

3 November 2017

Sean Porter  
Development Manager,  
NSW/ACT Communities  
Lend Lease  
Level 2, 88 Phillip Street  
Parramatta NSW 2150

Dear Sean

**Re: Information Regarding the Jordan Springs East Rezoning Application – Flood Evacuation**

This letter provides information in relation to the management of flood evacuation from the Jordan Springs East development and the implications that a proposed rezoning of approximately 38 hectares of employment land to residential land would have on the existing and historically accepted flood evacuation strategy.

Background

Molino Stewart assessed the evacuation capacity of the proposed urban development of Jordan Springs East (formerly Central Precinct) in July 2014 in support of a Bulk Earthworks Environmental Impact Statement and concluded that:

*“...the development has been designed in such a way that vehicular evacuation should be possible in advance of the site being flooded by the Hawkesbury Nepean River if residents respond in a timely way to evacuation orders issued by the NSW SES.*

*Should people not evacuate until flood waters arrive at their dwellings there would be sufficient time for them to walk ahead of flooding from either South Creek or the Hawkesbury River along continually rising evacuation routes.”*

In undertaking that work it was noted that the precinct is:

*“...zoned to contain a mix of residential and employment land uses. In preparing this Flood Evacuation Analysis it has been assumed that the entire Central Precinct would be developed as residential.”*

Furthermore, the analysis was conducted assuming that the development would have 1,333 dwellings with 1,168 of those dwellings requiring evacuation.

Lend Lease now proposes to only have residential development within the precinct and increase the lot yield to 1,626 lots. Some of the precinct has already been developed and the additional lots would be in those areas which are not yet developed. About 18 of the lots will have multiunit dwellings totalling about 328 dwellings across the 18 lots.

This report assesses the capacity of the road network to cater for the evacuation of the Jordan Springs East development were it to be developed with 1,936 residential dwellings. It takes into consideration discussions which were held with the NSWSES Regional Controller, Peter Cinque, on 12 October, 2017.

Currently Proposed Development and Evacuation Routes

Figure 1 shows the indicative layout plan (ILP) for the development which is now proposed. The development has been divided into six stages which have been further subdivided to reflect the staging of development.

Stages 1, 2, 3A, 4A, 4B and 5 are either complete or under Development Applications and Construction Certificate processes.

Stage 2 has 333 dwellings and is completely above the reach of the probable maximum flood (PMF). Although a PMF would isolate this stage from the Main Access Road which leads west through Jordan Springs, it has direct access onto the Bus Only Road which leads south through Werrington. This means that the stage would not be completely isolated by flooding and therefore does not need to be evacuated.

Stage 1 has 394 dwellings. For evacuation management purposes it has been subdivided into a north and south zone labelled in Figure 1 as 1N and 1S. The vehicles from 1N would evacuate via the Main Access Road and those in 1S would evacuate via the Bus Only Road. However, not all of the vehicles from either of these zones need to evacuate because they have road access out of the precinct even during a PMF event.

Those in the northern part of Zone 1N have direct access onto the Main Access Road and those in the southern part of Zone 1S have direct access onto the Bus Only Road. These areas are shown in Figure 2. Between these two zones there are an estimated 105 dwellings which do not need to evacuate from Stage 1. This leaves 71 dwellings from Stage 1 which will evacuate west along the Main Access Road and 218 dwellings which will evacuate south along the Bus Only Road.

There are proposed to be a total of 1,185 dwellings in the remaining stages and all will evacuate west along the Main Access Road.

For the purposes of evacuation planning and analysis the development was divided into Precinct A which has evacuation access to the Main Access Road and Precinct B which has evacuation access to the Bus Only Road. Both precincts are shown in Figure 2.

#### Local Evacuation Analysis

The flood evacuation analysis has been undertaken using the SES Timeline Evacuation Model (Oppen et al., 2009). The model was developed as an empirical means of consistently estimating the ability of people to safely evacuate by motor vehicle.

A tool has been developed for applying the Timeline Evacuation Model to assess the flood evacuation capability of proposed developments (Molino et al., 2013). It does this by calculating the time required and time available for vehicular and pedestrian evacuations.

