MEMO

ARCADIS Design & Consultancy for natural and built assets

PLANS AND DOCUMENTS referred to in the PDA DEVELOPMENT APPROVAL
Approval no: DEV2023/1466
Date: 11 October 2024
Queensland Government

Date 1/03/2024
To Erin Dyer (Charter Hall)
From Gary Ellis (Arcadis) and Darlan Castro (Arcadis)
Copy to
Subject Flagstone Estate: LCC TLPI No. 1/2023 Response – Flood Overlay Code

1 INTRODUCTION

This Technical Memo has been prepared for Charter Hall to provide for the Flagstone Logistics Estate an assessment of larger design storm events for and exceeding 1% AEP in 2100 and requirements to satisfy Logan City Council Planning Scheme 2015 Section 8.2.5 – Flood Overlay Code (October 2023). Moreover, analyse these larger events and determined minimum Flood Planning Levels for the site development areas for corresponding accepted land use compatibility. It is noted that purported flood planning levels relate to uniform development (i.e. minimum 0.5% AEP in 2100 immunity) for specific flood zonal areas as defined in Section 7.4. Uniform development is defined by all relevant individual lot pads elevated to or above the corresponding flood planning level for this specific storm event.

2 SITE DESCRIPTION & INDUSTRIAL LAND USE

The subject development is situated at 4499 - 4651 Mount Lindesay Highway, North Maclean. The site is situated within the Greater Flagstone Priority Development Area (PDA) located within the Logan City Council (LCC) local government area. The site is approved for specific land use "*Industry and Business Zone*" with overlay for indicative future bio-diversity corridor.

3 RELATED EXISTING APPROVALS

The proposed development is approved with a Development Permit for the reconfiguring a lot - one (1) lot into eleven (11) lots and new roads, consisting of five super lots and six auxiliary lots, comprising drainage, open space and a sewer pumpstation. Additionally, compliance assessment endorsements are noted as follows:

- Bulk Earthworks and Drainage (Condition 11A)
- Western Boundary Wall (Condition 13A)
- Updated SBSMP (Condition 21)

Refer to EDQ correspondence (Reference: DEV2018/961/4_D23/116559) dated 2 August 2023 for endorsement and approved plans and report. Figure 1 shows the approved overall bulk earthworks (and finish surface levels) and associated drainage and pipe infrastructure. Refer to Appendix A for copy of this endorsed drawing No 0100 Issue 07.

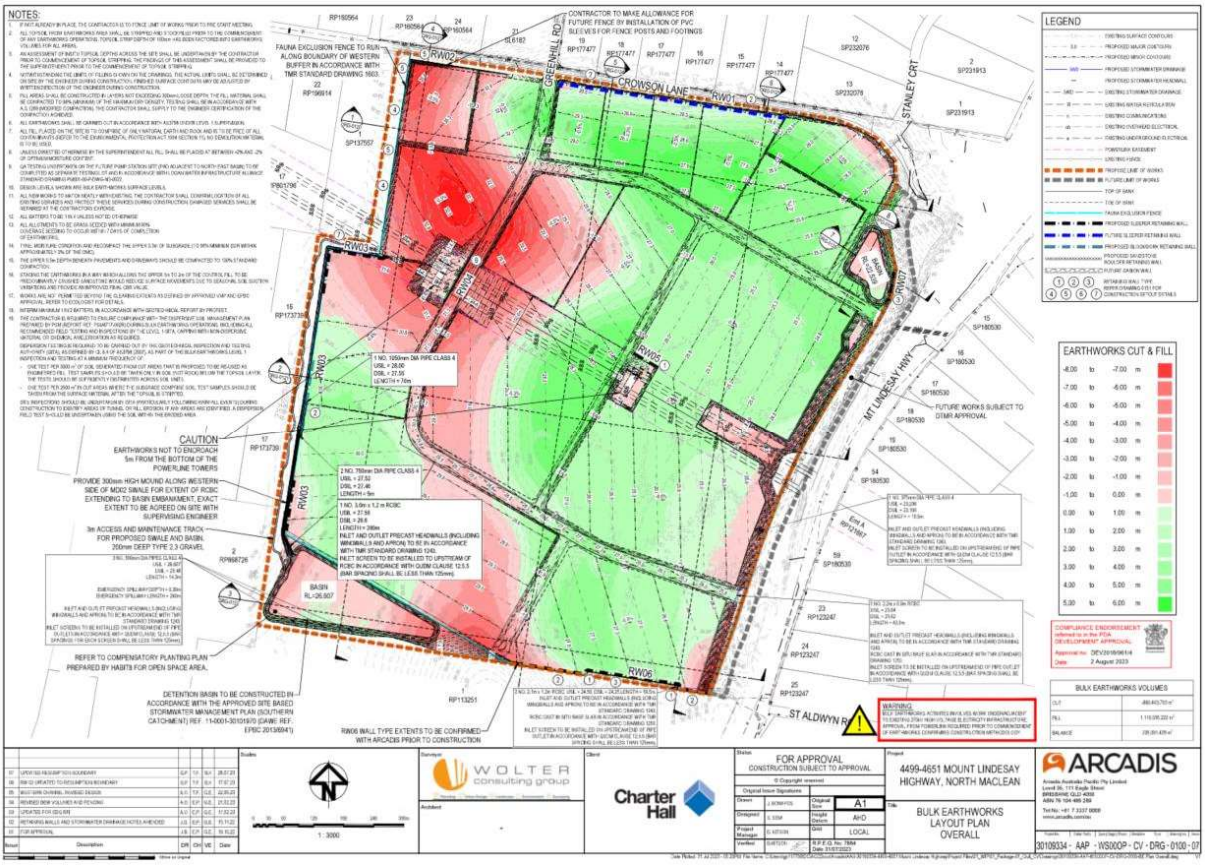

Figure 1 – Endorsed Bulk Earthworks Overall Plan

4 OM-05 FLOOD HAZARD OVERLAY

The Logan City Council Planning Scheme 2015 Part 8 is the specific reference document for this assessment concerning land use flood compatibility and associated assessment benchmarks for accepted development. Particularly, the subject site and surrounding PDA associated land parcels are to be considered subject to the recently introduced TLPI: No. 1/2023 (effective Date 30 Oct 2023) and associated OV-05 Flood Hazard Overlay.

Figure 2 below shows the present OV-05 Flood Hazard Overlay mapping for the Estate and surrounding land parcels. The subject site and surrounds include all flood risk type areas and High Flow Area, specially:

- High Flood Risk
- Moderate Flood Risk
- Low Flood Risk
- Very Low Flood Risk

It is noted that the High Flow Area is a minor encroachment to the development area and is limited to the drainage channel only and not considered any further for this assessment. The associated overlays trigger assessable code requirements as per Section 8.2.5 Flood Hazard Overlay Code. A full response to this code performance and acceptable outcomes are included to Appendix B based upon the

outcomes of updated Logan River flood model (see Section 6). Notably, the current Logan City riverine flood modelling and flood overlay mapping is reflective of previous natural ground levels and not current approved finish surface levels (bulk earthworks) and progressed works. Further, owing to existing approvals (refer Section 3, including hydraulic flood assessment) and works already undertaken, this benchmark assessment is:

- Based upon BEW finish surface levels (development and adjoining); and
- limited to those flood events equal to and larger than the DFE (1% AEP) and relevant to compatible land use concerning industrial development. Specifically, the 1%, 0.5% AEP and 0.2% AEP at 2100 events.

