103 vehicles	
R17 (Warwick Farm): 74 vehicles	I1 (Chipping Norton): 1,660 vehicles	
I7 (Liverpool): 1,155 vehicles	I2 (Chipping Norton): 206 vehicles	
I4 (Moorebank): 2,903 vehicles (note: many of these are trapped on the small high flood island in I4)	R9 (Moorebank): 99 vehicles	
I14 (Moorebank): 23,391 vehicles	R11 (Moorebank): 6 vehicles	
Hzone (Warwick Farm): 1,563 vehicles	I4 (Moorebank): 2,584 vehicles	
	I14 (Moorebank): 22 vehicles	
Total: 32,178 vehicles	Total: 8,040 vehicles	None

¹ Note that these numbers include those that are eventually overtaken by floodwaters in Chipping Norton and Moorebank.

These results indicate that at least 32,178 vehicles (with one to two people per vehicle), or about 48% of the approximately 67,500 total modelled vehicles, do not successfully evacuate and are affected by flooding in Scenario B (note that, to avoid double counting, this estimate does not include the count of additional vehicles trapped on the Moorebank Peninsula but not caught by floodwaters in Table 17).

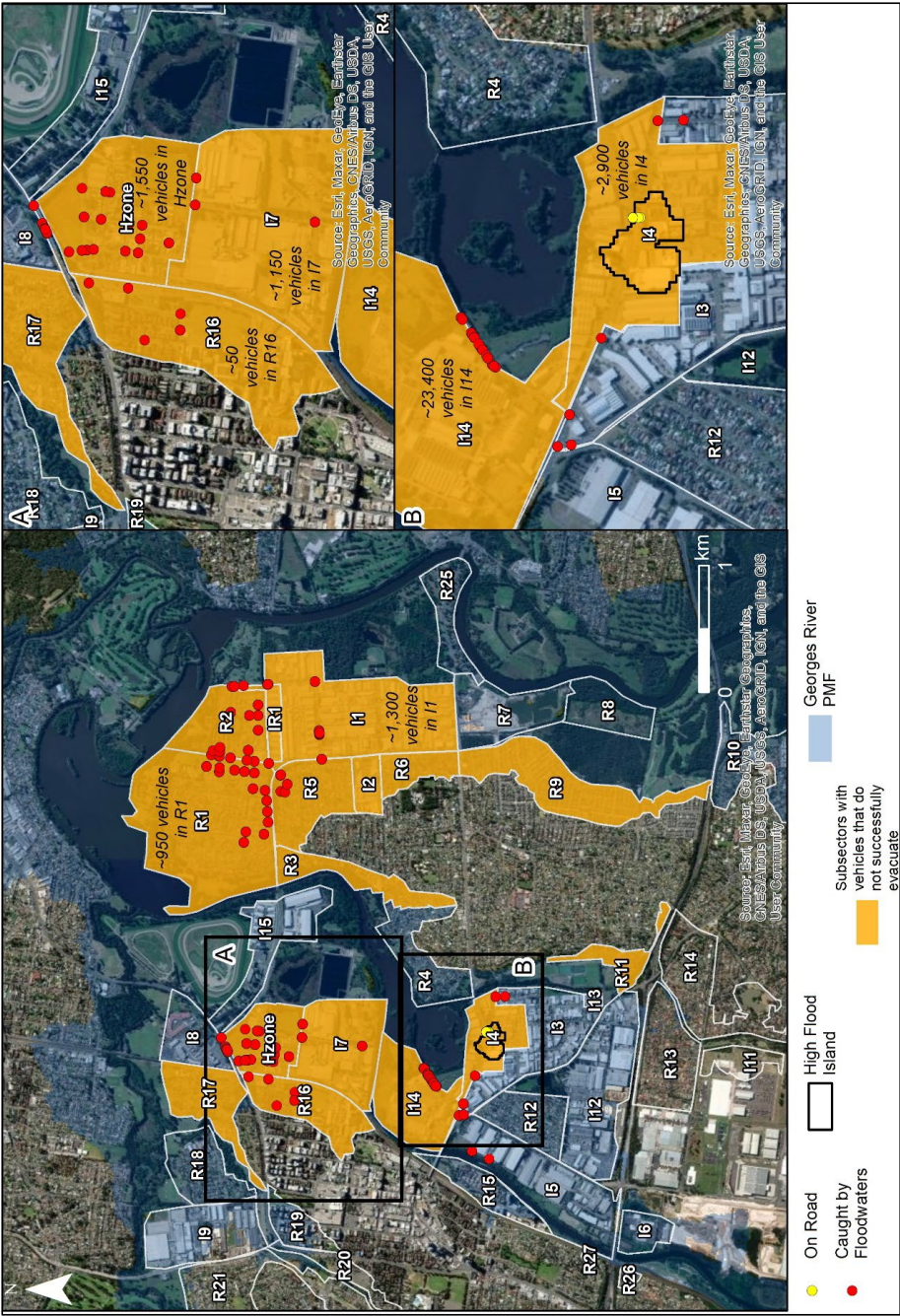


Figure 24. End results of Scenario B showing subsectors where vehicles do not successfully evacuate, and vehicles trapped on the road or caught by floodwaters.

6.7 Sensitivity Analysis

With any modelling it is appropriate to consider the sensitivity of the outputs to the model's assumptions and inputs.

It would be fair to say that most, but not all, of the assumptions used in the modelling, including those recommended by the NSW SES, are conservative and so the modelling results presented in this report present a worst case, extremely low probability scenario.

While it is important to understand the worst possible case when undertaking analyses with regard to loss of life, particularly when tens of thousands of people are involved, when evacuation consequences are inconvenient rather than fatal (such as long traffic queues), more likely outcomes may be tolerable.

The following observations are made with regard to the sensitivity of the model outputs to changing key parameters.

6.7.1 Flood Behaviour

It has been assumed that the Georges River flood will be rising as fast as the design PMF. While it is possible that floods smaller than a PMF could rise as quickly as a PMF, the assumed rate of rise is likely to be at the upper end of the scale with regard to rates of rise across the full spectrum of flood probabilities.

Nevertheless, it is possible that some floods could rise more quickly than the design flood. One way to determine where the flood used in the modelling sits in that regard would be to undertake a Monte Carlo analysis of different temporal spatial rainfall distributions across the catchment. However, this exercise may not be practical for the Georges River catchment due to the high level of computational capacity required. Alternatively, selected additional flooding scenarios could be considered for the assessment of evacuation performance beyond the scope of this study, and the modelled outputs from this study could be interpreted to determine the potential evacuation constraints during other flooding events.

Provision of and Requirements for Flood Warning (NSW SES, 2019) states that the target warning lead time for the Liverpool and Milperra gauges above 4.0 m gauge height is 12 hrs. It defines the Target Warning Lead Time as the minimum lead time that will be provided before the height or the flood class level is exceeded. It makes no statements about this being dependent on the rate of rise of the flood because presumably it is dictated by the travel time of fallen rain and river flows from the upstream gauge locations to Liverpool whereas the rate of rise is determined by the amount of rain which has fallen. Therefore, the warning time available is a minimum of 12 hrs regardless of the rate of rise of the flood. It is noted that a more comprehensive flood forecasting and warning system for the Georges River may be able to extend the available warning time and therefore reduce evacuation constraints. This might include development of a Georges River Probabilistic Forecast product.

However, were a flood to rise faster than has been modelled that would compress the duration of the evacuation and more subsectors are likely to be using evacuation routes simultaneously which would increase congestion and queuing and is likely to result in more vehicles being trapped by floodwaters.

Any slower rate of rise than that used in the modelling would provide more time for evacuees to depart and result in less risk of evacuees being trapped.

On balance, most floods would have more time for evacuation than has been modelled rather than less.

6.7.2 Number of Premises Evacuating

The number of existing premises in 2016 is likely to be quite accurate and the number of premises in future planning proposals can be controlled by the urban planning process. The main unknown in the modelling of the future development scenarios is the extent of infill development and intensification which will take place under existing zonings. While planning controls permit duplexes and granny flats on average sized blocks, town houses on large blocks and residential flat buildings on R3 and R4 zoned land, there is nothing preventing growth in dwelling numbers beyond what has been assumed in the modelling. The numbers used in the modelling are the best available forecasts but they could be high or low.

Where infill development takes place will have a significant impact on evacuation capacity.⁶

The model has been set up so that creek and overland flow flooding can also be incorporated to test the impact of concurrent flooding from another source during a Georges River flood. This sensitivity analysis is yet to be run. In the current model scenarios, only areas impacted by Georges River flooding evacuate.

Although there are no warning systems for flooding of the creeks and the NSW SES is unlikely to have sufficient lead time to issue evacuation orders, people may self-evacuate and add to the evacuation traffic on the road network. This is less likely to be problematic from flooding on Brickmakers Creek, Cabramatta Creek and Maxwell's Creek as they would be evacuating onto the Hume Highway in a location where in most scenarios it has some spare capacity. Furthermore, there are numerous streets between these creeks and the Highway where vehicles could queue above the reach of floodwaters.

Flooding from Anzac Creek may be more problematic as it may increase the evacuation loads on Nuwarra Road and Heathcote Road which already have capacity issues which are preventing vehicles evacuating in some scenarios.

The 2016 Census indicates that dwellings in Liverpool LGA had an average occupancy rate of about 95% on Census night. That means that when a flood occurs about 5% of the dwellings could be unoccupied and therefore not have to evacuate. As this discounting has not been applied then the modelling may be overestimating the number of evacuating residential vehicles by about 5%.

Overall, the number of premises evacuating in the modelling is likely to be at the upper end of possible estimates.

6.7.3 Number of Evacuating Vehicles

The numbers of vehicles per dwelling have been derived from Census data and while the number of vehicles per person has been increasing in Australia and Liverpool LGA, the number of people per dwelling has been declining (steady in Liverpool LGA from 2011 to-2016). It is therefore unlikely that the number of vehicles per dwelling would continue to increase substantially. This is particularly likely to be the case in those parts of the study area which are close to the Liverpool CBD and are well serviced by public transport.

⁶ Since completing the modelling it has become apparent that there may have been development since the census dates used but which was not included in the infill data provided by Council. In the case of non-residential development the 2011 Census travel to work data has been used and there has been a significant development on Governor Macquarie Drive opposite the race course stables as well as on the corner of Alfred Road and Wendlebury Road since that date. In the case of residential development there is recent development in Shepherd Street which is not picked up by the infill development (although it is included in the Planning Proposal scenario) and there may also be scattered small scale residential intensification.

It is also arguable that assuming one vehicle per dwelling for new apartments is conservatively high, particularly as it would be possible to impose development controls which limited the number of vehicles at new developments.

Another conservative assumption in the modelled scenarios is that everyone who is outside of the floodplain when evacuation is called will be able to return to their homes in the 12-hour warning window and then evacuate from there. In the sort of extreme rainfall that would require large scale evacuation from the Georges River it is probable that flooding is occurring across the broader Sydney Metropolitan Area and road and public transport networks will not be operating efficiently. Therefore, some people will not be able to reach their homes because their route home is either flooded or otherwise disrupted and so the estimated numbers of vehicles leaving from residential premises would be an overestimate.

It is much harder to estimate the number of vehicles evacuating from business premises and the method used would represent the absolute maximum number were all employees at work at the same time. Where a factory has two 12 hours shifts for instance, then only half of the vehicles estimated to be at those premises in the modelling would be there at any one time.

Not many businesses operate 24/7 and a business which is open as much as 70 hours per week is unoccupied for nearly 60% of the time. It is therefore unlikely that all businesses and all dwellings will have to evacuate simultaneously. Furthermore, with evacuation orders being issued about 12 hours in advance, it should be possible to tell many people not to come to work if businesses are not open at the time that the evacuation order is given.

If evacuation is ordered when people are at work then the situation is more complicated. The duration of the total evacuation in the PMF scenario modelled is close to 24 hours. While businesses are likely to close during the evacuation and therefore there is an opportunity to ensure that less flood prone businesses are occupied when their evacuation needs to be triggered, those employees will leave work at the end of their shift earlier in the evacuation. Therefore, it is possible that the modelled scenario underestimates the traffic on the road network early in the flood when lower premises are evacuating, and higher premises are leaving at the end of a normal day's work but merging with evacuation traffic.

The evacuating traffic from the equestrian zone was even more difficult to estimate. The number of vehicles in the area increases during race meets but those are cancelled in the weather which generates floods. There are numerous stables with many horses and during an evacuation it is likely that the owners would want to evacuate the animals. Large numbers of horses can be transported in many small horse floats or a small number of very large horse floats. In either case multiple trips are likely to have to be made as there would not be sufficient floats to evacuate all of the horses in one trip. Furthermore, when these vehicles are queuing, they are likely to take up more road space than a 6m length assumed in the modelling. The modelling has therefore probably underestimated the traffic impacts from evacuating the equestrian zone, however, the future planning for that area is to change its land use so in the planning proposal scenarios these underestimates had no impact.

All of the above suggests that the number of evacuating vehicles being used in the model is an upper bound number.

6.7.4 Flood Warning Times

The warning times used to guide evacuation triggers in the model are the minimum times which the Bureau of Meteorology is willing to commit to. NSW SES has advised that for the Georges River these are based on observed fallen rain and measured stream gauging as well as some rainfall forecasting. In a real event there may be longer warning times available, particularly if the flooding evolves more slowly. The BoM flood warning timeframe of 12 hours may be able to be increased with the



development of a Georges River Probabilistic Forecast product or other features of a more comprehensive flood forecasting and warning system.

6.7.5 Warning Dissemination Time

The modelling assumes all houses are door knocked to receive an evacuation order. It does not make any allowance for people receiving an evacuation order by electronic broadcast, direct contact from neighbours, friends or relatives, or by observing others evacuating nearby. While they may receive the message more quickly than assumed it is unlikely that the majority will receive it more slowly and so the capacity of evacuation routes is unlikely to be underutilised because of slower warning dissemination than assumed in the model.

It is noted that all evacuation models assume a departure profile based on various curves, taking into account warning diffusion processes and time taken to initiate protective action. The TEM assumes a linear departure pattern as a simplification. NSW SES has advised that research indicates that the choice of departure curves has limited impact on results as the capacity of the evacuation network in inclement weather is the main limiting factor.

6.7.6 Departure Delays

The two-hour delay between people receiving an evacuation order and actually leaving is a NSW SES recommendation. While post-flood surveys Molino Stewart has undertaken for the NSW and Victorian SES suggest that is about the right order of magnitude for people who evacuate, those same surveys suggest that the vast majority of residents do not evacuate at all when ordered to do so. Most would probably await the arrival of floodwaters at their doorstep before leaving and then it would be too late for vehicular evacuation and, for those who get isolated by floodwaters, too late for pedestrian evacuation.

While this suggests that the model may be significantly overestimating the amount of actual traffic congestion on the road, it may mean that it significantly underestimates the number of people who safely evacuate ahead of rising floodwaters.

This evacuation model is in effect modelling the capacity of the transport network to see how many people can be evacuated within the 12-hour warning timeframe given a 100% compliance rate.

6.7.7 Route Capacities

Urban roads can have a capacity of between 1,200 to 1,400 vehicles per hour per lane and freeways a rate of 2,000 vehicles per hour or more at a free flow speed of 100km/hr (Austroads). A rate of 600 vehicles per hour per lane as per the NSW SES TEM (Oppen et al., 2009) is conservatively low and is the rate recommended for modelling the departure of vehicles from car parks.

NSW SES has advised that this traffic flow rate accounts for poor driving conditions due to inclement weather. It has advised that this rate has been reviewed by an external peer review group for the current HN Flood Strategy and is similar to evacuation rates observed in evacuations in the USA during inclement weather. Lower effective lane capacities and lower vehicle free speeds are often observed during inclement weather in the Sydney Metropolitan area.

It is unlikely that the rate will be significantly less than this.

However, it is acknowledged that the model does not account for through traffic which may be using the roads. While flooding could close the Hume Highway, Cumberland Highway and Newbridge Road to through traffic early in a flood, the M5 and M7 are likely to remain open to through traffic well into



the event and this could reduce the available road capacity for evacuation. Nevertheless, using 600 vehicles per hour per lane for the motorways arguably allows for some through traffic taking up capacity.

The modelling also assumes that there is no provision for contraflow traffic on any of the evacuation routes. Any route which has contraflow would have its capacity increased. Contraflow for flood evacuation is not supported by NSW SES because of its resource demands and the fact that contraflow lanes do not flow at the same rate as other lanes.

6.7.8 Traffic Destinations

While the model makes a reasonable estimate of the distribution of non-residential traffic to different destinations based on Journey to work data, it has assumed all residential evacuees will head north on the M7 towards the M4 and the Homebush Evacuation Centre. It is noted that in reality, most people will make their own accommodation arrangements with only the residual travelling all the way to evacuation centre/s. However, there is no data available to be able to estimate how many people will evacuate to certain locations where they have friends or family.

Some will be able to find temporary accommodation with friends or relatives in flood free areas within the study area but above the reach of the PMF. Similarly, many evacuees will be able to head south (i.e. Campbelltown), east or west because that is where they can readily find temporary accommodation. However, since most of the metropolitan area is north of Liverpool and that the mass care facility would be in the Sydney Olympic Park precinct, it is reasonable to assume that most residential traffic will travel north on the M7. Nevertheless, the assumed number of vehicles converging on The M7 is likely to be an overestimate.

Although this assumption results in significant queues on the M5 and the Hume Highway leading into the M7, a comparison of Scenarios 2 and 3 with Scenarios A and B shows that sending some non-residential traffic in directions other than northward relieves this queueing somewhat. This in turn revealed that regardless of what is happening on the highway and motorways, there are significant capacity issues on some of the roads feeding onto these regional roads. In other words, many of the evacuation capacity issues are occurring within the network before evacuees have a choice about which direction they will head out of the study area.

7.1.2 Residential Flood Islands

The following residential subsectors were identified as low flood islands and are listed in order of frequency of evacuation trigger:

- R25 – Newbridge Road East (approximately 38 current dwellings or 114 people)
- R15 - Shepherd Street/Riverpark Drive (at least 553 current dwellings or 1,548 people, noting this is likely to be an underestimate due to recent development)
- IR1 – Residential component is Riverside Road Chipping Norton (approximately 8 current dwellings or 24 people)
- R1 – Chipping Norton North of Governor Macquarie Drive (approximately 783 current dwellings or 2,349 people)
- R12 – between Moorebank Avenue and Heathcote Road (approximately 331 current dwellings or 1,026 people)
- R2 – Chipping Norton North of Governor Macquarie Drive (approximately 502 current dwellings or 1,506 people)

In addition, Sammut Crescent Chipping Norton, which is in R4, has a group of 11 houses (approximately 33 people) which are at the end of a cul-de-sac which can be isolated early in a flood.

The modelling suggests that under existing conditions all of these areas would have sufficient time to safely evacuate but should they delay evacuation residents may become trapped and then overwhelmed by flood waters. If emergency resources are limited their efforts need to focus on the timely evacuation of these subsectors.

Houses in Newbridge Road East start flooding in a 20% flood but they are part of a voluntary purchase scheme and over time are likely to be removed from the floodplain.

Shepherd Street, Riverside Road and Sammut Crescent get isolated in a 5% AEP flood

A 1% AEP flood is needed before parts of R12 becomes isolated, but it is virtually completely isolated and inundated in a 0.5% AEP flood.

A 0.2% flood is needed before parts of Chipping Norton are isolated.

The whole Moorebank Peninsula is a high flood island which becomes isolated when flooding exceeding a 0.2% AEP event cuts the on ramp from Moorebank Avenue, all other access to the peninsula having been cut at lower flood levels. A slightly higher flood would overtop the M5 and flow into the Moorebank Avenue underpass. Should this happen, it would take days to drain because the drainage system is only designed for local runoff.

As infill development increases on the Moorebank peninsula the flood modelling suggests that evacuation traffic queues on Nuwarra Road could create evacuation challenges for residents on Riverside Road. It may be necessary to use low forecast flood level to trigger their evacuation but that would increase the frequency with which they would need to evacuate and on some occasions, it would prove in hindsight to have been unnecessary.

7.1.3 Industrial Flood Islands

The industrial subsectors which are low flood islands are, in order of frequency of evacuation trigger:

- I5 – between Moorebank Avenue and the Georges River (1,162 modelled employees/ vehicles)
- I3 – Between Anzac Creek and Heathcote Road (953 modelled employees/ vehicles)
- I13 – Junction Road (38 modelled employees/ vehicles)
- I15 – Governor Macquarie Drive Warwick Farm (359 modelled employees/ vehicles)

- I1 – Chipping North (1,955 modelled employees/ vehicles)
- I7 – Scrivener Street Place Area (2,378 modelled employees/ vehicles)
- IR1 – Barry Road Chipping North (156 modelled employees/ vehicles)
- I12 – Between Moorebank Avenue and Heathcote Road (1,319 modelled employees/ vehicles)

The modelling indicates that all of these should have time for safe evacuation if evacuation orders are followed in a timely manner.

IR1 is the industrial properties fronting Barry Road. It is challenging to evacuate because the premises are raised more than 1m above the road which is quite flat and floods rapidly once the river breaks its banks in a 5% AEP flood. Furthermore, the modelling suggests that timely evacuation may become more challenging as residential infill development takes up more of the evacuation capacity of Nuwarra Road.

Similarly, the balance of the Chipping Norton industrial area (I1) has properties which can get isolated when the low lying parts of Riverside Road and Childs Road flood. The modelling suggests that these properties are at greatest risk of not being able to evacuate as residential infill development occurs.

It may be necessary to trigger the evacuation of these two subsectors at a lower forecast river level to ensure they have time to evacuate as residential densities increase.

Together I5, I3, I13 and I12 make up the Georges River South Place Area. Parts of this area is impacted by 5% AEP flooding with significant isolation in the 2% AEP event but complete isolation not occurring until the 0.2% flood.

In addition, I4 and I14 are high flood islands and they constitute the Georges River North Place area. They become isolated in a 2% AEP flood.

Under existing conditions and with projected infill development it is expected that these areas will continue to have sufficient time to evacuate.

7.1.4 Evacuation Capacity Improvements

Another way of dealing with the growing evacuation challenge on the Moorebank Peninsula would be to increase the evacuation capacity. The model has sent all of the evacuating vehicles from Chipping Norton along Nuwarra Road which is a single lane road to near its intersection with Heathcote Road. While Heathcote Road is a two lane road, its on ramps onto the M5 are single lane.

While parts of Chipping Norton could use Brickmakers Drive as an evacuation route, once that joins Nuwarra Road it once again narrows to a single lane. It is noted, however, that there is a very wide road reserve on Nuwarra Road and the M5 underpass so there may be capacity to provide an additional lane through there. Once at Heathcote Road one stream of traffic would need to be directed onto Heathcote Road and the other through to Wattle Grove Road and Anzac Road from where they could enter the M5 via Moorebank Avenue.

This arrangement may only be suitable early in a flood evacuation because in larger floods Brickmakers Road gets flooded and also evacuees from Hammondville and Holsworthy need to use Anzac Road. It would also be dependent on emergency services having sufficient resources to direct traffic at the Heathcote Road intersection.

While a flood larger than a 0.2% event would be needed to cut the M5 at Moorebank Avenue, this could be overcome if the proposed additional M5 lanes across the Georges River could be provided with a higher level of flood immunity. This would ensure that the peninsula did not get isolated and the M5 did not remain closed for long periods in more extreme events.

Route capacities may also be increased through the provision of contraflow traffic however, this would only be of significant benefit if there are no downstream capacity constraints. For example, there



would be little benefit in providing a second lane of evacuation capacity through contraflow if the two lanes then had to merge into one to enter a motorway. The contraflow lane would not reduce evacuation time but might provide some additional space for vehicles to queue above the reach of floodwaters. It is noted that NSW SES does not support the use of contraflow for flood evacuation.

7.1.5 Alternative Evacuation Modes

The NSW SES evacuation planning for the Georges River relies upon motor vehicle evacuation and that is why vehicular evacuation has been the focus of the modelling in this study. Nevertheless, not everyone has access to a motor vehicle for evacuation. Based on 2016 ABS Census data (available at the Statistical Area [SA]1 level), a significant number of dwellings in the study area do not have a vehicle. In some suburbs in Liverpool and Warwick Farm (i.e. R16 and R17) over 30% of dwellings do not have a vehicle (Figure 26). It is estimated that there are around 4,000 people without a vehicle at home in Liverpool and Warwick Farm. On the Moorebank peninsula, where car ownership is higher; it is estimated that 550 people do not have a vehicle at their home.

Warwick Farm (particularly subsector R17) is noted as an area requiring special consideration, as it contains a number of public housing developments. NSW Land and Housing Corporation (LAHC) currently has 1,298 dwellings in the study area across both Warwick Farm and Cartwright (the latter only subject to creek flooding) with an average occupancy of 2 people per dwelling. LAHC has also informed this study that its development projection for the study area over the next 20 years is 481 additional dwellings, with 45% of the additional dwellings in Warwick Farm and 55% in Cartwright. LAHC notes that these tenants are older and have higher rates of disability and mobility issues when compared to the general population, and currently 37% of tenants in the Liverpool LGA are eligible for seniors housing. As indicated by subsector R17, where 43% of dwellings do not have a vehicle, these residents are also more likely to not have access to a vehicle.

The suggestion has been made that pedestrian or rail evacuation could be relied upon for some, or all, of the flood evacuation.

In response, the NSW SES has advised that large scale rail evacuation in Sydney cannot be relied upon as a primary evacuation strategy or where vehicular evacuation fails during flood events because of the unreliability of the rail network during major storm events. For example, in April 2015, Sydney Trains estimated nearly 200 significant incidents to Sydney Trains and NSW Trains, and approximately 585 peak and non-peak services were affected during a 3-day period of storms (TfNSW, 2017).

NSW SES has also advised that pedestrian evacuation is limited by a number of factors including safety challenges of pedestrians and vehicles sharing routes, the large number of officials required to coordinate the evacuation on-ground, pedestrians being exposed to the weather, and the limited capacity to carry important documents and possessions.





Figure 26. Percentage of dwellings without a vehicle in the study area (based on 2016 ABS Census data at the Statistical Area [SA] 1 level).

7.2 Future Challenges

7.2.1 General

The following section focusses on the evacuation challenges specific to each development. However, there are some considerations which are common to more than one of the planning proposals:

Existing “Spare” Capacity - The results of Scenario B can provide some indication of the scale of development that could be included without compromising evacuation capability in the study area. However, it is stressed that this only allows for a high-level calculation, and the capacity would have to be modelled in order to test the impact of a reduction in vehicles from certain developments. These nominal capacities are discussed in the following sections. Note the vehicles which escape the floodwaters but are trapped on the Moorebank Peninsula have not been accounted for in those calculations.

Evacuation Route Upgrades - It would be important to ensure that any road infrastructure upgrades that are to be relied upon to improve flood evacuation are fully approved and funded before the development which they support is approved.

People Without Access to Vehicles – As explained in Section 7.1.5, there are already many people in the study area who do not own a motor vehicle. It is possible that some of the proposed apartment developments in close proximity to Liverpool Station could be approved with less than one parking space per dwelling meaning that there would be an expectation that a proportion of the population will not own a car. This would increase the number of people who do not have a vehicle who would have to evacuate during a flood.

7.2.2 The Grove

The evacuation modelling suggests that there should be sufficient road capacity for the evacuation of The Grove proposal providing that a flood free evacuation route connection is created between Homepride Avenue and Orange Grove Road. Without this connection existing residential and commercial development in the area is unable to have assurance of safe evacuation.

7.2.3 Shepherd Street

The modelling suggests that there is sufficient road capacity for the evacuation of proposed development on Shepherd Street⁷. The challenge in this location is the inundation of the Shepherd Street underpass. If evacuees delay they may be trapped between the river and the rail line. There are two ways in which this residual risk can be managed.

The first would be to provide an emergency level crossing of the railway line at Atkinson Street (Figure 27). This would require approval from Sydney Trains but such an arrangement has been provided in two locations of the Hawkesbury floodplain near Mulgrave Station and Windsor Station. This could either be a vehicular and pedestrian crossing or only a pedestrian crossing and be opened by emergency services when the Shepherd Street underpass is flooded. This would not only benefit future development but also existing developments in the subsector.

⁷ Note that it has been determined that the number of existing vehicles requiring evacuation from Shepherd Street has likely been underestimated due to recent apartment developments but many of these are included in the vehicles estimates for the Planning Proposal scenario.

However, it is noted that this option would require the closure of the rail corridor after the cessation of train services on the line to the south of Liverpool rail station and would need to be examined further with the rail operator and emergency services.

The second method would be to make provision for sheltering in place because some parts of the precinct are flood free and others are low hazard in a PMF flood.



Figure 27. Atkinson Street looking west across railway line

7.2.4 Warwick Farm Structure Plan

The evacuation modelling makes it clear that there is insufficient road capacity to cater for the evacuation of the planning proposals for the Warwick Farm racing precinct. Closer investigation shows that there are a number of reasons for this.

Firstly, the proposed scale of the development in the precinct would see about 3,700 vehicles evacuating from the precinct, mostly via Warwick Street onto the Hume Highway. These vehicles alone would occupy the road for more than six hours at the modelled rate of 600 vehicles per hour.

Secondly, the industrial area to the south (I7) starts evacuating only half an hour earlier and has nearly 2,400 vehicles which need to evacuate through the Munday Street Place Area, occupying the same evacuation road for about four hours. This means that when the evacuee response delays and traffic safety factors are taken into consideration, the total evacuation time exceeds the available warning time by a few hours.

Thirdly, at the same time that these two subsectors are evacuating onto the Hume Highway at Warwick Farm, so are subsectors I15, I8 and R17 which is taking up much of the capacity of the three lanes on the Hume Highway meaning that the proposed development has to queue before evacuating.

Finally, because the area is relatively flat, there is very little time between when the lowest parts of the subsector begin to flood and the whole precinct is flooded. Everyone, has to evacuate from the

precinct and the surrounding precincts simultaneously with no opportunity for those on higher ground to delay their evacuation.⁸

Other than reducing the scale of the proposed development, there is not a lot which can be done to mitigate the above challenges. Providing two exit lanes on Warwick Street might assist if it does not create capacity issues on the Hume Highway.

In Scenario B, there are 2,845 vehicles caught in floodwaters in Liverpool and Warwick Farm, which is in part due to the additional vehicles associated with the planned development in Warwick Farm. The Warwick Farm developments account for 3,709 additional vehicles in Scenario B. This would imply that the road network has the potential spare capacity for 864 vehicles from Warwick Farm in Scenario B. Reducing vehicle lengths to 6m in this area within the model may increase the number of vehicles able to evacuate from the area but accounting for proposed growth in public housing north of the Hume Highway may decrease this number.

Sheltering within buildings is not advisable as the area is surrounded by hazardous floodwaters in the PMF for more than 24 hours and for up to 8 hours in a 0.2% AEP flood.

The precinct is not a flood island and rises gently towards the Hume Highway which then rises rapidly as it crosses the rail line to higher ground west of the railway walking out ahead of rising flood waters should vehicular evacuation fail would be an option.

7.2.5 Moore Point

The planning proposals for Moore Point far exceeds the capacity of the road network to cater for their evacuation during a flood. Together they would result in nearly 32,000 vehicles having to evacuate in advance of a flood under the current settings. Although the developments themselves would be constructed to be above the flood planning level, Newbridge Road is cut by flooding in a 2% AEP flood near the Bridges Road intersection (Figure 28). And vehicular evacuation would need to be completed before that occurred.