For the Hawkesbury-Nepean Valley, the Bureau of Meteorology has previously advised that it can provide at least nine hours warning of any level being reached at Windsor, based on fallen rain. The recently published *Resilient Valley, Resilient Community* (NSW, 2017) states that “the Bureau of Meteorology has advised that it can provide up to 15-hour flood level predictions for large flood events.” To be conservative in this analysis, it has been assumed that only nine hours will be available for evacuation.

The NSW SES has for the past 20 years assumed for evacuation planning in the Hawkesbury Nepean Valley that the flood is rising at a rate equivalent to the 72 hour PMF design flood which rises at about 0.5m per hour within the range of levels which affect development in the Valley. Any flood could rise this quickly, not just a PMF. However, it is understood from presentations by the Hawkesbury Nepean Flood Risk Management Taskforce that some events could rise slightly faster than this but we do not have access to that data. Should vehicular evacuation fail and pedestrian evacuation be necessary, a flood rising as fast as a 24 hour PMF (1.5m per hour) has been used in the previous pedestrian evacuation analysis for Jordan Springs East and this is certainly faster than rates presented by the Taskforce. That analysis showed that pedestrian evacuation on a rising gradient will be possible and the proposed increase in dwelling numbers would not change this.

The following assumptions have been made with regards to vehicular evacuation:

- All premises below the PMF within the site will be evacuated as well as those in Zone 1S which will be isolated by floodwaters.
- All vehicles at evacuating premise will be evacuated
- All evacuation traffic for Precinct A will travel through the Main Access Road and traffic for Precinct B will evacuate via the Bus Only Road (Figure 3).
- There will be one evacuation lane available on each of these evacuation routes.
- A maximum evacuation rate of 600 vehicles per hour per lane will be achieved on all roads.
- Evacuation traffic will be generated through broadcast warnings and doorknocking at a rate of 600 vehicles per hour from each precinct.
- People will take one hour to accept a warning after they have been door knocked and a further hour to prepare to evacuate.
- The evacuation is orderly and that all parties know what to do, where to go and what to take.
- In accordance with NSW SES Guidelines, a further one hour will be allowed for in evacuation time to account for delays due to car accidents, break downs and other contingencies.

The average number of vehicles per dwelling was determined using the average vehicles per dwelling statistic in the 2011 census for the Penrith LGA, in which Jordan Springs East is situated. This is 1.8 vehicles per dwelling. However, the census also reports that 2.9 percent of dwellings did not report the number of vehicles at their dwelling. The total number of vehicles was therefore calculated by increasing the vehicle estimates by this percentage.

The resulting calculation is an estimated 2,326 vehicles having to evacuate from Precinct A and 404 vehicles having to evacuation from Precinct B.

The time required to safely evacuate all vehicles is 7.4 hours in Precinct A and 3.7 hours in Precinct B. This provides surplus times of 1.6 hours and 5.3 hours for evacuating Precincts A and B respectively. This shows that there is sufficient time for all of the dwellings to be evacuated ahead of rising floodwaters.

It is noted that the previous evacuation analysis, for what was then called Central Precinct (Molino Stewart, 2014), assumed that the entire development would be residential development rather than partially employment land as is currently the case under SREP 30. This meant that the analysis was based on the evacuation of many more dwellings than was finally approved. The current proposal requires the evacuation of only 306 more dwellings than was originally analysed.

Furthermore, the analysis makes the simplifying and conservative assumption that there will only be 9 hours available for the evacuation of the whole precinct. In reality there will be much more time than this. The NSWSES will initially only order those dwellings at or near the minimum levels on the site to evacuate based on initial flood forecasts. As flood level forecasts are updated and it becomes apparent that floods are expected to rise higher than initially predicted then those impacted by the revised forecast will be ordered to evacuate. This updating will occur until the peak flood level is forecast.

In a flood rising as fast as the 24hr PMF it could take as long as 30 hours from the time that the first people in Jordan Springs East are ordered to evacuate to the time that the last of them are ordered to evacuate, meaning that there is closer to 39 hours available for evacuation to take place rather than the 9 hours assumed in the analysis.

## Regional Evacuation Considerations

The proposed Jordan Springs East development will require approximately 2,730 vehicles to evacuate during a regional PMF. It is proposed that the traffic from Precinct A will head west from the site using the Main Access Road to Jordan Springs and that from Precinct B will head onto Dunheved Road. Both streams of traffic would head west to The Northern Road then to the M4 and finally to the regional evacuation centre at Sydney Olympic Park if they are unable to find accommodation elsewhere. This is in accordance with the NSW SES evacuation plan for the Valley (Figure 4).

