



675 Victoria Street, Abbotsford

Flood Impact Analysis

24 October 2024

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1. Introduction

HARC was engaged to undertake flood modelling and impact assessment and to provide advice in relation to a proposed development at 675 Victoria Street, Abbotsford. The aim of the analysis is to undertake flood modelling to determine flood impacts associated with the Yarra River and overland stormwater flow in Victoria Street, across the site under existing and proposed developed conditions. This information will be used to assess whether the proposed redevelopment meets the requirements of the State Planning Policy and the Land Subject to Inundation Overlay (LSIO) decision guidelines, as well as Melbourne Water's and the City Of Yarra's requirements.

1.1 Site Location

The site is located at 675 Victoria Street, Abbotsford, as shown in Figure 1-1. It is zoned Commercial 1 and is affected by a number of overlays. In particular, the site is within an LSIO associated with the Yarra River, as per the Yarra Planning Scheme. The current flood extent can be seen in Figure 1-2.



Figure 1-1: Site Location (site outlined in red)

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Figure 1-2: LSIO extent

1.2 Flood Information

Flood level information provided by Melbourne Water in their letter of 28 July 2023, indicated an applicable flood level at the site of 10.9m AHD

Correspondence from Yarra City Council indicated that there were concerns regarding overland stormwater flow in Victoria Street and its potential to enter the proposed site via the crossover. Council have noted that the height difference between the invert of the roadside channel and the apex of the driveway is limited. As such, Council requested that flood modelling be undertaken to determine the potential overland flow levels, so that crossover levels could be determined. This is discussed further in Section 2

1.3 Previous Melbourne Water advice and correspondence

The correspondence with Melbourne Water and Council regarding the flood conditions on the site are summarised below:

Melbourne Water 28 July 2023: Melbourne Water letter to City of Yarra stating an objection under Section 56 (1) of the Planning & Environment Act to the proposed development citing as the ground of objection:

1. The development is inconsistent with State Planning Policy relating to floodplain management, particularly Clause 13.03-1S – Floodplain Management as the development

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will impact on the natural flood carrying capacity and flood storage function of the adjacent waterway which could intensify the impact of flooding on adjacent properties.

2. The proposed development is inconsistent with the purpose and decision guidelines set out in the Land Subject to Inundation Overlay (LSIO) within the Yarra City Council Planning Scheme.
3. The proposed development is inconsistent with the 'Guidelines for Development in Flood Affected Areas' (DELWP 2019) in relation to freeboard, flow conveyance, flood storage and flood safety.

This report details the flood impact assessment and flood modelling for the proposed development that demonstrates compliance with the criteria in Melbourne Water's grounds of objection.

City of Yarra Development Engineering Formal Referral Response, 17 July 2023: Council requested a flood analysis to determine the peak flood level at the crossover location. Council requested that the applicant provide the marked-out catchment area, as well as:

- Cross sectional drawings showing the peak water level
 - Existing and design ground level
 - The grading across these sections
 - The apex
- Provide the relevant flood data from Melbourne Water. The design ground levels and floor levels within the proposed drawing may need to be updated based on the recommendation.

Phone correspondence with the City of Yarra and a subsequent email dated 22 March 2024, reiterated City of Yarra's information requirements. It also provided pipe and pit information for local overland stormwater flow modelling purposes in Victoria Street. Pit invert levels were supplied to enable modelling.

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1.4 Proposed redevelopment

The site currently contains a commercial development, known as the 'Icon' building, used primarily for business/commercial. It is proposed to redevelop the site as mixed use with a basement car park. The Yarra River is located to the north of the proposed development, as shown in the layout in Figure 1-3.