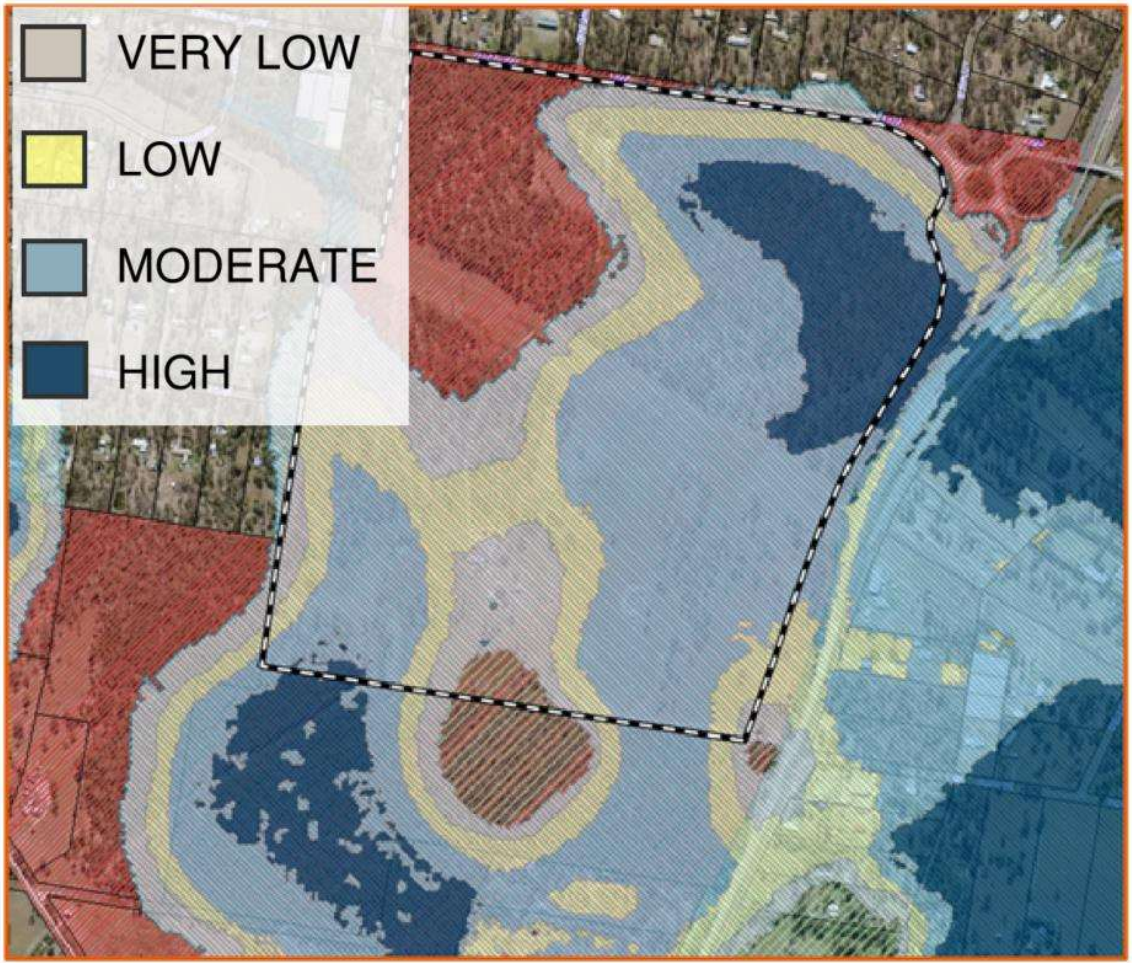

Figure 2 – LCC Flood Hazard Overlay Mapping

Importantly Flood Hazard mapping produced within this report uses LCC's flood risk hazard matrix for plotting hazards in context of relevant AEP events up to and including PMF. Refer Logan Planning Scheme 2015 SC6.2.10 Flood Figure 1.8.2 – Hydraulic risk matrix (included as a legend in Appendix C mapping).

The stock water surface level (WSL) results provided by Council (within the updated model package) have been compiled below to allow for comparison of inundation extents. Refer to Figure 3.

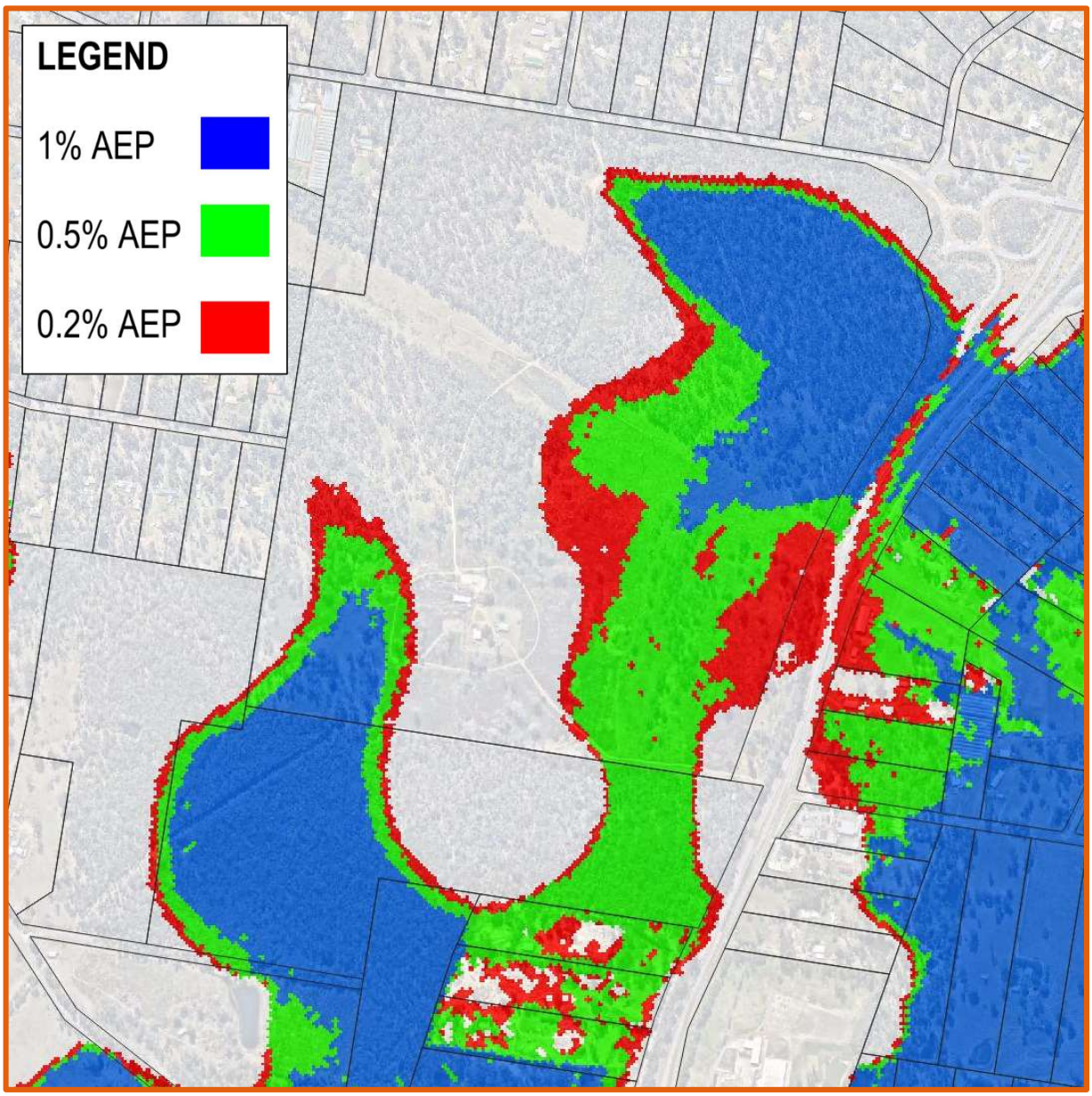

Figure 3 – LCC Stock Results Compiled for Inundation Extents (1% AEP – 0.2% AEP)

5 ADOPTED FLOOD MODEL

The adopted flood model for this assessment is the Logan and Albert rivers hydraulic model 2023, which was released by Council under a Data / Image Use agreement signed on the 1st of December 2023. This updated model incorporates changes to the previously provided Climate Change assessment, specifically in relation to the Representative Concentration Pathways (RCPs) for greenhouse gas and aerosol concentrations in the year 2100. The model now adopts the RCPs 4.5 as the Climate Change scenario. It should be noted however that hydrology was not made available for a climate change 0.05% AEP event and was therefore without climate change for the purposes of this assessment.