Newbridge Road has two west bound lanes and even if exit roads from the developments could be configured to match this road capacity, it would take more than 26 hours for all of the vehicles to evacuate from the precinct without allowing for warning acceptance, warning lag and traffic safety factors. This compares to the 12 hours warning time which is available.

While in theory some of the development could evacuate east on Newbridge Road, this would not be advisable because the only flood free evacuation route in that direction is along Nuwarra Road and that is likely to exceed its capacity with forecast infill development.

Some of the development could also theoretically head south on Heathcote Road and or Moorebank Avenue but the modelling has shown that would have an impact on other traffic currently using those roads.

This planning proposal either needs to be reduced substantially in scale or an alternative to vehicular evacuation has to be accepted as the primary flood emergency response for the precinct.

⁸ On review of the model results it would appear that in Scenario B we did not change vehicle lengths from 15 m to 6 m in this area to account for the fact that there would not be the horse floats in the future. This will also be contributing to the capacity constraints and would need to be corrected and rerun to get a more accurate estimate of available capacity.

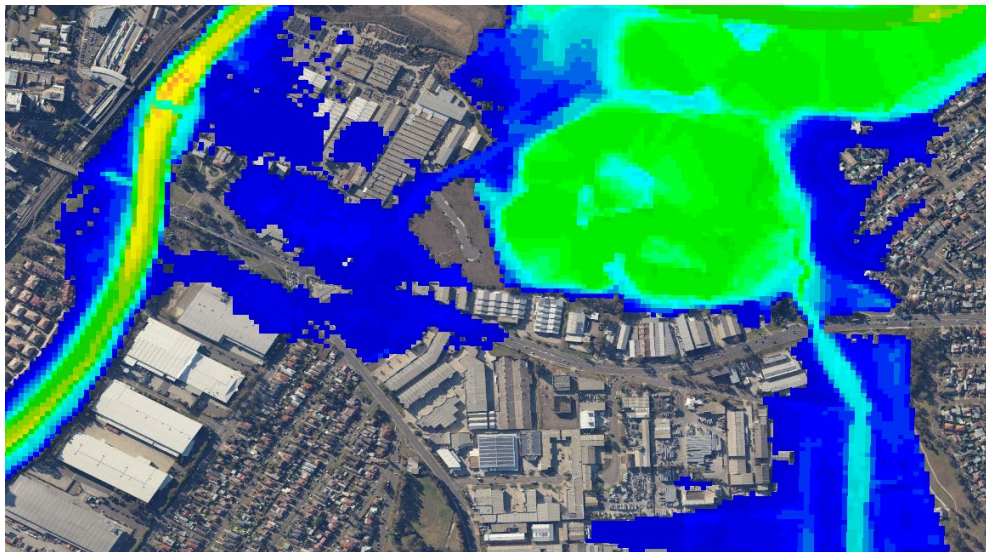


Figure 28. 2% AEP flood extent

In Scenario B there are 26,294 vehicles caught in floodwaters in Moorebank, which is largely due to the additional vehicles associated with the planned development in Moore Point. The Moore Point developments account for 31,859 additional vehicles in Scenario B. This would imply that the road network could have capacity for 5,565 vehicles from Moore Point, accounting for the road upgrades included in Scenario B.

Sheltering in place would be problematic because the area is surrounded by hazardous flood waters for more than 24 hours in a PMF and tens of thousands of people would be sheltering. The chance of loss of life due to a secondary emergency or inappropriate behaviours is high.

Pedestrian evacuation might be viable but that itself presents several challenges:

- Because of the low point in the middle of the precinct, the western part of the precinct would need to evacuate west over Newbridge Road bridge which is higher than the PMF and the eastern side of the development would have to evacuate east on Newbridge Road over Anzac Creek which has flood immunity up to the 0.5% AEP flood. This would create two different destinations for evacuees
- The NSW SES plans do not currently make provision for multiple local evacuation centres during extreme flood events, only smaller scale floods
- Evacuation centres usually only cater for a proportion of the population that cannot find their own accommodation. These centres would have to cater for tens of thousands of people arriving on foot most likely in inclement weather.
- Ground levels and pedestrian links will need to be designed so that people exiting at ground level, or alternatively from other floors, from buildings have a continuously rising evacuation route to land above the PMF level

7.2.6 Moorebank East

The five development sites at Moorebank East would add substantial evacuation traffic to the Moorebank peninsula which may approach its evacuation capacity with infill development under current zonings. While the model shows that all of the proposed development in Moorebank East



would be able to evacuate in time, it only does so by blocking the evacuation of residential and non-residential vehicles evacuating from Chipping Norton.

In Scenario B there are 3,039 vehicles caught in floodwaters in Chipping Norton, which is largely due to congestion on Nuwarra Road and which is exacerbated by the planned development vehicle numbers from Moorebank East. In this scenario, Moorebank East accounted for 3,728 additional vehicles. This could imply that only approximately 700 vehicles in Moorebank East could be added to the road network before vehicles are caught by floodwaters in Chipping Norton. However, it is noted that Site C, which includes 363 vehicles in the model, has development approvals. This would take up half of the available road capacity, accounting for the planned road upgrades included in Scenario B. It is also noted that there could be many more vehicles which escape the floodwaters but are potentially stranded on the peninsula because of the blocking effect of these developments.

The widening of a section of Nuwarra Road and the use of Brickmakers Drive and Anzac Road early in the evacuation, as suggesting in Section 7.1.4, might go some way to mitigating this impact and facilitate some additional development in Moorebank East.

A rising pedestrian evacuation route has also been approved for this site to be used in case vehicular evacuation failed. This is important because this whole area is surrounded by hazardous floodwaters for more than 24 hours in the PMF.

8 | Conclusions and Recommendations

8.1 Conclusions

This study has identified several Georges River flood evacuation findings and challenges for Liverpool LGA, including the following key points.

8.1.1 Current Evacuation Findings and Challenges

- Even under present conditions, there are challenges to flood evacuation from the Georges River PMF within the study area. This is primarily due to capacity constraints on Nuwarra Road, which results in long queuing and vehicles being caught in floodwaters and stranded on roads. The model suggests that more than 130 vehicles could be caught by floodwaters in Chipping Norton, and over 2,300 trapped on the Moorebank Peninsula when the M5 is cut by floodwaters.
- In the most extreme flood events, the M5 will flood at the Moorebank Avenue underpass and, because its drainage is only designed for local rainfall, could be closed for several days due to ponded water. This could prevent some evacuees from leaving the peninsula and would disrupt through traffic for weeks. A planned additional westbound lane crossing the Georges River at this location could be constructed in such a way to ensure access to Moorebank Peninsula in even the most extreme floods.
- Subsectors I9 and R18 in Warwick Farm, which are subjected to both Georges River and creek flooding, may be unable to evacuate due to a lack of a reliable evacuation route on public roads that are not at risk of being cut by creek flooding.
- The following residential subsectors were identified as low flood islands, where occupants may get trapped and overwhelmed by floodwaters if they don't leave promptly. Emergency services may need to focus resources on these areas to ensure timely evacuation. They are (listed in order of frequency of evacuation trigger):
 - R25 – Newbridge Road East (approximately 38 current dwellings or 114 people)
 - R15 – Shepherd Street/Riverpark Drive (at least 553 current dwellings or 1,548 people, noting this is likely to be an underestimate due to recent development)
 - IR1 – Residential component is Riverside Road Chipping Norton (approximately 8 current dwellings or 24 people)
 - R1 – Chipping Norton North of Governor Macquarie Drive (approximately 783 current dwellings or 2,349 people)
 - R12 – between Moorebank Avenue and Heathcote Road (approximately 331 current dwellings or 1,026 people)
 - R2 – Chipping Norton North of Governor Macquarie Drive (approximately 502 current dwellings or 1,506 people)
- The following industrial subsectors were identified as low flood islands (listed in order of frequency of evacuation trigger):
 - I5 – between Moorebank Avenue and the Georges River (1,162 modelled employees/ vehicles)
 - I3 – Between Anzac Creek and Heathcote Road (953 modelled employees/ vehicles)
 - I13 – Junction Road (38 modelled employees/ vehicles)
 - I15 – Governor Macquarie Drive Warwick Farm (359 modelled employees/ vehicles)
 - I1 – Chipping North (1,955 modelled employees/ vehicles)
 - I7 – Scrivener Street Place Area (2,378 modelled employees/ vehicles)
 - IR1 – Barry Road Chipping North (156 modelled employees/ vehicles)

- I12 – Between Moorebank Avenue and Heathcote Road (1,319 modelled employees/ vehicles)
- While the NSW SES evacuation planning for the Georges River relies upon motor vehicle evacuation, there are currently thousands of people within the floodplain that do not have access to a vehicle (over 30% of dwellings in some areas). It is recognised that both rail and pedestrian evacuation have their limitations and may not be able to be relied upon. Furthermore, they are generally not supported by the NSW SES.
- Failing to evacuate or deliberately Sheltering in Place in the Georges River floodplain is particularly risky considering buildings can be isolated and inaccessible to emergency services for more than 24 hours in the PMF.

8.1.2 Future Evacuation Findings and Challenges

- The planned two-lane addition to the M5 over the Georges River would improve evacuation capacity from Moorebank and Chipping Norton for existing development, as it would improve traffic flow onto the M7 via the Hume Highway.
- Future infill development within currently zoned land may be able to be accommodated through the provision of planned road upgrades in the study area, particularly the additional lanes on the M5 over the Georges River.
- Major evacuation capacity constraints are apparent when accounting for future planning proposals in the study area. Modelled Scenario B resulted in over 32,000 vehicles caught by floodwaters across the study area and over 8,000 stranded on the Moorebank Peninsula. Table 18 summarises the key challenges for future development in the study area.

Table 18. Constraints on Future Development

Development	Challenge
The Grove	Requires a flood free evacuation route connection between Homepride Avenue and Orange Grove Road
Shepherd Street	May require an emergency level crossing of the railway line at Atkinson Street
Warwick Farm Structure Plan	Insufficient road capacity to cater for the evacuation of the planning proposals
Moore Point	Insufficient road capacity to cater for the evacuation of the planning proposals
Moorebank East	Approved and proposed development in Moorebank East would be able to evacuate in time but proposed development blocks the evacuation of Chipping Norton

- “Spare” evacuation capacity has been investigated at a high level for some of the large planning proposals included in Scenario B. However, it is stressed that this is only a high-level calculation, and the capacity would have to be modelled in order to test the impact of a reduction in vehicles from certain developments. Also note that the vehicles which escape the floodwaters but are trapped on the Moorebank Peninsula have not been accounted for in those calculations.
 - **Moorebank East:** Modelling suggests that the road network could have capacity for approximately 700 evacuating vehicles from Moorebank East, accounting for the

road upgrades included in Scenario B. Given that the model included more than 360 vehicles from approved Site C, this would leave only half of the capacity for development at Sites A, B, D and E.

- **Moore Point:** Scenario B suggests that the road network may have capacity for approximately 5,500 evacuating vehicles from Moore Point, accounting for the road upgrades included in Scenario B.
- **Warwick Farm:** Scenario B suggests that the road network could have capacity for 850 evacuating vehicles from Warwick Farm in Scenario B, accounting for the road upgrades included in Scenario B.

8.2 Recommendations

Based on the findings of this study, the following recommendations are made to address Georges River flood evacuation challenges for Liverpool LGA.

8.2.1 Current Flood Evacuation Challenges

- Ensure that the proposed additional lanes on the M5 across the Georges River are configured to reduce the probability of flooding isolating the Moorebank Peninsula
- Investigate the provision of an additional southbound lane on Nuwarra Road between Brickmakers Drive and Heathcote Road to reduce the queuing that severely limits the evacuation of Chipping Norton onto the M5
- Investigate an emergency level crossing at Atkinson Street to improve the evacuation capability of current developments on Shepherd Street and Riverpark Drive
- Investigate an emergency flood evacuation route through private property between Homepride Avenue and Orange Grove Road (Figure 25 is one possibility) to ensure a flood-free evacuation route for the existing commercial, industrial and residential developments in the areas
- Investigate development of a comprehensive flood forecasting and warning system in the Georges River Catchment to increase the warning time for evacuation
- Investigate the benefits of an intelligent traffic system (ITS) to see whether this could increase evacuation route capacities at route bottlenecks
- Investigate whether contraflow arrangements are likely to increase flood evacuation capacity
- Use data and consider outcomes from this study to inform preparation of Volume 2 and 3 of the Georges River and Woronora River Valley Flood Emergency Sub Plan
- Identify means of safely managing the thousands of people on the floodplain who do not have access to private motor vehicles, many of whom may have mobility challenges. This might include pedestrian evacuation, mass transport or sheltering in place.

8.2.2 Planning Proposals

- Many of the above listed recommendations to deal with “current” challenges may also facilitate evacuation capacity improvements for future planning proposals
- Development at Moorebank East should be restricted, considering it is estimated that half of the evacuation capacity is taken up by the already-approved Site C development. An additional lane on Nuwarra Road should be investigated to see whether it would provide sufficient additional evacuation capacity to enable further development at Moorebank East without compromising the safe evacuation of existing development in Chipping Norton



- Development at Shepherd Street has a relatively low flood evacuation risk and is unlikely to compromise the evacuation of nearby developments. Emergency access in the area could be improved through the provision of an emergency level crossing at Atkinson Street
- The Grove in Warwick Farm should only be approved if a flood free emergency evacuation route can be created between Homepride Avenue and Orange Grove Road
- The planning proposals for Moore Point and the Warwick Farm Structure Plan either need to be substantially scaled back or:
 - more time to evacuate is provided through an improved warning system
 - improved evacuation route capacity is provided through road upgrades, contraflow traffic arrangement and/or an ITS
 - alternatives to private motor vehicle evacuation is catered for through mass transport, pedestrian evacuation or sheltering in place.

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Appendix A | Subsector Trigger Levels

Molino Stewart Subsector	Classification	Initial Trigger Level	Staging of evacuation	Initial Trigger PMF Time Step (12 hrs before trigger level reached)
R25 (Chipping Norton)	Low flood island	Flooding of evacuation route	All	-7.5
I5 (Moorebank)	Low flood island	Flooding of factories	All	-5.0
I3 (Moorebank)	Low flood island	Flooding of factories	All	-5.0
R26 (Liverpool)	Rising road access	Flooding of houses	By level	-5.0
I13 (Moorebank)	Low flood island	Flooding of evacuation route	All	-5.0
R4 (Chipping Norton)	Sammur Place is a low flood island while rest of sector has an overland escape route but whole peninsula is a High flood island	Flooding of houses	By level except Sammur which leaves pre t=8.0. Then until t=11.0	-4.5
I15 (Warwick Farm)	Low flood island	Flooding of evacuation route	All	-4.5
I1 (Chipping Norton)	Low flood island	Flooding of factories	By level until t=11.5	-4.5
I8 (Warwick Farm)	Rising road access	Flooding of properties	All	-4.5
I14 (Moorebank)	High flood island	Flooding of evacuation route	All	-4.5
I7 (Liverpool)	Low flood island. Road on western side of bridge gets cut at t=12.5	Flooding of buildings	By level until t=12.5	-4.5
R3 (Chipping Norton)	Rising road access to Newbridge Road but whole peninsula is a High flood island	Flooding of evacuation route	By level until t=11.5	-4.0
I4 (Moorebank)	High flood island	Flooding of buildings	All	-4.0
R15 (Liverpool)	Low flood island	Flooding of evacuation route	All	-4.0
I6 (Moorebank)	Rising road access to Moorebank Ave but whole peninsula is a High flood island	Flooding of factories	All	-4.0
Equestrian (Hzone) (Warwick Farm)	Rising road access	Flooding of houses	By level	-4.0
IR1 (Chipping Norton)	Low flood island	Flooding of evacuation route	All	-4.0
R1 (Chipping Norton)	Low flood island	Flooding of evacuation route	By level until t=10.0	-4.0

Molino Stewart Subsector	Classification	Initial Trigger Level	Staging of evacuation	Initial Trigger PMF Time Step (12 hrs before trigger level reached)
R11 (Moorebank)	Rising road access to Nuwarra Road but whole peninsula is a High flood island	Flooding of houses	By level until t=11.0	-4.0
R12 (Moorebank)	Low flood island	Flooding of houses	All	-4.0
I12 (Moorebank)	Low flood island	Flooding of buildings	All	-4.0
R2 (Chipping Norton)	Low flood island	Flooding of houses	By level until t=10.0	-4.0
R17 (Warwick Farm)	Rising road access	Flooding of houses	By level	-4.0
R10 (Hammondville)	Rising road access to Heathcote Road but whole peninsula is a High flood island	Flooding of properties	By level until t=11.0	-3.5
R27 (Liverpool)	Rising road access	Flooding of houses	By level	-3.5
R7 (Moorebank)	Low flood island	Flooding of evacuation route	All	-3.0
R8 (Moorebank)	Rising road access to Nuwarra Road but whole development will be at virtually same level and then peninsula is a High flood island	Flooding of houses	All	-2.5
R5 (Chipping Norton)	Rising road access to Nuwarra Road but whole peninsula is a High flood island	Flooding of houses	By level until t=11.0	-2.5
I2 (Chipping Norton)	Rising road access to Nuwarra Road but whole peninsula is a High flood island	Flooding of factories (to the north)	By level until t=11.0	-2.5
R9 (Moorebank)	Rising road access to Nuwarra Road but whole peninsula is a High flood island	Flooding of houses	By level until t=11.0	-2.5
R18 (Warwick Farm)	Rising road access	Flooding of houses	By level	-2.5
R6 (Chipping Norton)	Rising road access to Nuwarra Road but whole peninsula is a High flood island	Flooding of houses	By level	-1.5
I9 (Warwick Farm)	Rising road access	Flooding of buildings	All	-1.0

Molino Stewart Subsector	Classification	Initial Trigger Level	Staging of evacuation	Initial Trigger PMF Time Step (12 hrs before trigger level reached)
R16 (Liverpool)	Rising road access	Flooding of houses	By level	-0.5
R23 (Holsworthy)	Rising road access to Heathcote Road but whole peninsula is a High flood island	Flooding of houses	All	0.0
R19 (Liverpool)	Rising road access	Flooding of houses	By level	7.5
R21 (Warwick Farm)	Rising road access	Flooding of houses	By level	10.0

Appendix B | Model Outputs

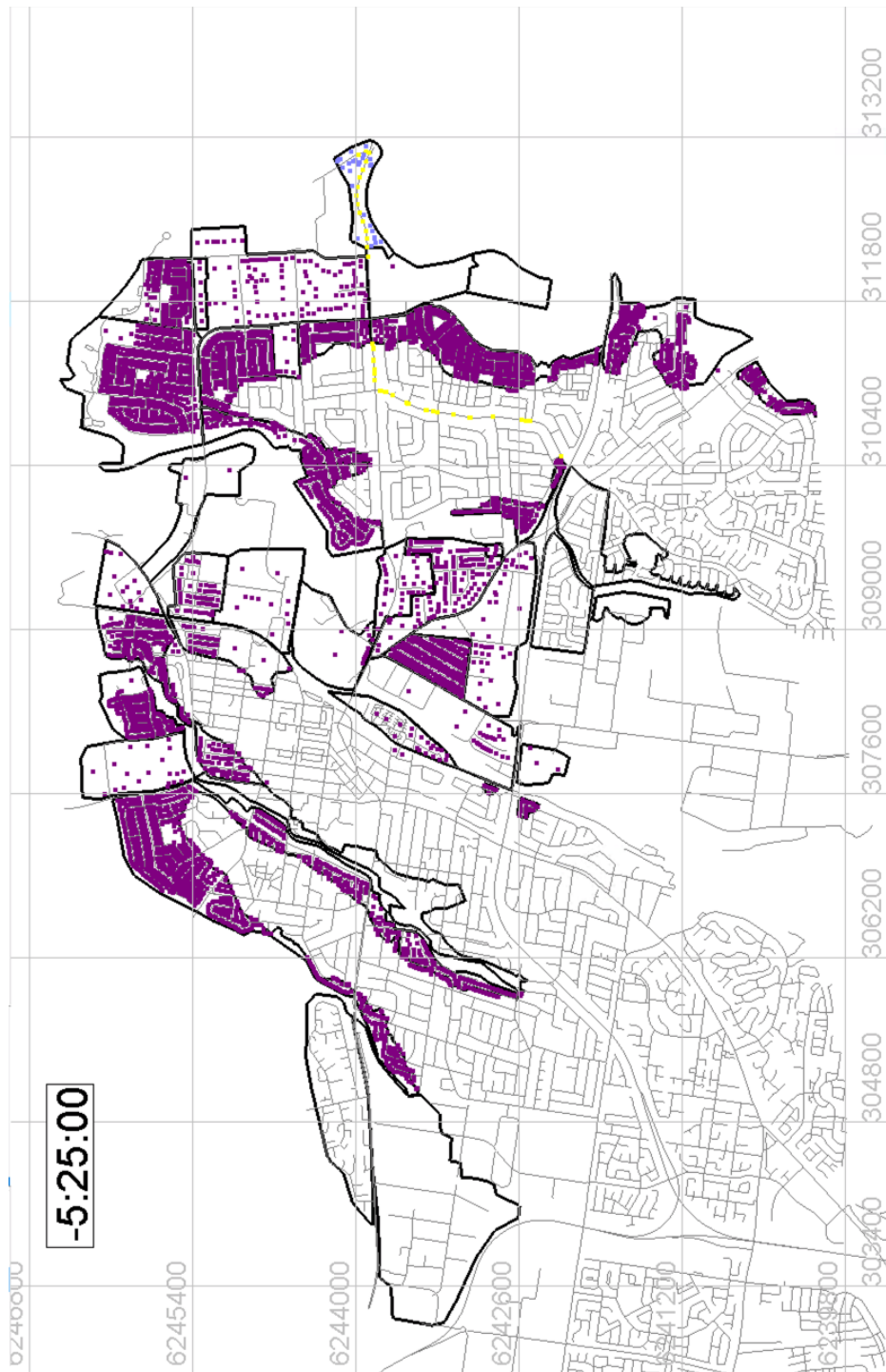


Figure B1. Georges River PMF timestep -5:25 (Scenario 1: Base Case)

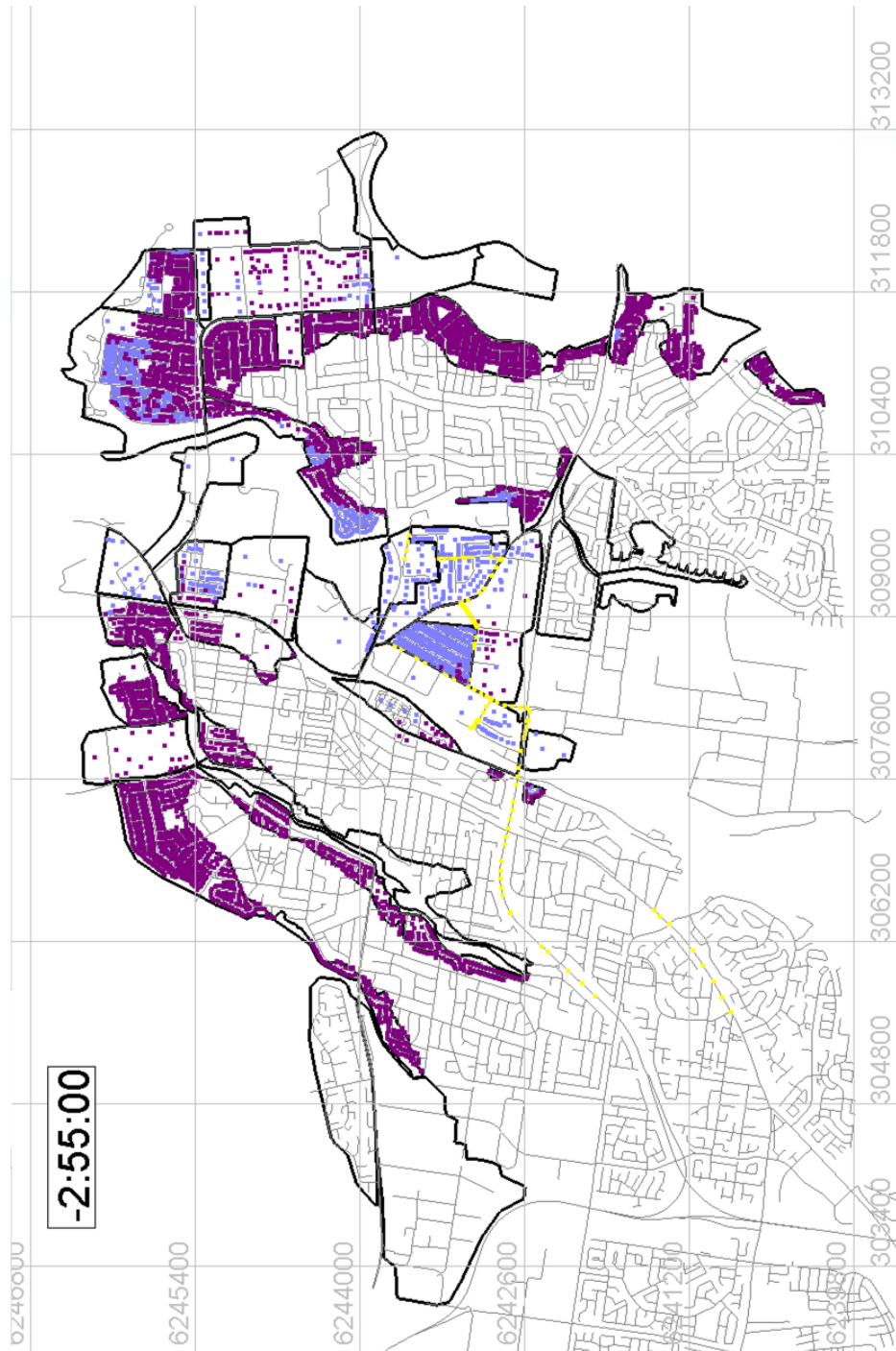


Figure B2. Georges River PMF timestep -2:55 (Scenario 1: Base Case)

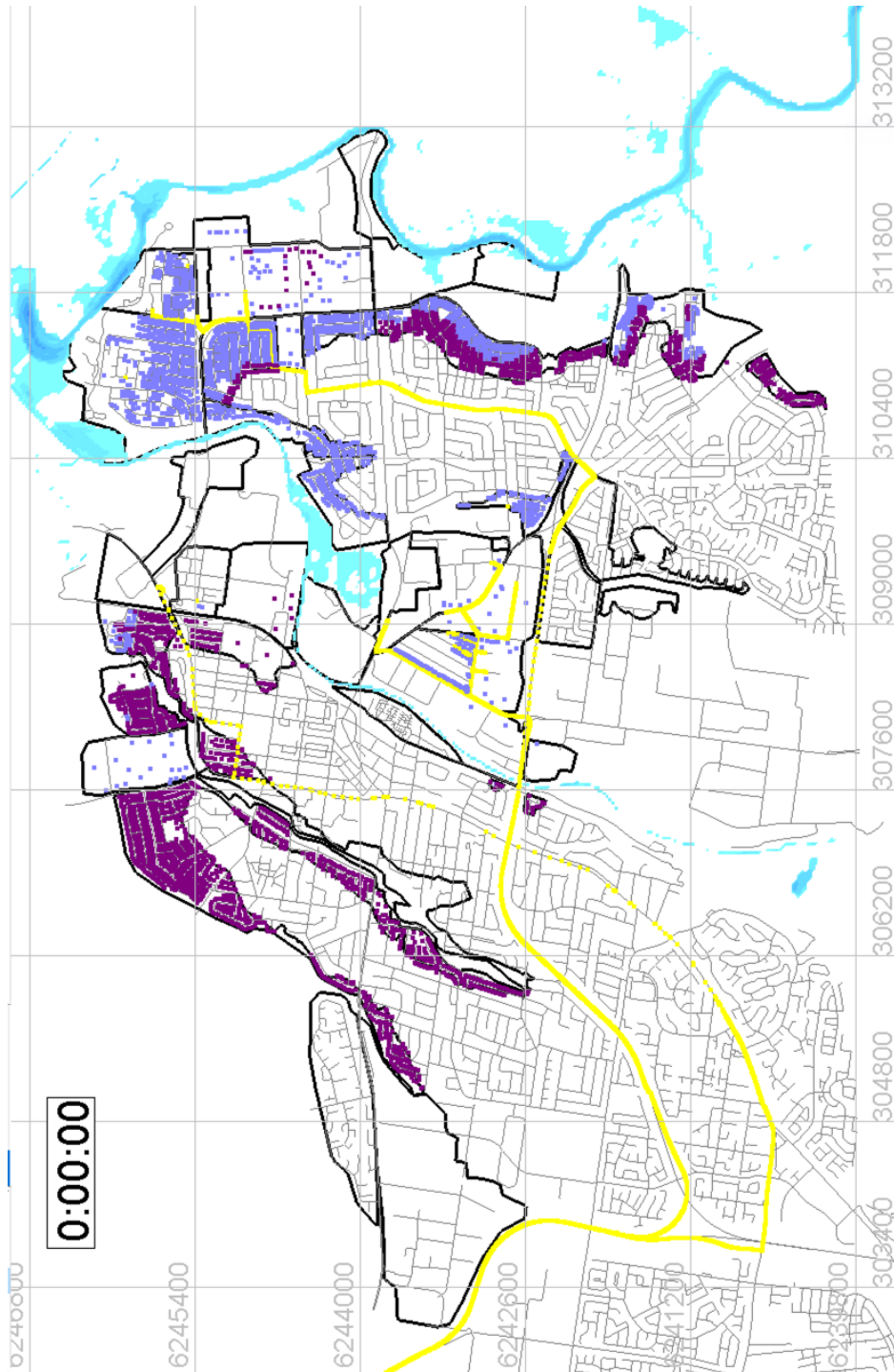


Figure B3. Georges River PMF timestep 0:00 (Scenario 1: Base Case)