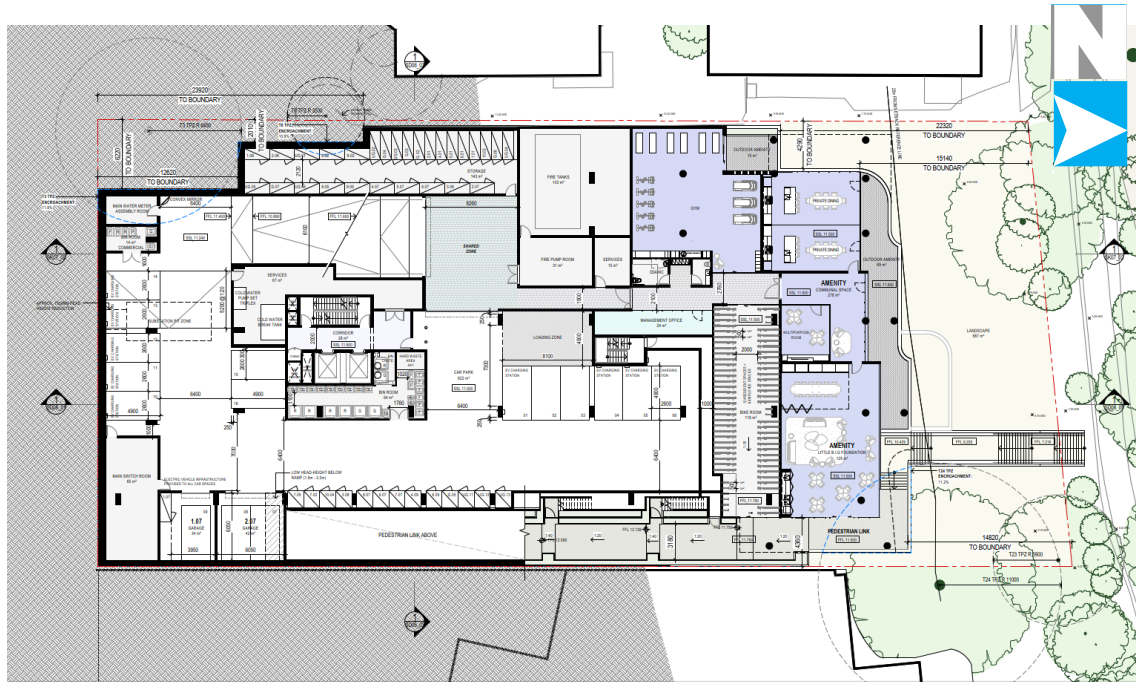


Figure 1-3: Proposed development lower ground floor layout

The proposed finished floor level of the lower ground floor building is 11.50m AHD as illustrated in Figure 1-4 below. This provides a freeboard of 600 mm above the applicable flood level.