Our analysis suggests that the Northern Road could be at full traffic capacity during this time due to evacuations from North Penrith (Thornton, Waterside and the Coreen Avenue Industrial Area), Penrith, Jamisontown and Londonderry as well as evacuating traffic from the Hawkesbury including; Richmond, Windsor and Bligh Park.

This suggests that the evacuating traffic from Jordan Springs East may need to queue within flood free land until the Northern Road is available to use. Currently the NSW SES, in its emergency planning, assumes that a queued car uses 6 m of road (linearly). This implies that there needs to 16.4 km of road for the traffic to queue.

Traffic evacuating from Precinct A will queue on The Main Access Road to Jordan Springs and its shoulder until the queue reaches back to the extent of the PMF. It is recommended that at the PMF extent signage is erected to indicate to traffic not to queue beyond this point during flooding. There would also be the opportunity to queue traffic within local roads in Jordan Springs between the Main Access Road and The Northern Road. Table 1 lists roads within Jordan Springs which are enroute between these roads and these are shown in Figure 5. It would also be possible send some traffic out of Precinct A via the NPWS road which provides a further 700m of road on which to queue.

In addition it would be possible to park vehicles temporarily in the car park at Jordan Springs Shopping Centre which would hold 450 cars. This would reduce the total required queue length to 13.7 km.

These roads alone would not be sufficient to queue all of the Precinct A traffic so that the remaining traffic from Precinct A will then need to evacuate south along the Bus Only Road towards Dunheved Road and queue along this route. The traffic from Precinct B will also follow this route. It should be noted that were all of the evacuating traffic to use only one of the two egress points, then there would still be surplus time, therefore the additional traffic towards Dunheved Road will not impact on the ability of everyone to evacuate from the site.

However, Dunheved Road itself would not have sufficient capacity to queue all of this traffic. An additional evacuation route through Cambridge Gardens could provide additional queuing space and allow all of the evacuation traffic to queue in flood free land. Table 2 outlines the proposed route and it is shown graphically in Figure 5. This route minimises crossing of drainage lines and would be unlikely to be cut from local flood waters.

This regional evacuation strategy has assumed that there would be fully formed shoulders along the Main Access Road and Dunheved Road so that two lanes of traffic could queue on these roads. Examination of Dunheved Road using Google Street View suggests (see Figure 6) that the current shoulder may not be sufficient and if two cars need to queue side by side using the lane and shoulder, the existing shoulder would need to be widened.

Table 3 shows that the available queuing length on all of these roads combined would be approximately 15.6km which is about 2km more than the road length required to queue all of the evacuating residential vehicles. This means that there would be no need to widen the shoulder of Dunheved Road.

It should be noted that the full queuing capacity of these roads will only need to be used if the whole of Jordan Springs East needs to evacuate at the same time AND regional flood

evacuation has taken up the full evacuation capacity of The Northern Road when Jordan Springs East is evacuating. This is unlikely as the evacuation of Jordan Springs East can be spread over nearly 30 hours and during this time evacuation from Richmond, Windsor and Bligh Park would cease because they will have evacuated earlier or their routes would have been cut by floodwaters.

Table 1. Proposed Jordan Springs Route

<b>Road</b>
Lakeside Parade (sealed)
Greenwood Parkway
Alinta Promenade
Cullen Avenue
Jordan Springs Boulevard
Water Gum Drive

Table 2. Proposed Cambridge Gardens Route

<b>Road</b>
Henry Lawson Drive
Singleton Avenue
Harvest Drive
Greenbank Drive
Pasture Gate Avenue
Hilton Road
Trinity Drive
Northern Road

Table 3. Evacuation Route Queue Lengths

Route	Length of Road Available to Queue (m)	Length With Queue on Shoulder (m)
NPWS Road <sup>+</sup>	700	700
Main Access Road to Jordan Springs	975	1950
Jordan Springs roads	5,966	5,966 <sup>+</sup>
Dunheved Road*	3,400	6,200
Cambridge Gardens	3,700	3,700 <sup>+</sup>
Total	9,800	16,000

\*Includes approximately 600m through Cambridge Gardens with no effective shoulder

<sup>+</sup>There is no effective shoulder along this route

## Conclusions

- There is sufficient time to evacuate all vehicles from the proposed Jordan Springs East development in advance of a flood rising as fast as the 72hr design PMF at Windsor.
- With the use of local roads through Cambridge Gardens and Jordan Springs and the shoulders of the existing routes, all of the traffic from within Jordan Springs East can queue in flood free land until the Northern Road becomes available if this is necessary.