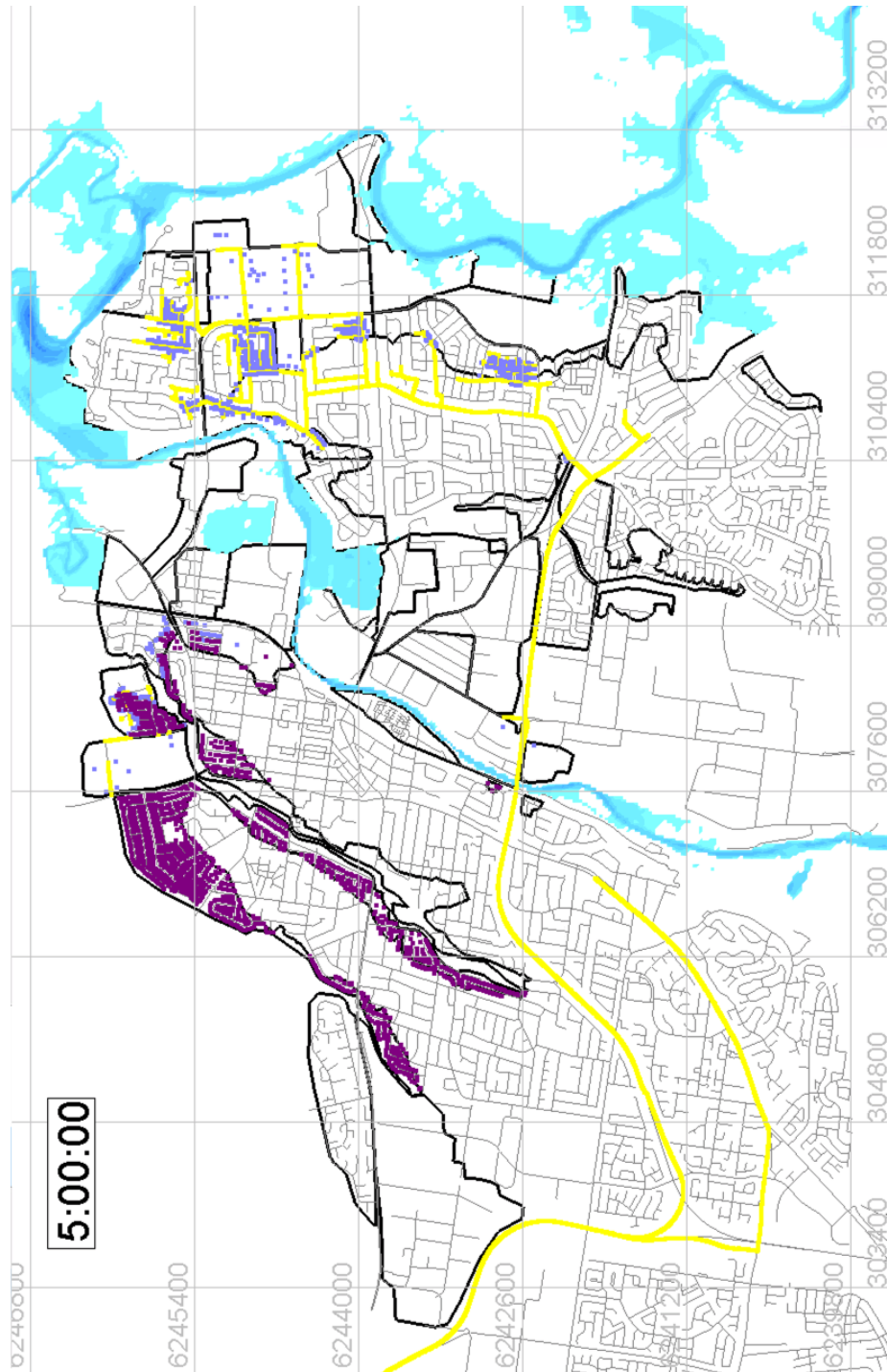


Figure B4. Georges River PMF timestep 5:00 (Scenario 1: Base Case)

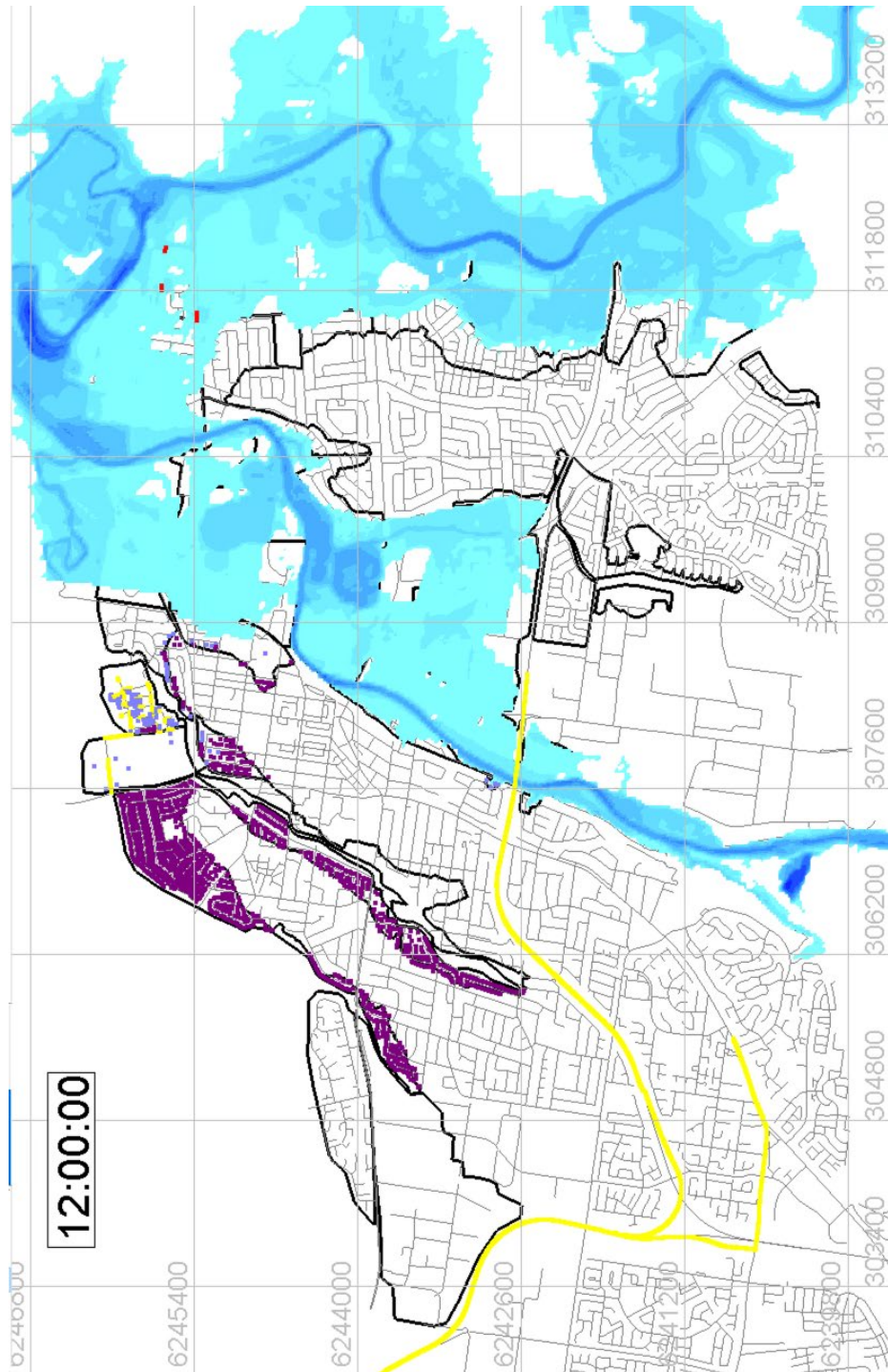


Figure B5. Georges River PMF timestep 12:00 (Scenario 1: Base Case)

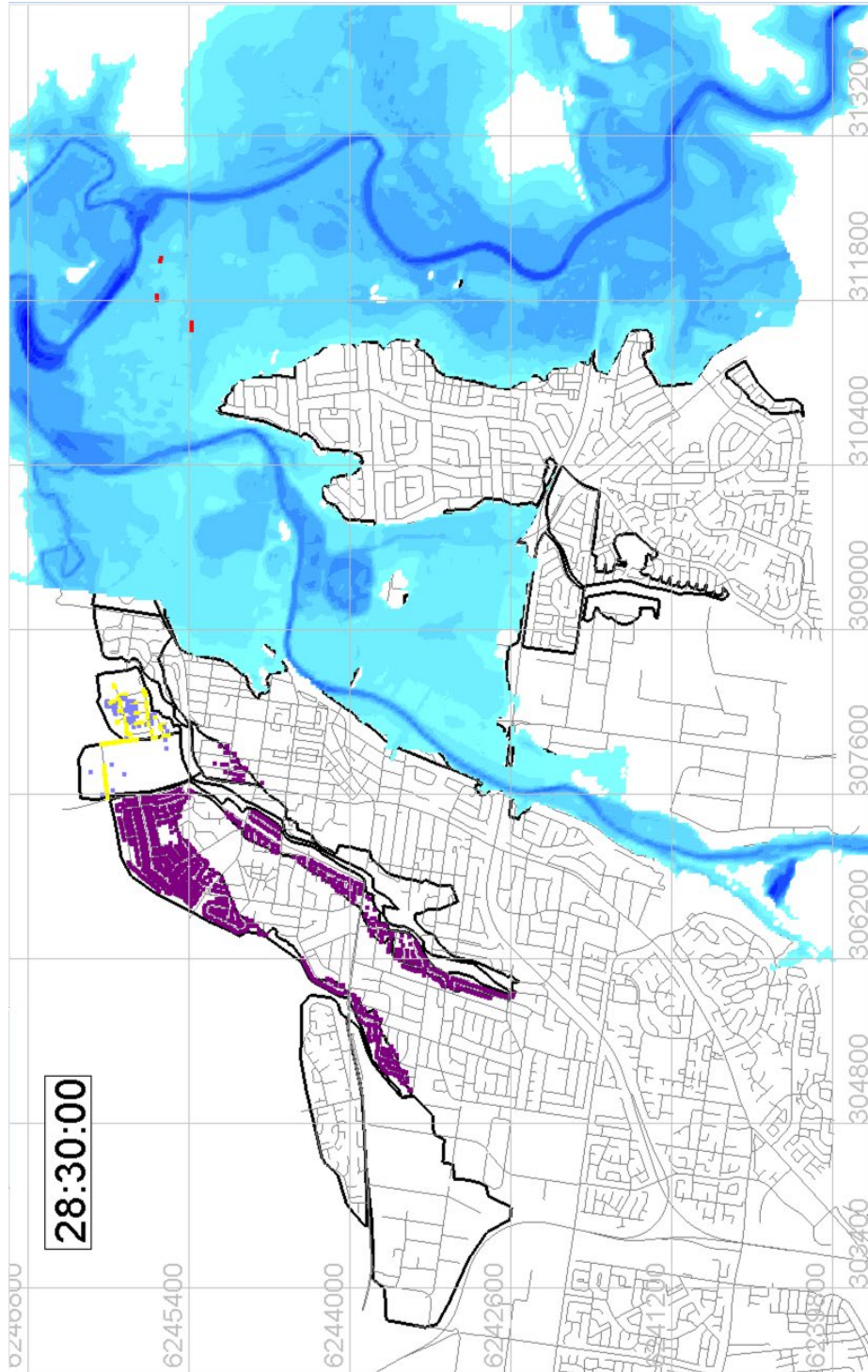


Figure B6. Georges River PMF timestep 28:30 (Scenario 1: Base Case)

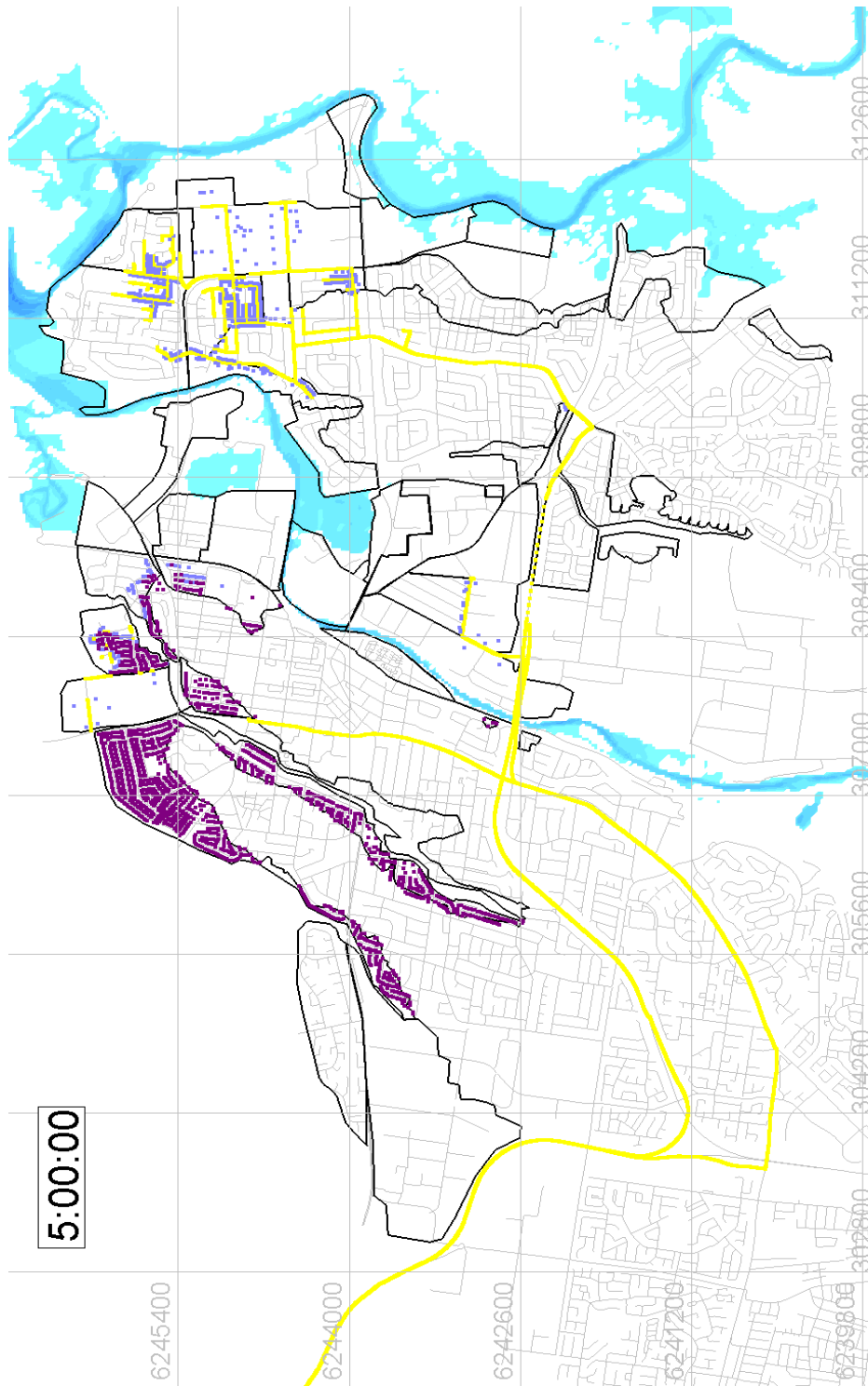


Figure B7. Georges River PMF timestep 5:00 (Scenario 2: Intensified Development under Existing Zoning)

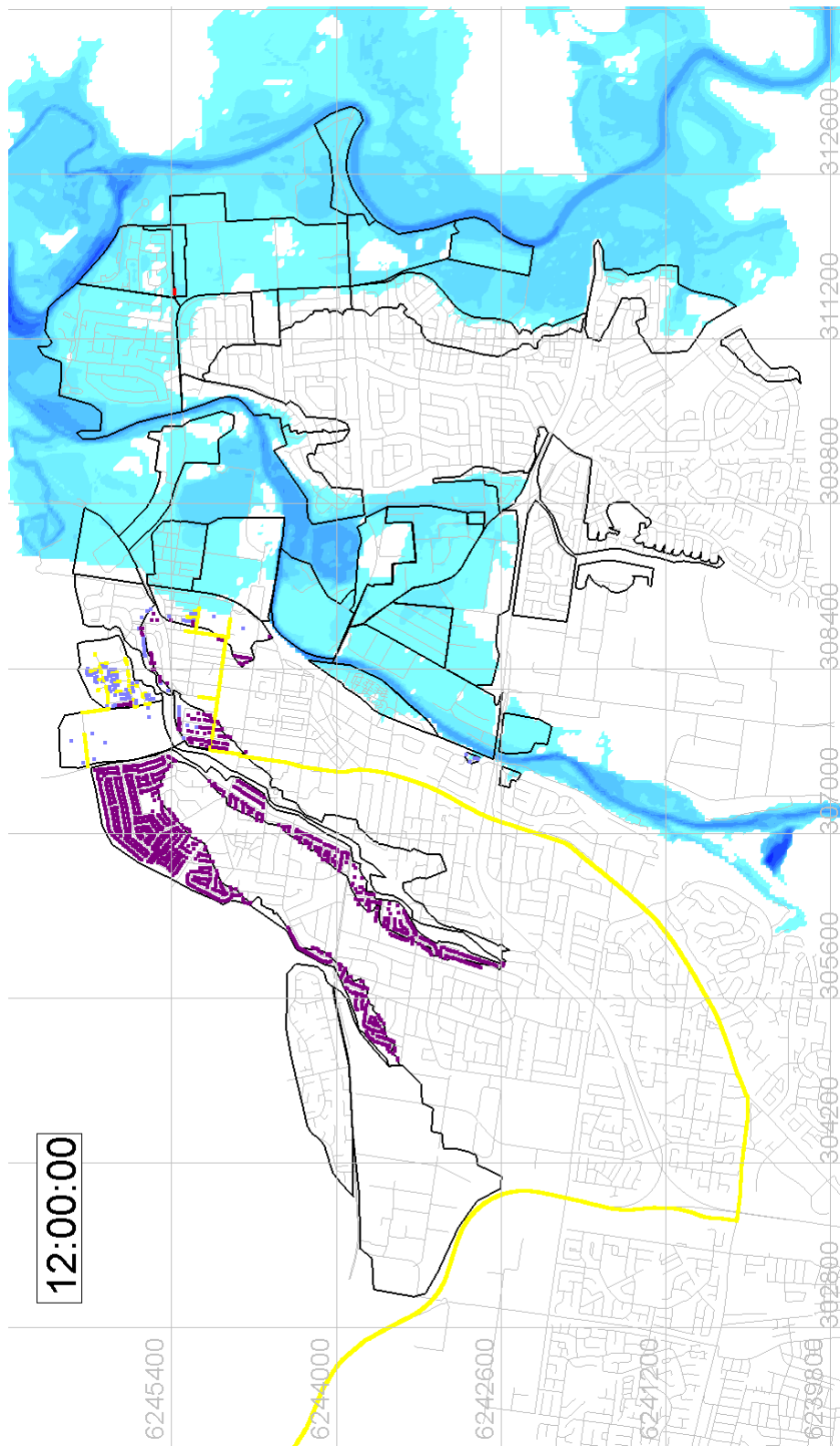


Figure B8. Georges River PMF timestep 12:00 (Scenario 2: Intensified Development under Existing Zoning)

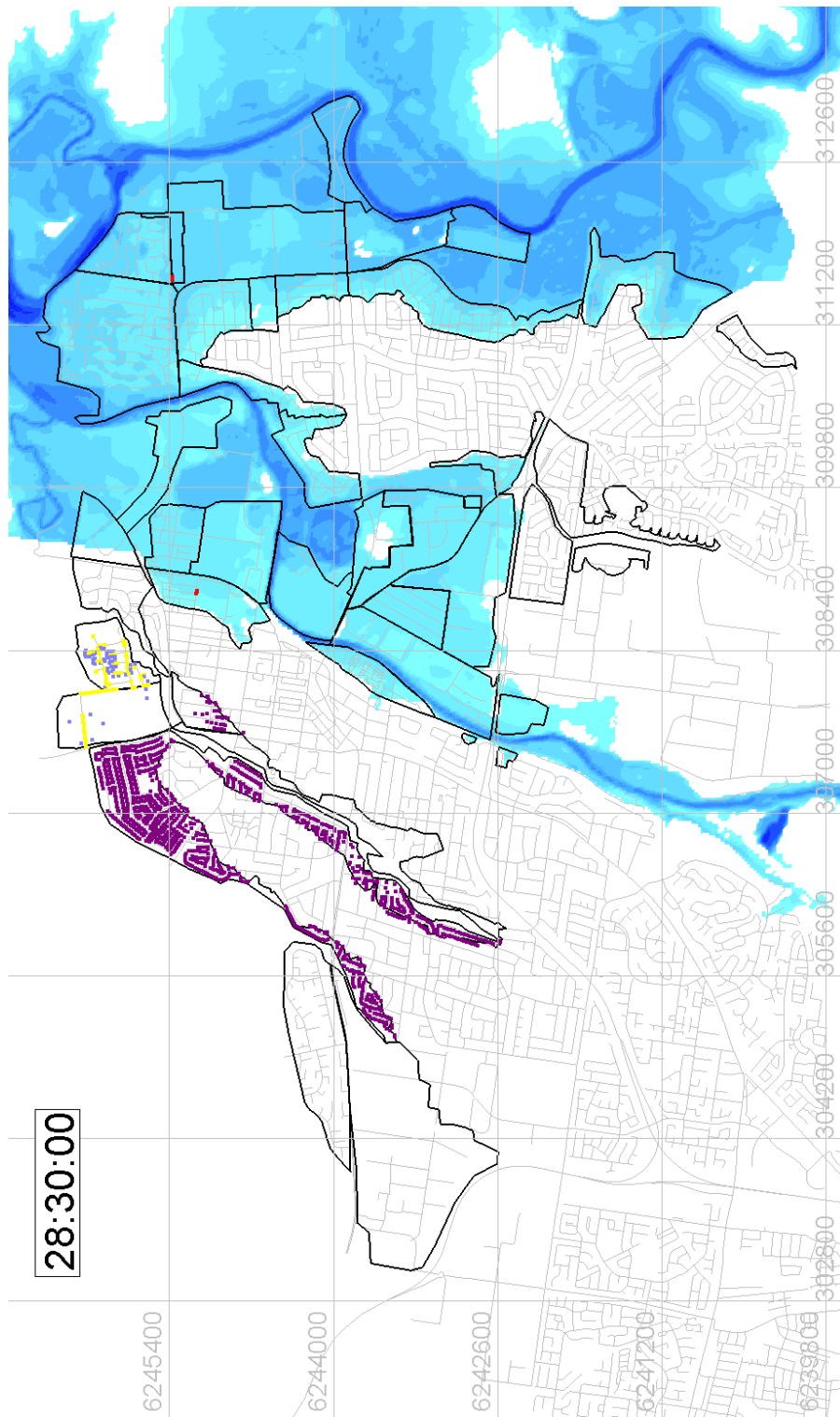


Figure B9. Georges River PMF timestep 28:30 (Scenario 2: Intensified Development under Existing Zoning)

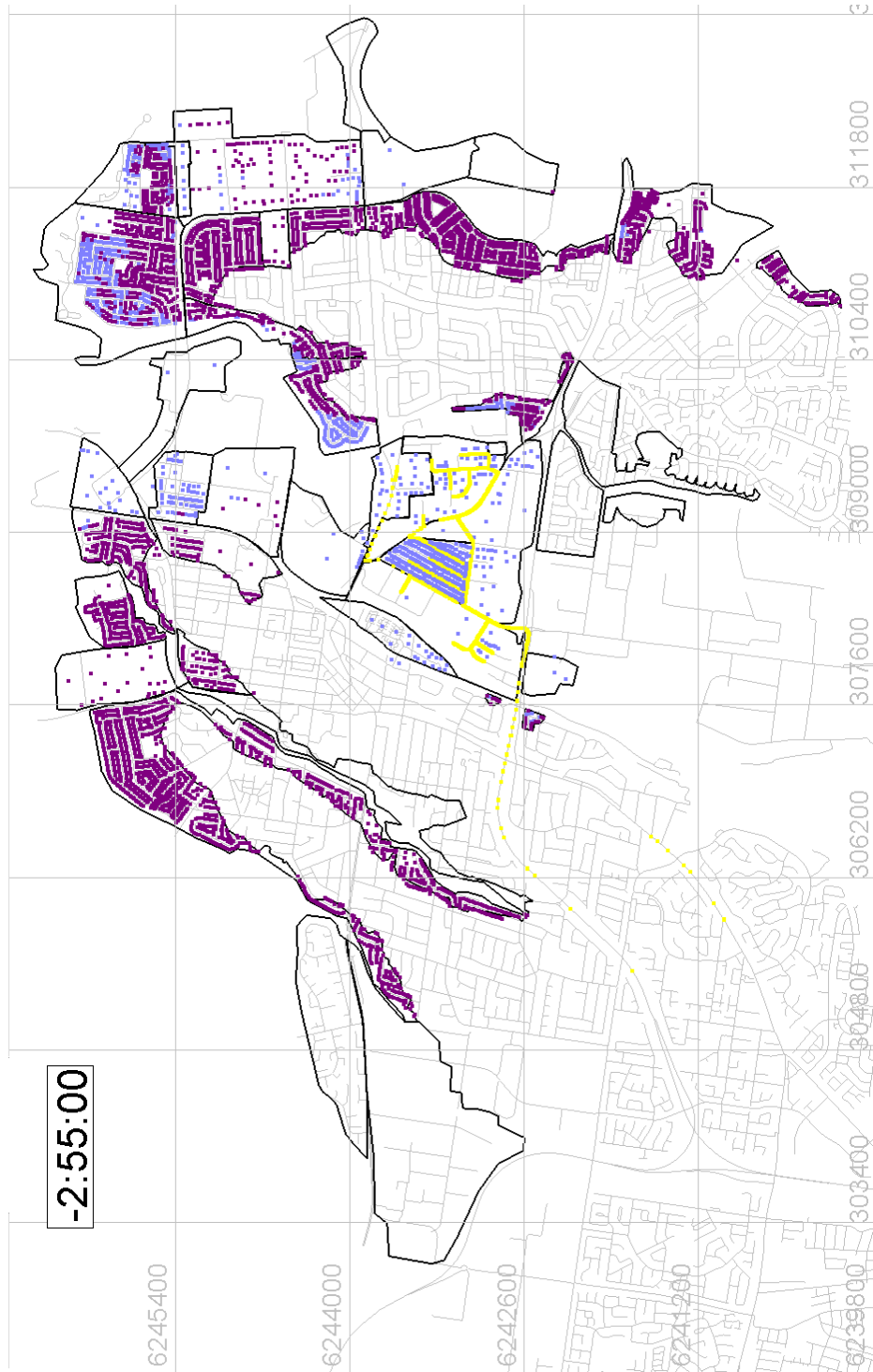


Figure B10. Georges River PMF timestep -2:55 (Scenario 3: Planning Proposals)

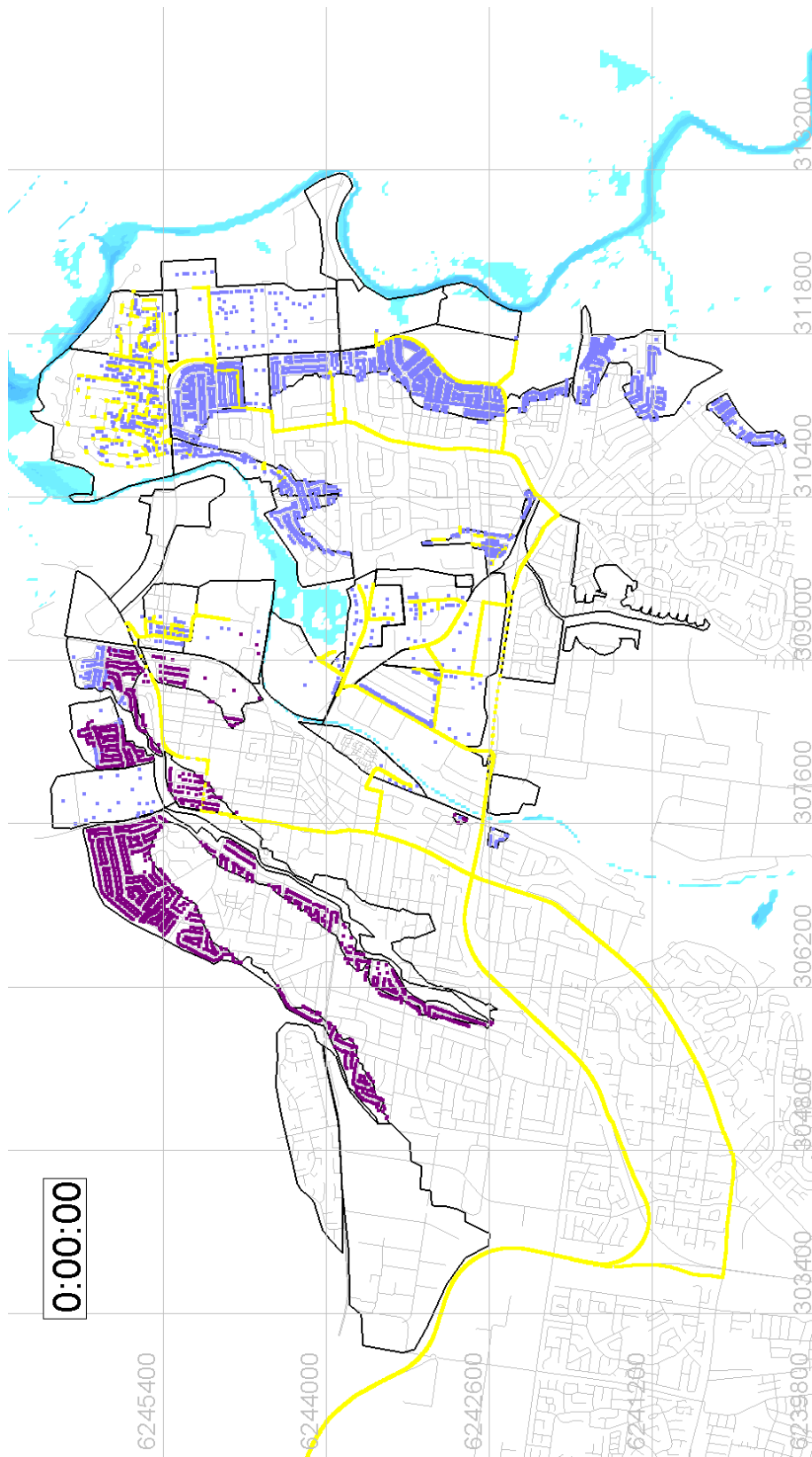


Figure B11. Georges River PMF timestep 0:00 (Scenario 3: Planning Proposals)

