Peer Review of Flood Assessment for Club Punchbowl Planning Proposal

Prepared for Canterbury Bankstown Council

Reference no. 300204010 | 18 March 2024

Revision	Date	Description	Author	Quality Check	Independent Review
1	2024/02/18	for Client Review	BW	MG	MG
2	2024/02/18	Post-Council Review	BW	MG	MG
3					

Prepared by ______________________________

(signature)

Bedilu Wolelo

Reviewed by ______________________________

(signature)

Martin Griffin

Approved by ______________________________

(signature)

Martin Griffin

SYDNEY

Level 16, 207 Kent Street

Sydney NSW 2000

p +61 2 9493 9700 www.stantec.com

TABLE OF CONTENTS

TABLES

FIGURES

1 Introduction

Waldron Hills Projects Pty Ltd has engaged Hydracor Consultants (formerly Acor) to undertake flood study to support a planning proposal at Lot 7, 14, and 15 DP132440, Lot 6 DP5245, Lot D DP382527, Lot A DP378634, and Lots B, 2, 3 and 4 DP21524. Tudor Planning and Design has also provided additional information relating to further flood modelling conducted by Hydracor Consultants to support the proposal. Stantec was engaged by Canterbury Bankstown Council to undertake a peer review of the provided flooding information to be included in a report to the Canterbury Bankstown Local Planning Pannel (CBLPP).

The site is situated within the upper reaches of Salt Pan Creek which is a tributary of the Georges River. Existing Canterbury Bankstown Council flood studies have indicated that the site is affected by flooding during the 1% AEP and the Probable Maximum Flood (PMF) storm events.

In order to address Council's concerns this peer review has assessed the provided flood information for the development in relation to meeting the flooding requirements for planning proposals as outlined within the Ministerial Direction 4.1. This assessment is summarised in **Section 5**. Aside from assessing if the proposed development meets these flooding requirements, the peer review also considers if the provided flood information is adequate, identifying any shortcomings of the submissions, and recommending when these updates should be made.

It is noted that this peer review is a desktop review of flood-related reports, letters and emails submitted to Council by the proponent and their consultants. A review of the hydrology / hydraulic models has not been conducted to confirm the reported information. As noted above, this relatively high-level flood assessment is in keeping with the planning proposal phase of the development review. It is assumed that in the future, Council and other consent authorities will have the opportunity to review in further detail potential flood impacts and flood risk in later stages of the development process.

2 Background

2.1 Study Area

The project site covering properties located at Lot 7, 14, and 15 DP132440, Lot 6 DP5245, Lot D DP382527, Lot A DP378634, and Lots B, 2, 3 and 4 DP21524 is bound by Punchbowl Road in the East Canterbury Road in the South, private properties and a major drain in the west and private properties in the north. The project site is located within the Canterbury Bankstown Council Local Government Area (LGA) within the former Bankstown LGA. The southern section of the site is zoned B1 Neighbourhood Centre and the northern part is zoned R2 Low Density Residential. The proposal aims to amend the R2 site zoning to R4 High density residential. B1 Zone will be replaced with E1 Local Centre Zone as per the NSW State Government's 'Employment Land Use Zone Reforms'. The project site locality is shown in **Figure 2-1**.

Figure 2-1 The Site Location

2.2 Existing Site

As can be seen in **Figure** 2-1, the site contains the Club Punchbowl building within Lot 14 and 15, a large commercial / hospitality use building. The majority of the remaining existing site is hardstand carpark area. There is an existing open stormwater channel that runs along the north-west boundary of the site in a south direction.

GoogleEarth Streetview imagery shown in **Figure 2-2 and Figure 2-3** from Punchbowl Road looking in both directions shows a low point in the roadway near the site entrance. The existing Club Punchbowl building can be seen in the background of **Figure 2-3.** Both figures show the large, flat hardstand area within the site and an existing brick fence running around the perimeter of the site with opening located only at the entry to the site, with this fence continues along the Canterbury Road frontage as well.

Figure 2-2 Site Entrance from Punchbowl Road looking North (Source: GoogleEarth)

Figure 2-3 Site Including the Club Punchbowl Building from Punchbowl Road looking southwest (Source: GoogleEarth)

A review of site Digital Elevation Model (DEM) obtained from ELVIS website indicates that the site elevation varied between 3.5m AHD at a drain located at the western boundary of the site to 8.35m AHD at the northern boundary. The site grades towards the middle from the north and the south creating a 'defined' local overland flow path. The site elevation reduces from east to west along the mid-section. The DEM indicates that there is a local sag on Punchbowl Road at the eastern boundary of the property. The sag area at Punchbowl Road connects with the 'defined' overland flow path inside the property. The review of the DEM indicates that the elevation of the footpath resembles the elevation of a local crest located south of the sag area on Punchbowl Road.

East of the site, review of DEM and areal imagery indicates that there is a formed channel that runs towards an underground piped drainage system that crosses Punchbowl Road at the sag area and traverses the subject site. In addition, Salt Pan Creek drain runs along the north-west edge of the property, with these two flowpaths converging within the subject site, before continuing south through open channel and under Canterbury Road west of the site. Refer to site DEM shown in **Figure 2-4**.

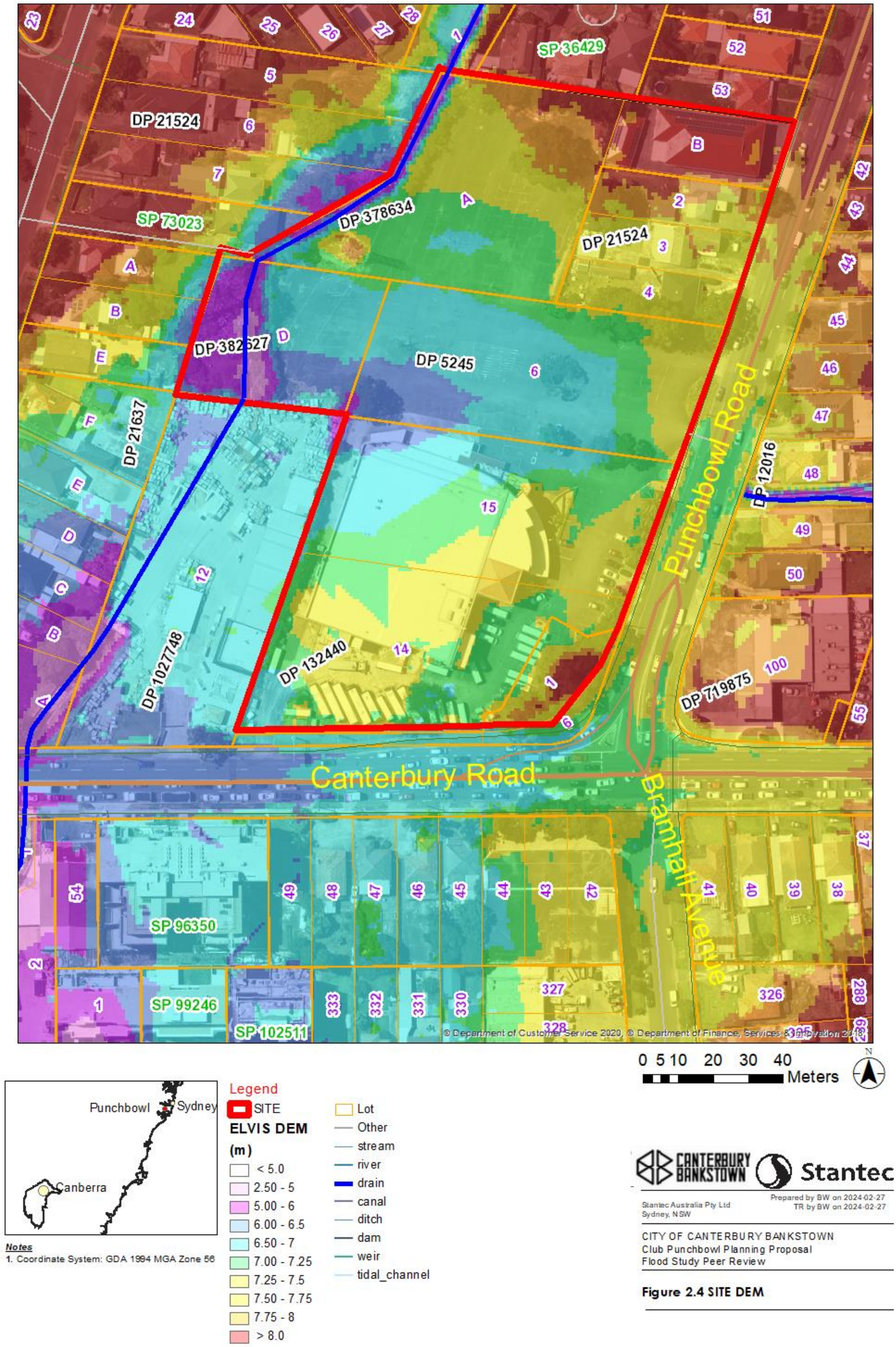


Figure 2-4 Locality Topography

2.3 Proposed Development

A review of the latest available development plans from 2023 and 2024 has been conducted with figure excerpts from the site layout (**Figure 2-5**), proposed building uses (**Figure 2-6**) and landcape plans (**Figure 2-7**) shown below. Waldron Hills Projects aims to redevelop the site to provide:

> Multi-dwelling residential housing along the northern boundary of the site

> Three residential flat buildings in the centre of the site and

> For the Canterbury Road frontage, a Club commercial building on the south side of the site near the existing club building footprint, with residential apartments on the levels above. For the Punchbowl Road frontage in the south-east corner, a second building with retail / commercial ground floor and residential apartments above.

> A local road starting from Punchbowl Road near the existing site entrance, continuing west, then circling to the north around the proposed residential flat buildings.

> Two basement carparks, one to be accessed on the south-west side of the site, and one on the west side of the residential flat buildings. The proposed basement entry locations are shown by the arrows in

The proposed development layout and model imagery is shown in **Figure 2-7** respectively. It is noted that the development layout has altered from the original Flood Investigation report from 2022, with changes in the building footprints, particularly the removal of a proposed building footprint south of the proposed central site road.