The critical duration for the site has been determined to be a 72-hour storm event for 1% AEP to 0.05% AEP (with climate change except 0.05% AEP, not available), and 36-hour storm event for the PMF (PMPDF). To determine the median Temporal Patterns (TP) for the site, all 10 distributions were run

using the 20m grid. These temporal patterns represent different flood scenarios and help in understanding the range of possible outcomes.

Once the critical duration and TP were determined, they were used as inputs for the assessments described in this memo. It is important to note that the assessment has been undertaken using a 10m grid, which is the level of resolution adopted in the regional assessment to capture the flood risk for the site.

It should be further noted that the critical TP for the 1% AEP climate change was found to differ in water surface levels / hazard classifications to Council's stock results for the wetland location southwest of the site. While "TP2" is supposedly used in Council's results according to the model report, it was determined that the critical TP is in fact TP6 for the subject site and immediate adjacent areas. This should be understood when reviewing updated flood hazard mapping provided within Appendix C of this report.

6 MODEL UPDATES

6.1 Base Case

The Logan River Flood model has been updated for the digital terrain as depicted within the approved endorsement plans (Refer to Section 3). This includes earthworks and major drainage mitigation systems.

Accordingly, refer to Figure 4, for pre and post update TUFLOW terrain images for the inclusion of endorsed earthworks finished surface levels (FSL). Areas internal to the site and west within the road were read into TUFLOW to inform the model topography.

Figure 4 – TUFLOW Digital Terrain Pre (existing model) and Post (approved FSLs) respectively.

6.2 Developed Case

The flood model DEM was updated to include "glass walls" to conservatively simulate floodplain blockages that may be created by future development within specific zonal areas. These "glass walls" are allocated to allotment pads as shown in Section 7.4 Figure 10, specifically zones A1-A3 and B1-B2, but zones C and D are excluded. This update allows for the establishment of flood planning levels and helps with compliance demonstration with OV-05 Flood Hazard Overlay Code, especially in cases where the land use may involve food storage or hazardous material storage/manufacturing (at a 0.5% and 0.2% AEP at 2100 respectively). Additionally, it provides relevant Design Flood Event (DFE) flood levels (at a 1% AEP at 2100) to ensure that development areas are above the DFE + 500mm freeboard requirement. For more information, please refer to Section 8.

6.3 Sensitivity Testing

Additionally, for purposes of sensitivity testing both the Base and Developed Case model has also been updated to reflect the approved development situated at 4563 - 4691 Mount Lindesay Highway, North Maclean (referred to in flood mapping as “NM2”) and associated endorsed earthworks and surface levels as shown in Figure 5 below. Importantly, this inclusion permits comprehensive and interconnected understanding of the associated floodplain behaviour and influences for both development areas.

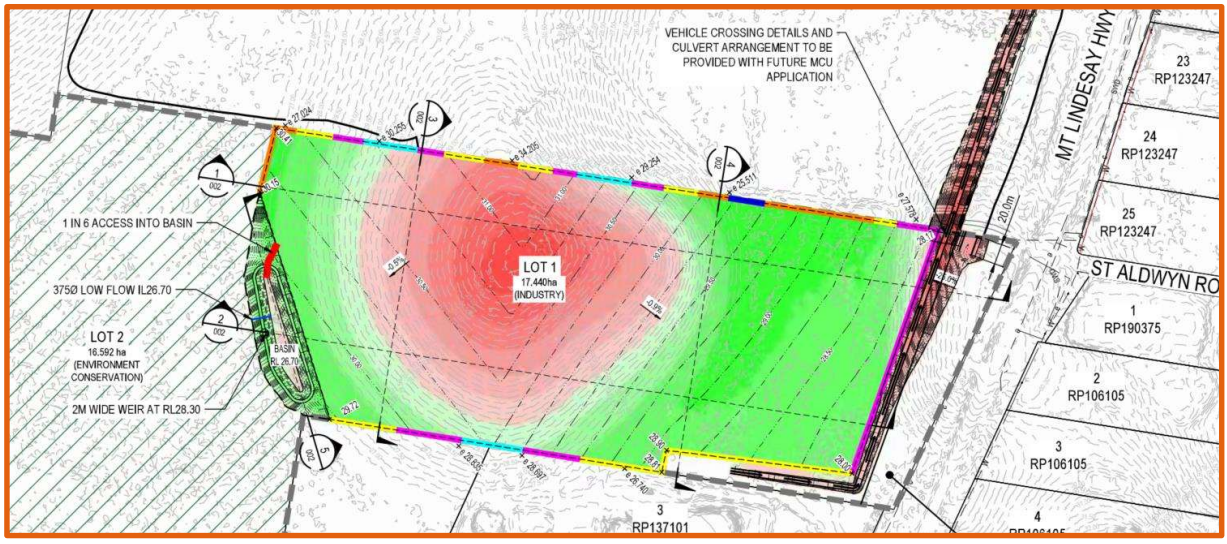

Figure 5 – Adjoining Development Bulk Earthworks.

7 RESULTS – BASE AND DEVELOPED CASES

7.1 Flood Inundation Mapping (1% AEP at 2100)

Concerning the approved BEW (FSL) works, the “Base Case” results demonstrate that the high hazard area is modified with the approved earthworks and is limited to the proposed drainage channel and detention basin infrastructure areas, i.e. development lot envelopes are situated above the DFE flood level. Refer to image below demonstrating the revised 1% AEP at 2100 inundation area. Accordingly, contrary to LCC Planning Scheme Flood Hazard Area mapping the development areas of the Flagstone Logistics Estate is now not subject to an inundation associated with this storm event. Refer to Appendix C for associated flood maps. Importantly, lot freeboard should be set based upon the higher of corresponding flood levels shown in Section 9 Table 1 for 1% AER at 2100 or 1% AEP local event flood levels (refer to the approved Arcadis SBSMP report).

Figure 6 – Base Case 1.0% AEP (100 year) at 2100 flood inundation.

7.2 Flood Inundation Mapping (Larger Events)

The larger events examination included those events associated with the Moderate Hazard Areas and compatible land use, specifically the 0.2% AEP and 0.5% AEP at 2100 in accordance with the TLPI provisions (31 October 2023) of the Logan City Council planning scheme.

7.2.1 Larger Event – 0.2% AEP at 2100

Concerning the approved BEW Finish Surface Levels works “Base Case”, the results demonstrate that the associated inundation area is subsequently modified from that shown in Section 4 – Figure 3. Refer to image (Figure 7) below demonstrating the revised 0.2% AEP at 2100 inundation area. Accordingly, the demonstrated flood inundation is considered to now be the revised flood inundation extent within current the Moderate Flood Hazard Area for the development area of the Flagstone Logistics Estate for approved BEW levels. Refer to Appendix C for associated flood maps.

It is noted that there is a variance in flood level comparing the base and developed cases for the 0.2% AEP at 2100 event which is attributed to the relative levels of floodplain blockage. Some downstream portions of the site experience greater flood planning levels in the Base Case due to increased flood conveyance (i.e.. less water being diverted to the east). Flood planning levels established within this document consider the maximum of the two to ensure the potential worst case flood level is captured.