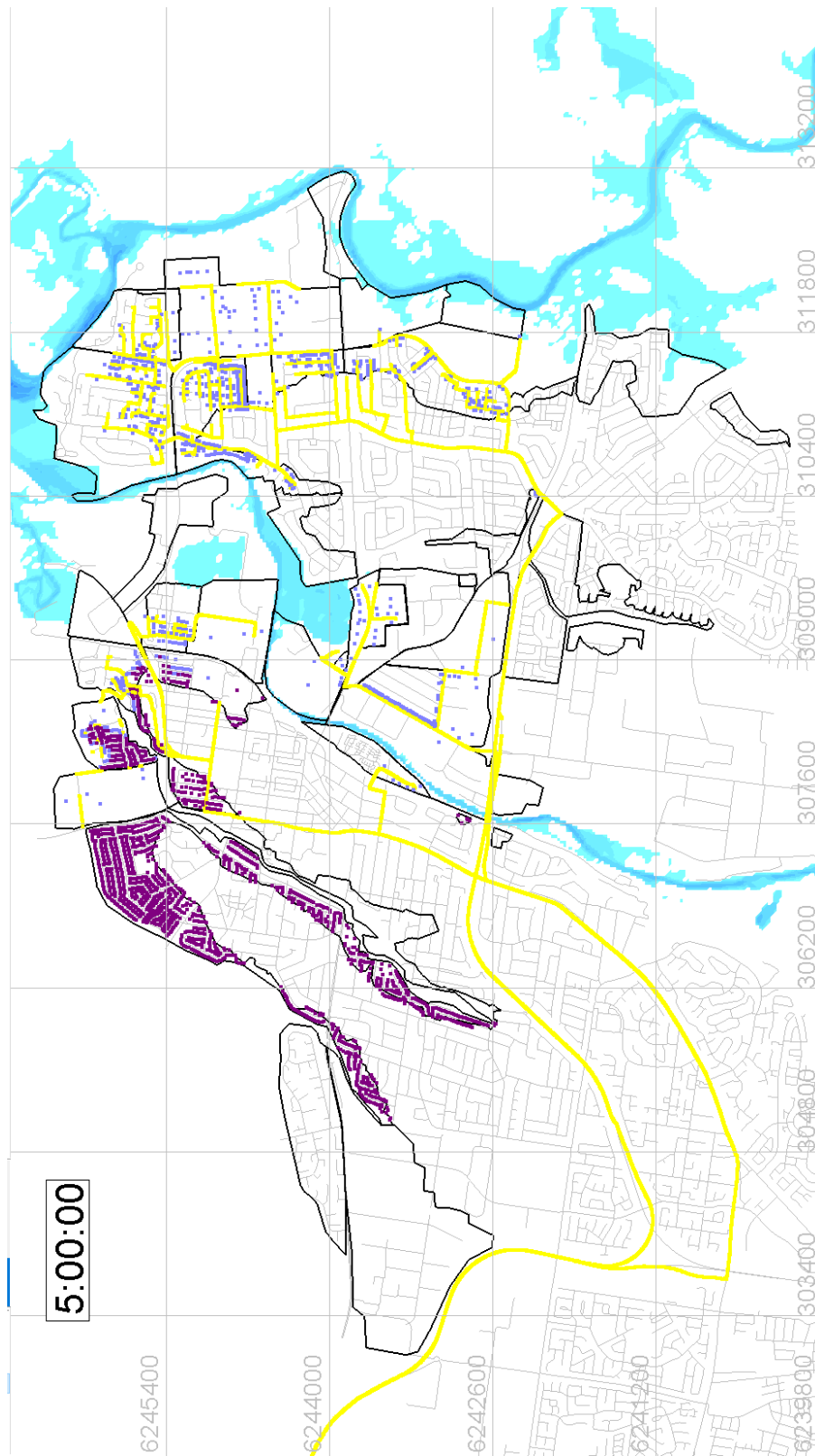


Figure B12. Georges River PMF timestep 5:00 (Scenario 3: Planning Proposals)

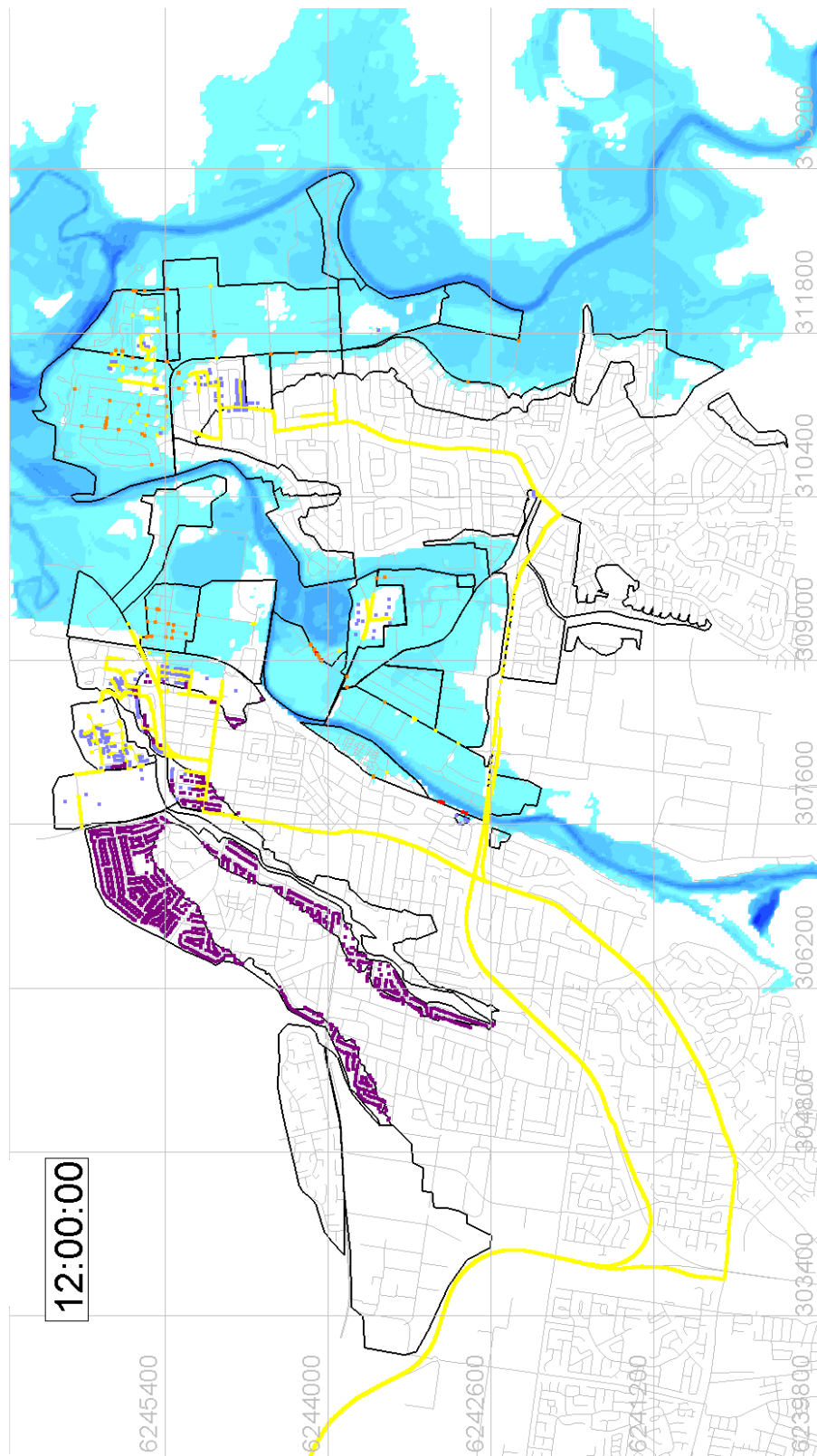


Figure B13. Georges River PMF timestep 12:00 (Scenario 3: Planning Proposals)

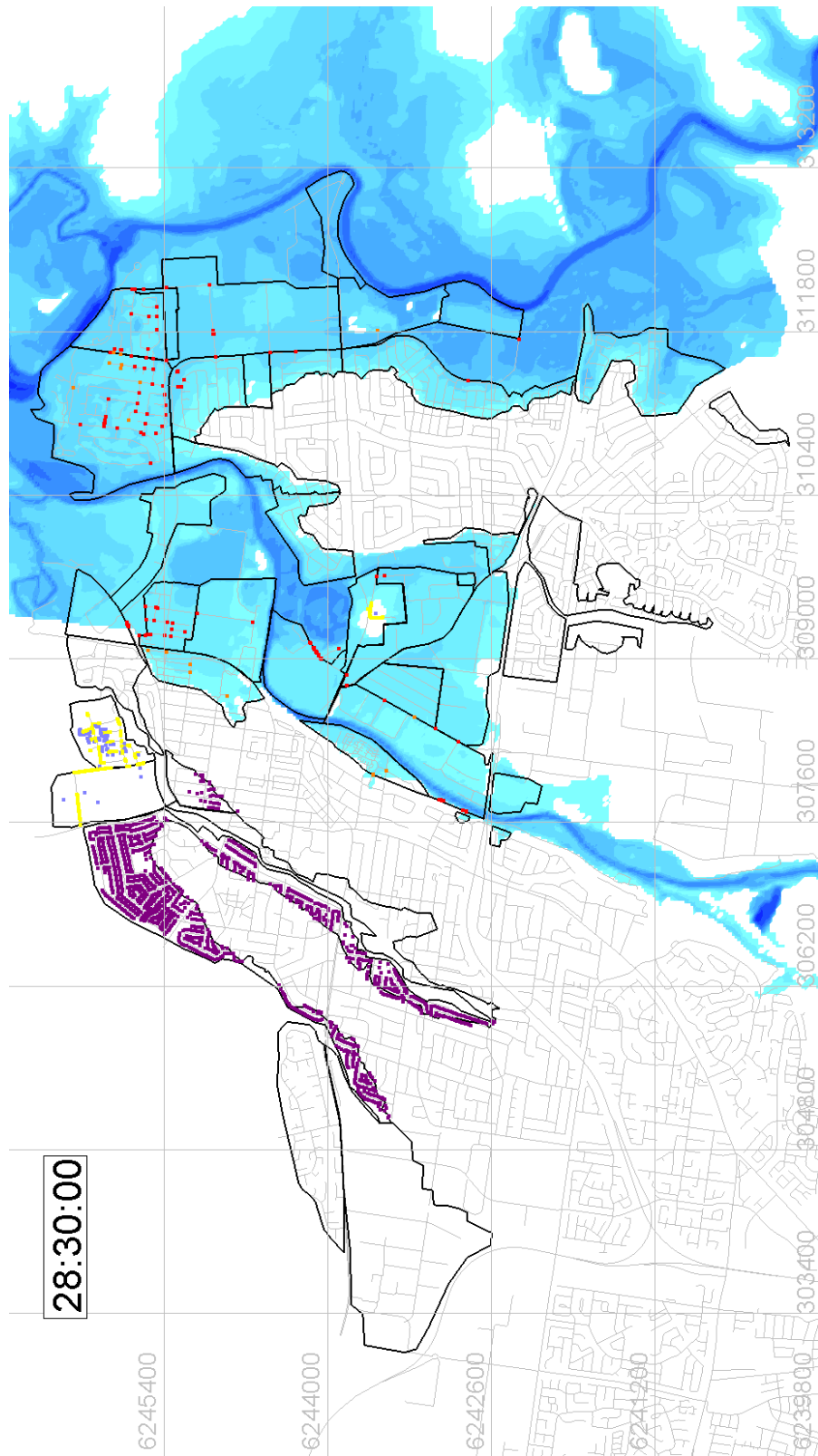


Figure B14. Georges River PMF timestep 28:30 (Scenario 3: Planning Proposals)

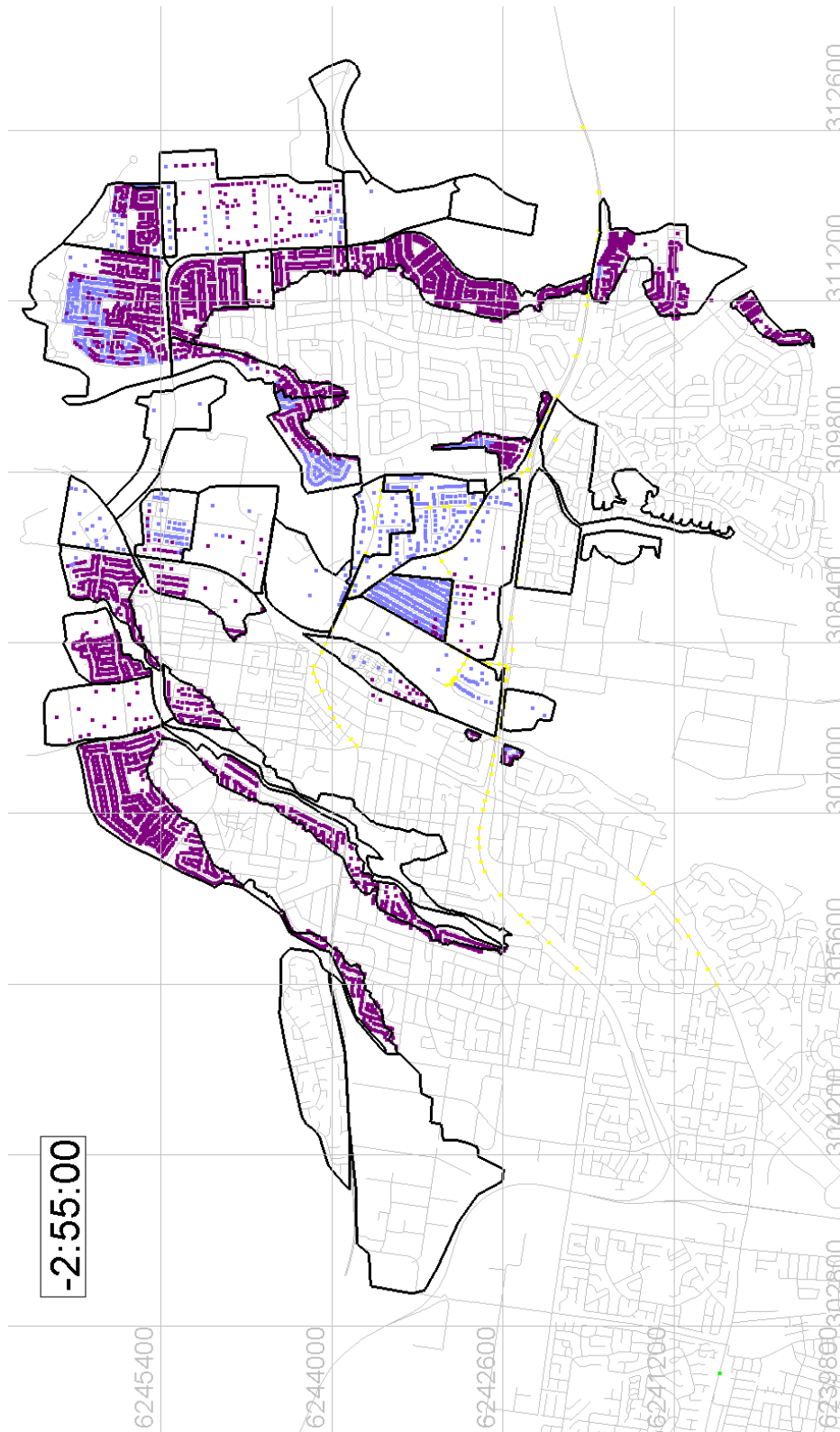


Figure B15. Georges River PMF timestep -2:55 (Scenario A)

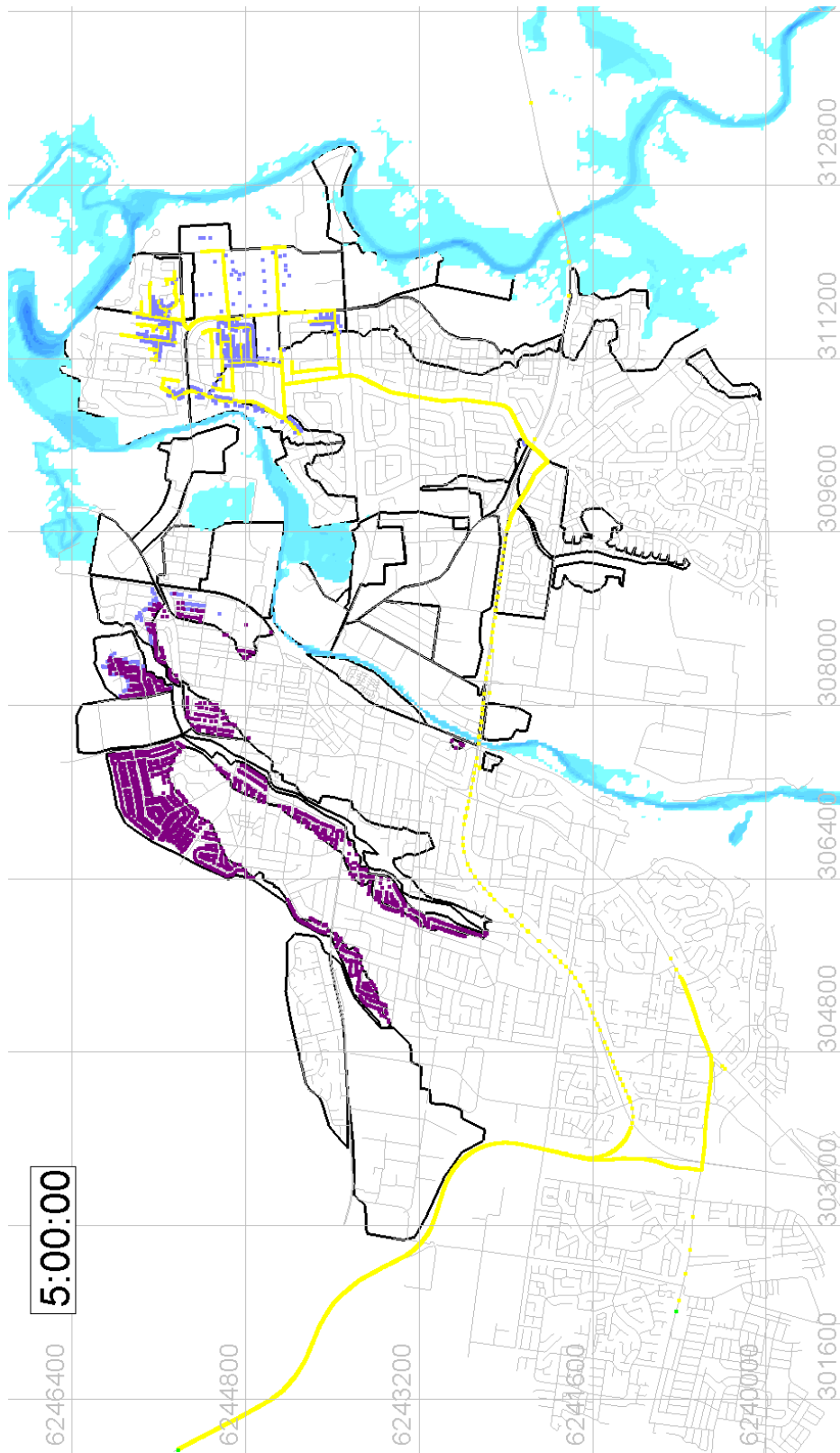


Figure B16. Georges River PMF timestep 5:00 (Scenario A)

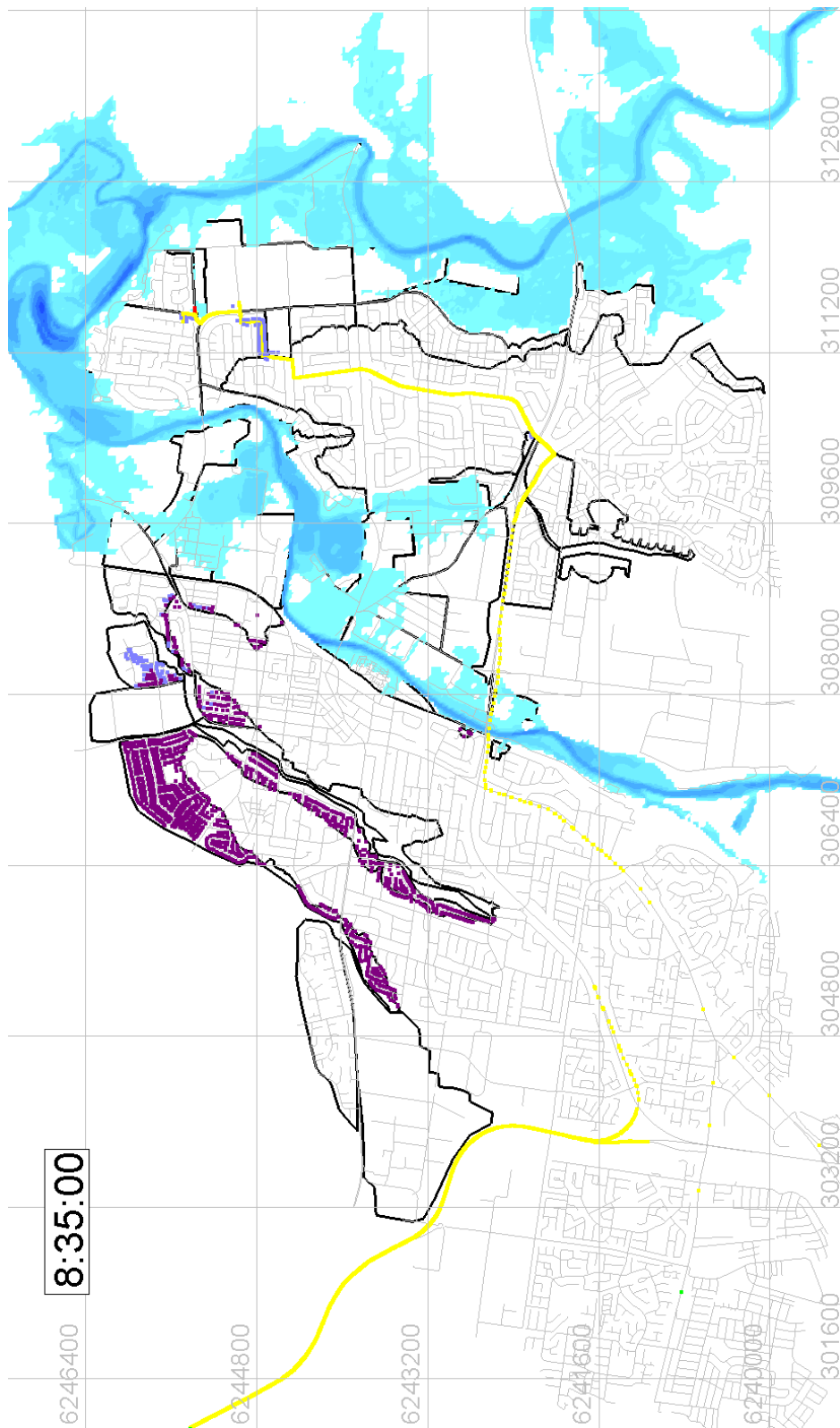


Figure B17. Georges River PMF timestep 8:35 (Scenario A)

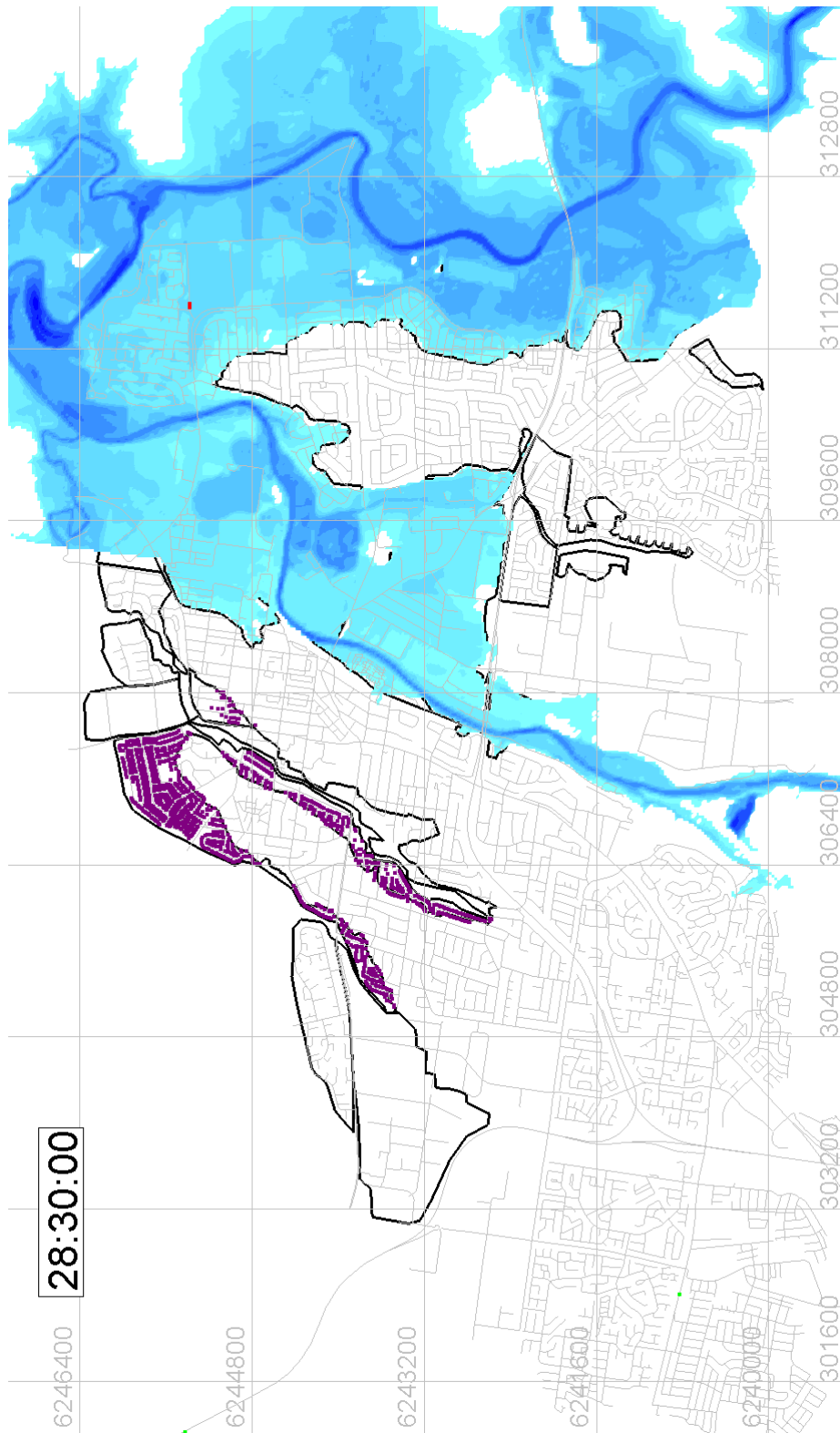


Figure B18. Georges River PMF timestep 28:30 (Scenario A)

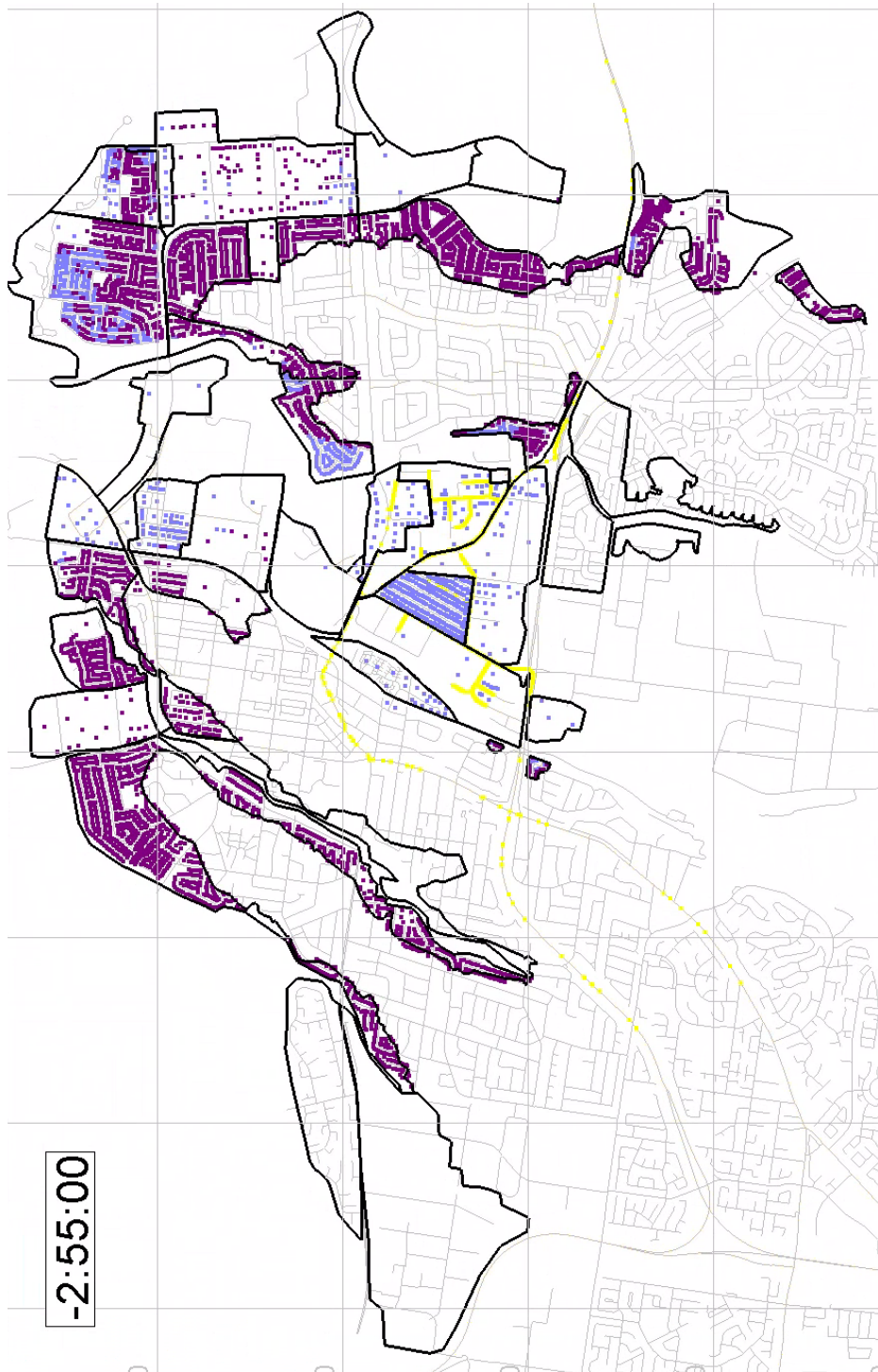


Figure B19. Georges River PMF timestep -2:55 (Scenario B)

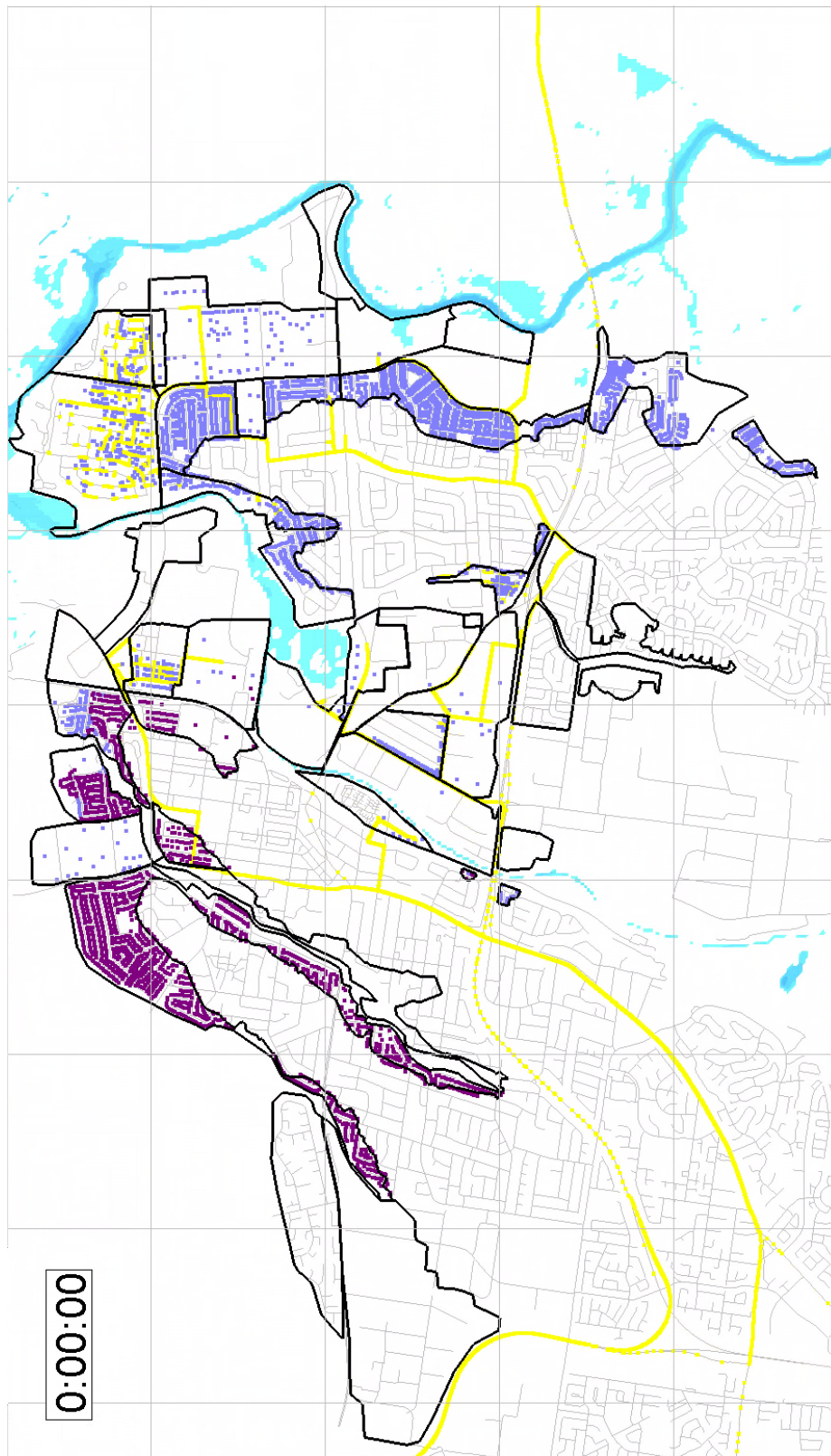


Figure B20. Georges River PMF timestep 0:00 (Scenario B)