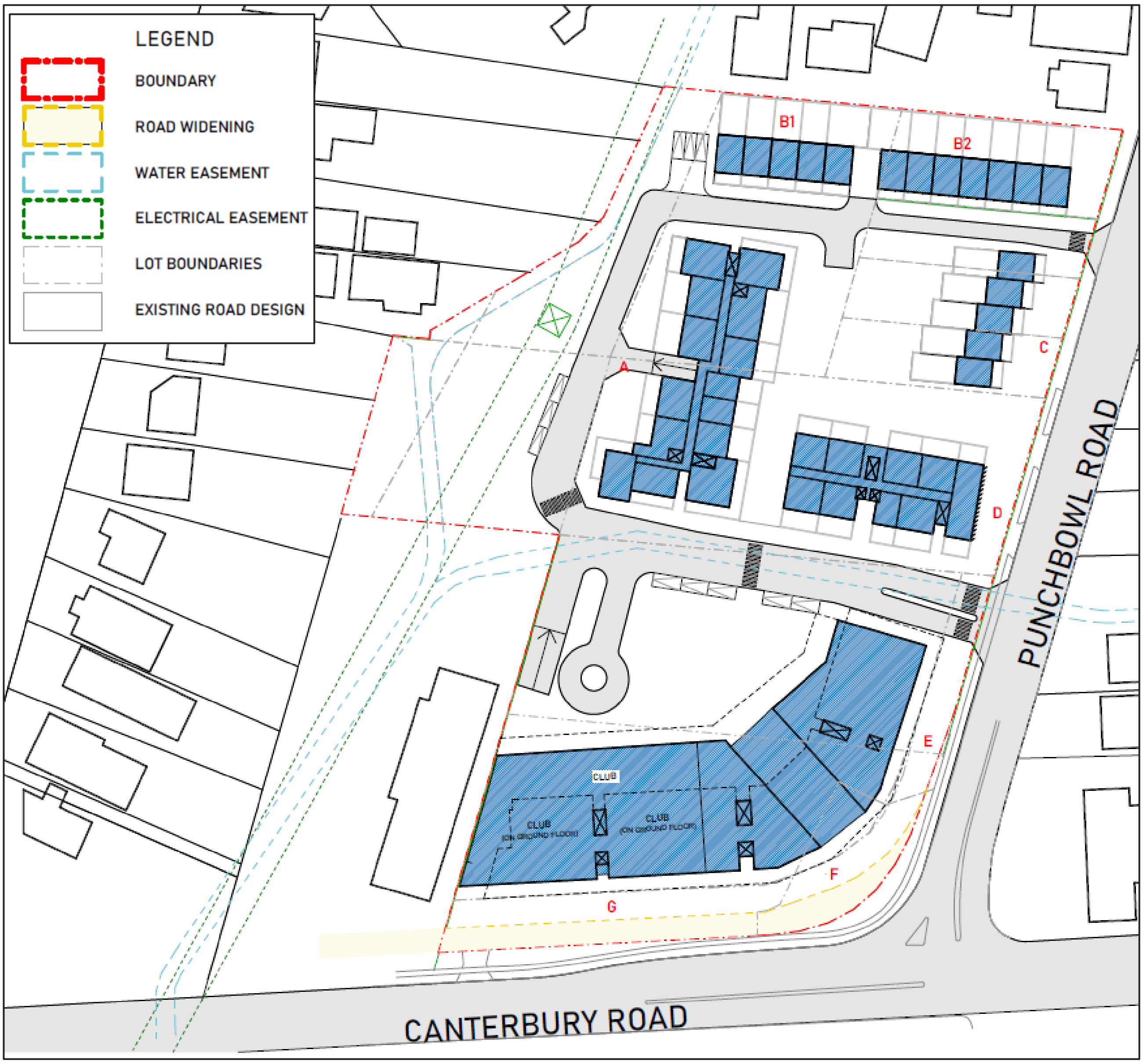


Figure 2-5 Layout of Proposed Development (Source CMT Architects, 12/10/2023)

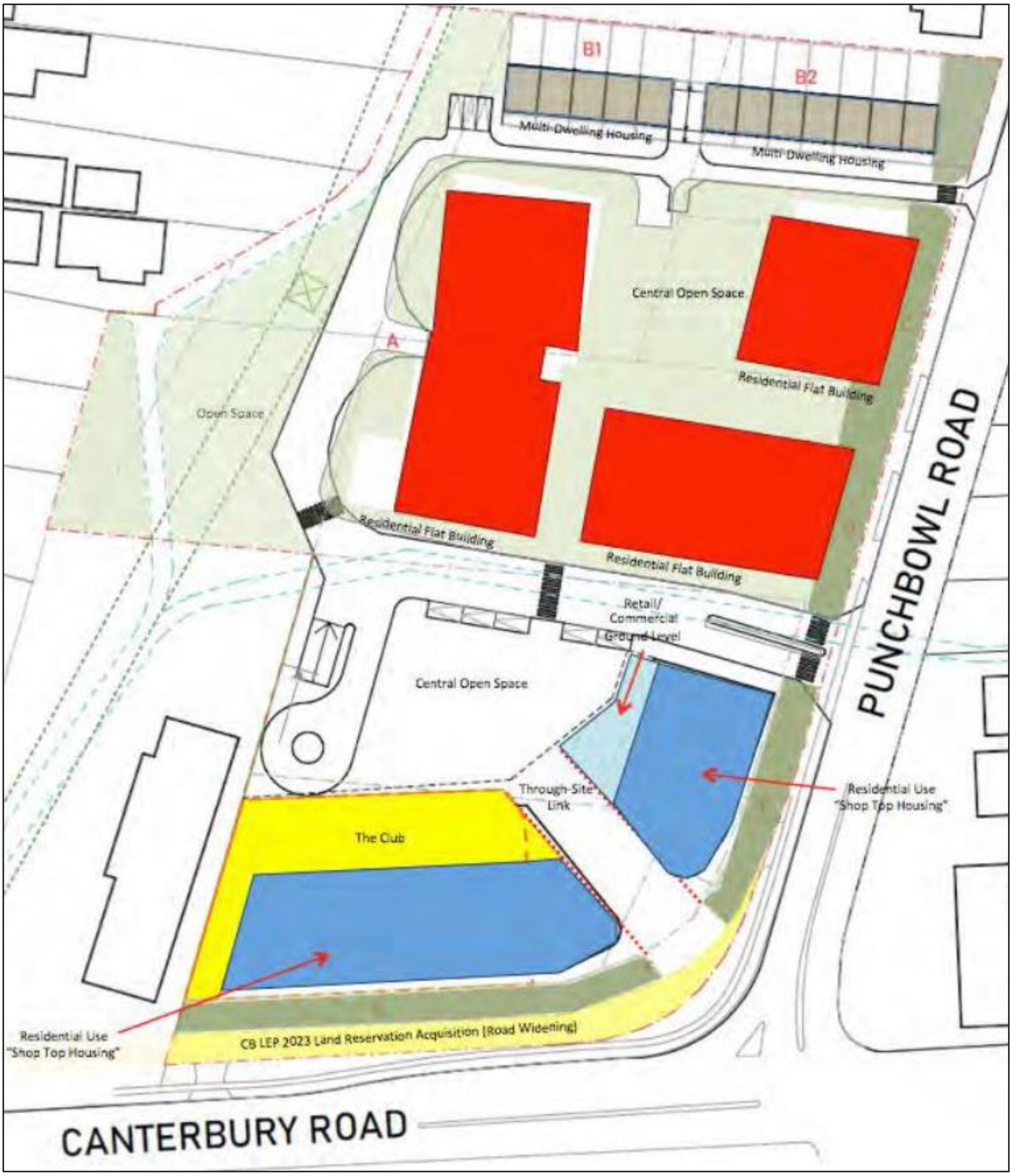


Figure 2-6 Proposed Use for the Development (Source Hydracor Consultants, 4/1/2024)

Figure 2-7 Proposed Landscape Masterplan for the Subject Site (Source CMT Architects, 09/11/2023)

3 Relevant References

3.1 Previous Council Flood Studies and Plans

Previous flood studies which are covering the Site and applicable to this assessment include:

> Salt Pan Creek Catchments Floodplain Risk Management Study and Plan (Bewsher, 2013) – This study was prepared for the portion of Salt Pan Creek floodplain that lies within the former Bankstown LGA which includes the subject site.

> Final Overland Flow Study: Canterbury LGA Salt Pan Creek Catchment (Cardno, 2016) – The rainfall on grid model captures the flood characteristics in the vicinity of the work adequately is appropriate to be adopted to inform the proposal.

These Council commissioned studies and plans are discussed briefly in the following sections. As a result of the subject site being located adjacent to the former LGA boundary, that in both studies the model boundary is close to the subject site, which is not an ideal situation as it means that any hydraulic modelling is more sensitive to assumptions of model boundary conditions given the proximity.

3.1.1 Salt Pan Creek Catchments FRMS&P (Bewsher, 2013)

The FRMS&P was prepared for former Bankstown Council based on flood modelling undertaken within the *Salt Pan Creek Catchments Flood Study* (BMT-WBM, 2009). The model boundary in this study, which broadly reflects the former LGA boundary, runs along both Punchbowl Road and Canterbury Road so the model is cut off immediately east and south of the subject site. In this model there is a model inflow location on Punchbowl Road to represent the upstream catchment to the east. Along Canterbury Road there is a downstream boundary without a discharge boundary, therefore there is likely a 'glass wall' effect in the modelling which diverts runoff from the model along Canterbury Road, rather than south through the open channel that runs from the subject site under Canterbury Road. The flood risk precincts from this study, including the model boundary shown in red outline is shown in **Figure 3-1**.

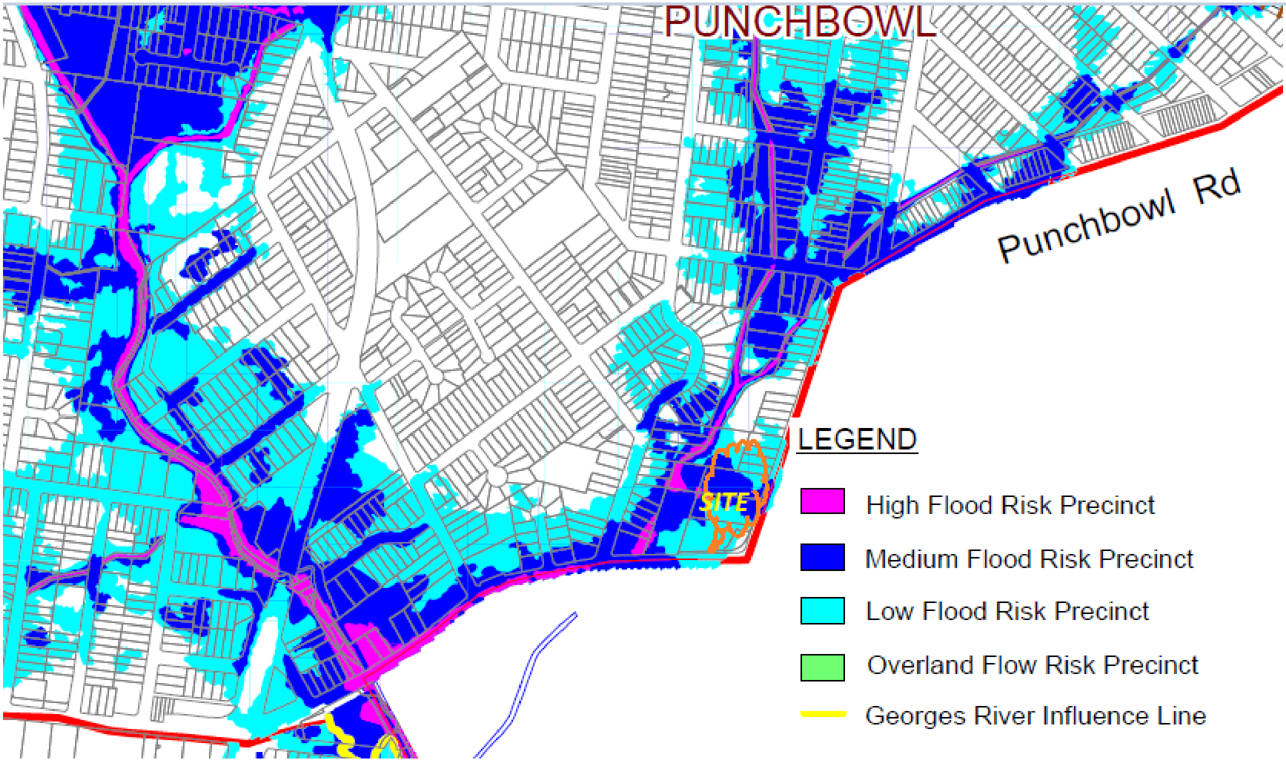


Figure 3-1 Flood Risk Precinct Mapping from the Saltpan Creek FRMS&P for Former Bankstown LGA (Source: Bewsher, 2013)

As can be seen in the figure above, the subject site is affected partially by medium flood risk, meaning the 1% AEP flood event, through the central part of the site from the eastern flowpath and for the north-west portion of the site. Some of the north-west portion of the site, specifically the open channel is also affected by high risk precinct, meaning high hazard conditions in the 1% AEP. The majority of the site is affected low risk precinct, meaning flooded in the PMF event.

3.1.2 Overland Flow Study Canterbury LGA Salt Pan Creek Catchment (Stantec, 2016)

Stantec (formerly Cardno) in 2016 prepared the local overland flow study for the former Canterbury LGA portion of Salt Pan Creek which did not cover the subject site in its study area, however the subject site was included within the hydraulic model extents. Flood function mapping for the 1% AEP event and pipe capacity assessment outcomes from this study are shown in **Figure 3-2 and Figure 3-3** respectively.