- Signage will need to be added to advise traffic not to queue in flood prone land
- The assumptions that we have made are conservative and assume the worst case scenario, in reality it is likely that:
  - Evacuation of Jordan Springs will be spread over 30 hours or more and not occur within the space of several hours as has been assumed in the modelling
  - Evacuation of traffic from Richmond, Windsor and Bligh Park is likely to have ceased using The Northern Road when the last of the Jordan Springs East traffic needs to evacuate.
  - There will be less traffic as many residents will choose either not to evacuate;
  - Many of those evacuating will be travelling to stay with family and friends within the local area and not require the Northern Road.

Should you have any further queries in relation to this matter, please do not hesitate to contact me.

Yours faithfully

For Molino Stewart Pty Ltd



Steven Molino

Principal

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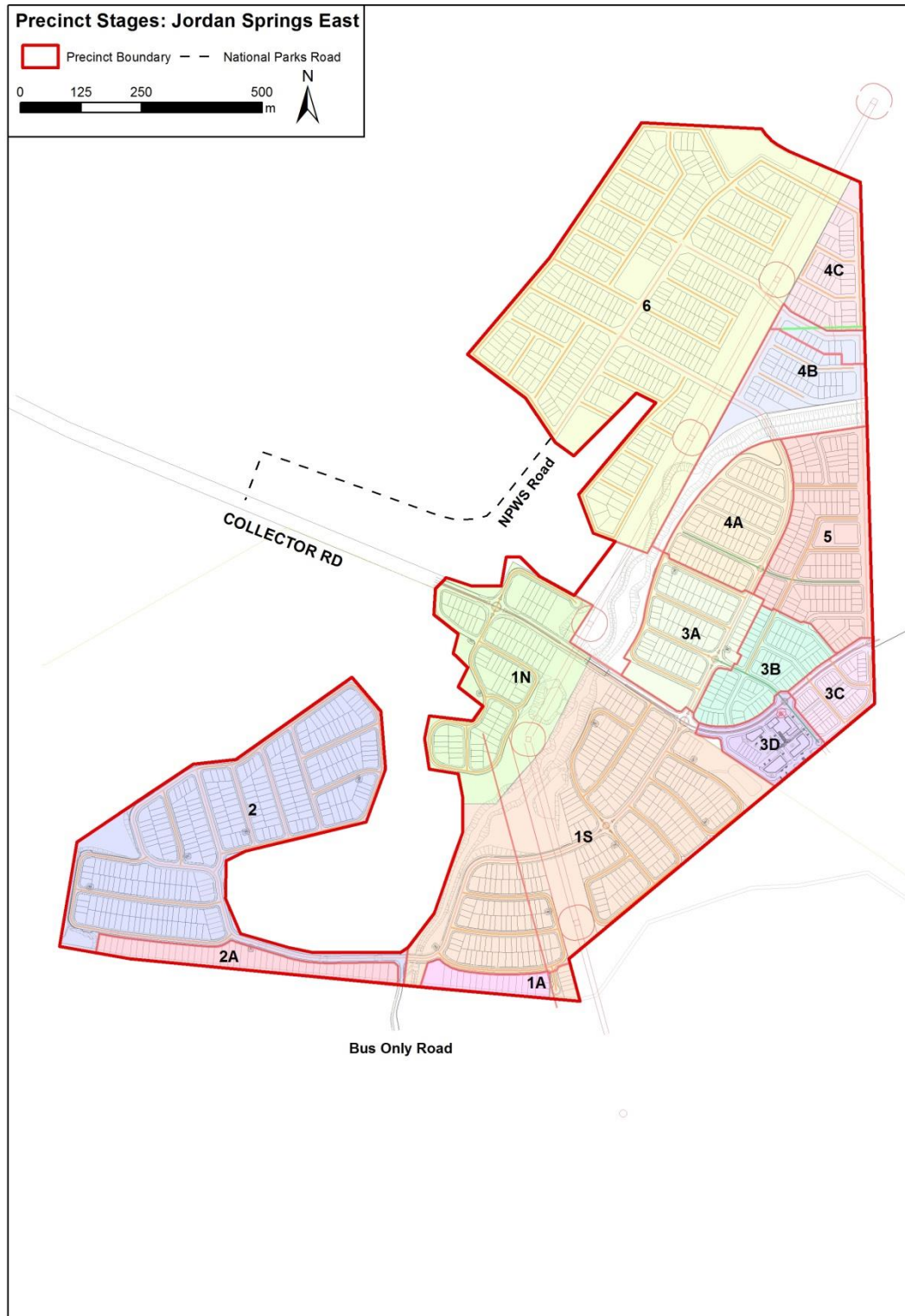