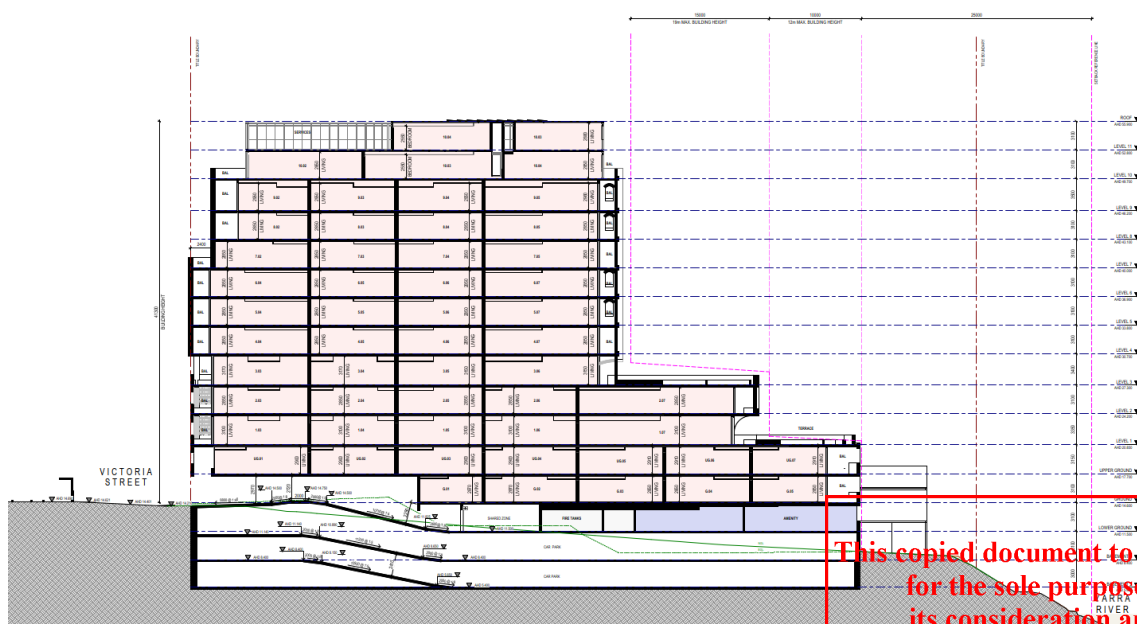


Figure 1-4: Proposed building elevation profile (South)

The development proposes a pedestrian access link from Victoria Street to the Yarra River Trail. The pedestrian access on Victoria Street is safe and above flood level and provides a safe evacuation route in times of Yarra River flood. The pedestrian link to the Yarra River Trail steps down gradually with safe platform refuges and can be closed off in times of flood.

The basement car park has no points of ingress for floodwaters (i.e. no openings below 11.5m AHD) and the entry point to the basement car park is located on Victoria Street, outside the Yarra River floodplain.

The apex of the entry ramp to the basement car park is currently at 14.75m AHD as shown in Figure 1-5 below. This provides appropriate freeboard for a Yarra River flood as it is above the minimum required 600mm and local flooding in Victoria Street.

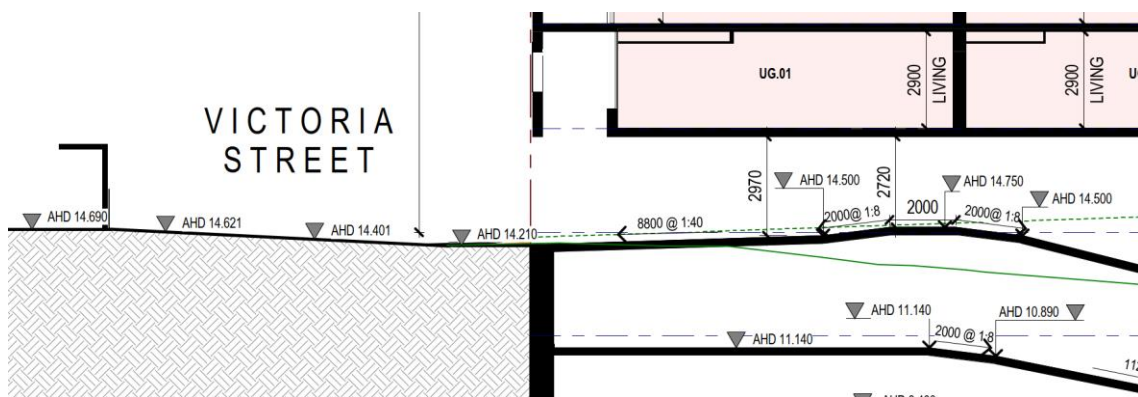


Figure 1-5: Proposed car park basement entry elevation section plan

The car park entry ramp on Victoria St, is the only point of vehicular access/egress into the basement. Access to the building from the basement is internal via stairs and a lift as demonstrated in Figure 1-6. There is external access to the lower ground floor that is set above flood level at 11.5m AHD. As such and as stated above, there are no other ingress points (i.e. no openings below 11.5m AHD) through which floodwaters could enter the basement or building.