Figure 3-2 1% AEP Flood Function Mapping for the Subject Site from the Salt Pan Creek Overland Flow Flood Study for Former Canterbury LGA (Source: Stantec, 2016)

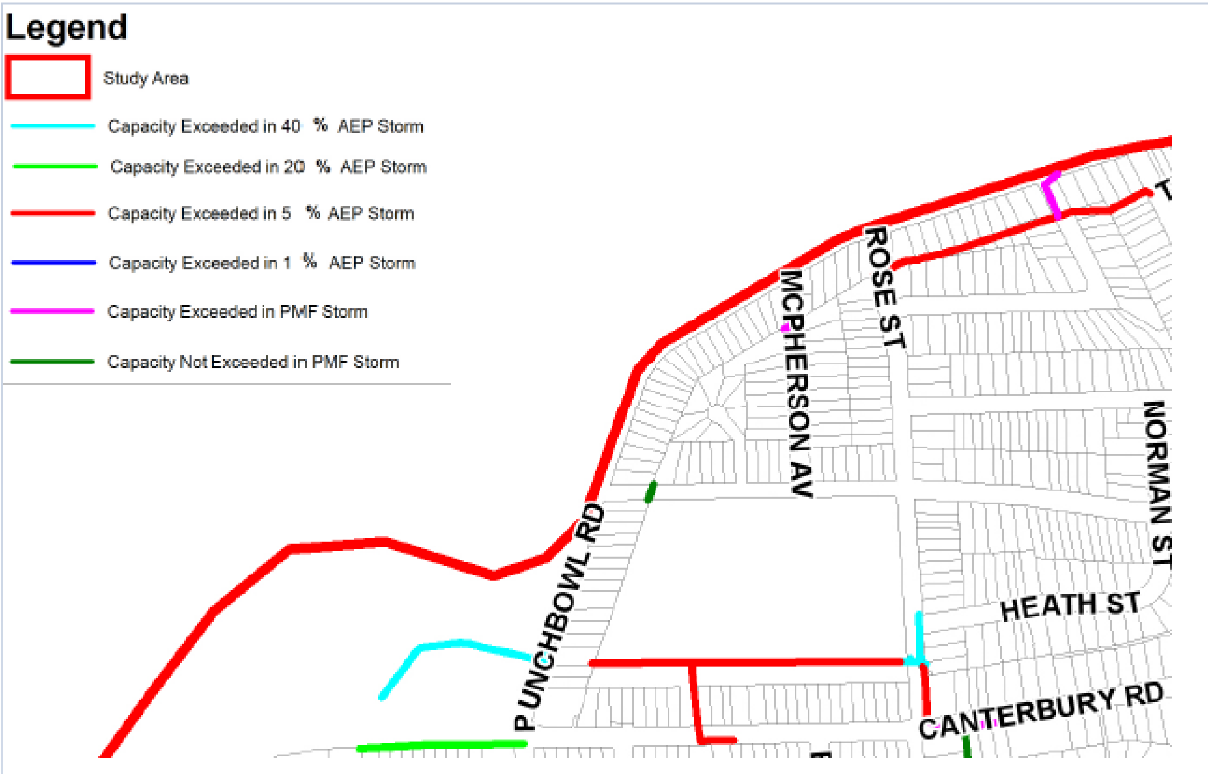


Figure 3-3 Existing Piped Drainage Capacity Assessment from Salt Pan Creek Overland Flow Flood Study for Former Canterbury LGA (Source: Stantec, 2016)

For this 2016 study, the eastern upstream catchment was fully modelled, while the model boundary for the northern flowpath was modelled as an inflow hydrograph just north of the subject site. As can be seen in **Figure 3-3** has determined that the existing piped drainage system that drains the drain located east of Punchbowl Road is sufficient only to convey runoff generated from less than a 40% AEP storm event, which is supported by the modelled flooding in the subject site in the 1% AEP event in **Figure 3-2**.

Comparing the relative flood affectation of the subject site in the 1% AEP event, the 2016 overland flow study modelling shows more widespread flooding of the site than in the 2013 FRMS&P, though both show relatively similar flooding of the site.

3.2 Guidelines and Legislation

The following guidelines and planning controls have been considered in preparing this report:

> Local Planning directions 2022, NSW Department of Planning and Environment;

> Flood Impact and Risk assessment Flood Risk Management Guideline LU01 (FIRA) (2023: NSW Department of Planning and Environment, and

> 2023 Flood Risk Management Manual

3.2.1 Planning Proposal Requirements

The Ministerial Direction 4.1 applies when an authority prepares a planning proposal that creates, removes or alters a zone or a provision that affects flood prone land. The key requirements of the local planning direction for planning proposals include:

1. A planning proposal must include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy, the principles of the Floodplain Development Manual 2005, the Considering flooding in land use planning guideline 2021 (all now superseded by FRM Manual 2023), and any adopted flood study and/or floodplain risk management plan adopted by the relevant council.
2. A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Environmental Protection Zones to a Residential, Business, Industrial or Special Purpose Zones.
3. A planning proposal must not contain provisions that apply to the flood planning area which:
    a. permit development in floodway areas,
    b. permit development that will result in significant flood impacts to other properties,
    c. permit development for the purposes of residential accommodation in high hazard areas,
    d. permit a significant increase in the development and/or dwelling density of that land,
    e. 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,
    f. permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require consent,
    g. 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, or
    h. permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.
4. A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which include items a), b), d), e), f) from item 3 above. An additional requirement for this area is if a planning proposal is likely to affect the safe occupation of and efficient evacuation of the lot.

For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.

3.2.2 Other Guidelines and References

In addition to the requirements of Ministerial Direction 4.1, this peer review makes reference to several other flood-related guidelines and regulations outlined in the following documents:

> NSW Flood Risk Management (FRM) Manual and Toolkits (2023): The 2023 FRM Manual replaces the Floodplain Development Manual (FDM) 2005, the 2022 Draft FRM Manual and Toolkits and a number of previous technical guides. The manual provides advice to local councils on the management of flood risk in their local government areas through the flood risk management framework and flood risk management process. Specifically, as it relates to this peer review, the following guideline document is relevant:

  - Flood Impact and Risk Assessment (FIRA) FRM Guideline LU01 2023: This guideline provides advice on the preparation of a FIRA. The aim of a FIRA is to support a development proposal which may alter flood behaviour to identify and analyse the impacts of the proposed development on the flood risk to the existing community, the impacts and risks of flooding on the development and its users, and how these impacts can be managed to minimise the growth in risk to the community due to the development.

> NSW Draft Shelter-in-Place Guidelines (2022) is about using shelter in place as one part of helping ensure people are safe during floods. The guideline provides draft requirements for Shelter-in-Place and where it is appropriate.

> Canterbury Bankstown Development Control Plan (DCP) (2023): Section 2.2 of the DCP (Flood Risk Management) outlines specific planning and development guidelines that must be followed within the local government area. These guidelines are crucial in ensuring that developments adhere to floodplain management requirements and mitigations. However, these controls are applicable in Council based assessments for Development Applications (DAs), where this planning proposal is at an earlier and more high-level stage of the development process. Nevertheless, consideration of these DCP controls has been considered with a view to the potential compatibility of the development to Council's requirements. Further analysis in assessing against these controls will be expanded upon in a potential future DA for the site.

4 Peer Review of the Flood Assessment

The peer review of the flood assessment has been summarised in the following sub-headings with a summary of the assessment outcomes, followed by a Stantec peer review comment and recommendation included in blue for each topic of review.

4.1 Reporting

4.1.1 Summary of Submitted Materials

The following flood-related reports, letters and emails submitted by the proponent and their consultants were considered as part of this peer review (listed in chronological order):

1. 2 June 2022 – Hydracor Consultants – Flood Investigation Report – Version 2.0
2. 26 April 2023 – Hydracor Consultants - Letter to Council – Response to Council RFI
3. 26 September 2023 – Hydracor Consultants - Letter to Council – Response to Council RFI
4. 9 November 2023 – Hydracor Consultants – Letter to Council – Response to Council RFI with 2 accompanying flood maps
5. 4 January 2024 – Hydracor Consultants – Flood Emergency Response Plan
6. 24 January 2024 - Tudor Planning and Design - Letter to Council – Planning Proposal at 913–925 Punchbowl Road and 21 Canterbury Road, Punchbowl (PP-2021-4589)
7. 12 March 2024 – Hydracor Consultants – Email to Council / Stantec with water level difference figures for different model versions
8. 14 March 2024 - Hydracor Consultants – Email to Council / Stantec with flood function mapping and PMF timing simulation
9. 15 March 2024 - Hydracor Consultants – Email to Council / Stantec with responses to items 2 and 4
10. 16 March 2024 - Hydracor Consultants – Email to Council / Stantec with updated post-development flood map set
11. 18 March 2024 - Hydracor Consultants – Email to Stantec with updated flood impact map

A summary of the key outcomes from the submissions are summarised in the following sections, with references to the above documents based on the above numbering. Stantec conducted an initial review of available information, in response to these initial comments Council issued two sets of clarifications via email to the proponent and/or their consultant, one dated 7 March 2024, and the other email dated 15 March 2024.

4.1.2 Peer Review Comments

As shown above, the flooding assessment has been summarised across many reports, letters and emails over a nearly 2 year span. Reviewing this information was complicated and confusing, with analysis and outcomes in some situations changing from the original report to the last email.

Recommendation:

Stantec recommends that the final flooding analysis and conclusions from all of the above reports be condensed into a single updated report, a Final Flood Investigation Report which includes:

- Summary chapter of model update sensitivity outcomes summarised in Ref 6 and water level difference figures from Ref 7 included in the report.
- Add discussion of PMF set-up and results into the report
- Add roughness map to report, add clarification of approach to post-development modelling, add discussion of PMF timing and suitability for Shelter-in-Place based on Draft Guideline,
- Flood Emergency Response Plan included as an appendix
- Removal of all superseded information including older model results.

This updated Flood Investigation Report should be submitted to Council prior to public exhibition of the planning proposal.

To limit any confusion for the CBLPP, this peer review report attempts to exclude all superseded or conflicting information from the above references in the following peer review summary, assessing only the relevant information from the 11 reference documents.

4.2 Flood Model Set-up

4.2.1 Adopted Model Methodology

Hydracor adopted the TUFLOW model prepared as part of the *Salt Pan Creek Catchments Flood Study* (BMT-WBM, 2009) as the basis for the flood assessment for the subject site. The TUFLOW model layout figure has been extracted from Ref 1 and reproduced in **Figure 4-2**. As stated in Ref 1, the following model methodology was applied:

> TUFLOW engine was updated from the original Council model 2009 version to 2020 version

> The eastern (Punchbowl Road) and southern (Canterbury Road) model boundaries for the TUFLOW model were retained from the original Council model. The western model boundary was updated and truncated from the Council model as shown in **Figure 4-2**, with stage discharge outlet added based on water level gradients from the Council model results.

> Downstream model boundaries (both 1D and 2D) were retained as a constant water level of 4.01m AHD for the 1% AEP event.

> For hydrology, a direct rainfall approach (rainfall-on-grid) approach was retained in the model, for the eastern flowpath near the subject site a single inflow hydrograph at Punchbowl Road was retained from the original model developed for Council. ARR87 design rainfall with 2 hour duration was retained as critical for the 1% AEP and PMF events, similar to the Council study.

> Initially modelling was for the 1% AEP only (Ref 1), however in response to a Council RFI, PMF modelling was subsequently conducted (Ref 2).

> 5m x 5m grid cell size was retained from the Council model, with calculations in TUFLOW at all mid-points meaning calculations would be spaced every 2.5 metres.