Figure 1: Master plan for Jordan Springs East

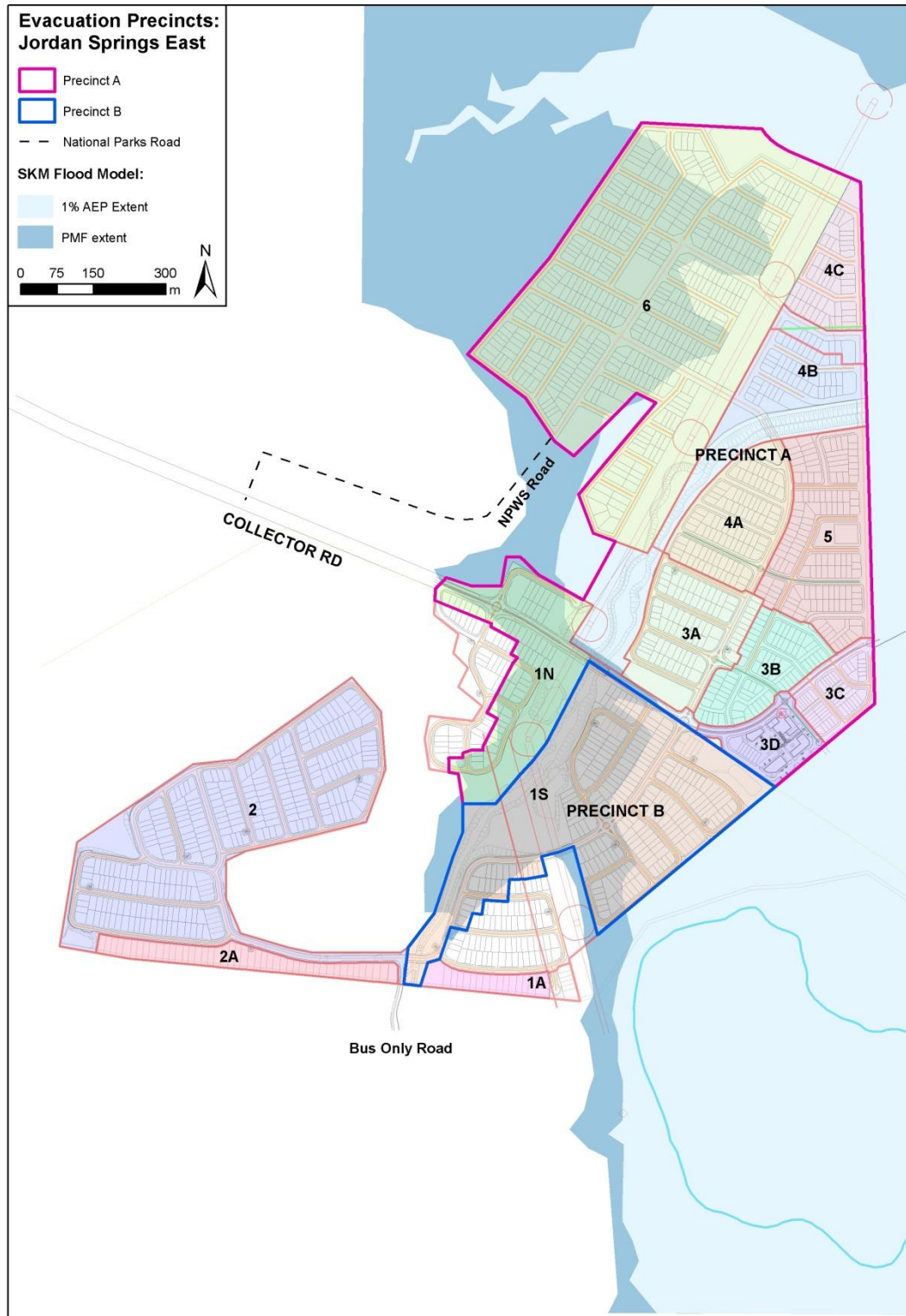


Figure 2: Evacuation sectors and flood extents for PMF and 1% AEP events across Jordan Springs East