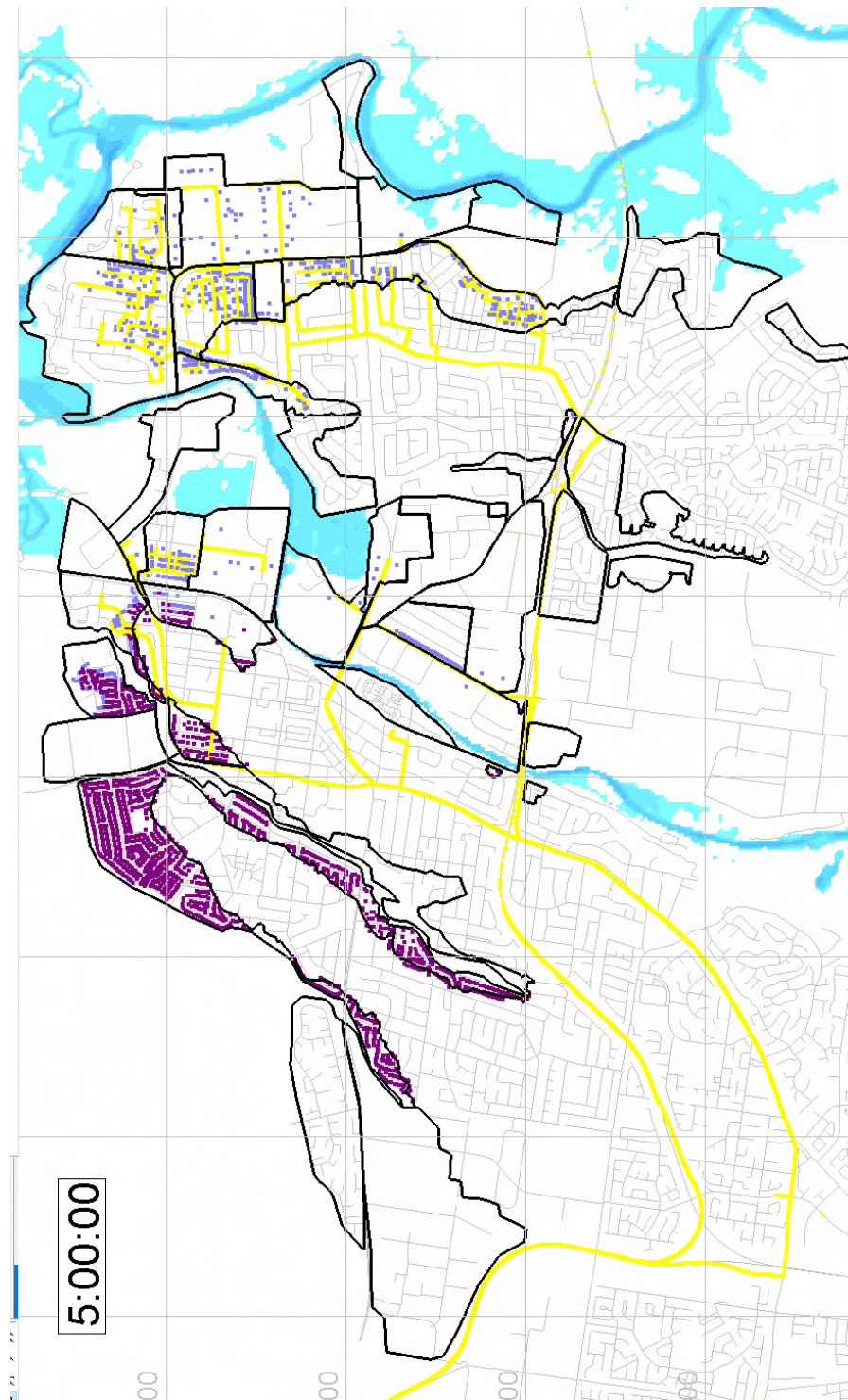
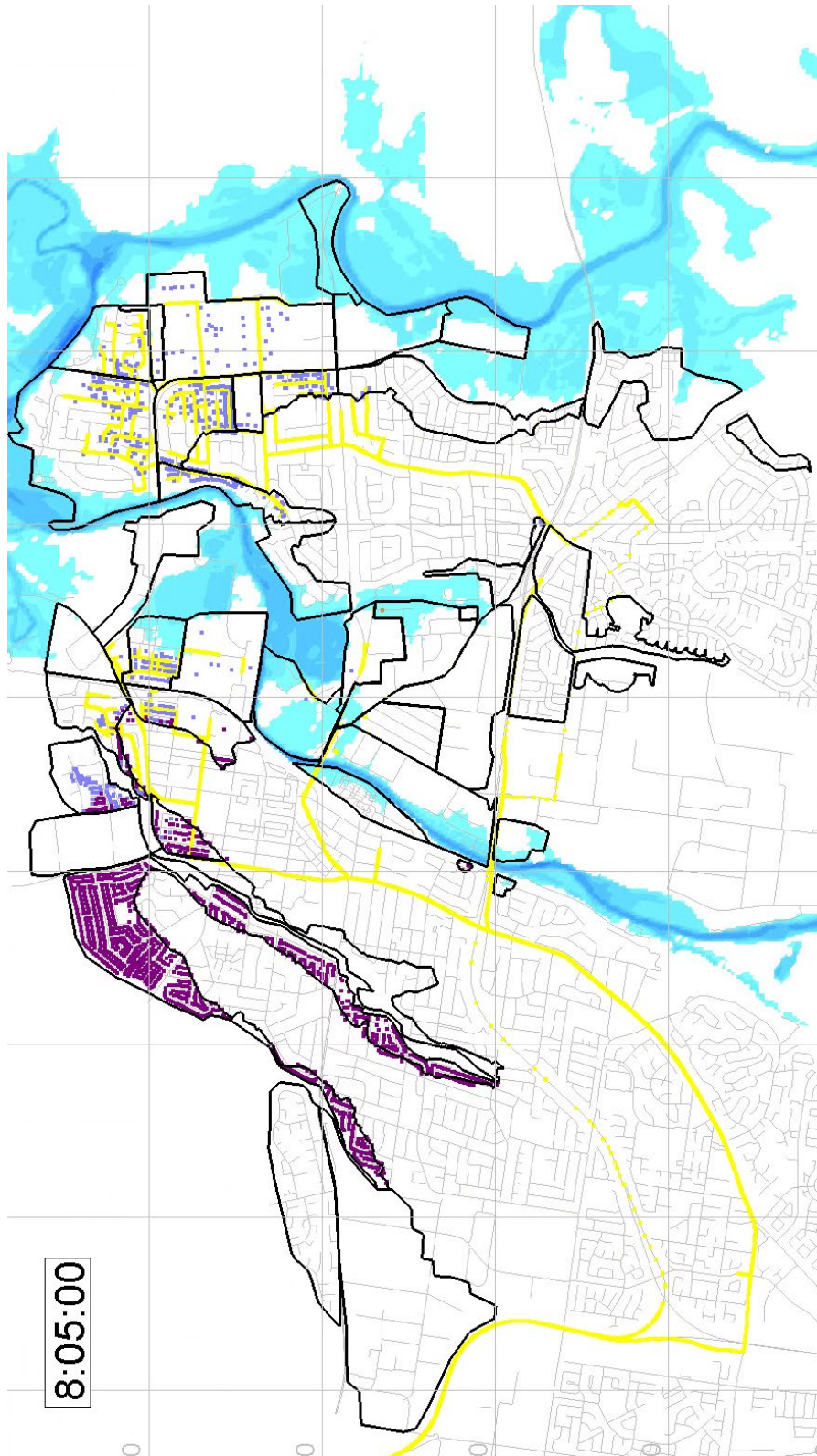


Figure B21. Georges River PMF timestep 5:00 (Scenario B)



Georges River PMF timestep 8:05 (Scenario B)

Figure B22.

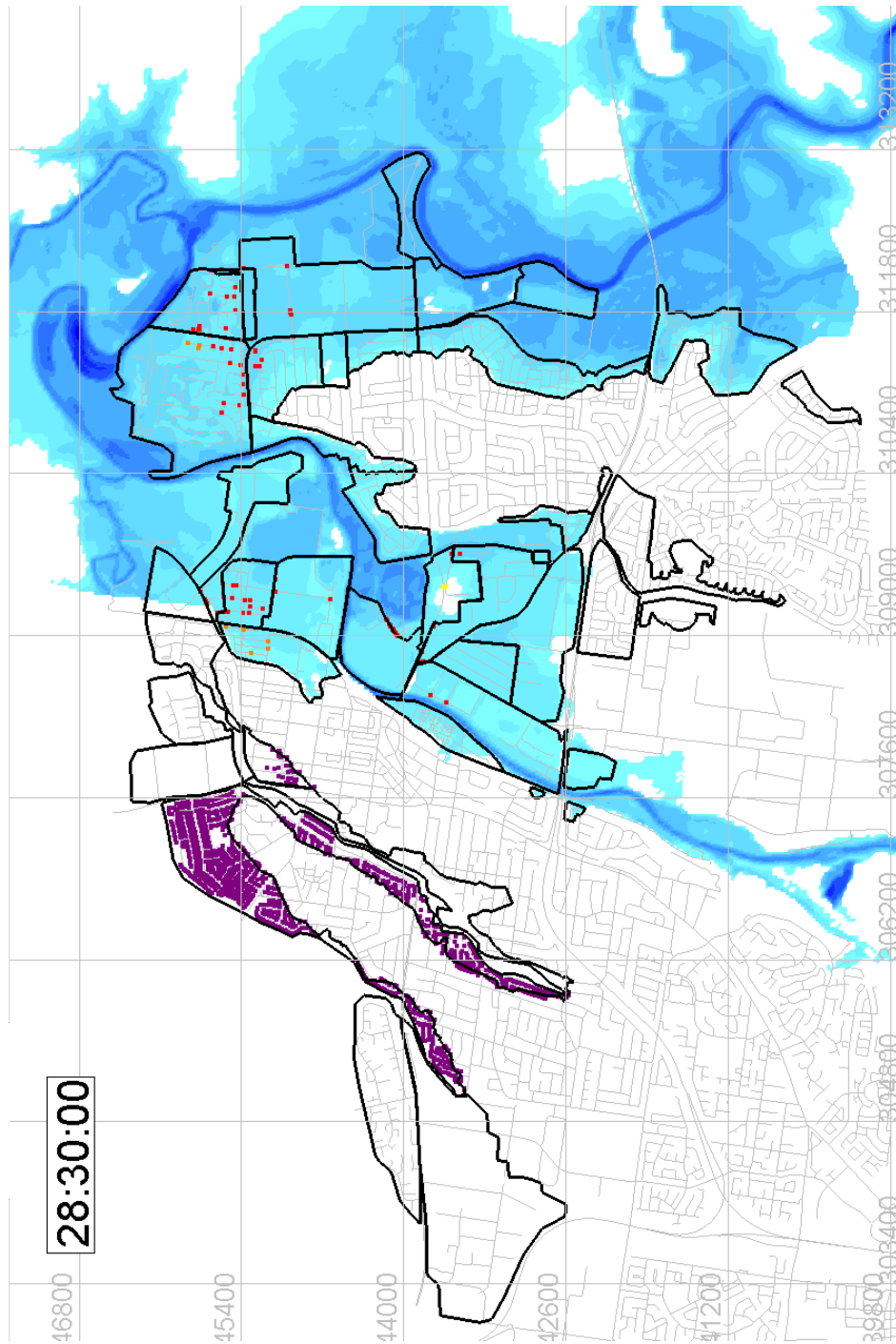


Figure B23. Georges River PMF timestep 28:30 (Scenario B)

Appendix C | Traffic Safety Factor Analysis for Scenario 1

Location	Time on Road (TOR)	Traffic Safety Factor (TSF)	Warning Acceptance Factor (WAF)	Warning Lag Factor (WLF)	Required Time (=TSF + WAF + WLF+TOR)	Available Time	Surplus Time	Time to Rise in Sector	Adjusted Surplus Time	Notes
R18 (Warwick Farm)		3.5	1	1	34	12	-22	19	-3	TRAPPED because there are no flood free public roads out
R19 (Warwick Farm)		3.5	1	1	33.5	12	-21.5	17.5	-4	TRAPPED because there are no flood free public roads out
R17 (Warwick Farm)		3.5	1	1	23.25	12	-11.25	20.5	9.25	Likely do have enough time to get out because there is not queueing the whole time, and there are several waves of cars leaving progressively
R27 (Liverpool)		3	1	1	20	12	-8	20	12	Actually do have enough time because low number of cars spread out over a long time (two waves with big gap in between)
R11 (Moorebank)		3	1	1	18.25	12	-6.25	20.5	14.25	Queueing (yellow) within subsector ends at +2 hrs, but last few cars aren't out until +11 hrs because Nuwarra Rd is backed up
R1 (Chipping Norton)		3	1	1	18	12	-6	4	-2	Queue extends into subsector because Nuwarra Rd is backed up
R2 (Chipping Norton)		2.5	1	1	16.5	12	-4.5	2	-2.5	Queue extends into subsector because Nuwarra Rd is backed up
R2 (Chipping Norton)		2.5	1	1	16	12	-4	2	-2	Queue extends into subsector because Nuwarra Rd is backed up
R12 (Chipping Norton)		2.5	1	1	15.5	12	-3.5	19	15.5	No queue within subsector, only because Nuwarra Rd is backed up
R16 (Liverpool)		2.5	1	1	15.5	12	-3.5	17	13.5	Likely do have enough time to get out because there is not queueing the whole time, and there are several waves of cars leaving progressively
R5 (Chipping Norton)		2.5	1	1	15.5	12	-3.5	19	15.5	Queue extends into subsector because Nuwarra Rd is backed up
R3 (Chipping Norton)		2	1	1	13.75	12	-1.75	20.5	18.75	Queue extends into subsector because Nuwarra Rd is backed up

Location	Time on Road (TOR)	Traffic Safety Factor (TSF)	Warning Acceptance Factor (WAF)	Warning Lag Factor (WLF)	Required Time (=TSF + WAF + WLF+TOR)	Available Time	Surplus Time	Time to Rise in Sector	Adjusted Surplus Time	Notes
I5 (Moorebank)		2	1	1	12	12	0			Queueing in subsector ends at -0.5 hr, but the last car isn't out until +5 hr because of queueing on Moorebank Ave
R6 (Chipping Norton)		2	1	1	12	12	0			Queue extends into subsector because Nuwarra Rd is backed up
I6 (Moorebank)		2	1	1	11.25	12	0.75			No queueing in subsector: some cars leave immediately at -2 hrs, and last car not out until +5.25 because of queueing to get onto the M5
R19 (Liverpool)		2	1	1	11.25	12	0.75			
I12 (Moorebank)		2	1	1	11	12	1			
I7 (Liverpool)		1.5	1	1	9.5	12	2.5			
R12 (Moorebank)		1.5	1	1	9.5	12	2.5			
R9 (Moorebank)		1.5	1	1	9.25	12	2.75			Queue extends into subsector because Nuwarra Rd is backed up
I3 (Moorebank)		1.5	1	1	9	12	3			
R26 (Liverpool)		1.5	1	1	8.5	12	3.5			
R10 (Hammondville)		1.5	1	1	8	12	4			
R4 (Chipping Norton)		1.5	1	1	7.5	12	4.5			
R21 (Warwick Farm)		1	1	1	6.5	12	5.5			
Hzone (Warwick Farm)		1	1	1	5	12	7			
I4 (Moorebank)		1	1	1	5	12	7			
I14 (Moorebank)		1	1	1	4.75	12	7.25			

Location	Time on Road (TOR)	Traffic Safety Factor (TSF)	Warning Acceptance Factor (WAF)	Warning Lag Factor (WLF)	Required Time (=TSF + WAF + WLF+TOR)	Available Time	Surplus Time	Time to Rise in Sector	Adjusted Surplus Time	Notes
R15 (Liverpool)		1	1	1	4.5	12	7.5			
I8 (Warwick Farm)		1	1	1	4	12	8			
IR1 (Chipping Norton)		1	1	1	4	12	8			No queue within subsector, only because Nuwarra Rd is backed up
I15 (Warwick Farm)		1	1	1	3.75	12	8.25			
R23 (Holsworthy)		1	1	1	3.5	12	8.5			
R25 (Chipping Norton)		1	1	1	3.25	12	8.75			
I13 (Moorebank)		1	1	1	3	12	9			
R7 (Moorebank)		1	1	1	3	12	9			



Ref No.: 164737.2023
 Contact: Deb Cuthbertson
 Ph: 8711 7777
 Date: 5 June 2023

The Hon. Paul Scully MP
 GPO Box 5341
 Sydney NSW 2001

Dear Minister,

I am writing to gain further clarity and direction in relation to 2022 NSW Flood Inquiry and how Liverpool City Council should proceed with the assessment of planning proposals and land use policies within the Georges River catchment.

Liverpool City Council is one of the fastest growing local government areas in the state and is experiencing substantial growth in both urban release areas and redevelopment in established areas. Council is continually looking at ways to activate and enhance the Georges River, providing residents and visitors with cool, clean, green spaces in which to connect, play, swim and relax. However, we acknowledge that there is significant risk that needs to be appropriately and robustly managed for existing and future development with proximity to this river system.

The NSW Flood Inquiry made 28 recommendations, which are intended to provide practical, proactive, and sustained mechanisms to ensure readiness for and resilience to flood (and by extension, other disasters). Specifically, Council is seeking additional direction and clarity regarding recommendation 15, 18 and 21 which were all supported in principle by the NSW Government.

Recommendation 15 suggested the NSW Reconstruction Authority be established as the clear lead agency in managing and coordinating housing and infrastructure renewal. The inquiry also notes that the Reconstruction Authority should be given appropriate powers to override planning arrangements (in particular, local government planning) in high-risk areas. Council request further clarification on the establishment and role of the NSW Reconstruction Authority.

Council is keen to continue to deliver housing supply and ensure excellent residential outcomes are achieved. However, Council currently has three residential planning proposals, and one commercial planning proposal on hold which are located within the flood catchment area of the Georges River. In addition, Council has recently received a Gateway Determination for Moore Point which proposed significant density along the banks of the Georges River.

Council is seeking direction on how to assess and progress with planning proposals and strategic planning matters on flood prone land within the Georges River catchment. Currently, a clear direction forward is absent as we await further progress on implementing the recommendations of the Flood Inquiry. There are considerable pressures upon council from applicants, the council body, community, and the slowing market supply to move forward on these planning proposals in an efficient and timely manner. It is our hope that a consistent approach that balances the need



Customer Service Centre Ground floor, 33 Moore Street, Liverpool NSW 2170

All correspondence to Locked Bag 7064 Liverpool BC NSW 1871

Call Centre 1300 36 2170 **Email** lcc@liverpool.nsw.gov.au

Web www.liverpool.nsw.gov.au **NRS** 13 36 77 **ABN** 84 181 182 471

for housing whilst still responding appropriately to the Georges River can be established and utilised going forward.

I look forward to further discussions and welcome the opportunity to meet with you to discuss how Council and the NSW government can work together on the matters raised. It would be appreciated if your office can make contact with my Executive Assistant, Ms Cuthbertson on 8711 7777 to arrange a meeting that is suitable for all parties.

Yours Sincerely,



Hon. John Ajaka
Chief Executive Officer

Department of Planning and Environment



Our ref: MDPE23/1863
Your ref: 164737.2023

Mr John Ajaka
Chief Executive Officer
Liverpool City Council
33 Moore Street
LIVERPOOL NSW 2170
cuthbertsond@liverpool.nsw.gov.au

22 September 2023

Subject: 2022 NSW Flood Inquiry Recommendations

Dear Mr Ajaka

Thank you for your correspondence to the Hon Paul Scully MP, Minister for Planning and Public Spaces, about the 2022 NSW Flood Inquiry (the Inquiry) Recommendations. The Minister has asked me to respond on his behalf.

The NSW Reconstruction Authority (NSWRA), established in December 2022, has been tasked with leading disaster resilience, risk reduction, adaptation and mitigation activities. Further information on the NSWRA's functions, including updates and their ability to "step-in" are found at [NSW Reconstruction Authority Act 2022](#).

The NSWRA has commenced work on high priority matters, including preparing a State Disaster Mitigation Plan (SDMP) by the end of the 2023. The SDMP provides guidance about the mitigation of disasters. This includes setting potential strategies and actions for mitigating the impact of disasters, an assessment and consideration of the impacts of climate change on disasters, and priority areas or regions for future projects. The NSWRA has also been charged with determining new flood planning levels for high-risk catchments, including Georges River.

The Inquiry also identified the need to move to a risk-based approach to managing potential floods. I acknowledge that planning authorities, such as Liverpool City Council, continue to need to make timely development decisions while the NSWRA completes its work. Consistent with the Inquiry's findings, the department recommends applying a risk-based approach when addressing flooding in planning decisions.

This includes ensuring that the level of assessment undertaken for planning or development proposals are proportionate, as well as including a balanced consideration of the merits, risks and impacts. Appropriate measures should also be put in place to limit impacts to an acceptable level and achieve a tolerable flood risk level for flood-affected proposals where appropriate.

The Department for Planning and Environment (the department) has published existing documentation to help guide planning authorities in their consideration of flood related matters. Planning authorities are required to assess planning proposals in line with the department's 2021 Flood Prone Land Package, which include:

- [Section 9.1 Ministerial Direction - 4.1 Flooding](#) – for planning proposals that create, remove or alter a zone or a provision that affects flood prone land

Department of Planning and Environment



- [Planning Circular PS21-006 - Considering flooding in land use planning: guidance and statutory requirements](#) – noting this circular also provides information on the application of Ministerial Direction – 4.1 Flooding (which was previously referred to as Local Planning Direction 4.3 – Flooding) and the application of the *Considering flooding in land use planning guideline*.
- the [Considering flooding in land use planning guideline](#) (2021).

Further information is published on the department's website at www.planning.nsw.gov.au/policy-and-legislation/resilience-and-natural-hazard-risk/flooding/flood-prone-land-package.

The department will continue to work with councils, government agencies and key stakeholders to implement the NSW Government's response to the Inquiry, including recommendations 18 and 21.

Should you have any questions, Santina Camroux, Director, Resilient Places, at the department can be contacted at Santina.Camroux@planning.nsw.gov.au or on 0418 644 552.

Yours sincerely

A handwritten signature in black ink that reads "Amanda Fairley".

Amanda Fairley
Acting Deputy Secretary
Programs, Infrastructure and Digital

ITEM 02

**Interim Heritage Order for 124 Moore Street,
Liverpool.**

Strategic Objective	Healthy, Inclusive, Engaging Embrace the city's heritage and history
File Ref	355027.2023
Report By	Thomas Wheeler - Heritage Officer
Approved By	Mark Hannan - Acting Director Planning & Compliance

EXECUTIVE SUMMARY

At the Governance Committee of 10 October 2023, a Report was tabled recommending the heritage listing of 124 Moore Street, Liverpool which is currently the subject of an Interim Heritage Order (IHO). On considering the Report, the Committee requested further information on the transfer of ownership of the property to Scouts NSW, and whether any restrictions on title were instigated to restrict the use of the site for scouting purposes only.

This Report has been prepared in response to this request for additional information. The background and supporting information can be read in the Committee Report from 10 October 2023 (Attachment A).

RECOMMENDATION

That Council:

1. Note this Report.
2. Endorse the listing of 124 Moore Street, Liverpool on Schedule 5 of the *Liverpool Local Environmental Plan 2008*.
3. Note that a Report is to be referred to the next available meeting of the Council recommending the commencement of a Planning Proposal to amend the *Liverpool Local Environmental Plan 2008*.

REPORT

At the Governance Committee of 10 October 2023, a Report was tabled recommending the heritage listing of 124 Moore Street, Liverpool which is currently the subject of an Interim Heritage Order. On considering the Report, the Committee requested further information on

the transfer of ownership of the property to Scouts NSW, and whether any restrictions on title were imposed to restrict the use of the site for scouting purposes only.

Further research undertaken by Edwards Heritage on behalf of Council identified that the original land transfer was dated 17 July 1928. The Certificate of Title (Vol. 3952 Fol.149) identified that the land was owned by William Pickersgill until 16 March 1926 when the land was transferred to the Trustees of the School of Arts by the Executors of his Estate.

The trustees of the School of Arts included Robert Clyde Howe, Leslie James Ashcroft, Lawrence Murphy, Edward Pearce and Dr James Pirie.

In 1928, the School of Arts Trustee agreed in writing to transfer the land to The Public Trustee for the State of New South Wales as Trustee for the Boy Scouts Association of NSW for consideration of £60.

The gifting of the land did include the transfer of a token sum of £60 from the Boy Scouts Association of NSW to the respective owner's group. Based on the evidence available through various newspaper articles from that period, this payment was drawn from funds raised through the community (and initiated by the Mayor at the time) to deliver a scout hall for the Liverpool Boy Scouts.

On 25 May 1925, The Cumberland Argus and Fruitgrowers Advocate reported on a meeting of persons interested in the Boy Scout movement held at Liverpool Town Hall on 14 May 1925, which was called and presided over by Mayor (Alderman) L. J. Ashcroft. The purpose of the meeting was to facilitate fundraising activities for the delivery of a Scout Hall for the Liverpool Boy Scout movement.

Furthermore on 28 November 1930, The Biz reported on the opening of the Scout Hall at 124 Moore Street and noted that in 1926 a "Queen" competition reaped £187; a "Popular Boy Scout" competition brought in £55; and a community ball raised £22. In addition, Former Mayor Ashcroft, E Hirst and J Shepherd provided an additional £140. Additional funds were raised through various small activities held by the community and supported by the Mayor of Liverpool.

There is no evidence to suggest that a restriction of the use of land was placed on the title. However, based on the token sale sum and the considerable fundraising activities of the community spearheaded by Mayor Ashcroft for the provision of a scout hall, there was a clear intent from the community for this site to be for the Scout movement and the benefit of the community.

LEGAL ADVICE

Following the October 2023 Governance Committee Meeting, legal advice was sought to establish whether any restrictions were placed on the transfer of title from Trustees of the School of Arts to the Boy Scouts Association of NSW.

A review of the available information associated with the title transfer has identified no restrictions to title, covenants or other agreements in place that would prevent the land from being used for any purpose.

FINANCIAL IMPLICATIONS

There are no financial implications relating to this recommendation.

CONSIDERATIONS

Economic	There are no economic and financial considerations.
Environment	There are no environmental and sustainability considerations.
Social	Preserve and maintain heritage, both landscape and cultural as urban development takes place.
Civic Leadership	There are no civic leadership and governance considerations.
Legislative	Include any relevant legislation and section here. There are no legislative considerations relating to this report.
Risk	There is no risk associated with this report.

ATTACHMENTS

1. Governance Committee Meetings 2023-10-10 - Report - IPC 02 - Proposed heritage listing of 124 Moore Street, Liverpool.

IPC 02	Proposed heritage listing of 124 Moore Street, Liverpool
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Strategic Objective	Healthy, Inclusive, Engaging Embrace the city's heritage and history
File Ref	315205.2023
Report By	Thomas Wheeler - Heritage Officer
Approved By	Lina Kakish - Director Planning & Compliance

EXECUTIVE SUMMARY

At the Council meeting of 26 July 2023, the Council resolved to defer the listing of the property located at 124 Moore Street, Liverpool on Schedule 5 – Environmental Heritage of the Liverpool Local Environmental Plan (LLEP) 2008, to enable further consultation with the owner (Scouts NSW) and a presentation to Council's Governance Committee (this report).

This report has been prepared in response to this resolution and includes the following documents as attachments:

- **Attachment A:** Heritage Significance Assessment, Edwards Heritage, prepared for Liverpool City Council.
- **Attachment B:** Heritage Significance Assessment, DFP Planning, prepared for Scouts NSW.
- **Attachment C:** Follow up response from Scouts NSW.
- **Attachment D:** Copy of the Council report tabled 26 July 2023.

This report does not re-assess the heritage significance assessments prepared for this site and reference should be made to the 26 July 2023 Council report (**Attachment D**) for that specific information. This report focuses on the consultation process and post 26 July 2023, actions and responses to the additional submission from Scouts NSW.

RECOMMENDATION

That Council:

1. Receives a report to a future Council meeting to decide whether to prepare a planning proposal to amend the Liverpool Local Environmental Plan 2008 to list 124 Moore Street, Liverpool under Schedule 5 – Environmental Heritage.
2. Receives and notes this report.

REPORT

Background

A detailed summary of the background of the proposal is contained in the Council report tabled at the 26 July 2023 Council meeting (**Attachment D**). In summary:

- February 2021 – Council resolved to issue an Interim Heritage Order (IHO) for the property which was then gazetted by the NSW government;
- March 2021 – Edwards Heritage was engaged by Council to prepare an Assessment of Heritage Significance for 124 Moore Street, Liverpool (**Attachment A**);
- June 2021 – Council resolved to prepare a planning proposal to list 124 Moore Street (and other properties), Liverpool in Schedule 5 - Environmental Heritage of the Liverpool Local Environmental Plan (LLEP) 2008;
- February 2022 – Council resolved to endorse the planning proposal (Amendment 95) and forward to the Department of Planning and Environment (DPE) seeking a Gateway determination;
- May and June 2022 – The planning proposal was on public exhibition;
- July 2022 – Council received a request from the landowner to defer the heritage listing and requested six months to engage a heritage consultant to peer review the Heritage Significance Assessment prepared for Council;
- October 2022 – Council resolved to receive a further report and recommendation following further consultation with the owner of 124 Moore St, Liverpool;
- April 2023 – Scouts NSW provided a response (Heritage Significance Assessment, DFP Planning (**Attachment B**);
- July 2023 – Council considered a report recommending that a planning proposal is progressed to heritage list the 124 Moore St property.