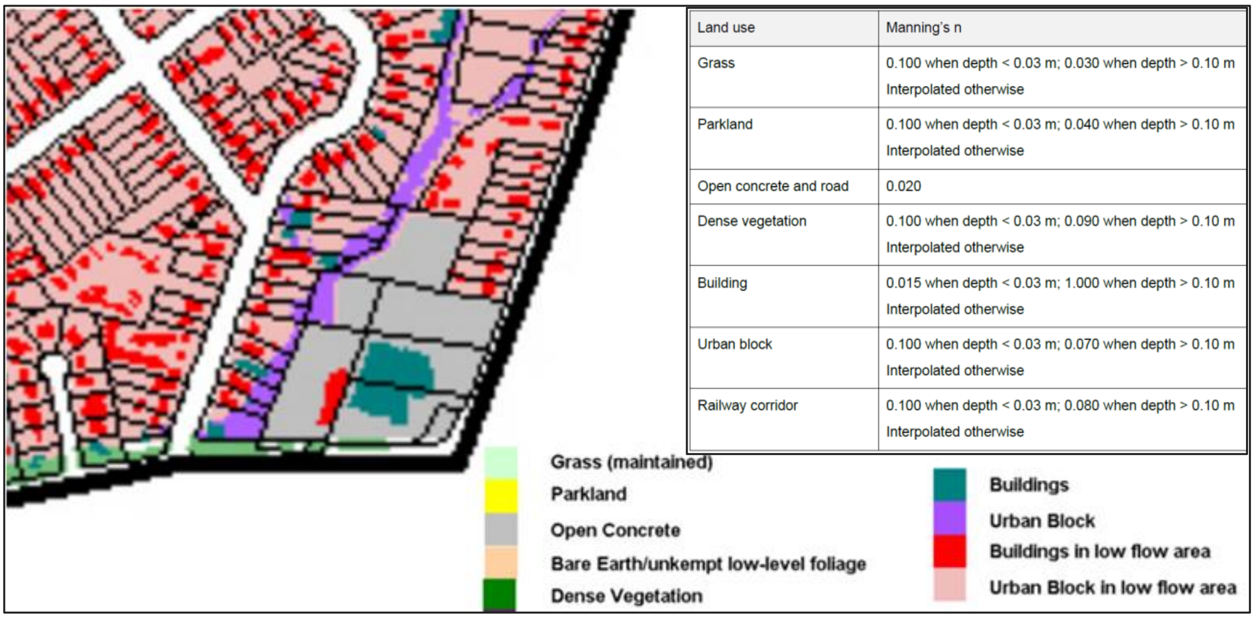
> Hydraulic roughness was retained from the Council model, with the roughness mapping for the subject site and surrounds extracted from the 2009 Flood Study (BMT-WBM, 2009) shown in **Figure 4-1**. Though not originally reported, confirmation was provided within Ref 9 from Hydracor Consultants that this roughness mapping was not altered aside from some updated building footprints around the site.

> As stated within Ref 1, model topography was updated around the subject site to include survey and additional topography information.

> The approach to modelling buildings was updated, with the Council model originally adopting higher roughness. As stated in Ref 1, buildings around the subject site were modelled elevated 0.5 metres higher than surrounding ground.

> Modelling of pit and pipe, open channels, culverts and bridges in 1D domain was retained from the Council model. A 50% blockage scenario was retained as the design case, with a 0% blockage scenario considered as sensitivity.

> The model was validated to the Council model using peak flow comparisons at several locations.



Land use	Manning's n
Grass	0.100 when depth < 0.03 m; 0.030 when depth > 0.10 m Interpolated otherwise
Parkland	0.100 when depth < 0.03 m; 0.040 when depth > 0.10 m Interpolated otherwise
Open concrete and road	0.020
Dense vegetation	0.100 when depth < 0.03 m; 0.090 when depth > 0.10 m Interpolated otherwise
Building	0.015 when depth < 0.03 m; 1.000 when depth > 0.10 m Interpolated otherwise
Urban block	0.100 when depth < 0.03 m; 0.070 when depth > 0.10 m Interpolated otherwise
Railway corridor	0.100 when depth < 0.03 m; 0.080 when depth > 0.10 m Interpolated otherwise

Figure 4-1 TUFLOW Roughness Mapping for the Subject Site and Surrounds (Source: BMT-WBM, 2009)

Figure 4-2 TUFLOW Model Set-up for the Flood Assessment of the Subject Site (Source: Ref 1)

4.2.2 Post-development Modelling

Compared to the existing scenario modelling summarised in the previous section, the following changes were made to assess post-development flooding (as confirmed by Hydracor Consultants in Ref 9):

- No changes were made to the existing model DEM, the assumption is that:
  - Post-development design surfaces were not available at planning proposal phase
  - Post-development design surface will be similar to existing surface with relatively minor changes in grading assumed.
- No changes were made to the existing roughness modelling. The majority of the site was therefore classed as 'open concrete' as shown in **Figure 4-1**, with a low roughness value (n = 0.02). The assumption confirmed with Hydracor is that the central access road conveying much of the flow will have a similarly low roughness value to existing.
- The building layouts have been changed from existing to remove the existing building from elevated terrain, with the new building polygons added. Included within the latest version of the post-development modelling (summarised in Ref 10 figures) is the latest building layout as well as a blocked area on the western side of the site to represent the elevated basement carpark entry at this location. The modelled post-development building footprints from the latest version of the model are shown in **Figure 4-3**.

4.2.3 Model Update Sensitivity Check

In response to a Council RFI, as summarised in Ref 6 the model set-up was updated from that described in **Section16 4.2.1** to account for the following improvements to the model detail:

- Reduce model grid size from 5-metre to 2-metre to provide additional detail in accordance with Council's recent modelling approach to other study areas;
- Extend the upstream model boundary to the east upstream of Punchbowl Road to allow runoff to be diverted from this upstream catchment through the area rather than being discharged onto Punchbowl Road directly upstream of the site.

This 'revised' model set-up was simulated for the post-development condition only for the 1% AEP and PMF events. A comparison of peak water level differences from the revised model less the original are included in **Figure 4-3 and Figure 4-4** for the 1% AEP and PMF events respectively (extracted from figures from Ref 7). The comparison of water level difference results between the revised and original post-development models showed that:

- In the 1% AEP the water levels are within +/- 0.1 metres throughout the study area with the exception of Canterbury Road where a small section has localised increases of up to 0.32 metres. Through the proposed central road of the post-development site there are water level reductions of up to 0.12 metres.
- In the PMF the water levels in Punchbowl Road and within the subject site are reduced by up to 0.32 metres. Downstream on Canterbury Road the water levels are increased by between 0.26 – 0.57 metres.

These water level differences between the two model versions are likely a result of the extended eastern model boundary allowing more flows to be diverted from Punchbowl Road south to Canterbury Road and away from the subject site. Where for the original model, the flows are input into Punchbowl Road and diverted more directly into the site. This would explain the reduced flooding in the subject site and increased flooding on Canterbury Road.

As stated in Ref 6, the original model set-up was retained as the model was not found to be sensitive to the model improvements with the following justification:

- The additional flood modelling provided at Council's request did not significantly alter PMF levels or hazard within the site. Subsequently the floor levels determined from the original assessment remain relevant to the Planning Proposal
- Hazards within the site are not significantly impacted by the revised modeling.

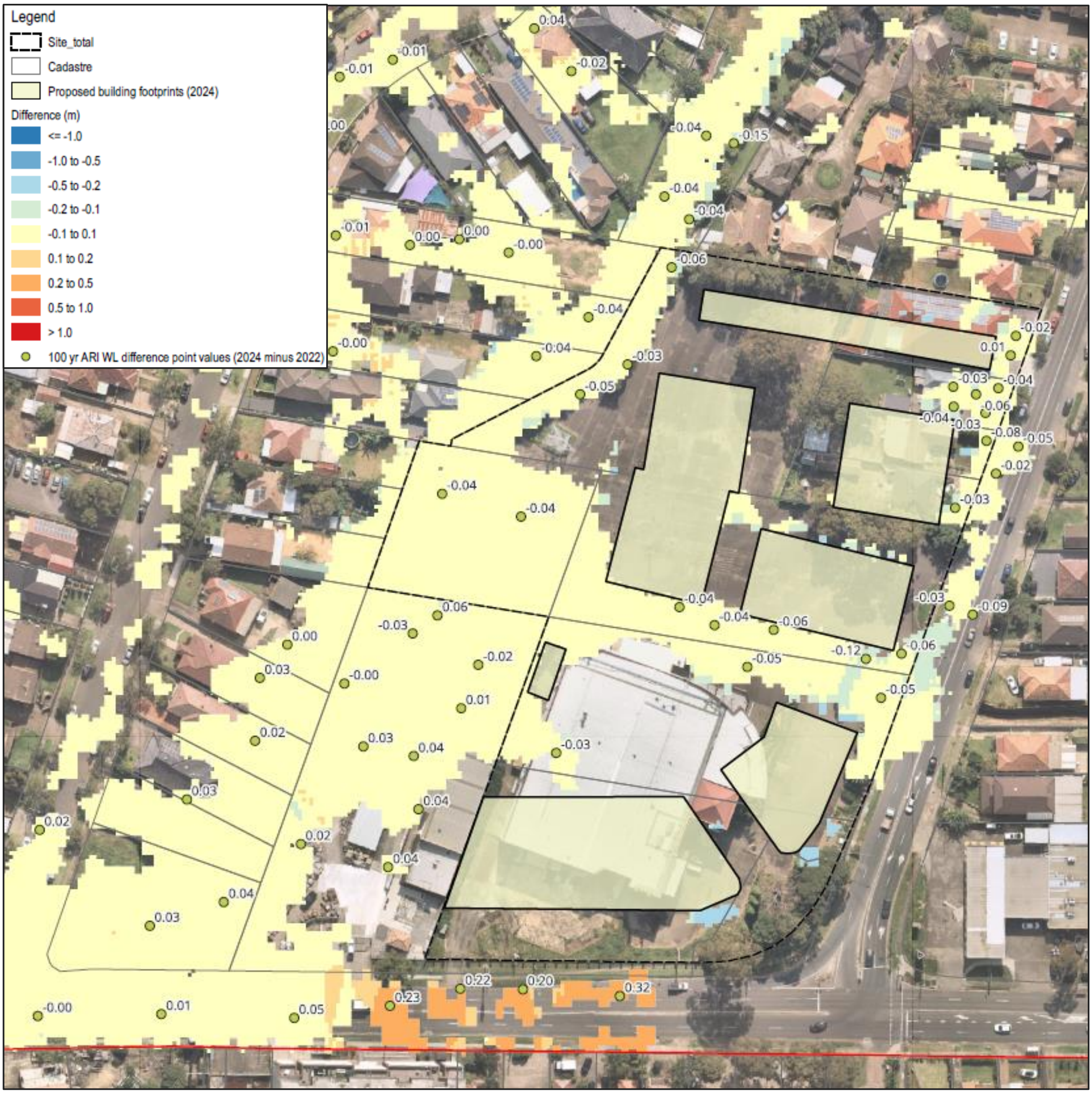


Figure 4-3 Water Level Differences – Sensitivity - Revised Less Original Model - 1% AEP for Post-development Scenario