Figure 7 – Base Case 0.2% AEP (500 year) at 2100 flood inundation.

7.2.2 Larger Event – 0.5% AEP at 2100

Concerning the approved BEW (constructed) works, the results demonstrate that the associated inundation area is reduced to that shown for 0.2% AEP event (Figure 7). Refer to image (Figure 8) below demonstrating the 0.5% AER at 2100 inundation area within the current Moderate Flood Risk zone. It is noted that for part of the estate, this larger event is limited to the southern portion of the drainage channel and future road network. Refer to Appendix C for associated flood maps.

It is noted that the Development Case results in a greater flood planning level than the Base Case for each impacted zone within the development.

Figure 8 – Base Case 0.5% AEP (200 year) at 2100 flood inundation.

The below Figure 9 overlays each of the assessed inundation extents at 2100 for Base Case approved BEW FSL, comparatively to Figure 3.

Formalised mapping for depth (including WSL contours) as well as collated flood hazard per LCC hazard matrix is provided within Appendix C.

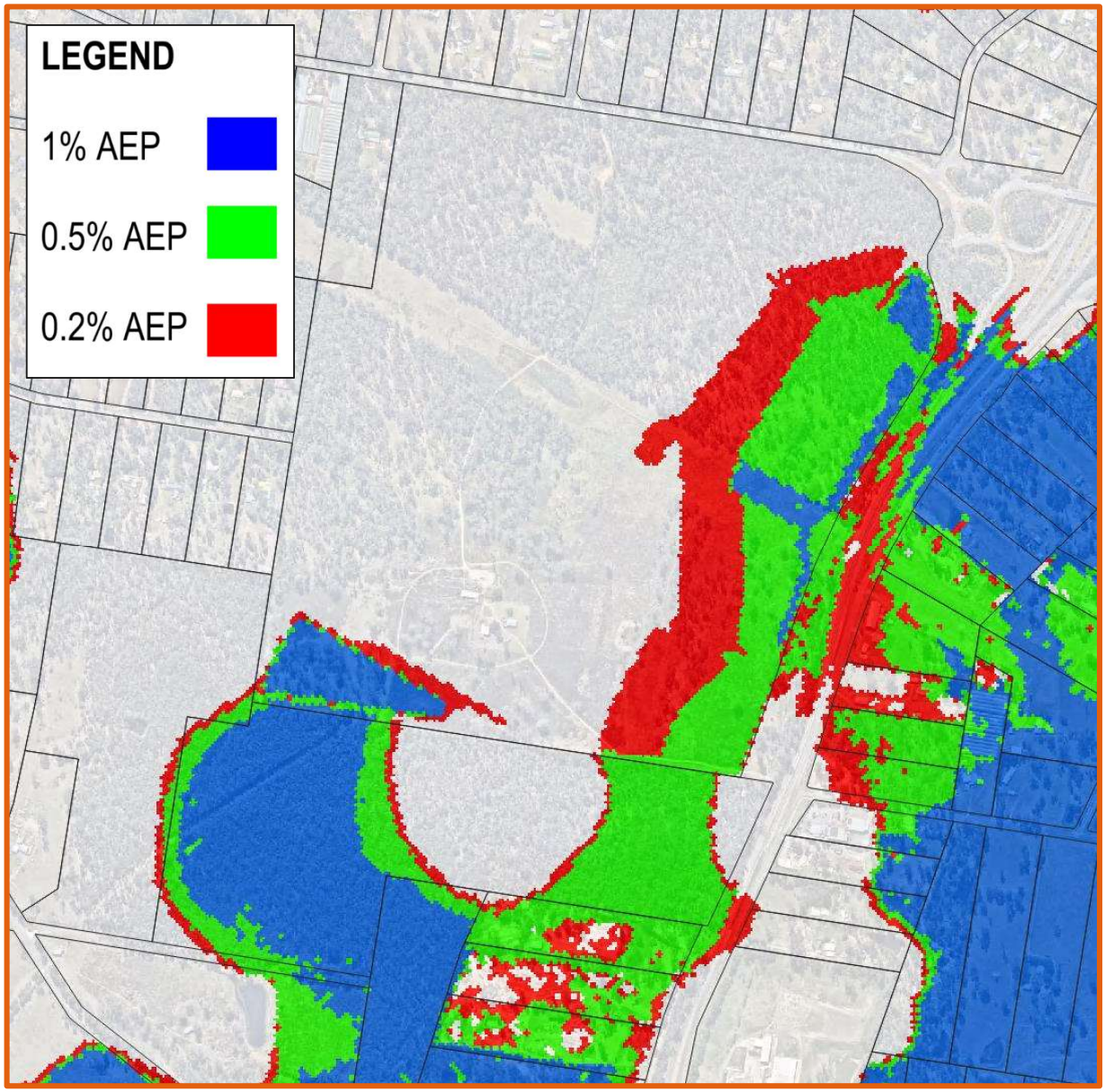

Figure 9 – Inundation extents for 1% AEP – 0.2% AEP under approved BEW FSL's.

7.3 Assessment of Events Larger than DFE (1% AEP)

In accordance with OM-05 – PO.25 (LCC Planning Scheme Policy 6.2.10), there is the requirement for an assessment of the impact of the development on flood response for events larger than the DFE (0.5%, 0.2%, 0.05% and PMF). This assessment should demonstrate no rapid or unexpected increase in safety risks or flood damage during a flood event larger than the DFE. This could include a significant or sudden change in distribution of the defined flood event flow, flood level or velocity which may result in:

i. the failure of a levee;
ii. blockage of infrastructure;
iii. concentration or diversion of flows;
iv. excessive scour;
v. realignment of the waterway;
vi. sedimentation;
vii. bank instability and collapse;
viii. a reduction in flood warning times;
ix. extension of the duration of inundation;
x. hindrance to emergency evacuation routes;
xi. disruption to critical infrastructure, services, or access routes.

Notably, this assessment assumes approved BEW surface levels plus any required future immunity works (represented via a “glass wall” scenario in the flood modelling undertaken) within the current LCC Moderate Flood Hazard area. The grid output for the flood hazard (per ARR classifications) has been compared to the benchmark scenario (i.e. approved BEW surface levels only) for the purposes of this assessment. Key locations have been focused upon to determine any impacts which the endorsed earthworks strategy has upon surrounding areas. It is determined that there is no demonstrable adverse impact concerning rapid or unexpected increase in safety risks or flood damage.

It is noted that with the revised larger event inundation extents that associated flood risk may alter and require further assessment to understand change to LCC flood risk categories for the ultimate completed site and adjoining properties developments.

Refer to Appendix C for comparative flood hazard maps per LCC hazard matrix. Also, refer to Appendix B, for detailed code response concerning the Items i) to xi). Flood velocities were found to be generally < 0.5m/s within the development pad areas, and therefore hazard is largely driven by the depth of flood waters. Slight variance in finished surface levels is therefore not anticipated to drastically alter hazard conditions internal or external to the site in view of the assessments conducted within this report.

It should be noted that the results presented for 0.05% AEP (2000y) are not considerate of 2100 climate conditions as the current LCC regional flood model (at the timing of this report) does not have hydrology for this particular event.

7.4 Flood Planning Level Zones

It is noted that the water surface levels for the large storm events has a gradient traversing through the site and flood Water Surface Levels (WSL) will vary for spatial variations. In order to provide appropriate Flood Planning levels (based upon worst case WSL scenario), it is determined to assign zones for each respective inundation area in conjunction with proposed development area lot configuration. It is proposed that these zones correspond to the revised large event inundation areas within the current Moderate Flood Hazard Area for the development based upon approved (constructed) bulk earthworks (refer Figure 10).