A decision was deferred at the July meeting where it was resolved that Council:

1. *Defer this item and refer this matter to a Governance Committee Meeting for further consultation with the landowners.*
2. *Discuss at the Governance Committee Meeting how we prevent this happening in the future.*

After the Council meeting, the landowner was invited to provide any further information that they wished to be considered in Council making a decision. Further written advice was provided by Scouts NSW and DFP Planning (**Attachment C**). The additional advice summarises the points presented by the DFP Consultant at the July Council meeting,

including the provision of justification for the consideration of buildings across the State or Sydney as a part of the comparative analysis.

Matters raised at the 26 July 2023 Council Meeting

This section addresses several issues raised during the Council meeting as a part of the considerations of this proposed heritage listing, as well as the proposed IHO for the property located at 15 Heathcote Road, Moorebank.

Land Zoning

While the property is zoned MU1 Mixed Use, it is currently a small land-locked parcel given that it is surrounded by strata-listed 1970/80s apartments. As a result, there is currently limited development potential of the property located at 124 Moore Street, Liverpool.

Assessing Significance

The assessment of heritage significance is guided by the ICOMOS Australia Burra Charter (globally accepted as an industry-leading framework for heritage significance) and the NSW Guidelines for Assessing Heritage Significance. In reviewing a report on heritage significance, a benchmark to consider is whether the consultant has used these documents to inform the process they followed and the outcomes they assessed. This means that the consultant is following industry best practice. Both heritage reports (**Attachment A and B**) adhere to this framework.

Previous Heritage Studies

The primary heritage study used as a reference tool within Liverpool is the 1992 study prepared by Neustein and Associates. The study followed the traditional expert lead methodology implemented through a street survey across the Liverpool LGA. This study did not incorporate an assessment of significance or any sort of formal assessment criteria and was based on the visual presentation to the street. In total, approximately 400 potential heritage items were identified but only 115 were listed.

In 2005, a review was undertaken by the Council of the original heritage study as a part of the preparation of the 2008 Local Environmental Plan. The study confirmed 380 potential heritage items, however, the Administrator at the time stated that only potential items supported by the landowner would be listed. As a result of this ruling, no additional items were added to the heritage register.

In 2015, a small, targeted heritage study was undertaken by Council's Heritage Advisory Committee focusing on potential items of note at that time. This resulted in a small pool of potential items. This study was deferred by Council with no action taken.

The Liverpool Comprehensive Heritage Study which is now underway is designed to provide a coordinated response to identifying potential gaps in the existing heritage register and to minimise an ad hoc approach being taken to identify and protect heritage items across the Liverpool LGA. The majority of the project will be completed utilising internal resources.

Consultants will be required to undertake the land use economics and land use planning study components of the project. Budget has already been approved and allocated to fund these activities.

Council Staff Comments on Heritage Significance

In assessing the property located at 124 Moore Street, Liverpool, the assessment considers the significance the building has within the local context. While there may be value in comparing the building to assets across the state in terms of technical significance, its value in considering the item for historic significance and even rarity within the context of Liverpool is minimal.

Furthermore, the fact that 4 out of 23 scout halls are heritage-listed cannot be categorically associated with a lack of significance for the subject property. There are various factors that can impact this outcome, including the following:

- The appetite within the relevant Council to heritage list properties;
- Whether a heritage study been undertaken; and
- Whether support or objections have been raised by state agencies and / or the community.

Therefore, it is acknowledged that there are potential variables which inform the outcome.

In relation to their being no active use for the building by Scouts NSW currently, this is considered only a minor consideration. Many heritage properties are no longer used for their original purpose or no longer have a direct connection to their original owner. This is the case for numerous heritage properties in Liverpool including:

- The Former Liverpool Courthouse;
- Liverpool State Hospital;
- Casula Powerhouse Arts Centre (former power station); and
- The Liverpool School of Arts.

The assessment of significance guidelines is clear that the previous user or owner does not need to be still using the asset, but there should be the ability to read that association within the fabric of the building or in its history, which can again be associated with the building.

For these reasons, it is the opinion of Council officer's that there are still valid grounds for the heritage listing of the property.

FINANCIAL IMPLICATIONS

There are no financial implications relating to this recommendation.

CONSIDERATIONS

Economic	There are no economic and financial considerations.
Environment	There are no environmental and sustainability considerations.
Social	Preserve and maintain heritage, both landscape and cultural as urban development takes place.
Civic Leadership	There are no civic leadership and governance considerations.
Legislative	There are no legislative considerations relating to this report.
Risk	The risk is deemed to be Low. There is a low civic and cultural risk that if the subject property is not heritage listed and subsequently demolished, that there will be community frustration and criticism.

ATTACHMENTS

1. Assessment of Significance - Edwards Heritage
2. Heritage Significance Assessment - DFP Planning
3. Follow up response from Scouts NSW
4. Council Report 26 July 2023

ITEM 03**Notice of Motion - Narrow Road Widths**

Strategic Objective	Evolving, Prosperous, Innovative Implement planning controls and best practice urban design to create high-quality, inclusive urban environments
File Ref	356486.2023
Report By	Kweku Aikins - Senior Strategic Planner
Approved By	Lina Kakish - Director Planning & Compliance

EXECUTIVE SUMMARY

At the Ordinary Meeting of Council on 27 September 2023, Council resolved (NOM 01) to table a Report at a future workshop that identifies the challenges, opportunities and cost implications of the following:

- 1. The build and maintenance of current residential narrow street widths when compared to a new minimum width, increased in width to address the practical needs of our residents and that includes traffic calming devices that ensures the same safety concerns as was proposed by making the streets so narrow.*
- 2. Any increase in the cost of housing as a result of increased residential street widths in new developments if implemented.*
- 3. Council's advice on challenges and appetite to object to the SEPPs that might override Councils vision to increase the minimum residential street widths, if implemented.*
- 4. The current cost to provide in-bay parking in existing and new narrow streets.*

Council Officers have provided responses to each of the queries above. It is recommended that Council receives and notes these responses.

RECOMMENDATION

That the Committee receives and notes the response to the Notice of Motion (NOM 01) from the Ordinary Meeting of Council on 27 September 2023 regarding Narrow Road Widths.

REPORT

Background

At the Ordinary Meeting of Council on 27 September 2023, Council tabled a Notice of Motion (NOM 01) regarding the delivery of roads across the Liverpool Local Government Area (LGA) with a narrow carriageway width. The NOM outlined a series of concerns about narrow road widths in residential areas, in particular concerns about emergency vehicle access, on-street parking, and traffic flow.

In response to the NOM, Council resolved to table a Report at a future workshop that identifies the challenges, opportunities and cost implications of the following:

1. *The build and maintenance of current residential narrow street widths when compared to a new minimum width, increased in width to address the practical needs of our residents and that includes traffic calming devices that ensures the same safety concerns as was proposed by making the streets so narrow.*
2. *Any increase in the cost of housing as a result of increased residential street widths in new developments if implemented.*
3. *Council's advice on challenges and appetite to object to the SEPPs that might override Councils vision to increase the minimum residential street widths, if implemented.*
4. *The current cost to provide in-bay parking in existing and new narrow streets.*

This Report provides a formal response to these four items.

Analysis

The following Section provides an analysis of the four items listed in the NOM from the Ordinary Meeting of Council on 27 September 2023.

Item 1 – The build and maintenance of current residential narrow street widths when compared to a new minimum width, increased in width to address the practical needs of our residents and that includes traffic calming devices that ensures the same safety concerns as was proposed by making the streets so narrow.

Established Areas

A suburb-by-suburb breakdown of constructed roads in the LGA (**Attachment 1**) has found that average carriageway widths in residential areas vary from approximately 5.7m to 8.5m.

Narrow streets are typically found in older release areas such as Wattle Grove and Prestons and are typically the result of best practice at the time (Australian Model Code of Residential Development (AMCORD), Commonwealth of Australia, 1995) (**Attachment 2**).

Providing a narrow carriageway whilst allowing on-street parking supports lower vehicle speeds, which in turn improves safety, particularly for more vulnerable users like pedestrians and cyclists, and enhances local amenity.

However, with the Liverpool LGA experiencing higher levels of car ownership compared with the Greater Sydney average – 2021 Census data indicates that 56 per cent of households within the Liverpool LGA had access to two or more vehicles compared with 46 per cent for Greater Sydney – competition for on-street parking in established areas can often be greater than was envisaged by the AMCORD Guidelines.

By not providing dedicated on-street parking areas, some narrow streets can become restricted to a single trafficable two-way lane, impacting vehicular accessibility. In response to these issues, Council has allocated an annual budget of \$200,000 to implement parking treatments within narrow streets.

The cost of complete reconstruction of such roads in established areas would be prohibitively expensive, and impact established infrastructure within the road reserve like footpaths, street lighting, and street trees, and likely necessitate services (e.g. electricity, stormwater, telecommunications, water, etc.) relocation.

Growth Areas

In 2021, the *Liverpool Growth Centre Precinct Development Control Plan* (DCP) was amended to enhance traffic flow and alleviate issues associated with the absence of dedicated on-street parking in local streets. The DCP amendment included changes to the road cross-section for local streets as shown in Figure 1 (**Attachment 3**), which were subsequently endorsed by Council at the Ordinary Meeting of Council on 31 March 2021.

The amendments maintained the corridor width of a local street at 16 metres (from property boundary to property boundary) however readjusted the cross-section to include on-street parking on both sides of the street. The change ensured that no additional land was required for the purpose of local road construction, nor any impact to the original dwelling yield.

Conclusion

With the DCP amendment in 2021 ensuring new local streets in growth areas are delivered with on-street parking on both sides of the street, as well as a trafficable carriageway width that facilitates two-way traffic flow, it is noted that the existing concerns with narrow streets in the established areas should be avoided in the growth areas as they develop.

With regards to the established areas, given the prohibitive cost of attempting to retrofit all narrow streets across the LGA, it is recommended that Council continues to utilise the existing annual budget allocation to target high-risk narrow streets to address on-street parking issues.

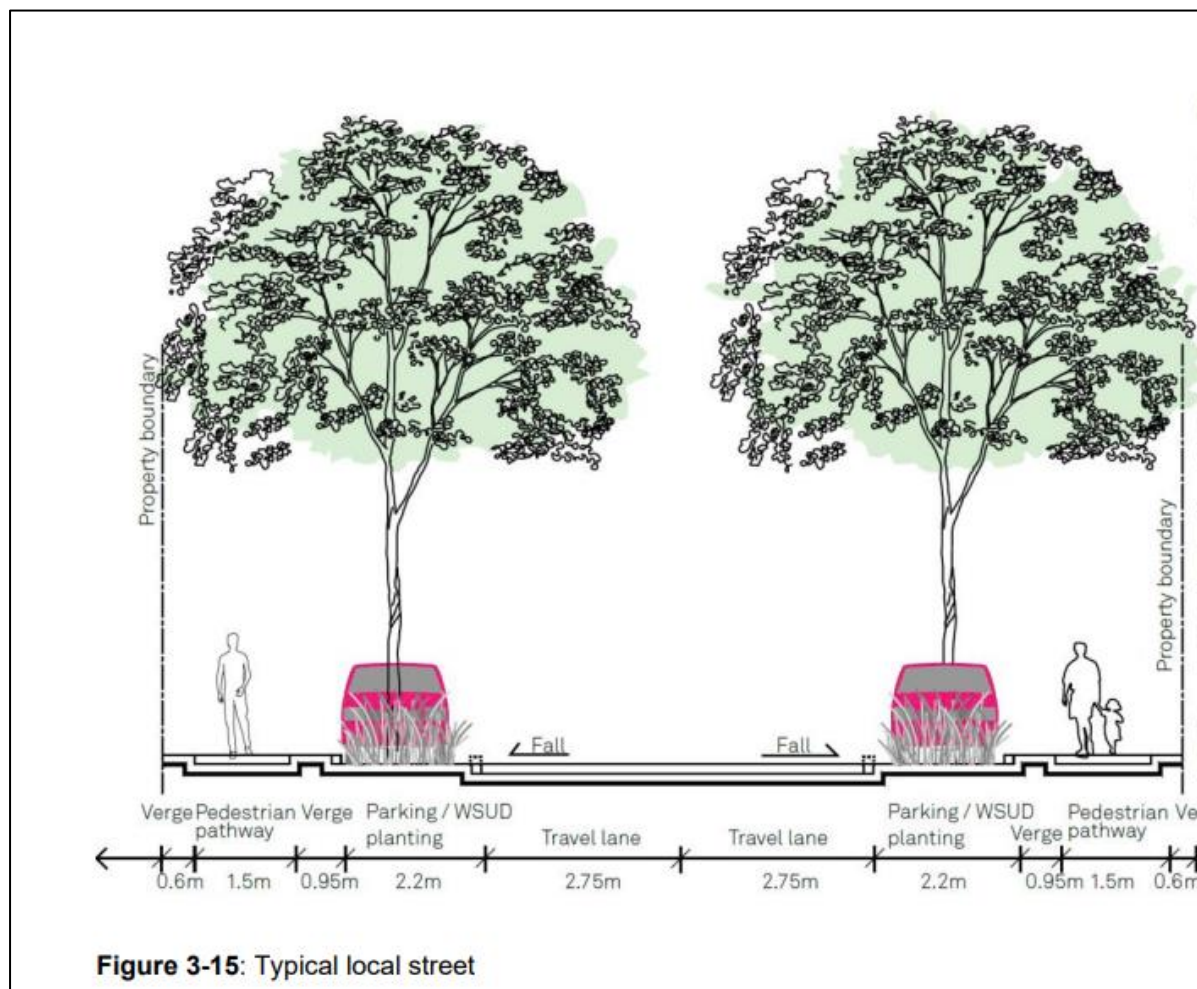


Figure 1: Cross section of typical local street in the Liverpool Growth Areas (Austral and East Leppington)

Item 2 – Any increase in the cost of housing as a result of increased residential street widths in new developments if implemented.

It is acknowledged that there would likely be an associated increase in construction cost as a result of providing a wider road carriageway for a local street, due to the inclusion of indented parking bays, associated traffic calming devices, and a wider trafficable pavement overall. Whether this increase in construction cost for a wider local street would translate to an increase in the cost of housing for homes serviced by that street is unclear.

There is no distinct correlation between increasing local road widths and the cost of purchasing housing. Whilst the cost of delivering land and housing may fluctuate based on construction costs and land values, the cost of buying housing is more related to the cost of comparable

dwellings in the area and factors such as the buyer's ability to pay and/or to seek debt. Nonetheless, if road widths are increased, this will proportionally reduce the saleable land that could be developed on larger sites in the growth areas.

Item 3 – Council's advice on challenges and appetite to object to the SEPPs that might override Councils vision to increase the minimum residential street widths, if implemented.

Road widths across the Liverpool LGA are governed by Development Control Plans (DCPs) and relevant technical guidelines, rather than State Environmental Planning Policies (SEPPs).

As such, it is unlikely that a SEPP would override initiatives to widen local streets. SEPPs will generally only provide land-use zoning reservations for arterial or sub-arterial roads which are normally delivered by Transport for NSW.

Item 4 – The current cost to provide in-bay-parking in existing and new narrow streets.

The cost of providing on-street parking bays is estimated at between \$3,000 and \$5,000 per parking space. There are two types of parking bay sizes:

- Half width paved parking bay – meaning one tyre on the road and another on the footpath verge. Estimated Cost: Between \$3,000 and \$3,500.
- Full width paved parking bay - meaning entire vehicle will be parked on footpath verge. Estimated Cost: Between \$4,500 and \$5,000.

Conclusion

This Report details the challenges, opportunities and costs associated with narrow streets in both established and growth areas across the Liverpool LGA. It is recommended that Council notes and receives the responses provided in this Report.

FINANCIAL IMPLICATIONS

There are no financial implications relating to this recommendation.

CONSIDERATIONS

Economic	<p>Deliver and maintain a range of transport related infrastructure such as footpaths, bus shelters and bikeways.</p> <p>Deliver a high-quality local road system including provision and maintenance of infrastructure and management of traffic issues.</p>
Environment	<p>Promote an integrated and user-friendly public transport service.</p> <p>Support the delivery of a range of transport options.</p>
Social	<p>Regulate for a mix of housing types that responds to different population groups such as young families and older people.</p>
Civic Leadership	<p>There are no civic leadership and governance considerations.</p>
Legislative	<p>There are no legislative considerations relating to this report.</p>
Risk	<p>There is no risk associated with this report.</p>

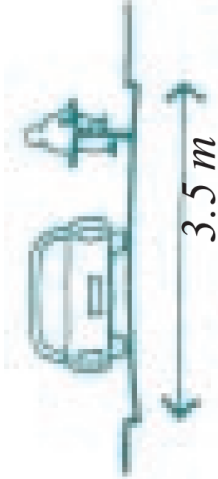
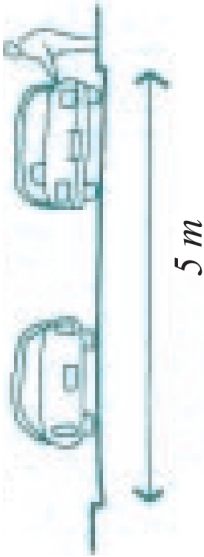
ATTACHMENTS

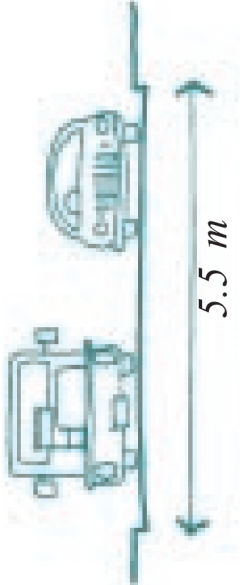

1. Average street widths by suburb
2. Typical road cross sections (Established Areas - AMCORD)
3. Typical road cross sections (Growth Areas)

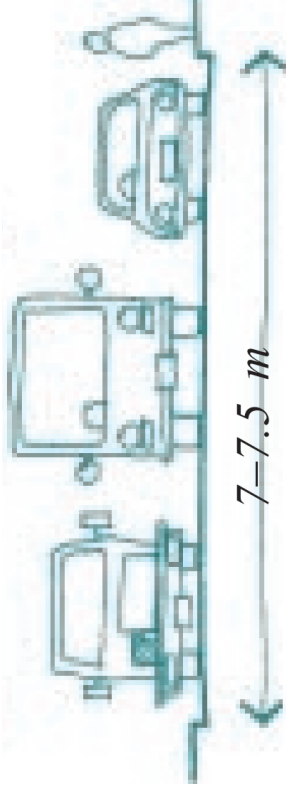
STREET WIDTHS BY SUBURB (AS BUILT)

Suburb Name	Average Width (m)	Min Width (m)	Max Width (m)
ASHCROFT	7.1	4.0	10.2
AUSTRAL	7.2	3.6	18.9
BADGERYS CREEK	6.3	3.0	7.5
BRADFIELD	7.4	4.2	16.0
BRINGELLY	8.0	3.6	17.0
BUSBY	7.4	3.8	10.3
CARNES HILL	6.2	4.6	15.0
CARTWRIGHT	6.7	4.8	11.4
CASULA	7.7	2.5	14.8
CECIL HILLS	6.2	3.0	11.1
CECIL PARK	7.7	7.1	11.1
CHIPPING NORTON	8.6	3.0	15.3
DENHAM COURT	6.7	3.6	10.5
EDMONDSON PARK	7.5	3.3	22.9
ELIZABETH HILLS	7.4	3.1	12.1
GREEN VALLEY	8.1	4.5	17.0
GREENDALE	6.3	4.5	19.8
HAMMONDVILLE	7.5	5.8	10.1
HECKENBERG	7.9	5.3	12.8
HINCHINBROOK	8.0	4.6	14.6
HOLSWORTHY	7.4	3.0	19.2
HORNINGSEA PARK	6.4	5.6	19.2
HOXTON PARK	6.5	4.3	12.9
INGLEBURN	7.2	7.2	7.2
KEMPS CREEK	6.0	4.0	8.0
LEN WATERS ESTATE	13.2	12.1	13.8
LEPPINGTON	7.8	4.4	15.3
LIVERPOOL	8.4	2.3	14.0
LUDDENHAM	6.7	4.0	10.1
LURNEA	7.8	4.8	12.0
MIDDLETON GRANGE	6.6	4.1	12.7
MILLER	7.9	4.5	14.0
MOOREBANK	7.8	2.5	12.5
MOUNT PRITCHARD	8.5	6.9	11.5
PLEASURE POINT	5.8	4.3	6.4
PRESTONS	6.9	4.4	17.5
ROSSMORE	6.7	4.0	25.3
SADLEIR	7.7	4.0	10.2
VOYAGER POINT	7.0	5.6	10.6
WALLACIA	5.7	5.1	6.0
WARWICK FARM	8.2	3.0	17.5
WATTLE GROVE	6.7	5.0	14.8
WEST HOXTON	6.1	3.2	11.0

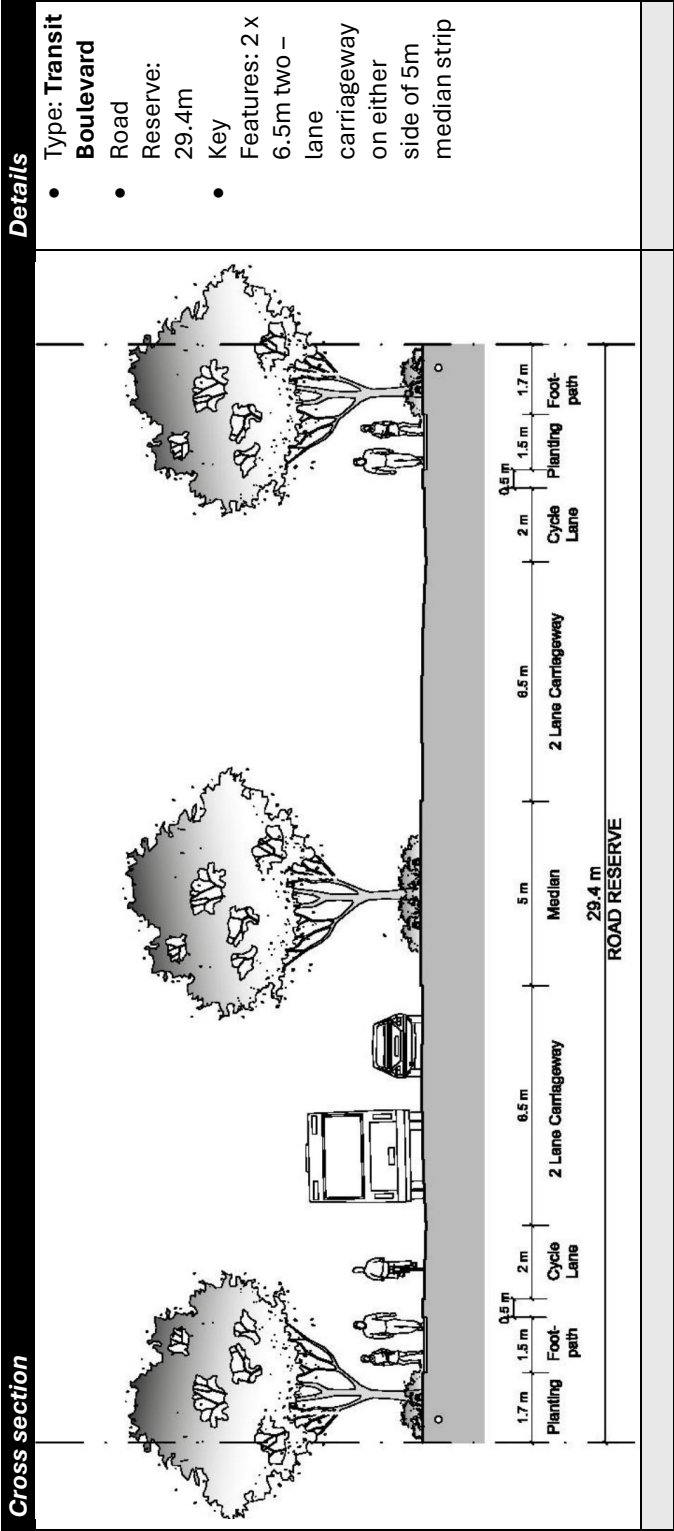
Typical carriageway cross sections – Established areas (AMCORD)

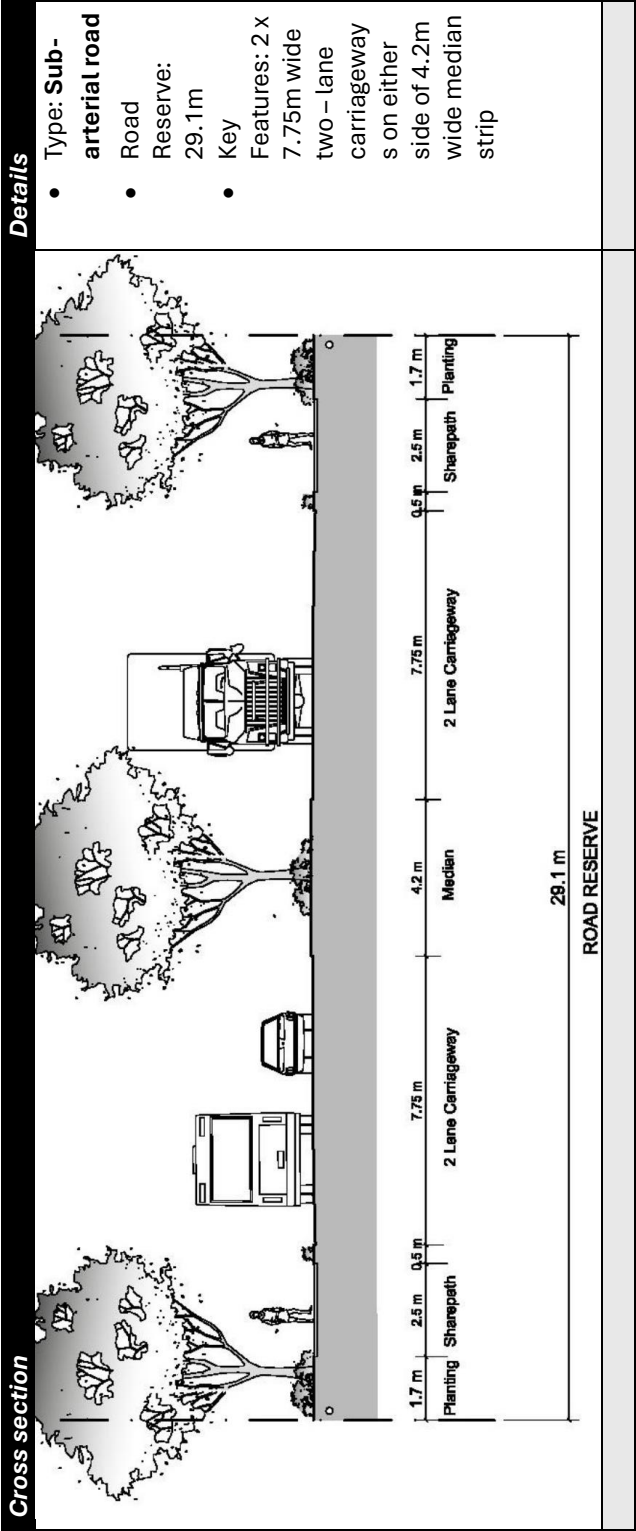
Cross section – carriageway		Details
	No cross section – Road reserve varies	<ul style="list-style-type: none">Type: Access LaneRoad Reserve: VariesKey Features: 3m carriageway (minimum)
		<ul style="list-style-type: none">Type: Access PlaceRoad Reserve: 10mKey Features: 3.5m -3.7m single lane carriageway allows a car to pass a cyclist (or pedestrian), but is clearly too narrow for parking without blocking the street <p><i>Note: Requires parking provision and provision for widening to 5.0m if necessary in the future. Maximum length is 100m. A passing bay is required if length is greater than 80m.</i></p>
		<ul style="list-style-type: none">Type: Access Street (300 vehicles/per day)Road Reserve: 12mKey Features: 5m carriageway allows a car to pass a parked car or a moving car

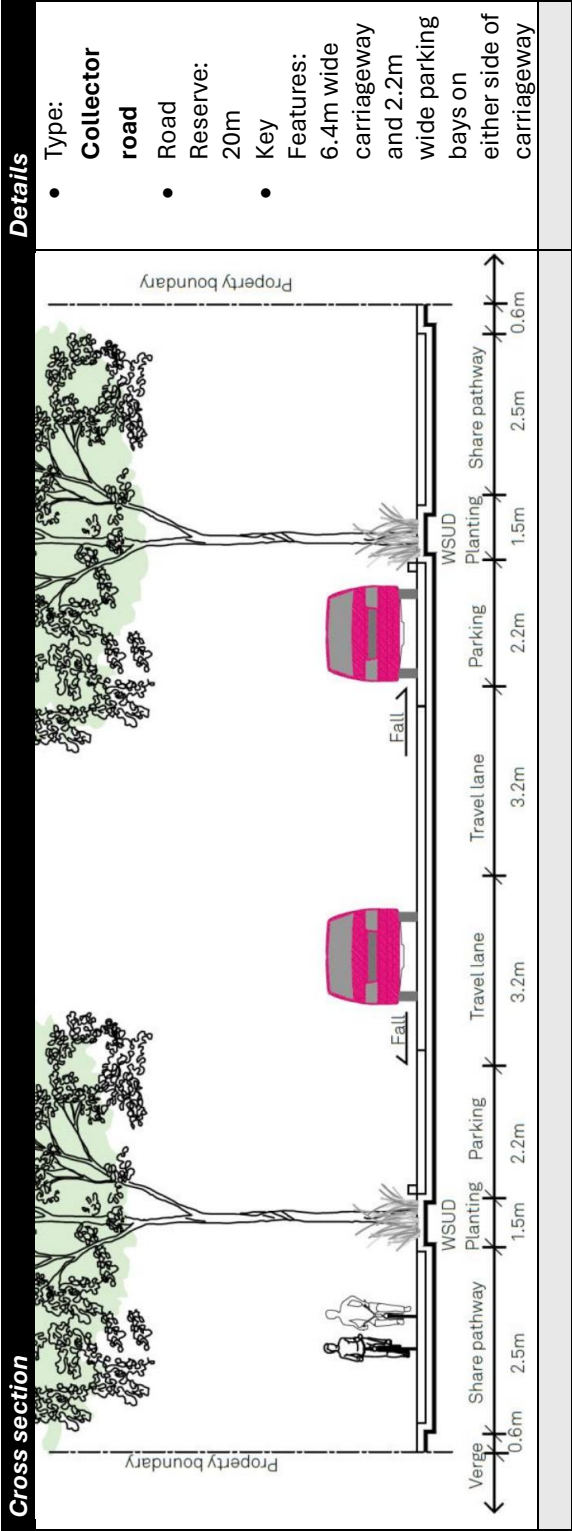
Cross section – carriageway		Details
		<ul style="list-style-type: none">• Type: Access Street (1000 vehicles/per day)• Road Reserve: 12m• Key Features: 5m -5.5m carriageway allows a moving car to pass a truck, but is too narrow for cars to park opposite each other without blocking the street.
		<ul style="list-style-type: none">• Type: Access Street (2000 vehicles/per day)• Road Reserve: 12m• Key Features: 5m or 7m carriageway is wide enough for two vehicles to pass each other