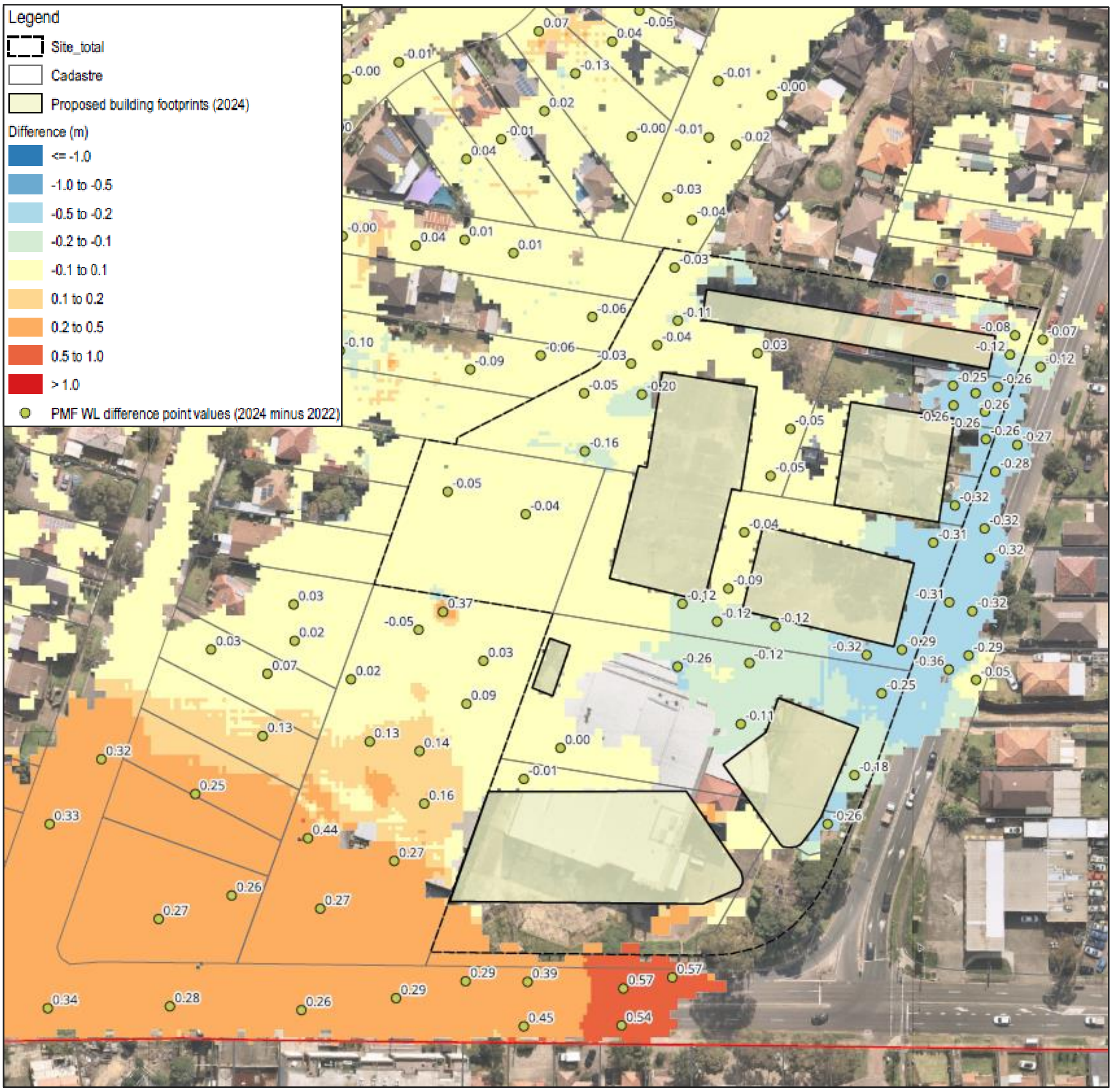


Figure 4-4 Pedestrian and Vehicular Connectivity (Captured from CMT Architects)

4.2.4 Peer Review Comments

Generally, Stantec would concur with noted comments from previous Council RFI's that both the upstream (eastern) and downstream (southern) model boundaries are too close to the subject site. This would normally expose the assessment to too much uncertainty regarding appropriate routing of modelled flows and impacts.

However in this instance the model set-up is found to be appropriate for the purposes of a planning proposal flood assessment for the following reasons:

> Validation was conducted to the Council Flood Study with respect to peak flows for the existing condition (Ref 1). Additional validation of the existing scenario result was conducted by comparing flood extents for to the 2009 Council Flood Study (BMT-WBM) and the 2016 Overland Flow Flood Study (Stantec, 2016). Additional validation in final reporting would be to prepare peak water level difference figures between the adopted model and Council's flood study would be advisable.

> The reported flood impacts of the post-development compared to existing scenarios are contained within the subject site, and there are no impacts up against the upstream or downstream model boundaries which would indicate that the model boundaries needed to be extended to encompass all impacts of the development.

- Hydracor conducted model updates as requested by Council and the model was not found to be sensitive to reduction in model grid cell size and upstream model boundary location in the 1% AEP.
- In addition, this sensitivity testing of model updates found that the original model provided higher flood levels in the 1% AEP and PMF events when compared to the revised model. This is due to additional flows being forced through the subject site in the original model from Punchbowl Road. Therefore the more conservative approach is to retain the original model which has more flood affectation of the site.
- The approach to post-development modelling is retain existing roughness and terrain, only changing building footprints. This is a high level assessment of flood impacts, which will require additional detail in modelling and design in later development stages such as the DA stage. However for the purposes of a planning proposal flood assessment, this level of detail in modelling of a flood impact assessment is in keeping with the intent of the Ministerial Direction 4.1 requirements.

Recommendation:

The current modelling methodology should be considered for further refinement in later development stages. This may include:

- Extending model boundary to the east (upstream) and to the south (downstream) to more accurately represent flow routing within the site and its surrounds.
- Fully block buildings from the model rather than raised 0.5 metres only (as noted within a previous RFI from Council discussed in Ref 4)
- Confirming if upstream flows to the east are double counted within the current model set-up.
- Assessing through a sensitivity model the impacts of including the brick wall around the perimeter of the site in the existing case either as a strip of high roughness or as a 2D terrain modification.
- As per the FIRA requirements, consideration of a climate change scenario in the 1% AEP. Currently Council do not adopt climate change in their flood planning event, however this should be confirmed with Council to be suitable as only a sensitivity model at the time of modelling.
- More detailed modelling of post-development conditions including adopting design surfaces and roughness to match proposed land use as well as any updated building footprints.

The current assessment is considered equivalent to a ‘simple’ Flood Impact and Risk Assessment (FIRA) as per FRM Guideline LU01. Given the high-level nature of the planning proposal phase, this level of assessment is considered suitable. In later stages considerations should be given to the above suggested refinements to develop the equivalent of the ‘detailed’ FIRA, with these requirements specified in Section of the FRM Guide LU01. No further action is recommended as it relates to flood model set-up as part of the planning proposal submission to Council.

4.3 Flood Model Results

4.3.1 Flood Impacts of Proposed Development

The flood impacts of the proposed development for the 1% AEP event are shown in **Figure 4-5** (extracted from Ref 11). There are negligible flood impacts outside of the subject site, with localised water level increases within the site.

While as noted in the previous section, the modelling approach to post-development conditions is still very high-level, these initial model results suggest that flood impacts should not be a major concern for the proposed development as long as the proposed landform changes are not too significant from existing.

The likely reason the flood impacts are only minor for the proposed development is that the proposed site road has been aligned with the existing flowpath from Punchbowl Road through the middle of the site. The preservation of this flowpath without building blockage will be critical to managing potential impacts.

Figure 4-5 Flood Impacts - Post-Development Less Existing – 1% AEP Event

4.3.2 Provisional Hazard

The provisional flood hazard of the proposed development for the 1% event is shown in **Figure 4-6** (extracted from Ref 10). The results show that the majority of the site is classed as low hazard in a 1% AEP event. Within the proposed road reserve through the centre of the site there is some intermediate hazard affectation, with isolated sections of high hazard affectation on the central-western side of the site.

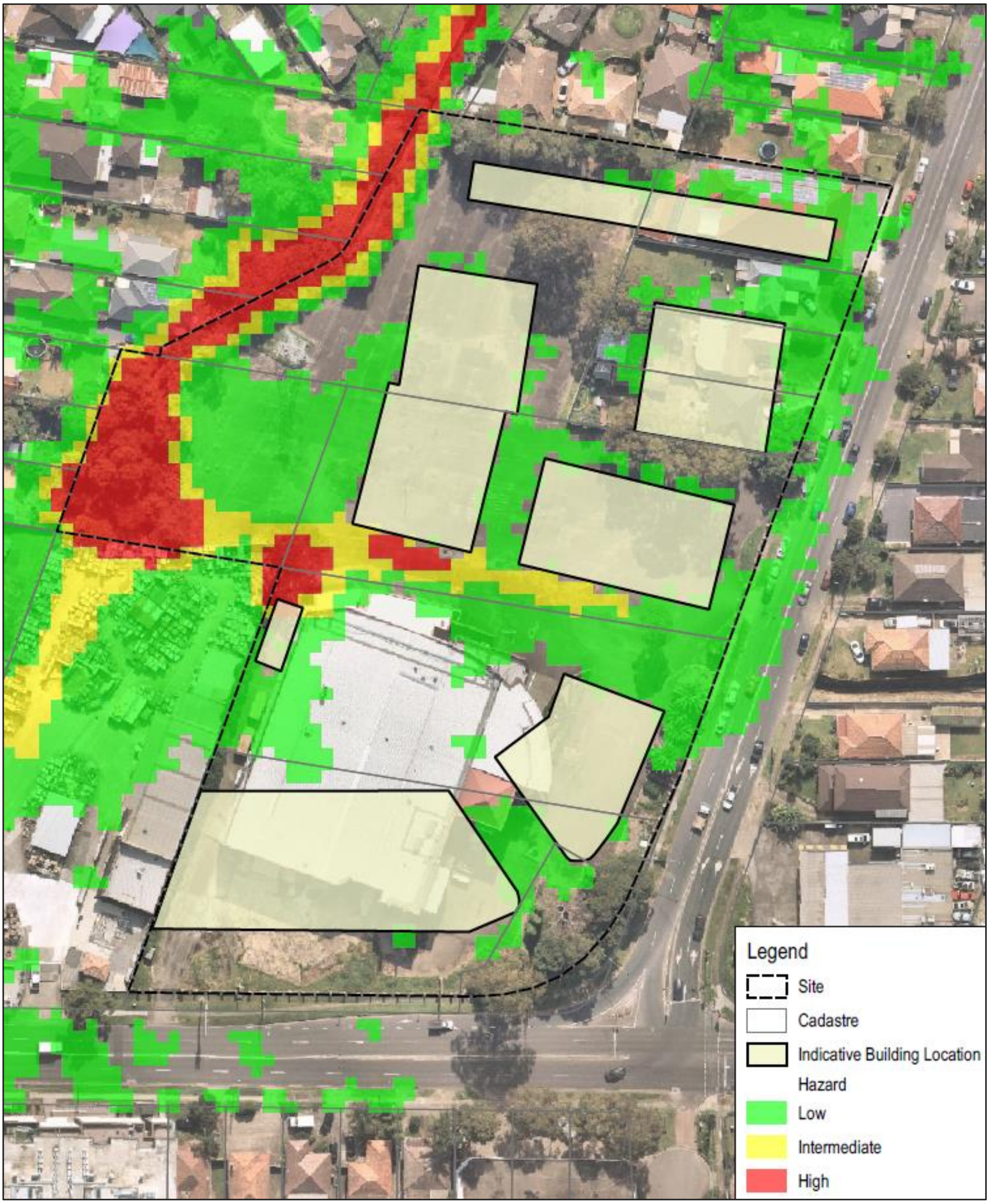


Figure 4-6 Flood Provisional Hazard Categories – Post-development 1% AEP Event

4.3.3 H1-H6 Flood Hazard

The H1-H6 flood hazard of the proposed development for the 1% AEP and PMF events are shown in **Figure 4-7** (extracted from Ref 10) and **Figure 4-8** (extracted from Ref 4) respectively.

The H1-H6 hazard maps show that in the 1% AEP there is H3 hazard within the central road reserve with isolated areas of up to H5 hazard near Building A. However it is assumed this isolated section of high hazard can be suitably addressed in civil design of the site during later development stages.

In the PMF event the central road corridor is H5 hazard along its entire length making it not a suitable flowpath. As noted above, there are some PMF H5 hazard areas up against proposed buildings, however a civil design could reasonably divert flooding away from these buildings to be resolved in future development stages.