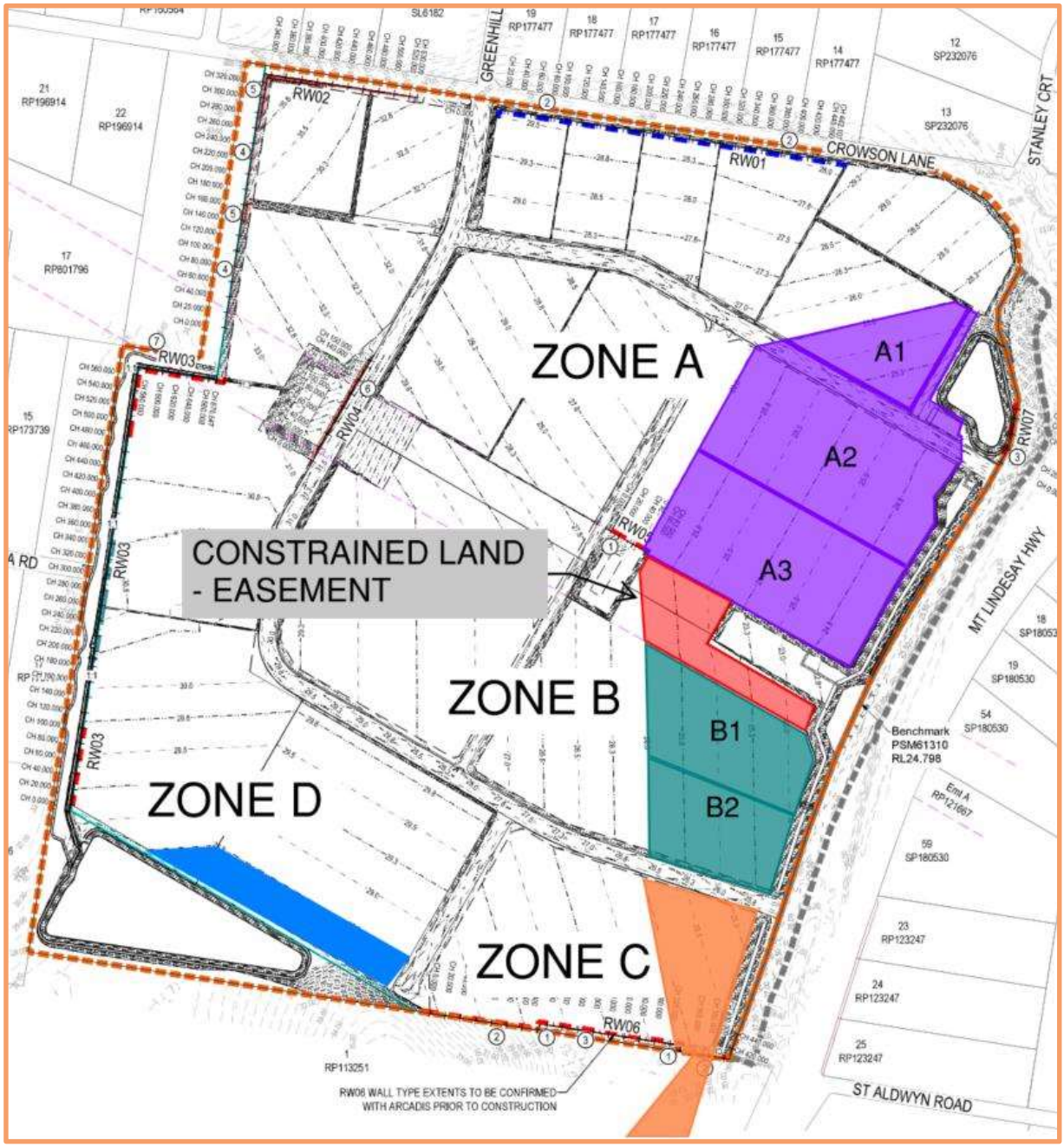

Figure 10 – Estate Flood Planning Level Zones (Revised Moderate Flood Hazard Areas)

7.4.1 Developed Zones

To establish flood planning levels, it is assumed that for each zone (excepting Zones C and D), it will be necessary to undertake future (building/civil) works to increase final FSL to above that required for flood immunity concerning both the 0.2% and 0.5% AEP event at 2100. It is assumed for the purposes of this exercise that each zone is modified accordingly, and this analysis was determined by creating a “glass wall” around pads internal to the subject site to simulate such outcome. Refer to Figure 11 for revised inundation extents under this scenario.

Flood hazard mapping produced in Appendix C also includes results for this scenario for the assessed AEP events.

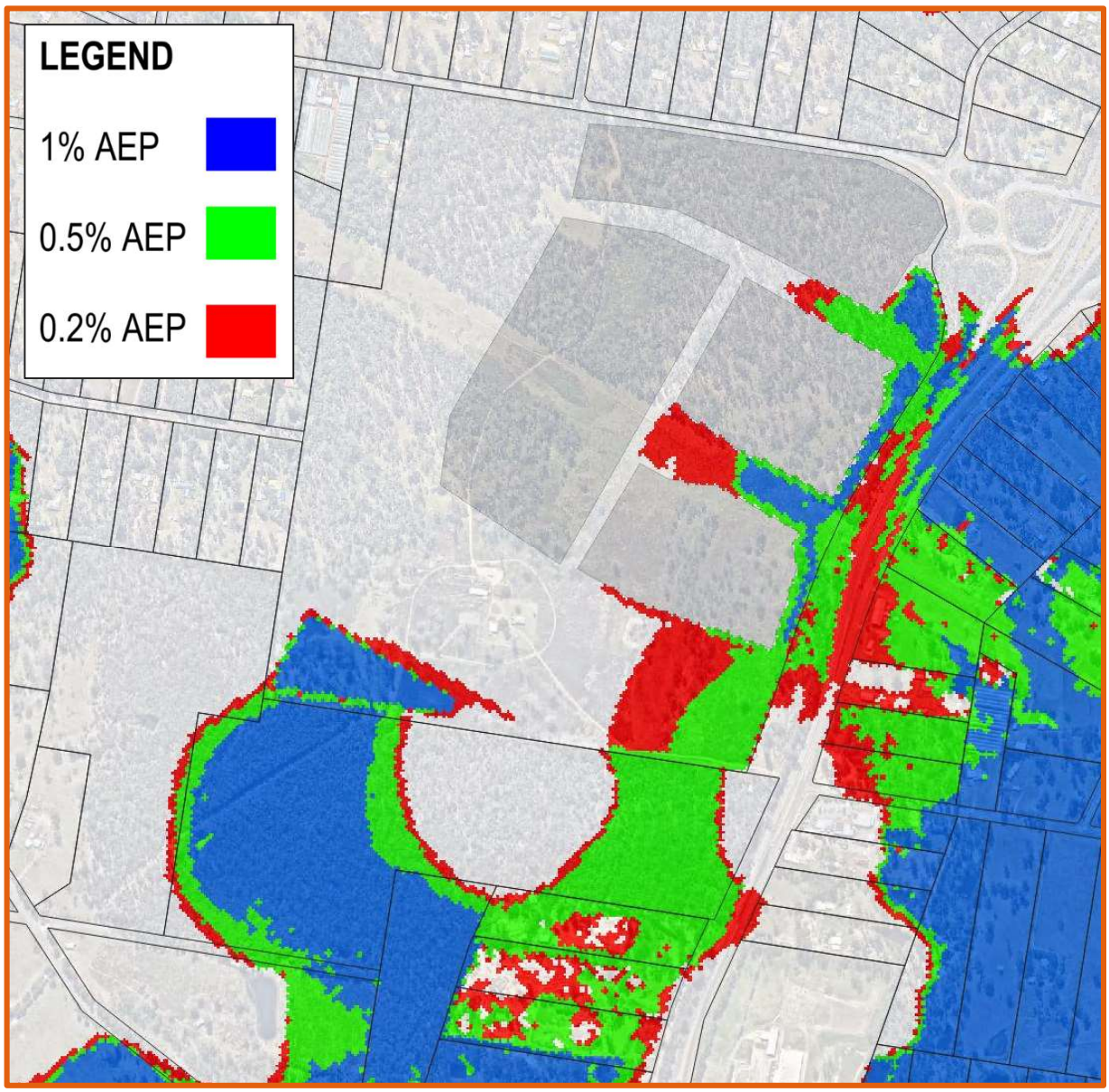

Figure 11 – Inundation extents for 1% AEP – 0.2% AEP under approved BEW, including "glass walls" for flood planning level determination.