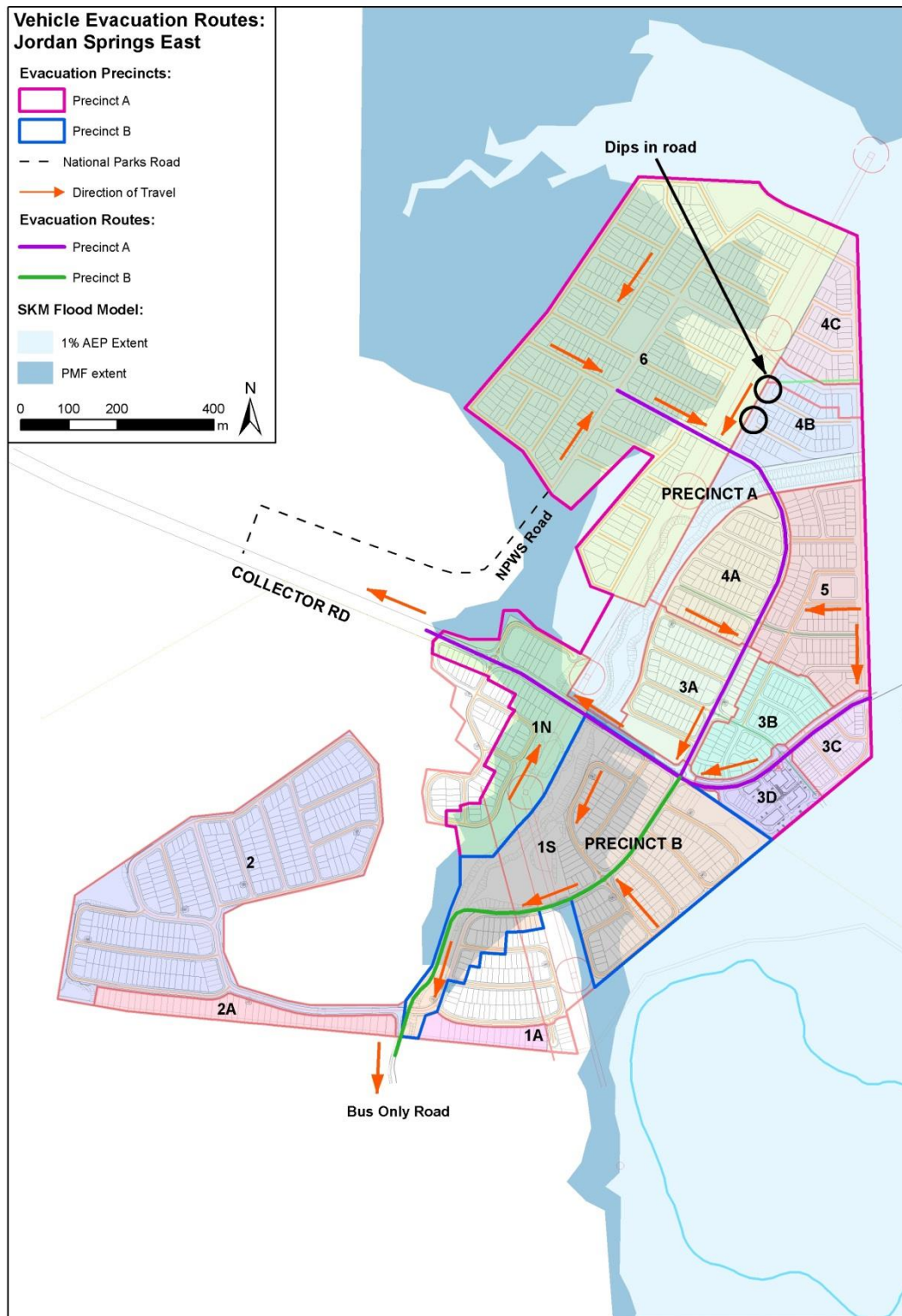


Figure 3: Vehicular evacuation routes within Jordan Springs East