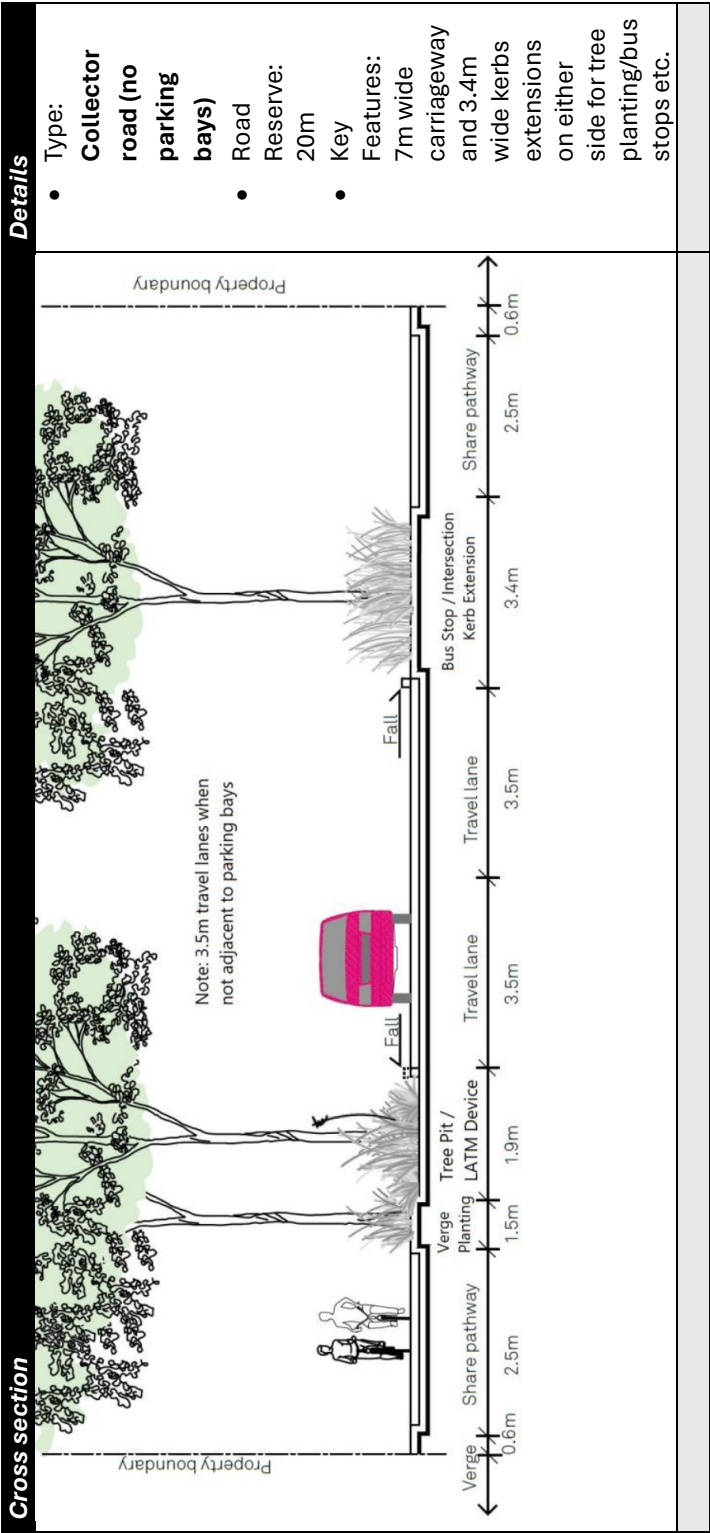
Cross section – carriageway		Details	
		<ul style="list-style-type: none">• Type: Minor Collector• Road Reserve: 16.5m• Key Features: 7-7.5 m carriageway is wide enough for two vehicles to pass each other while passing a parked car. It is wide enough for a moving car to pass between two parked cars, but is not wide enough for two moving vehicles to pass at once.	
No cross section – subject to AMCORD performance criteria for <i>street design and on-street carparking</i> including function and width; safety; access; and geometric design.		<ul style="list-style-type: none">• Type: Major Collector• Road Reserve: Subject to AMCORD performance criteria• Key Features: Subject to AMCORD performance criteria	

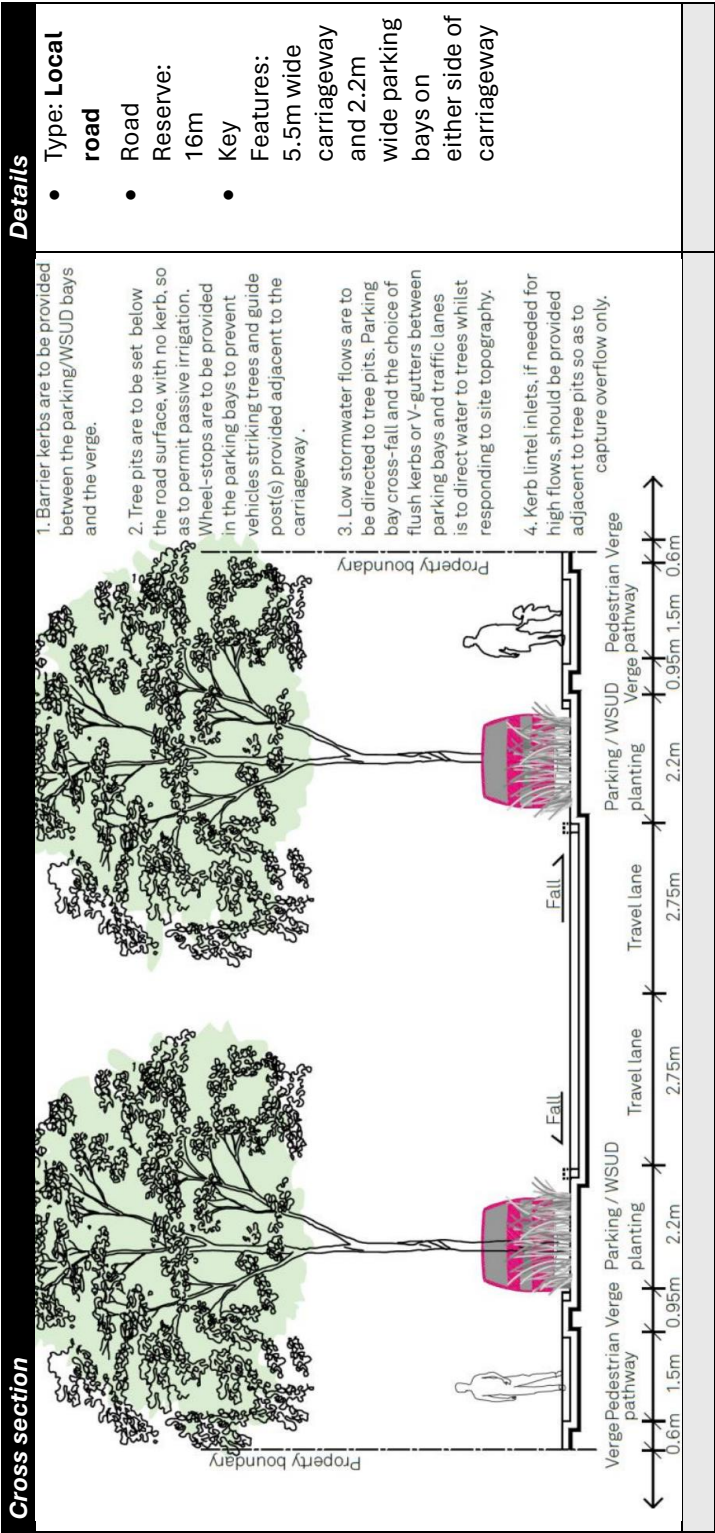
Typical road Cross sections – Growth areas

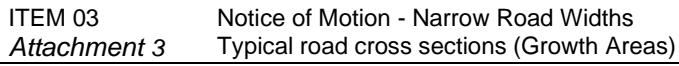












ITEM 04

Community Participation Plan Discussion Paper

Strategic Objective	Healthy, Inclusive, Engaging Communicate, listen, engage and respond to the community by encouraging community participation
File Ref	064679.2024
Report By	Brianna Van Zyl - Senior Strategic Planner
Approved By	Lina Kakish - Director Planning & Compliance

EXECUTIVE SUMMARY

At the Ordinary Meeting of Council on 7 February 2024, a Question with Notice (QWN 01) by Councillor Rhodes was raised regarding neighbour notification of subdivisions resulting in lot sizes greater than 300m² (**Attachment 1**). In response to the QwN, Council resolved:

‘That:

- 1. Council take this item to a Governance Committee before the end of March 2024 so that Council can give this the attention it deserves to make sure that people are being given equal rights and are not being discriminated based on the size of the lots being subdivided in regards to Community Participation Plan 2022 with the intention of fairer notification for all residents.*
- 2. Further information is provided on State Government process as it relates to Council process.’*

This Report has been prepared in response to the Council Resolution and details the most recent revision to the Community Participation Plan (2022), the justification around the notification requirements for subdivisions of lots greater than 300m².

The aim of this Report is to facilitate discussion on the current Community Participation Plan (CPP) and identify whether any further amendments to the CPP are required. If further amendments are required, they will tabled at a future Ordinary Meeting of Council for Council consideration and endorsement.

RECOMMENDATION

That the Committee receives and note this Report.

REPORT

Background

In March 2018, changes to the *Environmental Planning and Assessment Act 1979* (EP&A Act) required all Councils to prepare a Community Participation Plan (CPP). As a result of the legislative change, Council subsequently endorsed the Liverpool Community Participation Plan in October 2019.

Before Council's first CPP, all community participation requirements were outlined in Councils Development Control Plan (DCP). Whilst preparing the CPP, most of the public participation requirements were largely adapted from Part 1 (Chapter 18) of the DCP, including the provision to not require notification of Development Applications which propose to subdivide lots greater than 300m². Part 1, Chapter 18 of the DCP has since been revoked.

More recently, in December 2022, Council endorsed an amendment to the CPP which made the following changes to the document:

- Updating land use definitions to reflect the Standard Instrument;
- Removal of the requirement to advertise in the local newspaper as they have ceased being published;
- The addition of a figure which demonstrates the relationship between strategic documents;
- The addition of a clause which gives the Manager Development Assessment discretion to exhibit any application considered to have significant community interest for a longer period;
- The addition of a clause requiring Council-related Development Applications to be exhibited for a minimum of 28 days;
- Increase the notification distance to five properties in each direction, with Figure 2 being updated to reflect this (request from Council); and
- Amend notification requirements to include owners and occupiers (request from Council).

At the Ordinary Meeting of Council on 7 February 2024, a Question with Notice (QWN 01) was raised regarding neighbour notification of subdivisions resulting in lot sizes greater than 300m² (**Attachment 1**). In response to the QwN, Council resolved:

‘That:

- 1. Council take this item to a Governance Committee before the end of March 2024 so that Council can give this the attention it deserves to make sure that people are being given equal rights and are not being discriminated based on the size of the lots being subdivided in regards to Community Participation Plan 2022 with the intention of fairer notification for all residents.*
- 2. Further information is provided on State Government process as it relates to Council process.’*

Analysis

At the Ordinary Meeting of Council on 7 February 2024, the following items were discussed in relation to the CPP. Responses to each item is provided below.

a) Notification of lots greater than 300m²

Notification requirements in the CPP were largely sourced from the former Liverpool DCP 2008, which did not require the notification of Development Applications for subdivision of sites greater than 300m². This same position was carried over into the CPP.

The subdivision of lots greater than 300m² typically have less of an impact on neighbouring properties compared to smaller lot subdivisions (i.e. less than 300m²). Part of the reason for this is that smaller lots typically contain development with smaller setbacks and greater potential for visual, privacy or overshadowing impacts. Conversely, larger lots typically allow for more flexibility in design, which helps address privacy and amenity concerns.

In addition, under *SEPP (Exempt and Complying Development Codes) 2008*, a dwelling house can be constructed through the complying development pathway if the lot is greater than 200m². Therefore, the decision not to notify the subdivision of lots greater than 300m² was because a dwelling house could be achieved comfortably on the site through a Complying Development Certificate (CDC) which did not warrant detailed community consultation.

There is scope to increase the neighbour notification requirements to include the subdivision of lots greater than 300m² however this would add an additional step in the Development Application assessment process for larger subdivision proposals, as well as increase the associated Development Application approval timeframes for these proposals.

b) Notification of five (5) properties in each direction

As part of the amendment to the CPP in December 2022, the notification distance for some Development Applications were increased to require notification of five (5) properties on each side of the subject site rather than adjoining neighbours, as requested by Council. For clarity, the previous notification requirements are outlined in Figure 1, with the updated (current) version shown in Figure 2.



Figure 1: Previous notification requirement under CPP 2019



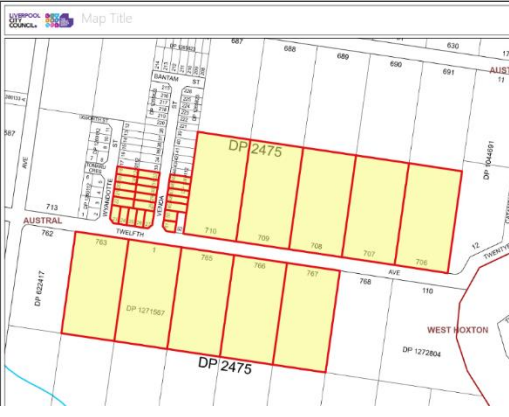
Figure 2: Current notification requirements as per December 2022 CPP

As a result of this change, Council staff have been required to send out significantly more letters for Development Applications such as (but not limited to): Light Industry, Manor Houses, Terraces, Semi-Detached housing, Commercial Premises and Secondary dwellings.

The requirement to notify five (5) properties in each direction has resulted in a greater number of notification letters being sent for relatively minor applications, especially in the rural areas of the LGA. Two examples of recent Development Applications which have resulted in a disproportionate number of letters being sent to residents, are presented in Table 1 below.

Table 1: Examples of Notifications for Development Applications

Development Application	No. letters sent	Notification Plan
DA-195/2023 Alterations and additions to an existing unauthorised structure (granny flat) and change of use to a secondary dwelling with a proposed attached outbuilding.	48	

<p>DA-145/2023 Two lot subdivision, and construction of semi-detached dwellings.</p>	<p>46</p>	
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The requirement to notify five (5) properties in each direction has also increased the resourcing associated with neighbouring property notification. A comparison of Bing Invoices, (the provider Council uses to conduct mail merges and send letters), from 2022 (prior to CPP changes) compared to 2023, shows the new notification requirements have resulted in an increase in overall costs (see Table 2).

Furthermore, Bing has recently advised Council that from 3 April 2024, each small letter will be subject to a 25c price increase.

Table 2: Comparison of Invoice Cost

Time of Year	2022 Invoice Costs	2023 Invoice Cost	Difference
Late April	\$493	\$875	+\$382
Late May	\$2570	\$2952	+\$382
Early October	\$436	\$2867	+2,431

Whilst Council staff are of the opinion meaningful neighbour notification is important, it is also important that the notification is reaching the right constituents, and not inadvertently increasing both Development Assessment approval timeframes and operational costs.

Moving forward, an option to resolve this issue is to include a tiered system for Development Applications that involve residential dwellings. For example, Development Applications that proposed:

1. 1-5 dwellings are sent to the directly adjacent landowners;
2. 5-20 dwellings are sent the three (3) adjacent properties; and
3. 20 or more dwellings continue as per the current CPP.

Alternatively, additional discretion could be included in the CPP for the Manager Development Assessment to allow for notification to be less than the CPP requires when the requirements outlined in the CPP are too onerous.

c) Examples of other Councils

Each Council deals with neighbour notification slightly different. A summary of how some of Liverpool's adjoining Councils manage notification is presented in Table 3.

Table 3: Examples of other Council notification practices

Council	Comment
Camden Council	Camden Council does not specify notification distances in the CPP. For all Development Applications they notify adjoining land only (including rear and across the road). Their CPP includes a discretionary clause for larger, more complex developments.
Campbelltown City Council	<p>Campbelltown City Council does not notify all development, only the land uses specifically listed in the CPP. Single Storey Dwelling houses are not notified under their CCP.</p> <p>Examples of development (but not limited to) which are exhibited and notified (with the notification distance being 100m) includes:</p> <p>Residential Flat Buildings, Boarding Houses, Seniors Housing, Place of Public Worship in R2 Low Density Residential, and Subdivisions containing more than 100 new lots.</p> <p>Other developments which are notified, but only to adjoining owners include:</p> <p>Additions to existing dwelling that create a second storey, Semi-Detached Dwellings, Dual Occupancies and Secondary Dwellings.</p>
Fairfield City Council	<p>The Fairfield City Council Community Engagement Strategy proposes a tiered system for engagement, which reflect the varying impacts, and sensitivity of proposed developments. Generally, letters are sent to notify neighbours of development for most residential, industrial and commercial developments. However, the notification distance varies from 30m to 100m.</p> <p>The following developments are not required to be notified:</p> <p>Office Premises, Business Premises, Kiosks, Local Distributions Centres and Specialised Retail Premises.</p>

d) State Environmental Planning Policies – Notification to Neighbours

Development permissible under a State Environmental Planning Policy (SEPP) is treated differently to development applied through a Development Application. Development permissible under a SEPP, specifically Complying Development, is considered straight forward building work which is expected to have minimal disturbance on neighbours. Examples include Secondary Dwellings, Single Storey Dwelling Houses, and certain change of use applications.

Certifiers using Chapter 3 of SEPP (*Housing*) 2021, or SEPP (*Exempt and Complying Development Codes*) 2008, must notify neighbours within a 20m radius of the subject site. This must be in the form of written notice and be given in person, through a letter box drop, or via the post. The written notice must contain the following information:

- The name, address, and telephone number of the applicant land where development will occur, and certifiers contact details;
- A statement that the certifier has received an application for a complying development certified and will determine the application in accordance with the Act;
- Description of the development; and
- Date on which the application was received by a certifier.

Neighbours can request to see the plans of the complying development, however, there is no obligation for the Applicant to make these available.

In addition, once the Complying Development Certification has been issued, neighbours within 20 metres from the boundary must be notified prior to any work commencing. This is called the pre-construction notification and is for information only. Neighbours cannot make a submission.

The Complying Development notification process is used as a notification of development, rather than consultation, as submissions are not received, or required to be considered if the Certifier is contacted.

Discussion Points

The following is a summary of discussion points to inform any next steps:

- Neighbour notification for subdivision of lots greater than 300m² is not deemed necessary, as Complying Development can occur on these lots. Complying Development does not require neighbour notification for the purpose of considering feedback;
- Increased notification requirements introduced into the CPP in December 2022 are increasing the cost to Council to undertake neighbour notification; and

- Liverpool CPP has greater notification requirements compared to other neighbouring Councils, and the introduction of further requirements will increase both Development Assessment approval timeframes and operational costs.

Next Steps

If Council decide to amend the CPP, formal Council endorsement will be required. Following this, the amended Plan is required to be placed on public exhibition for a minimum of 28 days, in accordance with Clause 2.23 of the *Environmental Planning and Assessment Act 1979*.

The results of the public exhibition will then be re-reported to a future Ordinary Meeting of Council for final endorsement.

FINANCIAL IMPLICATIONS

There are no financial implications relating to this recommendation. An amendment to the Community Participation Plan is within the existing budget of Council's City Planning Department.

CONSIDERATIONS

Economic	There are no economic and financial considerations.
Environment	Raise community awareness and support action in relation to environmental issues.
Social	Raise awareness in the community about the available services and facilities.
Civic Leadership	Encourage the community to engage in Council initiatives and actions. Provide information about Council's services, roles, and decision-making processes. Deliver services that are customer focused. Operate a well-developed governance system that demonstrates accountability, transparency, and ethical conduct.
Legislative	Division 2.6 of the <i>Environmental Planning and Assessment Act</i> requires Councils to prepare a Community Participation Plan, and Clause 2.24 requires for them to be reviewed periodically.

Risk	There is no risk associated with this report. Risks associated with any proposed changes to the Community Participation Plan would be reported to the Council meeting, e.g. financial impacts from increased requirements.
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ATTACHMENTS

1. Question with Notice and Council Resolution - 7 February 2024

ITEM NO: QWN 01

FILE NO: 005126.2024

SUBJECT: Question with Notice - Cllr Rhodes - Notification of subdivisions resulting in lot sizes greater than 300sqm

Pursuant to Council's Community Participation Plan, development applications involving dwelling houses and subdivision resulting in lots greater than 300sqm, are placed on Public Exhibition, whilst subdivision of lots less than 300sqm are not placed on public exhibition.

Please address the following:

1. What was the basis of Council's reasoning that just because the subdivision is greater than 300sqm that there was no reason to inform the community that such a development was proposed which might be right next door to them?
2. Have constituents lost all rights to raise issues of concern about any negative impacts such developments may have on them?

Response (Provided by Planning and Compliance)

Liverpool City Council's [Community Participation Plan 2022 \(CPP\)](#) adopted by Council at its meeting on December 2022 requires the public exhibition of Development Applications (DAs) for the subdivision of lots less than 300m². If a DA is lodged, the information will be placed on Council's website, and letters sent to adjoining landowners and occupiers in accordance with Figure 2 from the CPP.

Figure 2 Notification to adjoining & adjacent land



7

However, the CPP does not require the public exhibition of DAs for dwelling houses (including alterations and additions to an existing dwelling house), or DAs for subdivisions resulting in lots greater than 300m².

The subdivision of lots greater than 300m² typically have less of an impact on neighbouring properties compared to smaller lot subdivisions (i.e. less than 300m²). Part of the reason for this is that smaller lots typically contain development with smaller setbacks and greater potential for visual, privacy or overshadowing impacts. Conversely, larger lots typically allow for more flexibility in design, which helps address privacy and amenity concerns.

The CPP sets out the parameters for how Council will engage with the community across all planning functions. The type of engagement is dependent on the scale and impact of the proposed development.

If a development type is considered to have limited impact on local amenity, infrastructure and environmental issues (e.g. a swimming pool, dwelling house, subdivisions greater than 300m²), the proposal is not notified to neighbouring properties. Necessitating formal notification of neighbouring properties for less significant development proposals is likely to result in increased DA approval timeframes, as well as increased costs for DA assessment.

COUNCIL DECISION

Motion:

Moved: Cllr Rhodes

Seconded: Cllr Kaliyanda

That:

1. Council take this item to a Governance Committee before the end of March 2024 so that Council can give this the attention it deserves to make sure that people are being given equal rights and are not being discriminated based on the size of the lots being subdivided in regards to Community Participation Plan 2022 with the intention of fairer notification for all residents.
2. Further information is provided on State Government process as it relates to Council process.

On being put to the meeting the motion was declared CARRIED.

Councillors voted unanimously for this motion.

ITEM 05

Development Assessment

Strategic Objective	Liveable, Sustainable, Resilient Deliver effective and efficient planning and high-quality design to provide best outcomes for a growing city
File Ref	086929.2024
Report By	William Attard - Manager Development Assessment
Approved By	Mark Hannan - Acting Director Planning & Compliance

EXECUTIVE SUMMARY

This Report is prepared to table a snapshot of key Development Assessment (DA) statistics.

RECOMMENDATION

That the Committee receives and notes this Report.

REPORT

The following key Development Assessment (DA) statistics are provided:

Development Applications and Class 1 Appeals

Development Applications (DAs) Outstanding/Received/Completed	
Outstanding – 31 March 2024	291 DAs
DAs Received – March 2024	159 DAs
DAs Completed – March 2024	167 DAs
Class 1 Appeals (March 2024)	
Outstanding – 31 March 2024	39 Appeals
Lodged – Deemed Refusal / Against Council's Determination	1 Appeals / 0 Appeals
Appeals Upheld – s34 Agreement / Hearing	0 Appeals / 0 Appeals
Appeals Dismissed	0 Appeals
Appeals Terminated	0 Appeals
Appeals Withdrawn	0 Appeals
Development Application (DA) Approval Statistics (March 2024)	
DAs Approved	61 DAs
Total Capital Investment Value (CIV) (\$)	\$54.2M CIV
New Lots Approved	83 Lots
New Homes Approved	60 Homes
DA Fees Released from Trust (\$)	\$189k Fees
Contribution Fees Raised (\$)	\$4.6M Contributions

PANs Received, Returned & Average Timeframes (March 2024)	
PANs Received	159 PANs
PANs Returned	90 PANs
Average Timeframe – PAN to Lodgment	12 Days
Average Determination Timeframe	
Average Determination Timeframe – For Current Financial Year	243 Days
Average Determination Timeframe – For March 2024	167 Days

Development Assessment (DA) Team Vacancy (Technical Officers Only)

Position	Positions	Vacancy
Principal Planner	1	0
Senior DA Planners	9	2 (Under Recruitment)
Senior Planning Advisory Officers	3	2 (Under Recruitment)
DA Planners	14	0
Student Planners	4	1 (Under Recruitment)
Duty Officers	2	0

FINANCIAL IMPLICATIONS

There are no financial implications relating to this recommendation.

CONSIDERATIONS

Economic	There are no economic and financial considerations.
Environment	There are no environmental and sustainability considerations.
Social	There are no social and cultural considerations.
Civic Leadership	Undertake communication practices with the community and stakeholders across a range of media. Provide information about Council's services, roles and decision making processes.
Legislative	There are no legislative considerations relating to this Report.
Risk	There is no risk associated with this Report.

ATTACHMENTS

Nil

ITEM 06**Voluntary Planning Agreement Status Report -
March 2024**

Strategic Objective	Visionary, Leading, Responsible Demonstrate a high standard of transparency and accountability through a comprehensive governance framework
File Ref	094586.2024
Report By	Yee Lian - Contributions Planning Officer
Approved By	Mark Hannan - Acting Director Planning & Compliance

EXECUTIVE SUMMARY

The purpose of this Report is to provide a summary of activity associated with Voluntary Planning Agreements (VPAs), including offers under review, executed VPAs, land and monetary contributions.

RECOMMENDATION

That the Committee receives and notes this Report.

REPORT

Attachment 1 of this Report provides a status update of live Voluntary Planning Agreements (VPAs) up to 22 March 2024. The list currently includes:

- One (1) VPA Letter of Offer;
- Four (4) VPAs In-Draft and/or under Negotiation;
- 18 Executed VPAs (including four requesting to be revoked); and
- Five (5) completed VPAs.

FINANCIAL IMPLICATIONS

There are no financial implications relating to the recommendation.

CONSIDERATIONS

Economic	There are no economic and financial considerations.
Environment	<p>Manage the environmental health of waterways.</p> <p>Manage air, water, noise and chemical pollution.</p> <p>Protect, enhance and maintain areas of endangered ecological communities and high-quality bushland as part of an attractive mix of land uses.</p>
Social	There are no social and cultural considerations.
Civic Leadership	<p>Provide information about Council's services, roles and decision-making processes.</p> <p>Deliver services that are customer focused.</p> <p>Operate a well-developed governance system that demonstrates accountability, transparency and ethical conduct.</p>
Legislative	<p>Environmental Planning and Assessment Act 1979</p> <p>Environmental Planning and Assessment Regulations 2021</p>
Risk	There is no risk associated with this Report.

ATTACHMENTS

1. VPA Status Report to Council as at March 2024

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

Letter of Offer (1)					
REF	SUBURB	LOT / DP	LOCATION	APPLICATION	STATUS
VPA-56	Pleasure Point	1/875804 2/817692	Lot 1 Heathcote Road, Pleasure Point Lot 2 Pleasure Point Road, Pleasure Point	PL-65/2023	This is still at Pre-DA stage. Council's comments on the revised Letter of Offer were shared with the proponent by Legal Services on 13 March. Waiting for proponent's response.

Under Review or Negotiation (4)					
REF	SUBURB	LOT / DP	LOCATION	APPLICATION	STATUS
VPA-39	Edmondson Park	1-2/1204198; 62/1191356	Edmondson Park Town Centre (South)	Mod 4	Council to discuss the progress and possible additions to the draft VPA, with Frasers. Council to finalise the draft VPA post meeting with Frasers and report to Council by April/May 2024. Contributions Planning team (CP team) is waiting for feedback from Council teams to finalise the initial brief for internal discussion.
VPA-45	Edmondson Park	All land within Edmondson Park Town Centre (concept plan approval), excluding Frasers Land (refer to VPA 39) & Campbelltown LGA	Edmondson Park Town Centre (North)	Part 3A application	Under negotiation – Landcom shared their revised version of the draft VPA with Council on 29 Feb. Landcom made no changes to the previous version of their offer and disregarded the recommendations by Astrolab, council's independent reviewer. CP team to provide infrastructure gap analysis to inform future discussion with DPHI/PDU.
VPA-49	Luddenham	Lot 3 DP 623799	275 Adams Road, Luddenham	SSD-10446	CP team is waiting for the proponent's lawyer to respond to the revised draft VPA (legal to send the revised version to the proponent by 22.03).
VPA-57	Bringelly	Lot 16 Sec 2 DP 2650	145 Mersey Road, Bringelly	DA-116/2022	Public exhibition finished on 09.03.24 and no submission received. CP Team waiting for Legal Services to provide advice on amendments to the draft VPA.

Completed Planning Agreements (5)			
1	VPA-20	24 Bernera Road, Prestons	Status
	Clause 5.1	\$84,129 in Monetary Contributions for the Intersection upgrade of Bernera Road, Yarrunga Street and Yato Road	Notice of Completion sent to proponent on 07.03.2024
2	VPA-31	55 Yarrunga Street, Prestons	
	Clause 5.1	\$137,797 in Monetary Contributions for the Intersection upgrade of Bernera Road, Yarrunga Street and Yato Road	Notice of Completion sent to proponent on 07.03.2024
3	VPA-32	420-446 Macquarie Street, Liverpool	
	Clause 6.1	Monetary Contributions towards restoration works to Collingwood House	Contributions spent on project 100740 - Collingwood House Restoration between 2015/16 and 2016/17
4	VPA-44	5 Melito Court, Prestons	
		3 \$387,600.00 in Monetary Contributions for the Intersection upgrade of Bernera Road, Yarrunga Street and Yato Road	Notice of Completion sent to proponent on 04.12.2023
5	VPA-46	14 Yarrunga Street, Prestons	
		3 \$85,000 in Monetary Contributions for the Intersection upgrade of Bernera Road, Yarrunga Street and Yato Road	Notice of Completion sent to proponent on 07.03.2024

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

Executed Planning Agreements (18)					
1	VPA-5	Lot 29 501 Cowpasture Road, Hinchinbrook			
		VPA Items	Status	Comments	Last update
1	3.1.1	Monetary contribution towards district drainage	Completed		
2	3.1.2	Monetary Contribution and administration fee	Completed		
3	3.2.1	Removal of any waste and subsequent fill (related to the removal of the waste) to existing or otherwise approved finished ground level. Removal or other appropriate management of site contamination if any	In-Progress	Field work for contamination investigations with an expanded investigation area has occurred. Samples in lab, findings report to be prepared.	CP team requested updates. The proponent responded on 07.03.2024
4	3.2.2	Prepare the Vegetation Management Plan (that includes a staged program of works for, weed control, regeneration, and re-vegetation) for the Designated Land and obtain the approval of Council for the plan.	Completed		
5	3.2.3	Carry out the program of works for soil remediation, weed control, regeneration, and re-vegetation for all Designated Land as stipulated in the approved Vegetation Management Plan	Completed		
6	3.2.4	Maintenance works described in the VMP to optimise plant establishment and weed control	Completed		
7	3.2.5	Construction of drainage channel between the Cowpasture Road and Hinchinbrook Creek and to the Government Road stormwater detention basin to the South, varying between 15m and 40m width and at an average depth of 1m. In accordance with the drainage design approved as part of DA-926/2010.	In-Progress	Developer to provide WEA files to Council for final flood modelling assessment. Works as ex drawings had already been sent. Will follow up with engineers for models.	CP team to follow up the proponent on 12.04.2024
8	3.3	Designated Land - Public Recreation Land	Not Started	Developer to carry out waste removal and site investigation for contamination prior to dedication. Rubbish removal to occur in April 2024	CP team to follow up proponent early May re rubbish removal.