8 SENSTIVITY TESTING

8.1 Adjoining Development

The inclusion of the approved BEW for the adjoining development as described in Section 6.3 alters the revised flood inundation footprint per the figure below.

Flood hazard mapping produced in Appendix C includes results for this scenario for the assessed AEP events. This was assessed as both with and without "glass walls" to determine potential variance in flood planning levels.

The below Figures 12 and 13 overlay each of the assessed inundation extents under context of both approved earthworks, as well as development / glass wall scenario.

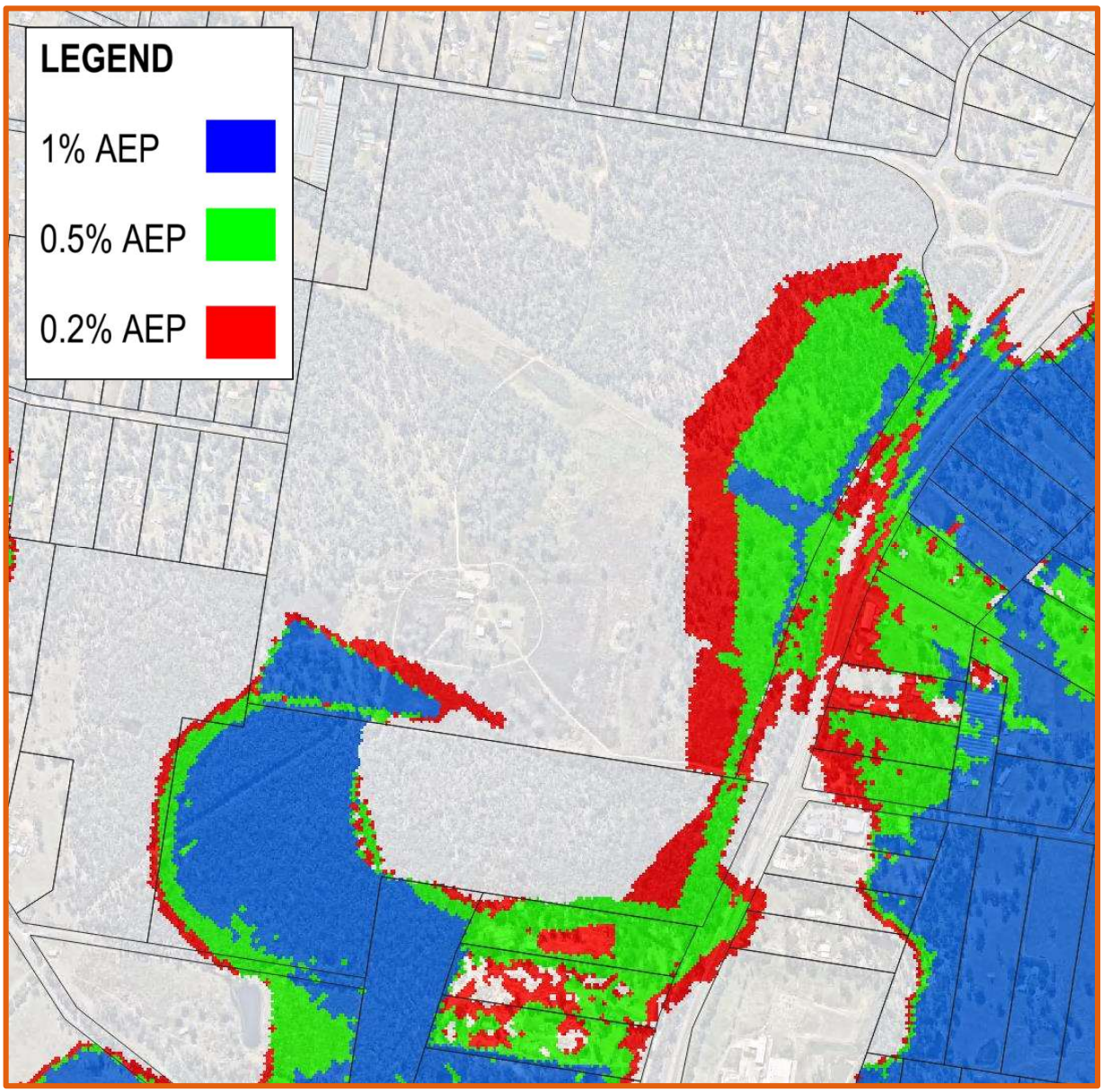

Figure 12 – Inundation extents for 1% AEP – 0.2% AEP under approved BEW for both sites.