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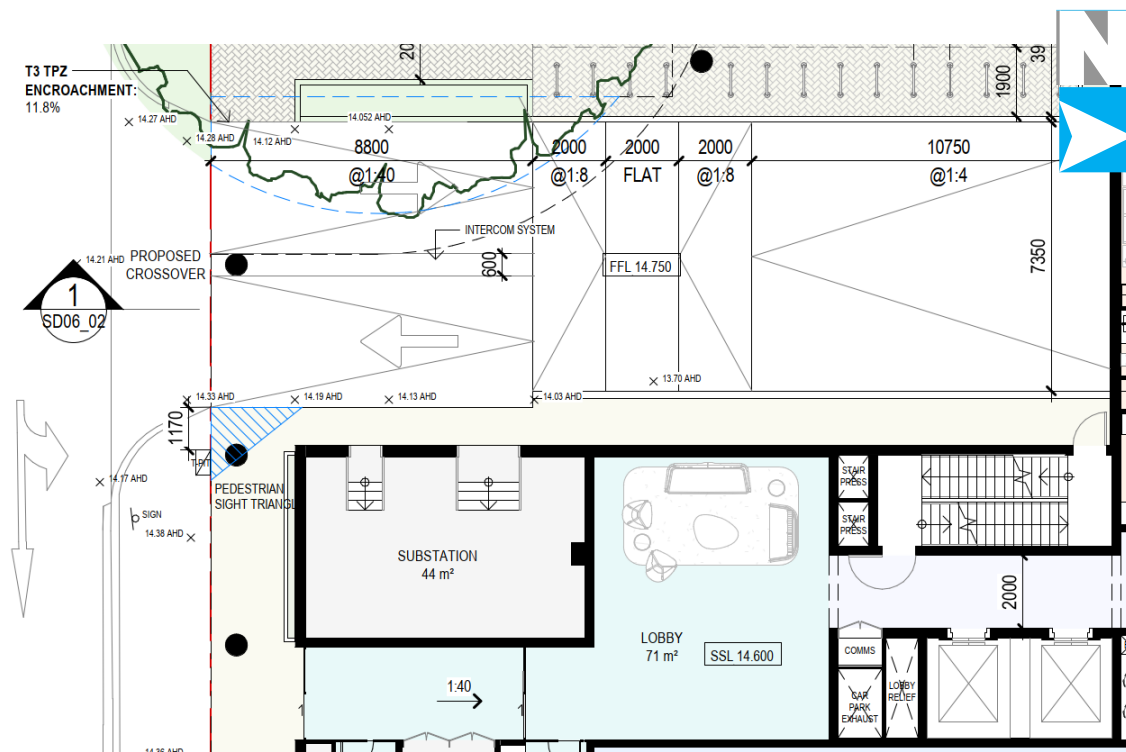


Figure 1-6: Proposed basement car park egress points

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2. Flood modelling of local overland flow

As a part of their request for further information on the proposed development, Council have requested flood modelling for the local overland stormwater flows in Victoria Street. It is understood that there has been no previous modelling of this area and information is limited.

2.1 Modelling Inputs

In order for HARC to undertake flood modelling of this area, City of Yarra provided pipe size and pit invert levels. The information provided is shown in Figure 2-1.