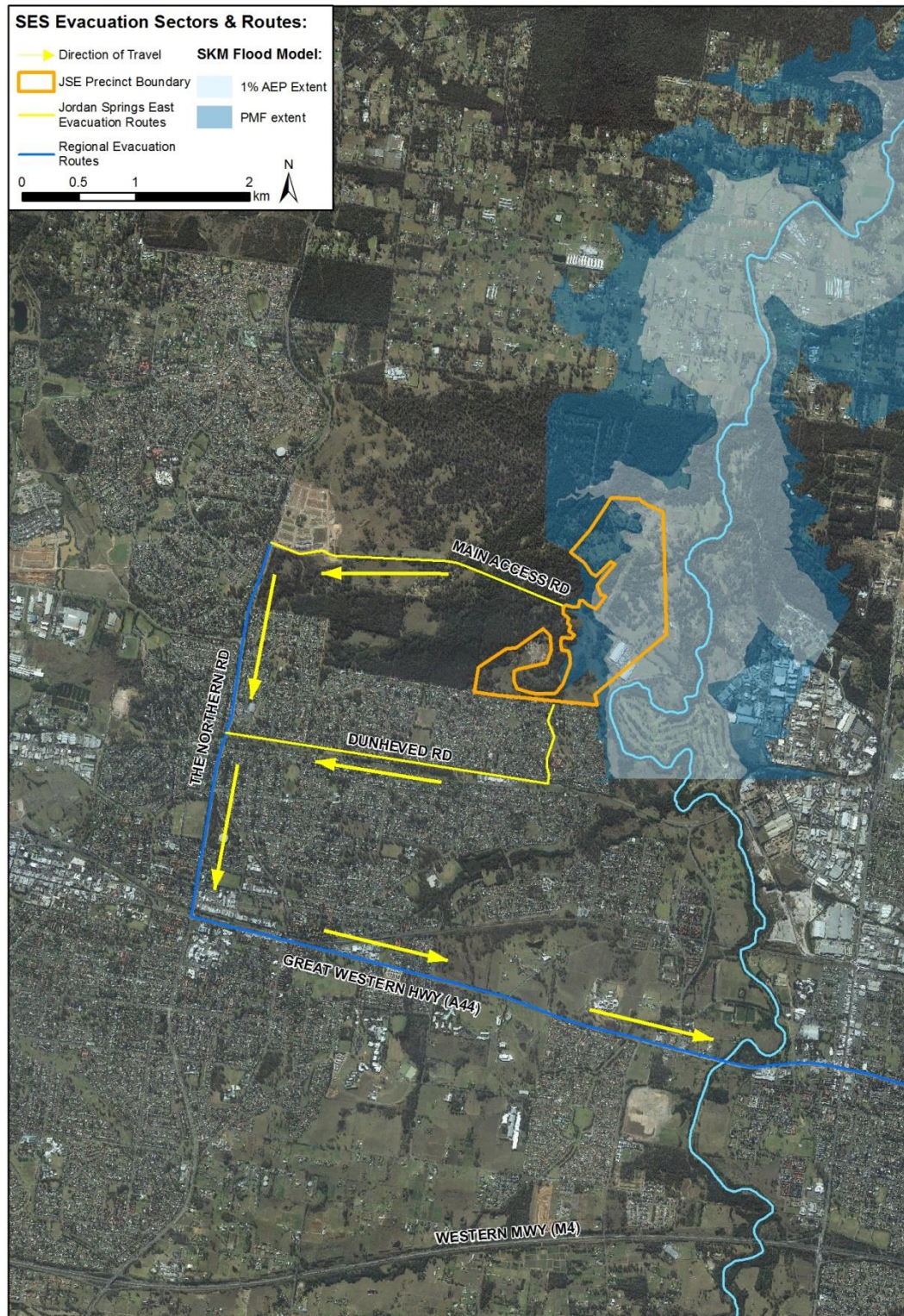


Figure 4: Proposed Evacuation Routes

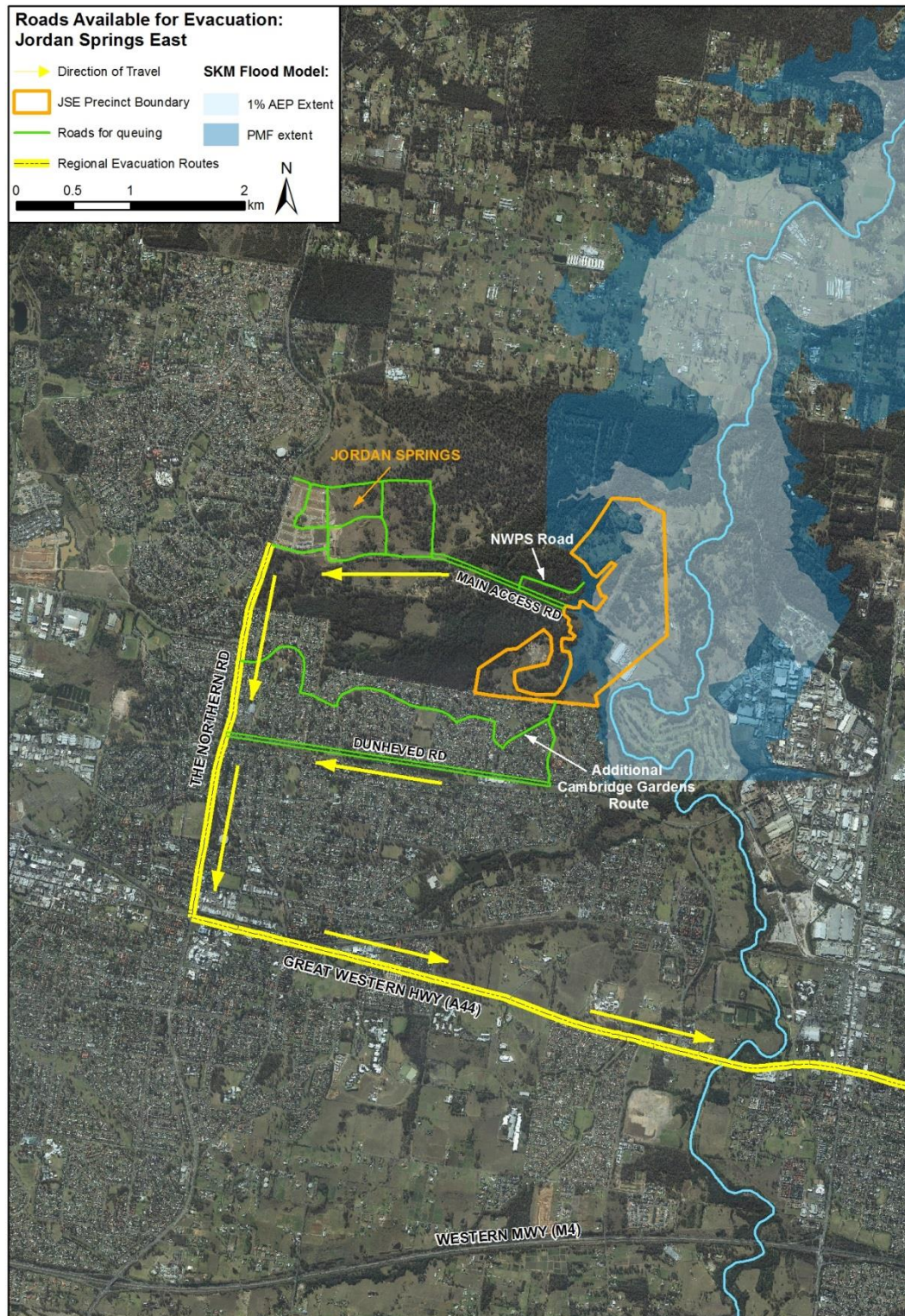


Figure 5: Proposed Roads for Queuing



*Figure 6: Dunheved Road evacuation route shoulder*