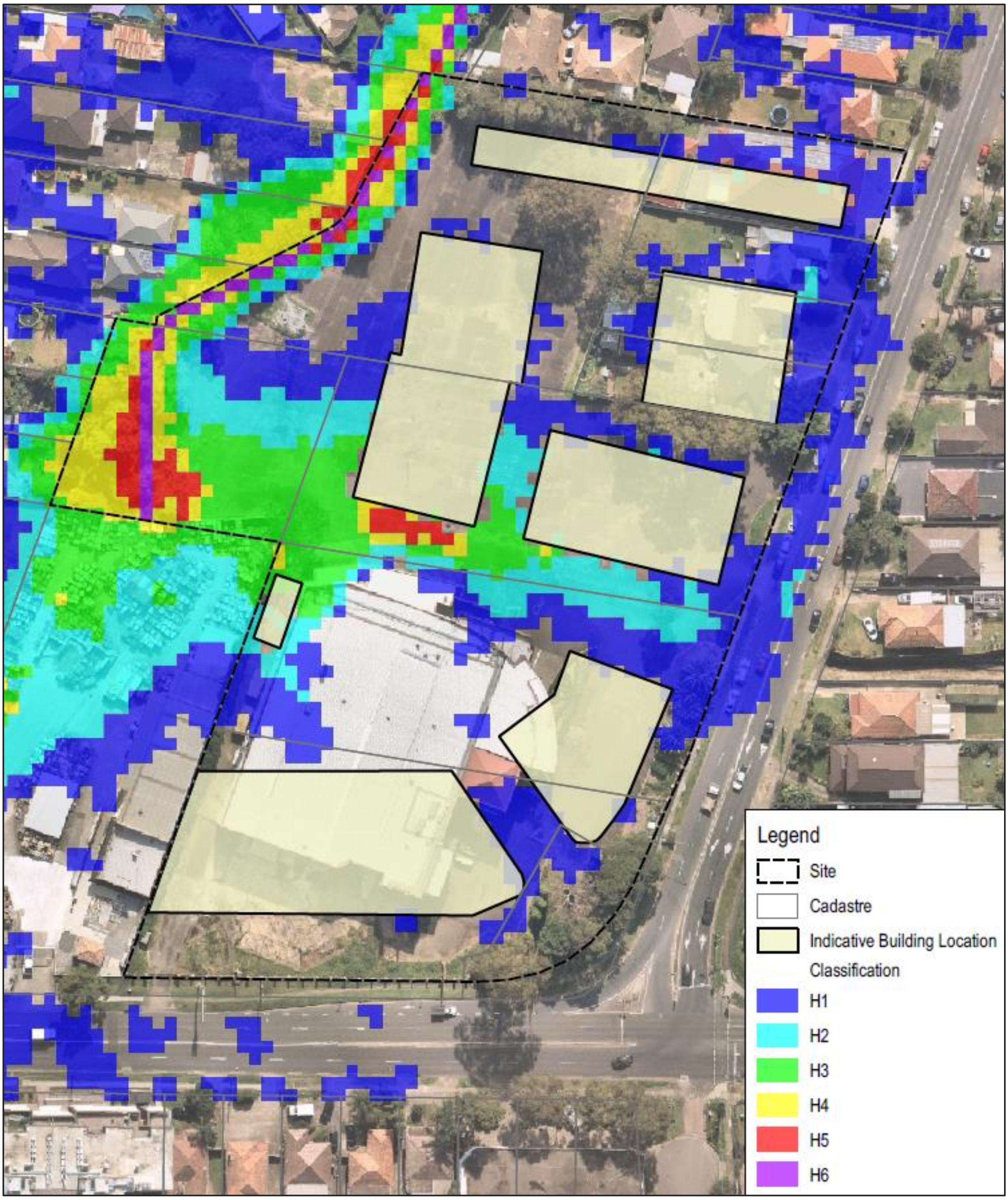


Figure 4-7 Flood Hazard Categories H1-H6 – Post-development 1% AEP Event

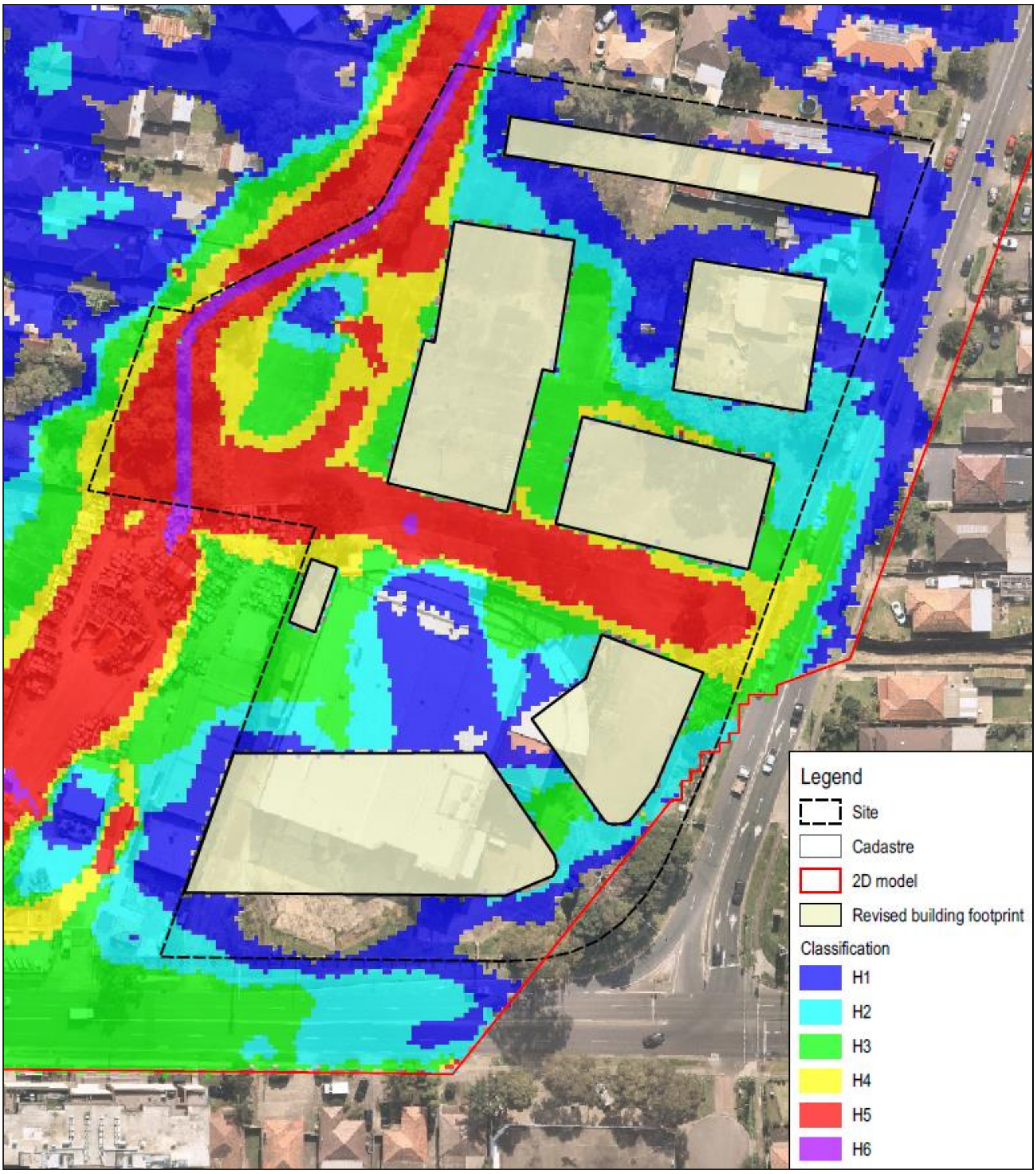


Figure 4-8 Flood Hazard Categories H1-H6 – Post-development PMF Event

4.3.4 Flood Function

As part of this peer review, Council in discussions with Stantec provided Hydracor the following definitions for flood function categories to be assessed for the 1% AEP post-development conditions:

i. Floodway:

- Velocity x Depth product greater than 0.25 m^2/s and Velocity greater than 0.25 m/s; or;
- Velocity is greater than 1 m/s.

ii. Flood Storage: Depth > 0.2m

The flood function mapping using the above criteria for the proposed development for the 1% AEP event is shown in **Figure 4-9** (extracted from Ref 8). The results show that the central road proposed for the site is a key floodway in the 1% AEP as well as the western side of the site for the northern flowpath. While Building A and Building D are both near the floodway of the central road, civil design of the site surface should be able to slightly divert floodway away from the buildings. Generally, the site layout maintains a clear floodway for both flowpaths.

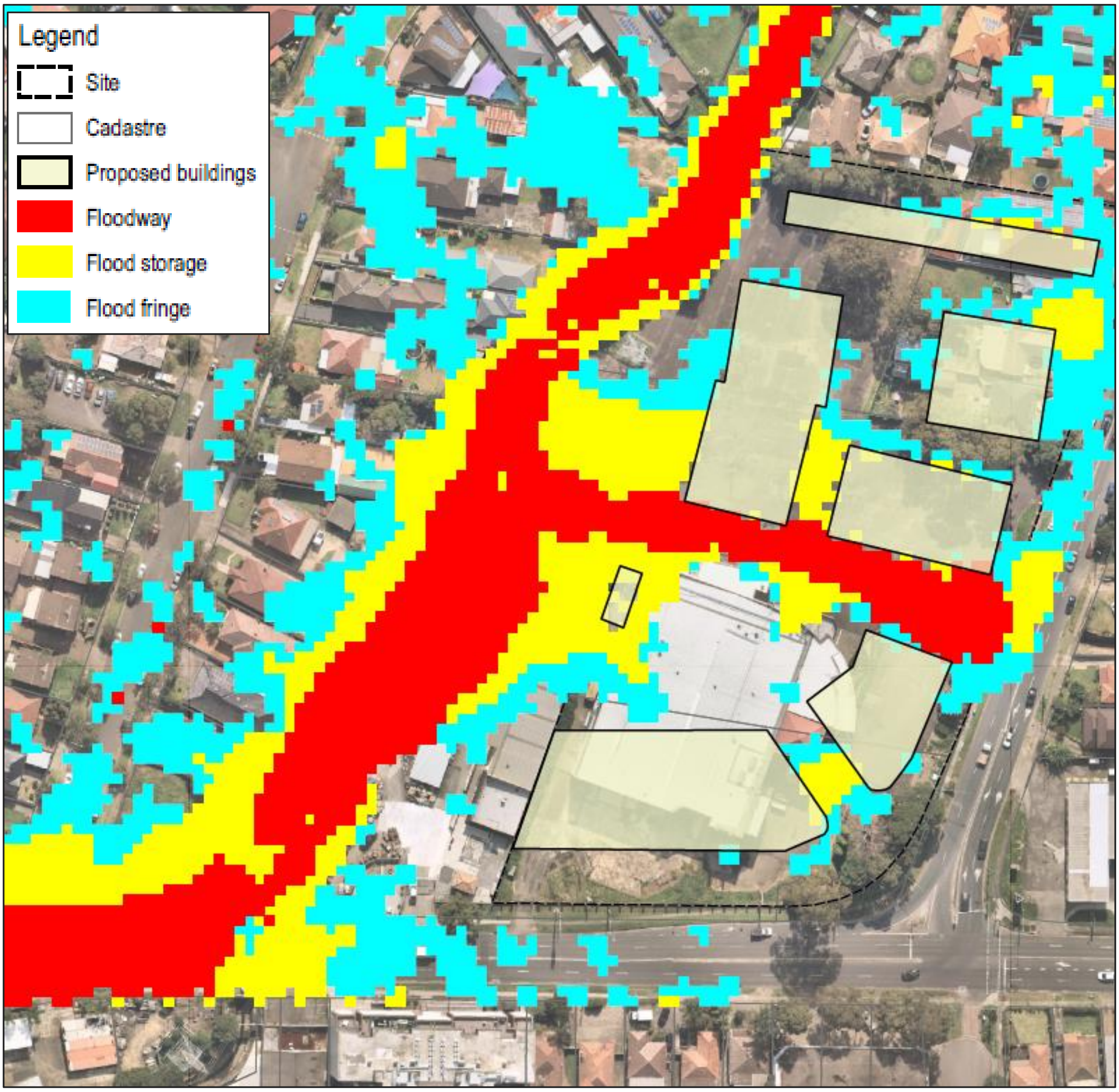


Figure 4-9 Flood Function Mapping – Post-development 1% AEP Event

4.4 Flood Level Review

4.4.1 Flood Planning Level

The peak 1% AEP flood levels in the form of 0.2 metre contours are included in **Figure 4-10**(extracted from Ref 10). The PMF flood levels in the site are shown in **Figure 4-11** (extracted from Ref 4).