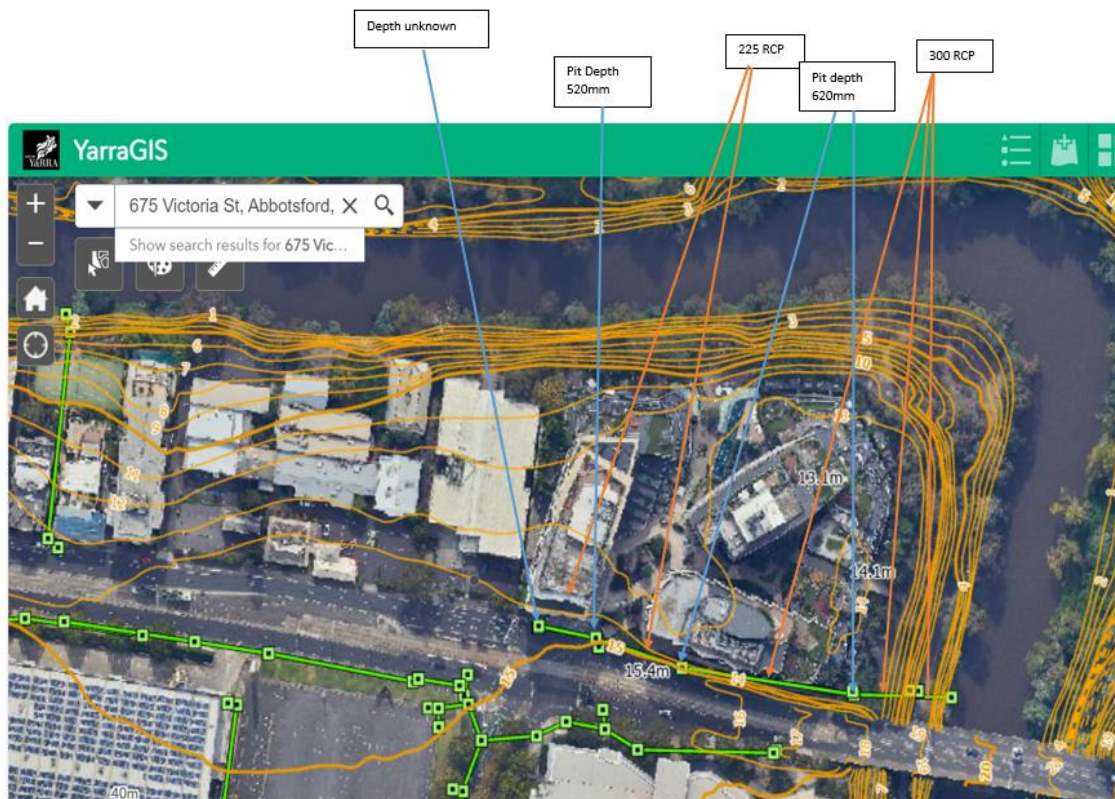


Figure 2-1: City of Yarra stormwater pipe and pit information

LiDAR data was obtained for the site and can be seen in Figure 2-2 below.

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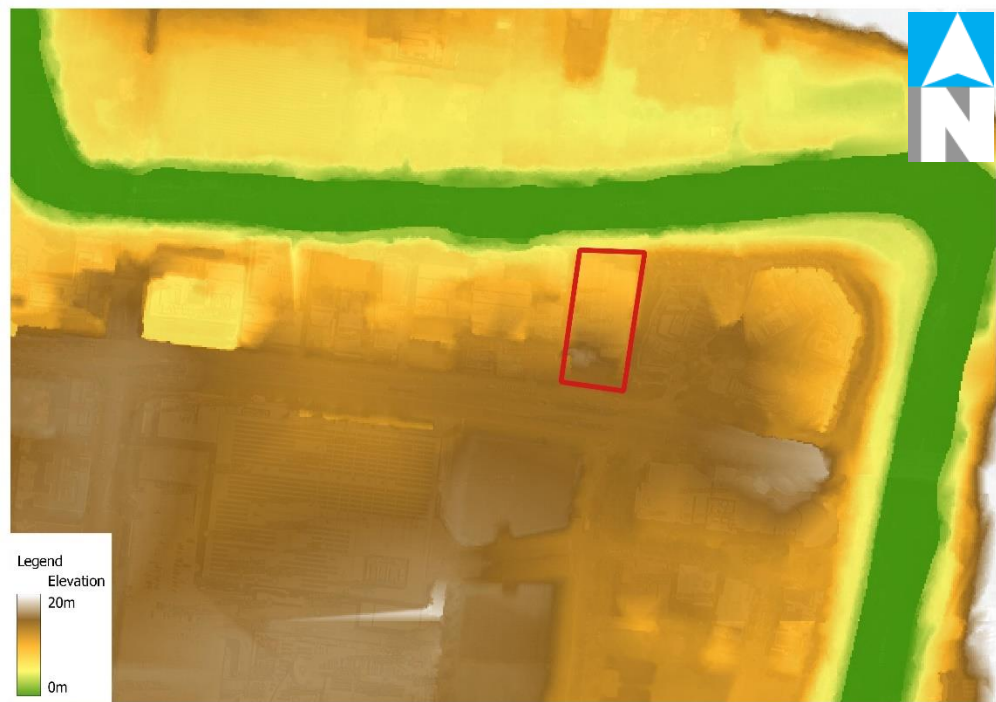