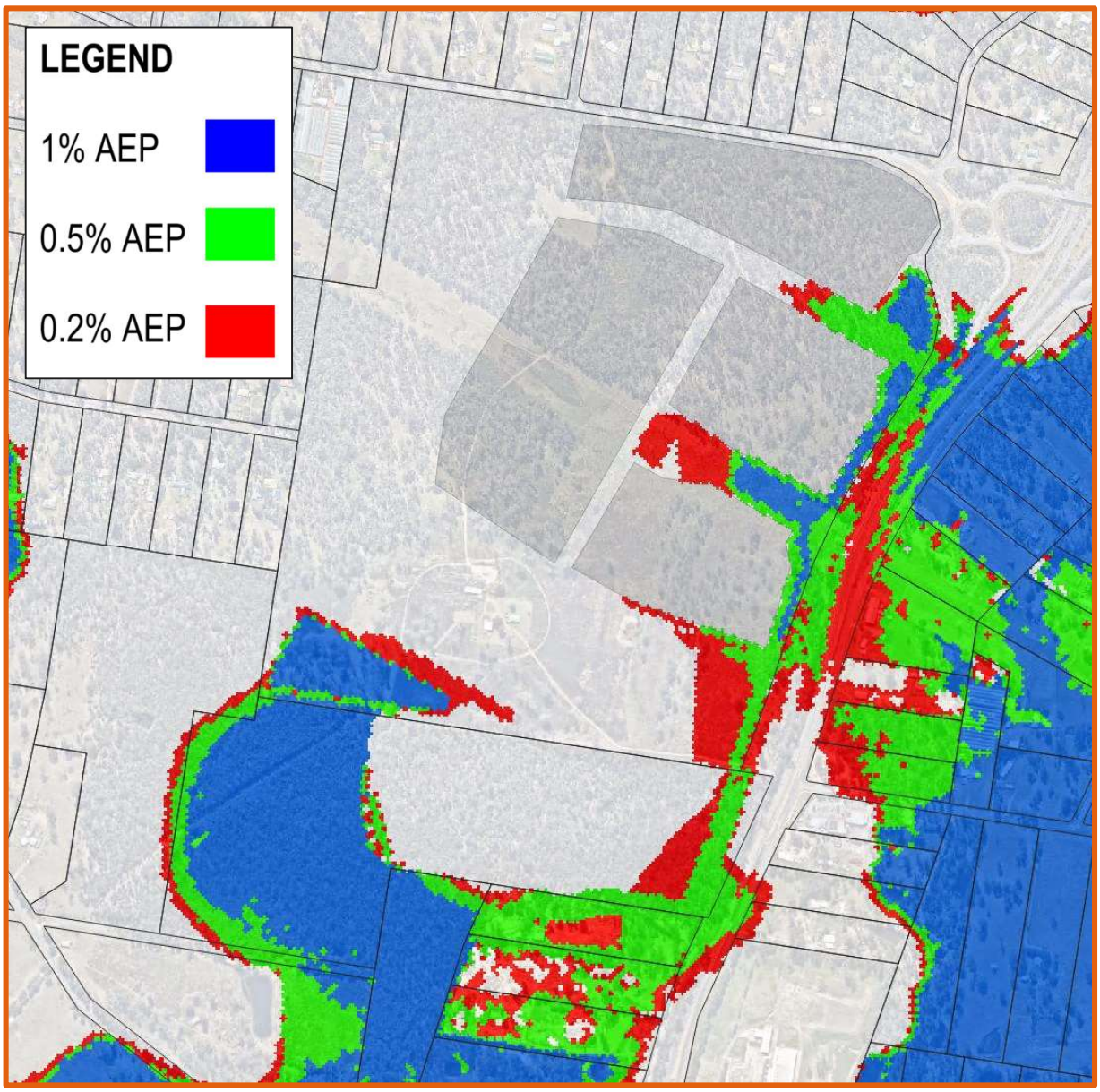

Figure 133 – Inundation extents for 1% AEP – 0.2% AEP under approved BEW for both sites and "glass walls" for flood planning level determination.

9 FLOOD RISK CATEGORY

Logan Planning Scheme 2015 SC6.2.10 Flood Figure 1.8.2 – Hydraulic risk matrix is shown in below table and is used to define areas of flood risk and corresponding flood hazard mapping. In conjunction with this investigation concerning specific large storm events and the change to surface levels, the assessment also applies this hydraulic risk matrix to determine revised flood risk areas for all scenarios. Refer to Appendix C for mapping.

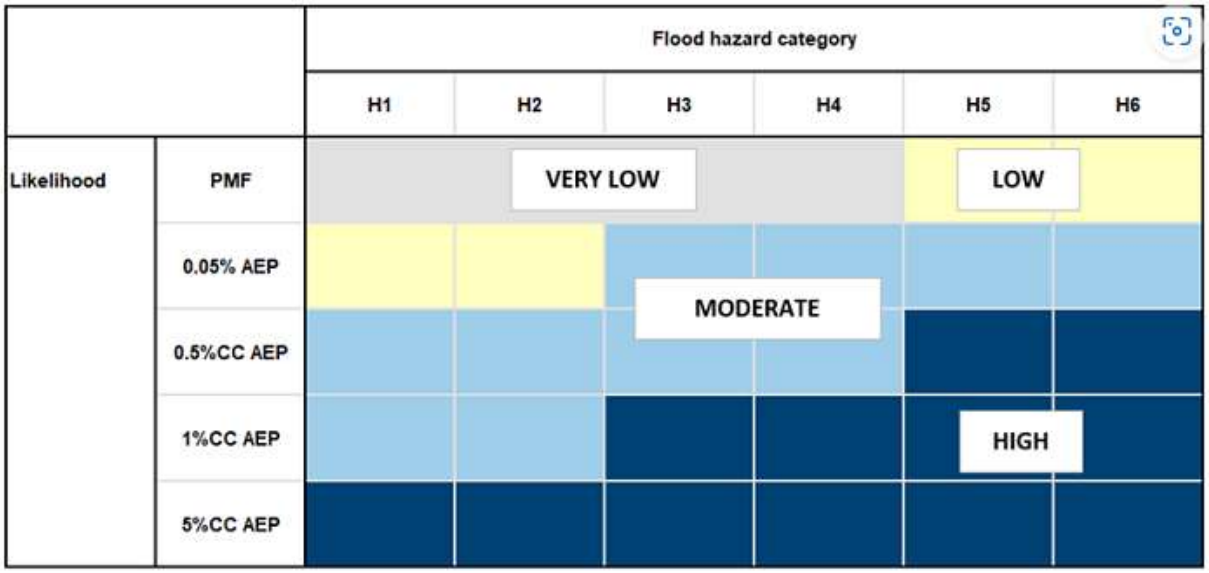

Figure 144 – Flood Hazard Category.

9.1 Base Case

The Base case revised flood risk mapping is as shown in Figure 15.

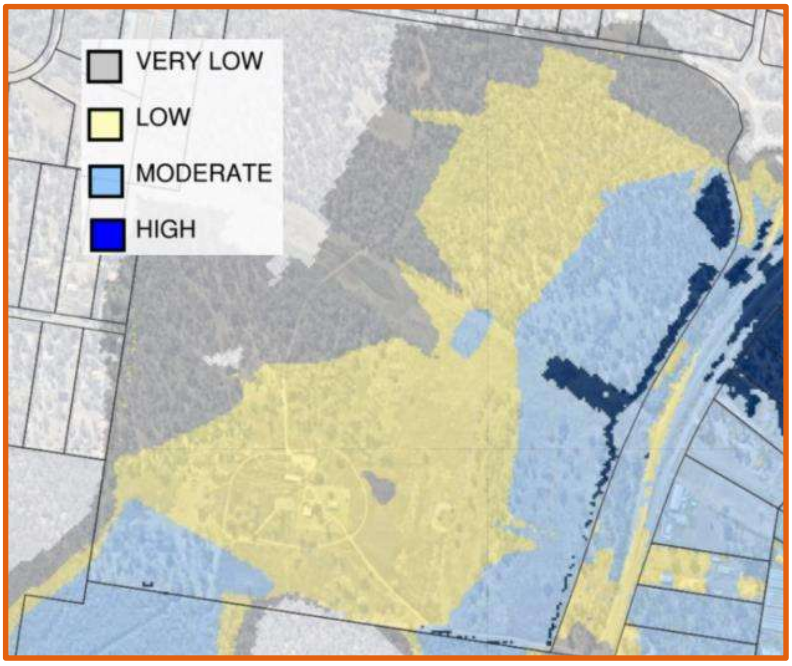

Figure 155 – Flood Risk Mapping – Base Case.

9.2 Sensitivity Case

The sensitivity case revised flood risk mapping is as shown in Figure 16.

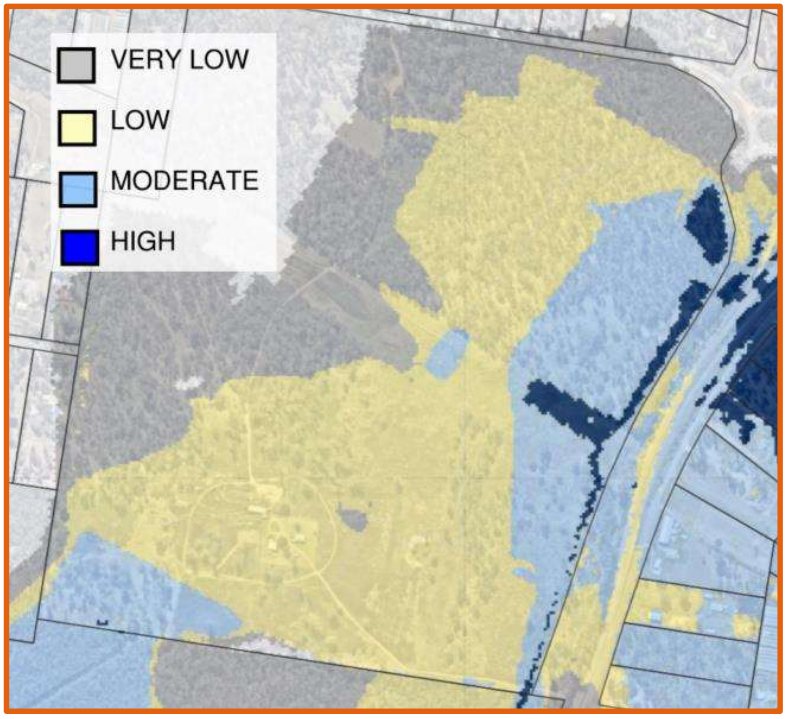

Figure 166 – Flood Risk Mapping – Sensitivity Case for approved FSL's.