Referring to Schedule 5 of Chapter 2.2 of Canterbury-Bankstown DCP 2023, a 0.5m freeboard is applicable to both residential and commercial habitable floor levels. Therefore with a 0.5m freeboard to the 1% AEP the Flood Planning Level for:

- Central buildings A1, A2,and D would have a FPL around 7.8 – 7.9m AHD (the 1% AEP flood levels are between 7.3 – 7.4m AHD), compared to PMF levels between 7.7 – 8.0m AHD.
- The furthest north, building B would have a Flood Planning Level of between 8.5 – 8.6m AHD (1% AEP level is 8.0 – 8.1m AHD), compared to PMF levels of 8.2m AHD.
- Northern building C, Flood Planning Level would be around 8.3 – 8.4m AHD (1% AEP level around 7.8 – 7.9m AHD), compared to PMF levels of 7.9 – 8.0m AHD.
- Southern commercial buildings E, F, and G would have a Flood Planning Level around 8.1m AHD (1% AEP level around 7.6m AHD), compared to PMF levels of 7.6 – 7.8m AHD.

These flood planning levels are only indicative, with further detailed modelling required to confirm FPL requirements as part of a future DA stage submission for the development.

As noted within Ref 4 in response to Council RFI:

> *In this regard, the post-development PMF flood level across the site is generally less than RL 8.0 m AHD. Subsequently, all floor levels proposed at or above RL 8.0 m AHD will be located above PMF floodwaters, removing the need for vertical evacuation. This advice will be included in the planning report.*

As noted above, at most locations the FPL (1% AEP plus 0.5 metre) is similar to the PMF level for the site. Therefore as part of later development stages including architectural design of the buildings, by meeting FPL requirements in the future, the building ground levels would likely be elevated above the PMF level. Hydracor's proposal to elevate ground floors above the PMF level would simplify the flood emergency response planning for the site. Therefore applying a design of ground floor levels at or above the FPL or PMF, whichever is greater is a suitable approach.

4.4.2 Basement Entry Level Requirements

There are two basement carpark entries proposed on the site (refer to arrow locations in **Figure 2-5**):

- One on the west side of Building A
- One on the south-west side of the central road.

Basements are high flood risk areas as the rate of ingress of floodwaters is extremely fast and the potential evacuation of these areas is significantly constrained, particularly as evacuation points are often affected by flooding.

In light of this high flood risk, basements could reasonably be classed as Special Flood Considerations (SFC) outlined in the guideline *Considering flooding in land use planning* which notes an eligible category is "*Development that is not identified as sensitive and hazardous development (refer to definitions) that requires risk to life or other safety consideration*". These two basements are the only components of the proposed development that would reasonably be considered SFC.

In accordance with Ministerial Direction 4.1 item 4 which addresses SFC requirements, the protection of these two basements should then be up to the PMF level.

It is noted that there is not currently a development control in Schedule 5 of Chapter 2.2 of the Canterbury-Bankstown DCP 2023 that specifically requires basement entries to the PMF level, however there is a control for safe and reliable evacuation up to the PMF level, which in light of basement carpark conditions could arguably only be satisfied by protecting basement entries up to the PMF level.

This was noted in a previous RFI from Council requesting protection up to the PMF level for all basement entries and responded to in Ref 2. It is understood that the proponent and their consultant is accepting of elevating basement carpark entries up to the PMF level, with the subsequent modelling blocking the basement entry location on the west side of the property to represent the raised entry ramp proposed. In addition within the site FERP (Ref 5) the following statement is provided:

Basement protection must be provided to prevent ingress and the finished habitable floor levels must be provided above the applicable Probable Maximum Flood (PMF) level. Permanent, unobstructed, evacuation routes should be provided from the basement to an area above the (PMF) level. These evacuation routes should be provided internal to the basement.

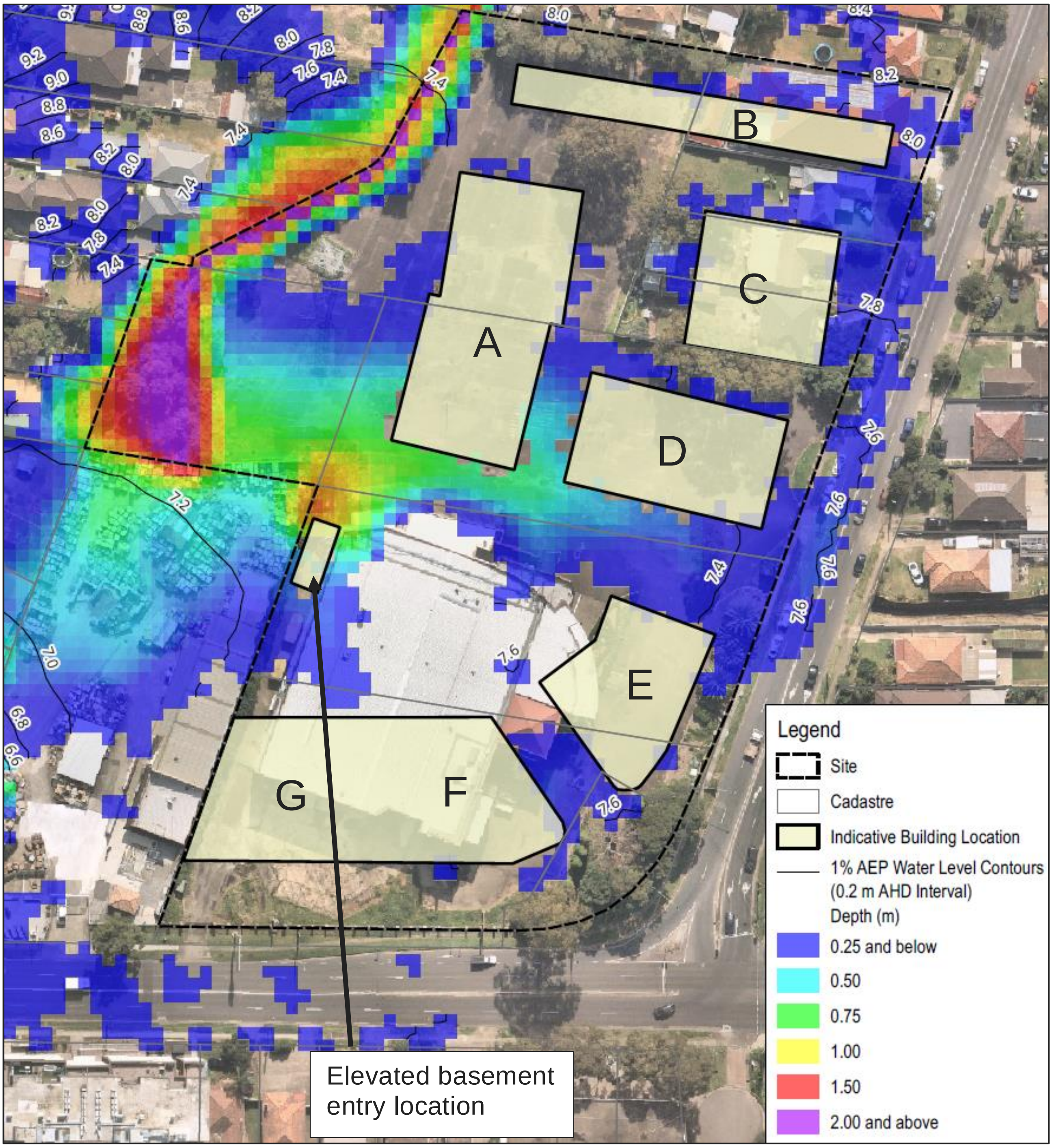


Figure 4-10 Peak Flood Levels and Flood Depths in the 1% AEP Post-Development Scenario

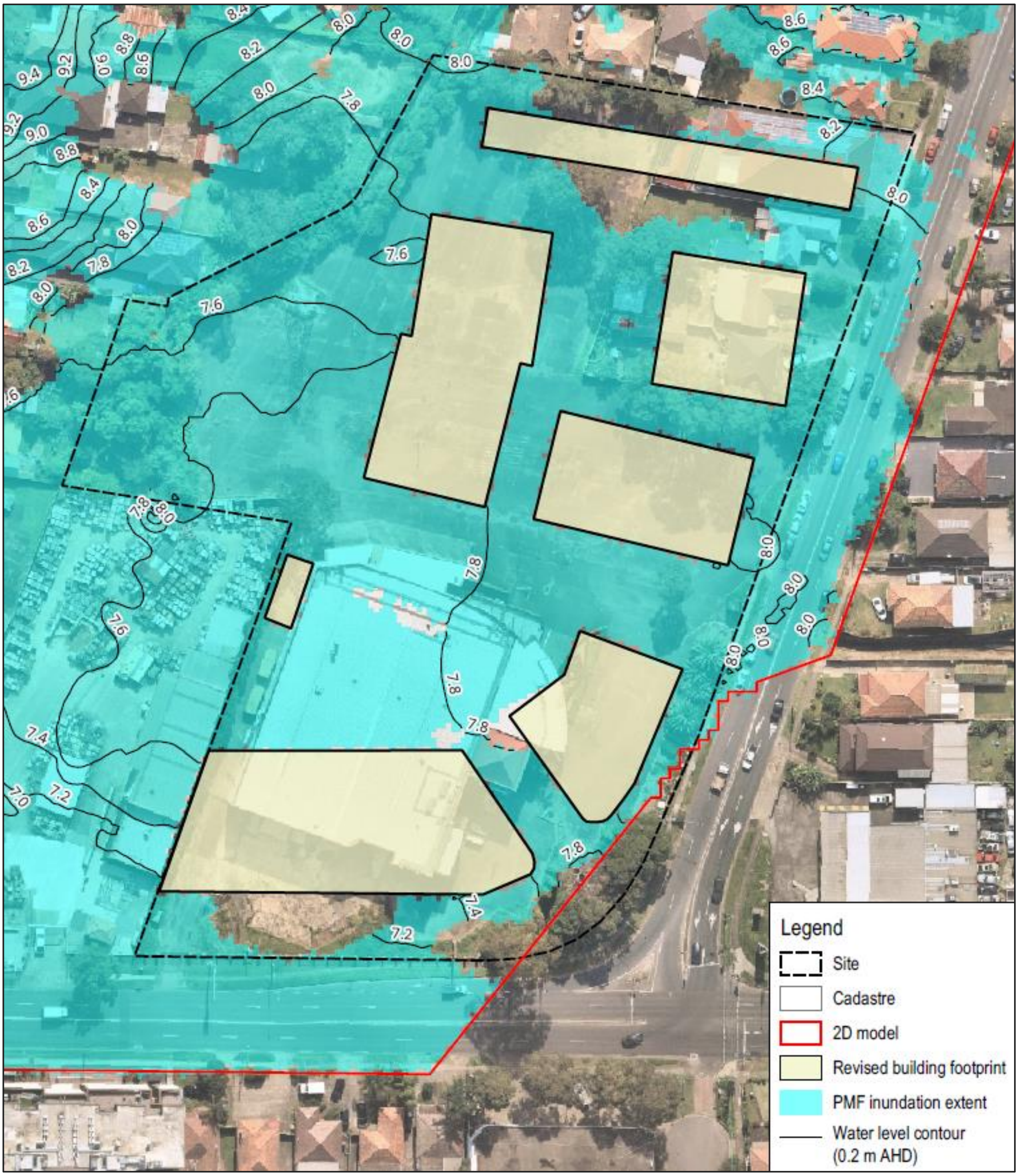


Figure 4-11 Peak Flood Levels and Flood Depths in the PMF Post-Development Scenario

4.5 Flood Emergency Response Provisions

As noted within the sites Flood Emergency Response Plan (Ref 5), the proposed emergency response is shelter-in-place (SIP). This is where proposed occupants of the site in all residences and commercial spaces would stay on-site, refraining from travel due to potential hazardous road conditions. This approach is suitable when the duration of flooding is not too long, and when flood-free refuge is provided in all events up to and including the PMF.