Figure 2-2: Elevation (LiDAR data)

The catchment for the modelling can be seen in Figure 2-3 below. The catchment was determined based on the elevation data and the location of the underground drainage network. The path of flow is from west to east and the underground drain outfalls to the Yarra River.



Figure 2-3: Model catchment

2.2 Modelling methodology

TUFLOW was selected as the appropriate method for modelling the local overland stormwater flow. The inflow boundary for the TUFLOW model was set as direct rainfall over the entire model extent. A 15-minute design rainfall with median temporal pattern was selected as the basis for modelling the overland flow and potential ponding on Victoria Street, at the frontage of the proposed development. Figure 2-1 is georeferenced to locate the 1D pits and pipes network. The 2D local drainage model outflow boundaries were set on the west and south side of the model domain.

2.3 Results

The result of the modelling for the 1 in 10-year Average Recurrence Interval (ARI) flood, also known as the 10% Annual Exceedance Probability (AEP) flood, is shown below in Figure 2-4. The modelling result for the 100-year ARI (1% AEP) flood is shown in Figure 2-5.

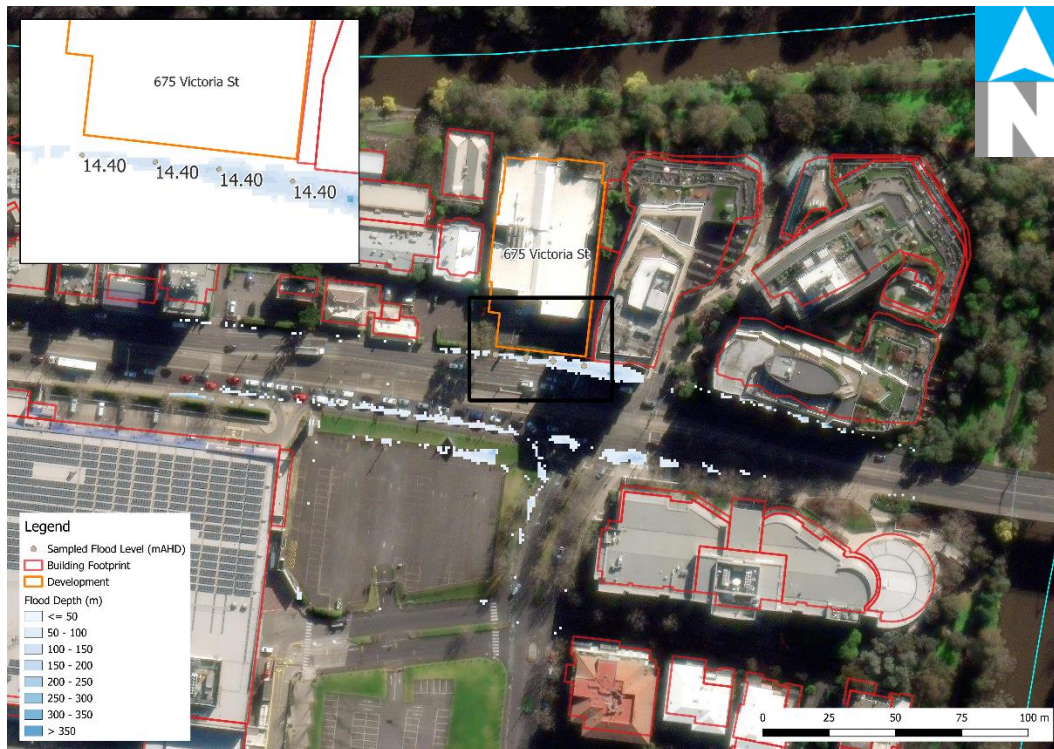


Figure 2-4: 1 in 10 year ARI flood extent

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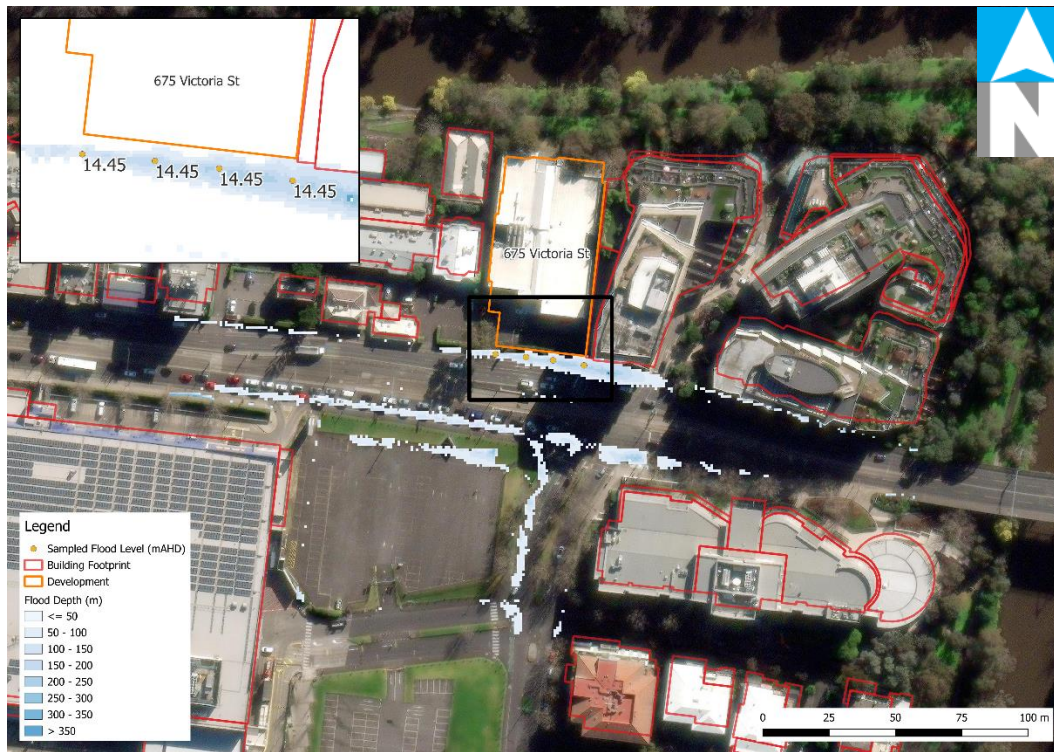


Figure 2-5: 1 in 100 year ARI flood extent

The results of the modelling indicate that the applicable flood levels for the local overland stormwater flows are:

- 1 in 10 ARI year flood level: 14.4m AHD (10 % AEP)
- 1 in 100 ARI year flood level: 14.45m AHD (1% AEP)

It can be seen from the modelling that the stormwater runoff ponds in Victoria Street in large flood events out the front of the property, with the greatest depth of flooding out the front of the adjacent property at 677 Victoria Street. The ponding occurs because the invert level of the stormwater pit appears to be higher than the level of the road in that location. This has not been confirmed by site inspection.