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

2	VPA-8	Coopers Paddock, Warwick Farm			
		VPA Items	Status	Comments	Last update
9	3.1.1	Removal of any waste and subsequent fill (related to the removal of the waste) to existing or otherwise approved finished ground level. Removal and / or other appropriate management of site contamination in accordance with the Site Contamination Report.	Not Started	Site audit statement required. Awaiting Australian Turf Club (ATC)'s response	Legal Services to provide advice to CP team about missing bank guarantees.
10	3.1.2	Carry out the program of works and maintenance as specified in the Vegetation Management Plan approved by Council	Not Started	ATC to lodge a Modification application for DA-133/2020 to impose VMP.	CP team advised proponent to submit the MOD application on 01.11.23. Principal Transport Planner Charles Wiafe to provide the CP team with ATC's email update for meeting held on 12 March 2024.
11	3.1.3	Carry out offsetting works within the Designated Land in accordance with the ecological report 'Ecological Constraints Report Proposed Rezoning Lot 1 DP 581034 Coopers Paddock Governor Macquarie Drive Warwick Farm' prepared by Travers Bushfire & Ecology and dated August 2011 and accepted by the NSW Office of the Environment and Heritage and the VMP approved by Council.	Not Started	Offsetting awaits completion of items 3.1.1 and 3.1.2.	This item is subject to the receipt of the revised VMP from the proponent.
12	3.1.4a	Governor Macquarie Drive to be widened to 2 lanes in each direction between the entrance to the Coopers Paddock Site and a new entrance into the ATC Site near the existing Old Tote Stand. The new carriage way is to be constructed on the southern side of the existing carriageway of Governor Macquarie Drive	Completed		
13	3.1.4b	Provision of the following works in both carriageways of Governor Macquarie Drive: <ul style="list-style-type: none"> • Lighting • Kerb and Guttering • Median Strip 	Completed		
14	3.1.4c	Subject to Council approval, construct 2 new intersections at the Coopers Paddock and Governor Macquarie Drive intersection and proposed car park entrance at Governor Macquarie Drive	Completed		
15	3.1. 5a	The construction of shared bike / pedestrian paths of a minimum width of 2.5 metres located adjacent to Governor Macquarie Drive on the northern side of the existing carriageway, to run the length from the existing cycle path near the William Long Bridge to the Hume Highway	In-Progress	This project is being overseen by Council's Traffic and Transport team	Principal Transport Planner Charles Wiafe to provide the CP team with ATC's email update for meeting held on 12 March 2024.
16	3.1.5b	The construction of a shared bike / pedestrian path of a minimum width of 2.5m within the Industrial Land	Not Started	Subject to DA-133/2020	Waiting for the Proponent to submit a MOD to Council.
17	3.1.5b	The construction of a shared bike / Pedestrian path of a minimum of 2.5 metres from Munday street to Warwick Farm Railway Station	Completed		
18	3.2a	Dedicated Land: That part of the Developer's Land south of Governor Macquarie Drive Coloured green and identified as 'Designated Land' and "RE1" and land coloured orange and identified as Environmental Land "E2" on the plan.	Not Started	Subject to completion of items 3.1.1, 3.1.2 and 3.1.3	Not triggered yet.
19	3.2b	Dedicated Land: That part of the Developer's Land immediately adjacent to Governor Macquarie Drive which is necessary to ensure that the road works to be carried out to Governor Macquarie Drive are within the dedicated road reservation and align with the zone boundaries at the time of the dedication of that land.	In-Progress	Land transfer being finalised by Council's Property team in consultation with the landowners.	CP team is waiting for Property Services for a response regarding the land swap. CP Team to follow up with Property Services on 25.03.2024

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

3	VPA-9	New Brighton Golf Club, Brickmakers Drive, Moorebank			
		VPA Items	Status	Comments	Last update
20	3.1a	Construction of a 2.5m shared pedestrian/bike path within the Georges River foreshore land to be dedicated to Council.	In progress	Developer to lodge a DA to Council for approval.	Developer provided an update on 29.02.2024
21	3.1b	Construction of a 2.5m shared pedestrian/bike path linking the Georges River foreshore land with Residential land along the northern boundary of Lot 103 DP 1070029 to Brickmakers Drive.	In progress	Developer to lodge a development application for the construction of the shared pedestrian/bike path	Developer provided an update on 29.02.2024
22	3.1c	Construction of a 2.5m shared pedestrian / bike network within the residential area.	In progress	Pathway completed according to aerials. Site inspection required by the CP Team and relevant teams to confirm if not already done.	Developer provided an update on 29.02.2024
23	3.2a	Preparation of a Vegetation Management Plan (VMP) to the satisfaction of Council that defines planting offsets required as a consequence of any possible clearing works.	In progress	Subject to status of item 3.1b The VMP will need to be submitted as part of their DA for the shared pedestrian/bike path.	CP team provided the Acting manager City Planning with a memo discussing Council's options re. acquiring contaminated land on 19.03.2024. This will be reported to the next ELT meeting.
24	3.2b	Riparian Planting within the Public Recreation Land along the foreshore (in accordance with an approved Vegetation Management Plan) and adjacent to cycleway links and golf course land. This includes the allowance for potential vegetation offsetting.	In progress	Subject to status of item 3.1b This will need to be submitted as part of their DA for the shared pedestrian/bike path	CP team provided the Acting manager City Planning with a memo discussing Council's options re. acquiring contaminated land on 19.03.2024. This will be reported to the next ELT meeting.
25	3.2c	Construction of a perimeter fence around the basin located on the southern boundary of Lot 2210 DP1090818, the design of which must be approved by Council in writing	Completed	Handed over to Council	
26	3.2d	Landscaping and recreational facilities provided on Lot 1 within the Community Scheme established as part of the Development comprising community swimming pool, mixed use court, cabana and meeting place, seating, and BBQs	Completed	Handed over to Community scheme (via 88b titles)	
27	3.2e	Reconstruction of Cantello Reserve Dog Park within Cantello Reserve	Completed	Handed over to Council.	
28	3.3a	Construction of 8m wide access and easement to enable the public to traverse under the M5 Motorway. The design must be approved by Council in writing.	In Progress	Pathway completed but requires additional provisions such as line markings and wayfinding signage. Further site visit to be arranged by CP Team and relevant teams. Last site visit 18 October 2023	CP Team to organise a site visit with the proponent and relevant Council teams ASAP.
29	3.4a	Installation of two (2) Gross Pollutant Traps (GTPs). The design must be approved by Council in writing	Completed	Handed over to Council	
30	3.4b	Construction of water quality control ponds. The design must be approved by Council in writing	Completed	Handed over to Council	
31	4	Land - Public Recreation - 40m wide strip of land running parallel to the Mean High-Water Mark of the nearest bank of the Georges River.	Not Started	Seeking Director's decision on memo about the management and ownership of contaminated foreshore land	CP team sent memo to Manager on 19.03.2024 for review and submission to the ELT meeting.

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

4	VPA-11	Georges Cove, 146 Newbridge Road, Moorebank (Tanlane)			
		VPA Items	Status	Comments	Last update
32	1	Embellishment of Northern Island Section Designated Land	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
33	2	Embellishment of Southern Island Section Designated Land	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
34	3	Dedication of the Northern Island Section Designated Land	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
35	4	Dedication of the Southern Island Section Designated Land	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
36	5	Development of a Vegetation Management Plan	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
37	6	Completion of works described in the Vegetation Management Plan within the Northern Island Section Designated Land	Not Started	Subject to development of VMP	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
38	7	Completion of works described in the Vegetation Management Plan within the Southern Island Section Designated Land	Not Started	Subject to development of VMP	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
39	8	Conduct of maintenance works described in the Vegetation Management Plan and Maintenance Schedule with respect to the Northern Island Designated Land	Not Started	Subject to development of VMP	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
40	9	Conduct of maintenance works described in the Vegetation Management Plan and maintenance Schedule with respect to the Southern Island Designated Land	Not Started	Subject to development of VMP	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
41	10	Construction of "Bike/Pedestrian Path" through the Northern Island Section Designated Land as shown on the plans attached as Annexure 1 and marked as "D"	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
42	11	Construction of "Bike/Pedestrian Path" through the Southern Island Section Designated Land as shown on the plans attached as Annexure 1 and marked as "D"	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
43	12	Construction and dedication of Bike/Pedestrian Path Link to Brickmakers Drive as shown on the plan attached as Annexure 1 as marked as "H1"	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
44	13	Construction and dedication of Bike/Pedestrian Path Link to from the edge of the R3 Land through the RE2 Land to the Designated Land as shown on the plan attached at Annexure 1 as marked as "H2"	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
45	15	Construction of passive recreation facilities on the Designated Land.	In-Progress	Contributions Planning to confirm status	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
46	16	Dedication of "Drainage Channel" will occur in three stages as illustrated by notations E1, E2 and E3 on Annexure 1 however all stages are subject to the Time for Completion noted in this row.	In-Progress	Acquisition and dedication status to be confirmed by Property Services. Construction of the road bridge is complete	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

47	17	Acquisition and dedication of stratum lot comprising the road bridge over drainage channel, embankment and road to Brickmakers Drive as well as the completion of the construction of the road bridge within that stratum lot as shown on the plan attached as Annexure 1 and marked as "F"	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
48	18	Construction and dedication of "Pedestrian Access to Newbridge Road" more or less in the position on the plan attached as Annexure 1 marked as "G" and a pedestrian path within the public verge along the entire length of the Land frontage to Newbridge Road.	In-Progress	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
49	19	Dedication of an easement over the Land for access for the purpose of allowing Council to undertake maintenance to the River Foreshore Land more or less in the position on the plan attached as Annexure 1 marked as "I".	Not Started	Contributions Planning to follow up with the proponent on the status.	CP team sent an email to internal teams on 18.03.2024 seeking responses from each team by 05.04.2024.
5	VPA-12	124 Newbridge Road, Moorebank			
		VPA Items	Status	Comments	Last update
50	3.1a-c	Embellishment of river foreshore land	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12
51	3.1d	Dedicated of river foreshore land	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12
52	3.2a	Development of a Vegetation Management Plan (VMP) and offset Strategy	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12
53	3.2b	Completion of works described in the VMP	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12
54	3.2c	Conduct of maintenance works described in the VMP	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12
55	3.3a-c	Construction of bike/pedestrian path	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12
56	3.3d	Construction of pedestrian footpath along northern boundary of site within Newbridge Road verge - RE2 Private Recreation	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12
57	3.3e	Construction of pedestrian footpath along northern boundary of site within Newbridge Road verge - B6 Enterprise Corridor	Not Started	Proponent to hold meeting with Council and clarify their intent of the existing, executed planning agreement.	Strategic Planning to attend a meeting with the proponent to discuss matters relating to RZ-4/2017 and VPA-12

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6	VPA-17	220-230 Northumberland Street, Liverpool			
		VPA Items	Status	Comments	Last update
58	5	Monetary Contribution	Not Started	Not triggered yet. Monetary Contributions to be paid prior to issuing any construction certificate.	CP team sent an email to proponent on 21.03.2024 to clarify details about the registration of the VPA on title and removal of the caveat.
7	VPA-18	Liverpool MegaCenta (The Grove) 10 Orange Grove Road, Warwick Farm			
		VPA Items	Status	Comments	Last update
59	Clause 6	Monetary Contributions	Not Started	To be paid prior to the first occupation certificate	Not triggered yet.
60	4.1	Roadworks including the rehabilitation of the road surface and construction of a pedestrian access on the Homepride Avenue	Not Started	DA-416/2021 approved for VPA roadworks. Developer to prepare and submit construction drawings towards a Construction Certificate	CP team sent an email to Charles Wiafe on 07.03.2024 following up on correspondence with the Developer.
61	4.2	RMS Roadworks - Orange Grove Road / Viscount Place Intersection	Not Started	DA-416/2021 approved for VPA roadworks. Developer to prepare and submit construction drawings towards a Construction Certificate	CP team sent an email to Charles Wiafe on 07.03.2024 following up on correspondence with the Developer.
62	4.3	RMS Roadworks - Hume Highway / Homepride Avenue Intersection	Not Started	DA-416/2021 approved for VPA roadworks. Developer to prepare and submit construction drawings towards a Construction Certificate	CP team sent an email to Charles Wiafe on 07.03.2024 following up on correspondence with the Developer.
8	VPA-19	20 Shepherd Street, Liverpool			
		VPA Items	Status	Comments	Last update
63	3.1	Transport Service - Establish and operate a publicly accessible shuttle bus service that connects the Development to the Liverpool CBD	Not Started	Action taken to commence shuttle bus	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.
64	3.2	Bike Share Pods	Not Started	CP Team awaiting internal staff comments	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.
65	3.3	Publicly accessible car share spaces	Not Started	CP Team awaiting internal staff comments	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.
66	3.4	Woodbrook Road pedestrian and Cycle underpass - TfNSW is now carrying out these works - Council has accepted a monetary contribution of \$71,825 ex GST in lieu of these works	Not Started	Work program under discussion between Council major project team and developer – contribution payment being confirmed by Finance team.	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.
67	3.5	Monetary Contribution - Local Traffic Infrastructure Contribution	Completed		
68	3.6	Monetary Contribution - Regional Traffic Infrastructure Contribution	Completed		
69	3.7	Bank Stabilisation Works	In-Progress	Work program under discussion between Council major project team and developer	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.
70	3.8	Riverwalk Works	In-Progress	Work program under discussion between Council major project team and developer	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

71	3.9	Pedestrian and Cycle Pathway upgrade through Lighthorse Park to Newbridge Road - LCC accepts completion of works except for the final portion of the path adjacent to Lighthorse Park. Council accepted a monetary contribution of \$310,334 ex GST in lieu of these works	Not Started	Work program under discussion between Council major project team and developer – contribution payment being confirmed by Finance team.	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.
72	3.1	Rehabilitation of riparian zone - Lighthorse Park	Not Started	Work program under discussion between Council major project team and developer	CP team sent an email to internal teams on 20.03.2024 seeking updates and correspondence by 12.04.2024.
73	3.11	Monetary Contribution - Open Space Contribution	Completed		
9	VPA-33	25, 29 & 35 Scott Street, Liverpool			
		VPA Items	Status	Comments	Last update
74	Clause 6	Monetary Contribution to Council to facilitate acquisition of land known as 37 Scott Street, Liverpool (The Laneway Land) for the purposes of a public laneway for pedestrian access by the Council.	Not Started	Finance team to confirm payment of monetary contributions	CP team sent email to Finance on 18.03.2024 seeking confirmation for monetary contributions payments.
10	VPA-36	4-8 Hoxton Park Road, Liverpool			
		VPA Items	Status	Comments	Last update
75	3	Provision of Affordable Housing Lots	Not Started	Developer to lodge DA	CP team to follow up with the Developer regarding overdue monetary contributions payment by 25.03.2024.
76	4	Monetary Contribution	In-Progress	Monetary Contributions to be paid within 60 days of the instrument being made. CP Team to follow up with Strategic Planning to confirm the dates of the Instrument Change for 4-8 Hoxton Park Road, Liverpool	CP team sent an email to Strategic Planning to confirm the details of the gazettal date for the related planning proposal on 07.03.2024. Waiting for a response.
11	VPA-37	Middleton Grange Town Centre			
		VPA Items	Status	Comments	Last update
77	4.B1	Dedication of New Park 2 to Council	Not Started		CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
78	4.B2	Embellishment of New Park 2	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
79	4.C1	Construction of a signalised intersection at Main St and Flynn Ave and the intersection for the new proposed access lane and Flynn Avenue	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
80	4.C2	Construction of a roundabout at Southern Cross Avenue and Main Street	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
81	4.C3	Construction of a T-intersection at Southern Cross Avenue and Middleton Drive	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

82	4.C4	Construction of a T-intersection at Southern Cross Avenue and Bravo Avenue	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
83	4.D	Construction of an upgrade to Cowpasture Road intersection, Flynn Avenue from Qantas Boulevard to Ulm Street as a widened 4 lane road within the existing road reserve	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
84	4.E	Construction of a road upgrade and services for Southern Cross Avenue to a standard comparable to the existing Southern Cross Drive between the western boundary of the land to the Middleton Grange Primary School	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
85	4.F	Construction of culvert, drainage and shared road works wholly within Lot 102 DP 1128111 – Public Reserve	In-Progress	Site preparation works commenced in accordance with DA-64/2007 and its associated modifications.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
86	4.H	Monetary Contribution	Not Started	Not triggered until the Developer applies for an Occupation Certificate for their non-residential development.	CP team responded to legal services question re. the need for any changes to bond requirements as a result of early provision of roads on 13.03.24.
12	VPA-40	28 Yarrunga Street, Prestons			
		VPA Items	Status	Comments	Last update
87	3	Monetary Contribution	Not Started	CP Team awaiting proponent's response	CP team sent an email to the proponent on 18.03.2024 seeking an update.
13	VPA-42	1370 Camden Valley Way, Leppington			
		VPA Items	Status	Comments	Last update
88	4.1	Maintenance Works required to maintain and keep in good repair the Acquisition Land, and any improvements on it, prior to its acquisition by Council	Not Started	CP Team awaiting proponent's response	CP team waiting for proponent to provide a status update by responding to CP team's email sent on 15.03.2024
89	4.2	Registration of Positive Covenant on the title of the Acquisition Land to provide for public use and access of the Acquisition Land and to ensure the Developer carries out the Maintenance	Not Started	CP Team awaiting proponent's response	CP team waiting for proponent to provide a status update by responding to CP team's email sent on 15.03.2024
90	5.1	Social Court	Not Started	CP Team awaiting proponent's response	CP team waiting for proponent to provide a status update by responding to CP team's email sent on 15.03.2024
91	5.2	Walking Loop	Not Started	CP Team awaiting proponent's response	CP team waiting for proponent to provide a status update by responding to CP team's email sent on 15.03.2024
92	5.3	Link across Riparian corridor (Boardwalk / Bridge)	Not Started	CP Team awaiting proponent's response	CP team waiting for proponent to provide a status update by responding to CP team's email sent on 15.03.2024
93	5.4	Pedestrian Crossing	Not Started	CP Team awaiting proponent's response	CP team waiting for proponent to provide a status update by responding to CP team's email sent on 15.03.2024
14	VPA-55	100 Southern Cross Avenue, Middleton Grange			
		VPA Items	Status	Comments	Last update
94	1	Monetary Contribution	In-Progress	CP Team reviewing VPA and payment of monetary contributions	CP team to finalise audit of payments received by end of April 2024

VOLUNTARY PLANNING AGREEMENT REPORT - MARCH 2024

15	VPA-10	90 Flynn Avenue, Middleton Grange			
		VPA Items	Status	Comments	Last update
	6	Monetary contribution	To be revoked	Requesting VPA to be revoked	CP Team to finalise draft memo by 25.03.2024
16	VPA-15	75 Flynn Avenue, Middleton Grange			
		VPA Items	Status	Comments	Last update
	6	Monetary Contribution	To be revoked	Requesting VPA to be revoked	CP Team to finalise draft memo by 25.03.2024
17	VPA-34	85 Flynn Avenue, Middleton Grange			
		VPA Items	Status	Comments	Last update
	6	Monetary Contribution	To be revoked	Requesting VPA to be revoked	CP Team to finalise draft memo by 25.03.2024
18	VPA-54	80 Flynn Avenue, Middleton Grange			
		VPA Items	Status	Comments	Last update
	1	Monetary Contribution	To be revoked	Requesting VPA to be revoked	CP Team to finalise draft memo by 25.03.2024

ITEM 07**Review of Council's Financial progress,
forecasts and assumptions**

Strategic Objective	Visionary, Leading, Responsible Ensure Council is accountable and financially sustainable through the strategic management of assets and resources
File Ref	093934.2024
Report By	Vishwa Nadan - Chief Financial Officer
Approved By	Farooq Portelli - Director Corporate Support

EXECUTIVE SUMMARY

In June 2023 the Council adopted its 2023-24 operating budget with estimated revenue of \$379.3 million and expenditure of \$250.8 million. In terms of the net operating result before grants and contributions provided for capital purposes, Council budgeted for an operating deficit of \$3.7 million.

Based on Q2 Budget Review, Council resolutions, program initiatives, market trends and actual budget performance, to 29 February 2024, Council is projecting an operating deficit of \$8.3m.

This report provides key variations and highlights key risks and opportunities that may impact on the projected result.

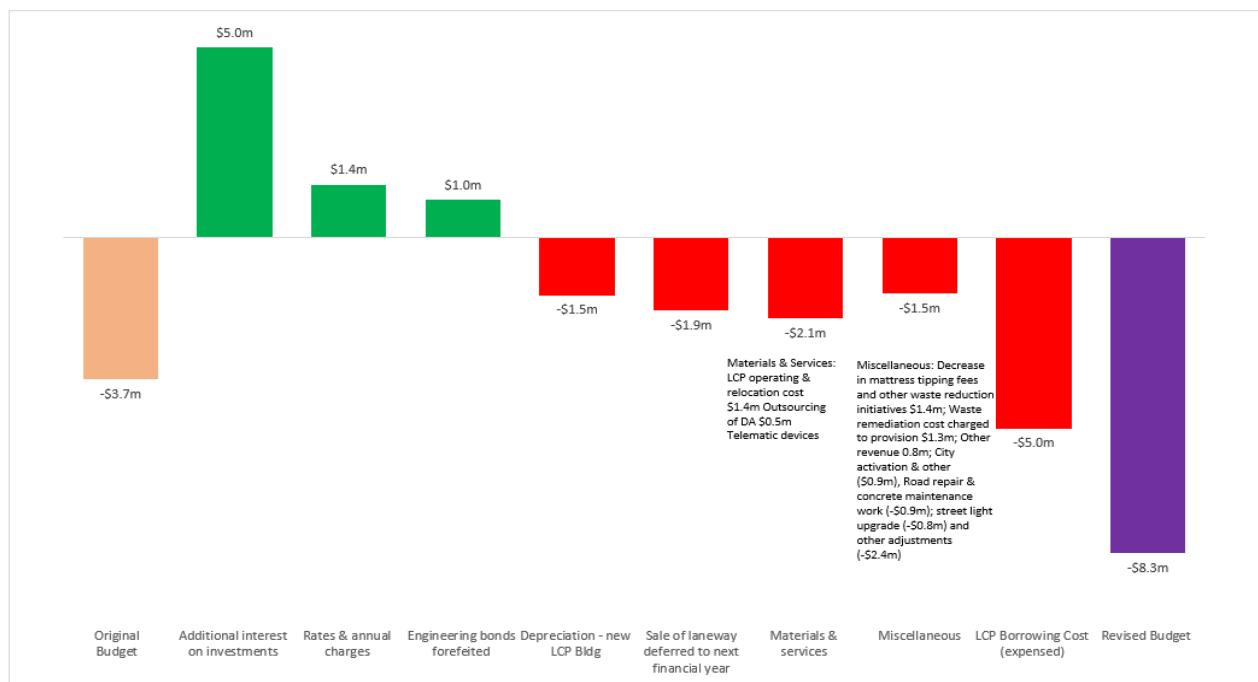
RECOMMENDATION

That the Governance Committee receives and notes the report.

REPORT**Budget Performance**

In June 2023 the Council adopted its 2023-24 operating budget with estimated revenue of \$379.3 million and expenditure of \$250.8 million. In terms of the net operating result before grants and contributions provided for capital purposes, Council budgeted for an operating deficit of \$3.7 million.

Based on Q2 Budget Review, Council resolutions, program initiatives, market trends and actual budget performance, to 29 February 2024, Council is projecting an operating deficit of \$8.3m. Key variations noted are:



On-going review of resource requirements to achieve corporate initiatives has resulted in an investment in additional unbudgeted positions and program costs. The \$4.6 million cost associated with engagement of additional staff resources and regrading's is expected to be absorbed by salary savings from current vacancies, deferred recruitment, and restructured positions across the Council. Detailed analysis of both revenue and expenditure is provided as **Attachment 1**.

Operating Revenue

Budget performance of key sources of operating revenue were as follows:

	YTD Budget \$'000	YTD Actual \$'000	FY Budget \$'000	FY Proposed Budget \$'000	Indicator
Rates & annual charges	113.378	114.558	170.067	171.467	🟢
Other operating grants & subsidies	5.291	9.125	14.484	14.104	🟢
Interest & investment income	7.622	11.366	11.433	16.433	🟢
FAG grants	0.165	0.164	8.968	8.968	🟡
Childcare fees & grants	5.681	5.070	8.521	8.552	🟢
DA & other building fees	4.553	3.437	6.829	6.829	🟡
Property rentals	4.046	3.458	5.644	5.316	🔴
Parking fines	2.347	2.125	3.520	3.520	🟢
Car parking fees	2.291	2.230	3.437	3.305	🟢
Recovery - restoration works	1.627	1.218	2.440	2.440	🟡
Ex-gratia income - Intermodal	0.000	0.000	2.245	2.245	🟢
Net gain from disposal of assets	0.000	0.442	1.900	0.000	🔴
Hire - community & recreational facilities	0.882	0.679	1.323	1.323	🟡
Fair value increment on investment	0.000	1.511	0.000	0.500	🟢

Operating Expenditure

Budget performance of key areas of operating expenses were as follows:

	YTD Budget \$'000	YTD Actual \$'000	FY Budget \$'000	FY Proposed Budget \$'000	Indicator
Salaries including superannuation	60.938	56.656	88.871	87.116	
Tipping & waste services	23.766	24.419	34.617	34.246	
Utilities (electricity / water / gas)	4.767	4.523	7.150	7.947	
Software licenses	2.692	2.300	4.038	4.229	
Contributions - NSW Fire / SES / RFS	2.507	1.881	3.761	3.761	
Insurance	2.846	3.134	3.079	3.579	
Contracted labour (agency)	1.851	2.007	2.777	2.084	
Tipping (hazardous waste)	0.913	1.606	2.401	0.069	
Borrowing costs	1.664	1.509	2.496	7.500	
Professional services	1.420	2.300	2.041	3.440	
Workers compensation	1.369	0.956	2.053	2.053	
Overtime	0.992	2.420	1.488	3.488	
Legal costs	0.965	1.225	1.448	1.821	
Internet (data)	0.772	0.655	1.157	1.107	
Consultants	0.560	1.769	0.840	1.643	

Risks & Opportunities

The following risks and opportunities have been identified with the potential to change the projected budget result for FY 2023/24.

- i) FAG Operating Grant [*Risk Probability: Low/Moderate*] – The NSW Grants Commission fully paid 2023/24 financial assistance grant in advance. Any change to their position for FY2024/25 is not known at this stage.
- ii) Net Loss from Disposal of Assets [*Risk Probability: Highly Likely*] – As part of the road renewal process, a portion of the road surface is scrapped off and then replaced. The replacement cost is capitalised, however, there is a written down value attached to the portion removed. The cost of write-off depends on the condition of the road at time of renewal and depth of surface removed. Budget includes a provision of \$2.5 million, however, the actual cost to June 2024 is not known.

Cash Reserves

At 29 February 2024, Council had \$412 million in cash and investments classified as follows:

	<i>Opening Balance 1 Jul 2023</i>	<i>Closing Balance 29 Feb 2024</i>
Externally Restricted		
S711 Contributions	280,969,884	301,358,394
City Development Fund	379,285	172,803
Domestic Waste Reserve	1,324,273	1,675,109
Environment Levy	5,928,977	6,591,575
Stormwater Reserve	868,572	2,010,896
Edmondson Park Reserve	2,859,276	2,937,760
Contribution Reserve	3,340,407	3,340,407
Grants Reserve - Capital	11,538,211	9,845,592
Grants Reserve - Operating	413,756	405,446
Better Waste & Recycling Reserve	1,861	0
Deferred Grants Reserve - Capital	36,932,973	55,366,342
Deferred Grants Reserve - Operating	7,169,256	1,296,934
Western Sydney Infrastructure Grants Program	-	131,794
Total Externally Restricted	351,726,732	385,133,056
Internally Restricted		
Employee Leave Entitlement Reserve	4,484,000	4,484,000
Insurance Reserve	1,796,043	1,796,043
Parking Strategy Reserve	2,578,921	1,624,015
General Property Reserve	7,164,084	5,928,971
Loan Reserve	40,650,595	0
Carnes Hill Stage 2 Precinct Development Reserve	4,290,076	4,273,106
Moorebank Intermodal Company Ltd Ex-Gratia Funds	524,796	-
Total Internally Restricted	61,488,514	18,106,135
Unrestricted General Reserves		
Investments (Equity) in Civic Risk Mutual	6,514,000	6,514,000
Unrestricted available cash	32,683,667	2,345,516
Total Unrestricted General Reserves	39,197,667	8,859,516
Total Cash and Investments	452,412,913	412,098,707

ATTACHMENTS

1. Budget Variance Analysis Report - Feb 2023

Liverpool City Council
Summary Financial Results - Consolidated
For the period 1 July 2023 to 30 June 2024

	2022-23 Annual Actual	2023-24 YTD Feb Actual	2023-24 Original Budget	2023-24 Revotes	2023-24 Resolutions	2023-24 Q1 Review	2023-24 Q2 Review	2023-24 Revised Projections	Variance (Revised Projections - Original Budget)	Comments
Other Expenses	3,335,121	3,364,138	5,037,487	0	2,000	223,230	(245,910)	5,016,807	(17,180)	<div><div>+\$200k City Futures program costs for sponsorships</div><div>-\$200k City Futures program cost transferred to fund Liverpool 2050</div><div>+\$50k Early land acquisition scheme funded from Austral/Leppington North contribution plan</div><div>-\$75k Adjustment of lease incentives for old Library. Lease agreement still to be finalised</div></div>
Net Loss from the Disposal of Assets	2,699,896	0	2,500,000	0	0	0	0	2,500,000	0	
Revaluation decrement / impairment of IPP&E	0	0	0	0	0	0	0	0	0	
Total Expenses	233,091,335	167,259,517	250,837,477	0	214,996	5,271,093	4,948,204	261,271,770	10,434,293	
Net Operating Result	145,863,129	37,416,055	128,484,136	8,148,946	385,004	(6,798,492)	(5,301,616)	124,917,978	(6,305,933)	
Less: Grants & Contributions for Capital Purposes *	145,330,834	43,428,945	132,227,319	8,148,946	600,000	(2,469,465)	(5,197,721)	133,309,079	(1,658,015)	
Net Operating Results Before Grants & Contributions for Capital Purposes	532,296	(6,012,891)	(3,743,183)	0	(214,996)	(4,329,027)	(103,895)	(8,391,101)	(4,647,918)	