10 FLOOD AND LAND USE COMPATIBILITY

10.1 TLPI No. 1/2023 OM-05 Response

Subsequent to Section 7.4.1, the following table presents the corresponding required minimum Flood Planning Levels for respective zones and sub-zones to satisfy relevant performance outcomes of the OM-05 Flood Hazard Overlay Code. Included to Appendix B is a full response to the overlay code performance and acceptable outcomes.

Table 1 – Estate Flood Planning Levels for Respective Zones

	Flood Planning Levels (Minimum) (RL m)		
Zone	1% AEP @ 2100*	0.5% AEP @ 2100*	0.2% AEP @ 2100*
A1	24.2	25.3	25.8^
A2	24.2	25.4	25.9^
A3	24.2	25.5	26.2
B1	NA	25.5	26.2
B2	NA	26.0	26.9
C	NA	**27.2**	27.7
D	27.0	28.1	28.6

^Level driven by base case. Unmarked levels are driven by the developed / glass wall case, or are equal in either scenario. Refer Section 7.2.1.

*It should be noted that these planning levels are based on:

- 1% AEP at 2100 – Base Case Approved BEW levels.
- 0.5% AEP at 2100 – Developed Case extracted from the zonal assessment (i.e. “glass wall”) conducted for the purposes of Section 7.4.1 and Zones A1 – A3 and B1 – B2.
- 0.2% AEP at 2100 – Worst scenario between Base Case and Developed Case (i.e. “Glass Wall”) for all Zones. In essence, these scenario levels assume that all pads with Zones A and B are elevated to above 0.5% AEP at 2100 and design incorporates storage system to elevate hazardous materials above the 0.2% AEP at 2100.

10.2 TLPI No. 1/2023 OM-05 Response – Sensitivity Case

Where the adjoining development occurs, then flood planning levels are revised as per Table 2. Importantly, all assumptions and notes remain relevant to this table. Notably, as per Figure 16 Zone C moderate risk area is reduced in area and predominantly limited to within the adjoining conveyance channel area. This can be seen in the 700mm reduction to the 0.5% AEP at 2100 flood planning level – reduced from RL 27.2m to 26.5m when comparing Developed Case and corresponding Sensitivity Case. Consequently, where the adjoining development earthworks are undertaken then Table 2 may be used for obtaining the prescribed flood planning level corresponding to the respective zone area.

Table 2 – Estate Flood Planning Levels for Respective Zones

	Flood Planning Levels (Minimum) (RL m)		
Zone	1% AEP @ 2100*	0.5% AEP @ 2100*	0.2% AEP @ 2100*
A1	24.2	25.3	25.7^
A2	24.2	25.4	25.8
A3	24.2	25.5	26.0
B1	NA	25.5	26.1
B2	NA	26.0	26.6
C	NA	**26.5**	27.0
D	27.0	28.1	28.6

^Level driven by base case. Unmarked levels are driven by the development / glass wall case, or are equal in either scenario. Refer Section 7.2.1.

*Refer Section 9 Table 1 notes.

11 SUMMARY

To achieve the required flood and land use compatibility in accordance with OM-05 Flood Hazard Overlay Code each respective development located within the current mapped flood hazard areas must produce development envelopes that are elevated as per Section 9 – Table 1. Notably, subject site flood hazard mapping is revised to that shown below, with all development pad areas excluded from the high hazard areas for the Base Case Scenario.

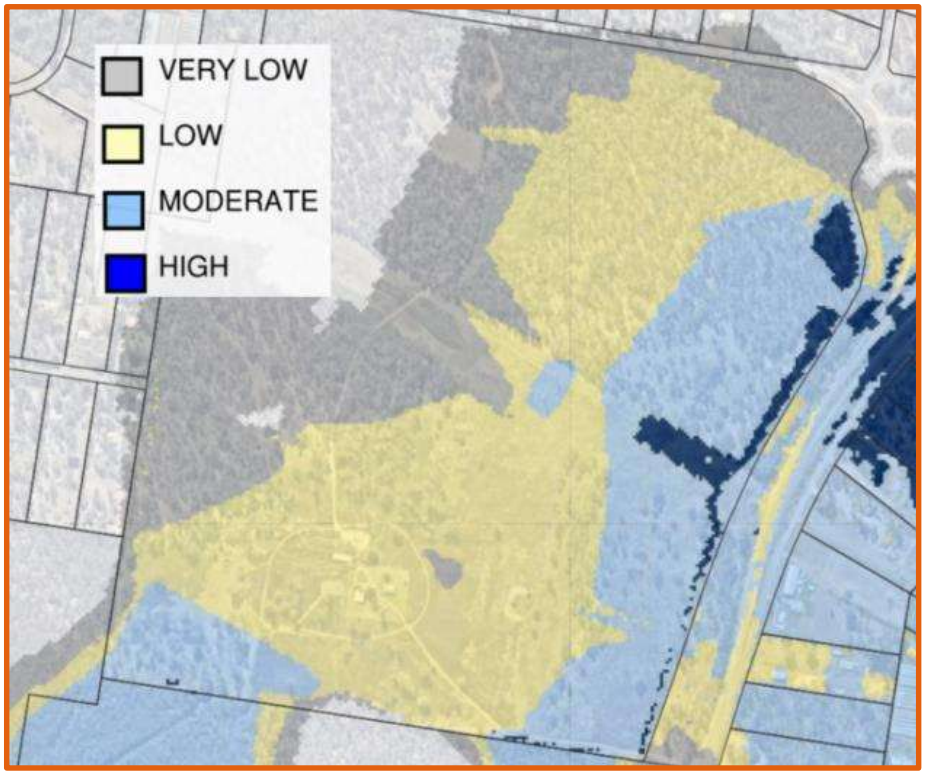

Figure 177 – Revised Hazard Mapping

This report is developed based upon Base Case approved BEW levels, (including adjoining development for sensitivity testing) and has made reasonable assumptions on future finished surface levels of particular land use development areas to allow compliance demonstration with provisions of OM-05 Flood Hazard Overlay Code. In the event that the estate and adjoining development or land use changes in any significant form which may modify the moderate flood risk area (for example lower development envelope finish surface level than purported zone flood planning level for the 0.5% AEP at 2100), this report **must** be updated to analyse and reflect the changes made.

Importantly, it is noted that with the revised large event inundation areas, completed development finish surface levels and purported associated revised flood risk mapping there remains a future requirement to undertake review and revision to LCC current flood risk categories for the site and adjoining areas.

Gary Ellis

Technical Director – Urban Development & Regeneration
E. | gary.ellis@arcadis.com
T. + 61 7 3337 0859 | M. + 61 4 18 171 290

Darlan Castro

Associate Technical Director – Urban Development & Regeneration
E. | darlan.castro@arcadis.com
T. + 61 7 5503 4822 | M. + 61 4 10 720 757