The requirements for Shelter-in-Place provisions in NSW are outlined within the Draft Shelter-in-Place Guidelines (2022). A summary of SIP requirements from this guideline are listed in italics below with a brief response in light of the flood information provided for the subject site.

The duration for flood inundation is less than six hours

As noted within Ref 5 as it relates to duration of flooding:

> *The flooding of adjacent roads is abrupt and short-lived during overland flood events, lasting no more than 3-4 hours*.

An animation of PMF timing of H1-H6 hazard for the subject site was provided by Hydracor in Ref 8. The access road and area around Building A becomes affected by H3 hazard by 25 minutes after the onset of PMF rainfall, with the majority of H3 hazard affectation for the site have passed 2.5 hours after the onset of rainfall. It is noted that this assessment is for the PMF 2-hour duration event.

Simulation of longer duration PMF events in later development stages may be needed to confirm, however it seems that flooding of the site should be less than 6 hours as required in the guideline.

The development is not located in an area of high-risk (eg, floodways and H5 or H6 flood hazard areas)

There is high hazard (H5 hazard) affectation near Building A. However this is likely as the proposed landform has not been altered from existing in the modelling to date. In future development stages where the design surface can be added to the post-development model it is expected that design will divert flows away from Building A and D to ensure the high hazard and floodway areas are not close to the building footprint.

Access to on-site systems to provide power, water and sewerage services during and beyond the event for the full range of flooding

The location of storage of food, water and medical emergency for SIP purposes should be above the PMF level and available during and beyond the event for the full range of flooding

These provisions can be proposed in later development stages where additional detail can be added to the site FERP.

SIP floor level is above PMF

SIP provides a minimum floor space per person

As noted in the previous sub-section it is proposed that all ground floor (and floors above) will be elevated at or above the PMF level. This will ensure that there is sufficient space as residents will require no action and can shelter in their residence with no movement to a refuge required.

SIP must be structurally safe and accessible during floods up to the PMF.

There is H5 affectation near Building A and D which would raise concerns regarding structural integrity in a PMF event for these buildings. However as noted above, in future detailed modelling of the post-development site, the design surface for the site should divert floodwaters away from these buildings and it is assumed that this hazard affectation up against these buildings can be reduced.

Further assessment of structural stability of refuge should be considered in later development stages.

4.6 Flood Affectation of 23 Canterbury Road

It is noted that Council has also requested the adjoining site at 23 Canterbury Road be reviewed with respect to flood affectation with potential development of this site. It is noted that no details of the proposed development of this site were provided. A high-level review of the local flood model results discussed in the prior sections focussing on this 23 Canterbury Road site is included below:

> As shown in **Figure 4-9**, the western side of the 23 Canterbury Road site is affected by 1% AEP floodway, therefore any potential buildings within this portion of the site may cause flow blockage and significant impacts. The eastern portion of the site is mostly flood-free in the 1% AEP and therefore may be suitable for potential development.

> As shown in **Figure 4-6** the majority of the site, including the western portion is affected only by low or intermediate provisional hazard meaning that potential development may be suitable as it relates to flood hazard in the 1% AEP.

> The H1-H6 hazard in the PMF event shown **Figure 4-8**, the western portion of the site is classed as H5 hazard meaning structural stability may be compromised in a PMF event. Therefore assuming shelter-in-place were the adopted emergency response (as the flash flooding nature of this floodplain suggests that evacuation will be difficult), then SIP refuge should not be located on the west side of the site.

> The flood affectation of this site is heavily influenced to the blockage assumption of the culvert upstream of the site. If a blockage factor different than 50% were applied (as in current modelling), then the site could have significantly higher or lower flood affectation therefore additional sensitivity modelling should be considered in any future development submissions.

5 Assessment of Flood Requirements

5.1 Planning Proposal Flooding Requirements

The proposed development has been reviewed against the planning proposal requirements of the NSW Flood Prone Land Policy specifically the Ministerial Direction 4.1 Flooding as discussed in **Section 3.2.1**. The basis for the assessment is the peer review summarised in the previous section based on desktop review of the 11 reference documents provided by the proponent and their consultants.

A summary of each of the planning proposal requirements is included in **Table 5-1** below.

It is important to note that owing to the early stage of the development process that the planning proposal is, it is understood that the below requirements are not expected to be addressed to a level of detail commensurate with a Development Application. With many details of the proposed development not available at the planning proposal phase, the intent of the assessment is to confirm if the proposed development at a high-level is compatible with the flood risk of the site using the below criteria.

It is expected that additional detailed analysis and modelling will be conducted in later development stages to provide further certainty to quantify flood impacts and flood risk more comprehensively. This will provide Council and other consent authorities further opportunity to comment and confirmation that the relevant development controls and requirements are addressed at those later stages.

This concept is allowed for within the FRM Guideline LU01 for Flood Impact and Risk Assessment with the two stage concept of a 'simple' and 'detailed' FIRA. This review has been conducted with the assumption that a simple FIRA assessment is suitable at the planning proposal stage.

Table 5-1 Review of the Planning Proposal Compared to Ministerial Direction 4.1 Flooding Requirements

Direction Provision	Consistent with Direction Provision
A planning proposal must include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy, the principles of the Floodplain Development Manual 2005, the Considering flooding in land use planning guideline 2021, and any adopted flood study and/or floodplain risk management plan adopted by the relevant council	Yes – The assessment is consistent with the principles of these documents and with the 2023 FRM Manual and Toolkits.
A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Environmental Protection Zones to a Residential, Business, Industrial or Special Purpose Zones	Yes - It is noted that the planning proposal does not involve rezoning flood planning area from recreational, rural, special zone to a residential. Increased density is proposed in a residential zone as part of the proposal.
A planning proposal must not contain provisions that apply to the flood planning area which:	The conditions that have been satisfied and not discussed as follows:
a) permit development in floodway areas,	a) As shown in **Figure 4-9**, the 1% AEP floodway has been maintained through the centre of the site through the alignment of the central road proposed. There are no major building obstructions proposed in either the eastern or northern flowpaths therefore this condition is considered suitably met. There is floodway close to Building A and D, however the addition of design surface to modelling in later stages is expected to be able to address this proximity to floodway.
b) permit development that will result in significant flood impacts to other properties,	b) Based on high level post-development modelling the proposed development does not alter existing flow paths in a major way as shown in flood impacts in **Figure 4-5**. Further assessment in later development stages required to confirm impacts, however the initial modelling suggests impacts should not be a major concern for the proposed development.

Direction Provision	Consistent with Direction Provision
c) permit development for the purposes of residential accommodation in high hazard areas,	c) As shown in **Figure 4-6**, the 1% AEP high hazard has been maintained through the centre of the site through the alignment of the central road proposed. There is high hazard close to Building A and D, however the addition of design surface to modelling in later stages is expected to be able to address this proximity to high hazard.
d) permit a significant increase in the development and/or dwelling density of that land,	d) In this case all development is proposed to have all floor levels at or above the 1% AEP plus 0.5m or PMF level, whichever is greater. Therefore there should not be an intensification of flood affected development as all proposed development is proposed to be elevated above the floodplain.
e) 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,	e) It is understood that no sensitive developments are proposed in the planning proposal.
f) permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require consent,	f) No development is proposed without consent associated with this submission.
g) 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, or	g) A high-level review of flood emergency response suggests that vertical evacuation or Shelter-in-Place should be feasible for most of the Site. The potential for SIP has been assessed at a high level against Draft SIP Guideline 2022 requirements as summarised in **Section 4.5**. This should be possible through site specific emergency response plans that do not increase the burden on emergency services or require significant road upgrades to enable evacuation.
h) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.	h) No developments with hazardous materials are proposed as part of this submission in areas below the Flood Planning Level.
A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which include items a), b), d), e), f) from item 3 above. An additional requirement for this area is if a planning proposal is likely to affect the safe occupation of and efficient evacuation of the lot	It is considered that basements are considered high flood risk and therefore SFC requirements may reasonably apply to the basement entry levels. The proponent and their consultant have proposed to elevate all basement entries above the PMF level which is in accordance with these SFC provisions.
For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council	In accordance with this provision, the planning proposal considers the 1% AEP and PMF flooding.

6 Conclusion

Stantec has been engaged by the Canterbury Bankstown Council to provide a peer review in relation to a flood assessment prepared to support Planning proposal at Lot 7, 14, and 15 DP132440, Lot 6 DP5245, Lot D DP382527, Lot A DP378634, and Lots B, 2, 3 and 4 DP21524 located at the corner of Canterbury Road and Punchbowl Road. The peer review has considered flood assessment reporting from 11 reference documents in a desktop review.

Generally the flood assessment has been found to be consistent with flooding requirements of the Ministerial Direction 4.1. Owing to the early stage of the development process that the planning proposal is, it is understood that the Ministerial Direction requirements are not expected to be addressed to a level of detail commensurate with a Development Application. With many details of the proposed development not available at the planning proposal phase, the intent of the assessment is to confirm if the proposed development at a high-level is compatible with the flood risk of the site using these criteria.

In relation to the peer review of reporting, Stantec recommends that the final flooding analysis and conclusions from all of the 11 documents be condensed into a single updated report, a Final Flood Investigation Report. This updated Flood Investigation Report should be submitted to Council prior to public exhibition.

With respect to the peer review of model methodology, the current assessment is considered fit-for-purpose for a planning proposal submission. The flood assessment is equivalent to a ‘simple’ Flood Impact and Risk Assessment (FIRA) as per FRM Guideline LU01. Given the high-level nature of the planning proposal phase, this level of assessment is considered suitable. In later stages considerations should be given to the suggested refinements to develop the equivalent of the ‘detailed’ FIRA, with these requirements specified in Section of the FRM Guide LU01. No further action is recommended as it relates to flood model set-up as part of the planning proposal submission to Council.

7 References

Canterbury Bankstown Development Control Plan 2023

Bewsher (2013), Salt Pan Creek Catchments Floodplain Risk Management Study and Plan

Cardno (2016), Final Overland Flow Study Canterbury LGA Salt Pan Creek Catchment

CMT Architects (2023), Planning Proposal drawings and models

Hydracor Consultants (2022), Flood Investigation report

Hydracor Consultants (2024), Flood Emergency Response Plan

Hydracor Consultants, Various letters in response to Council comments

Tudor Planning and Design (2024), letter to Council – Planning proposal at 913 – 925 Punchbowl Road and 21 Canterbury Road, Punchbowl (PP-2021-4589)

NSW Department of Planning and Environment, 2021, Considering flooding in land use planning

NSW Department of Planning and Environment, 2022, Local Planning directions 2022

NSW Department of Planning and Environment, 2023, Flood Risk Management Manual

NSW Department of Planning and Environment, 2023, FRM Guide - Flood Impact and Risk Assessment (LU01)

Stantec Australia
Level 16, 207 Kent Street
Sydney 2000 NSW

T: +61 2 8448 1800

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind.

We care about the communities we serve—because they're our communities too. This allows us to assess what's needed and connect our expertise, to appreciate nuances and envision what's never been considered, to bring together diverse perspectives so we can collaborate toward a shared success.

We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

Stantec trades on the TSX and the NYSE under the symbol STN. Visit us at **stantec.com** or find us on social media.

Design with community in mind