The modelled flood extent is generally consistent with the information released from Councils most recent flood modelling and mapping project shown in Figure 2-6 below.

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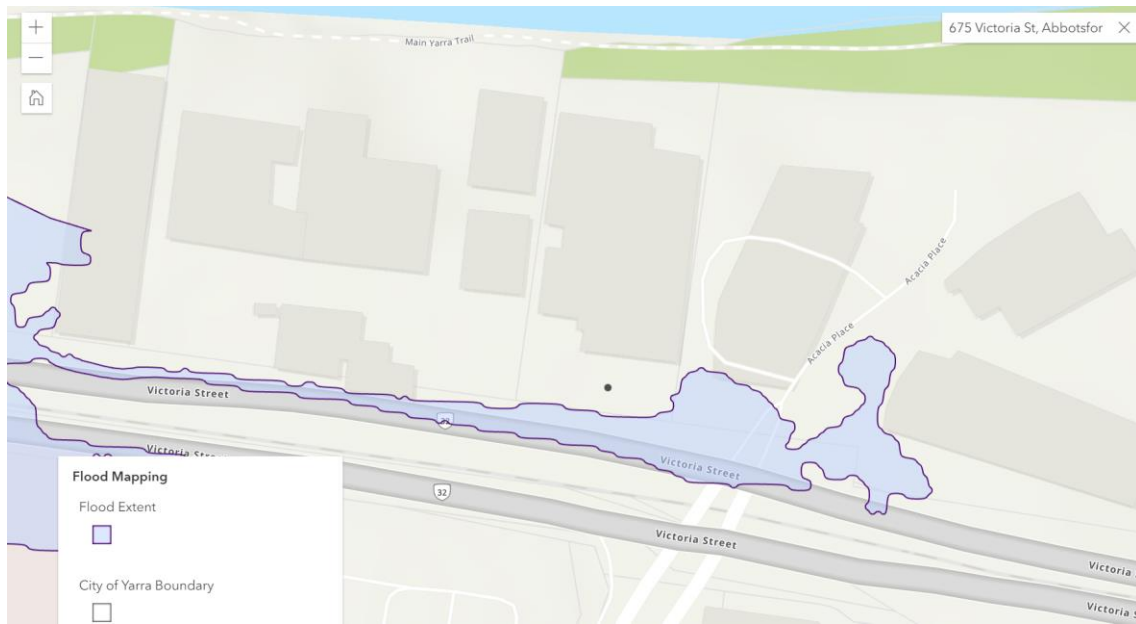


Figure 2-6: Council Flood mapping (extract from Yarra City website)

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3. Yarra River Hydraulic Modelling

To assess the potential impact of the development on the Yarra River floodplain, a TUFLOW 2D hydrodynamic model of the site and its surrounds was set up. TUFLOW implements an implicit matrix solution to solve the two-dimensional, depth-averaged momentum and continuity equations for free surface flow. The package includes fully dynamic 1D/2D linking with the one-dimensional solver ESTRY. The model was built and run using TUFLOW HPC version 2023-03-AE-iSP.

The TUFLOW model was developed using the following information sources:

- 1m resolution LiDAR aerial survey data;
- Architectural drawings of the proposed development by SJB Architects;
- Flood level contour information for the Yarra River immediately upstream and downstream of the site.

3.1 Baseline Model Setup

The hydraulic model covers that part of the Yarra River shown in Figure 3-1: Model Schematics – existing case. A cell size of 1m x 1m was applied over the whole model domain. This is the finest resolution that can be adopted while using a 1m LiDAR topographic data.



Figure 3-1: Model Schematics – existing case

3.1.1 Existing conditions

The existing building extends all of the way to the Design and Development overlay setback line within the Yarra Planning Scheme. However, there is an under-building car park located in the rear northern half of the building, that is currently subject to flooding and is considered flood storage. The existing layout can be seen in Figure 3-2 below.

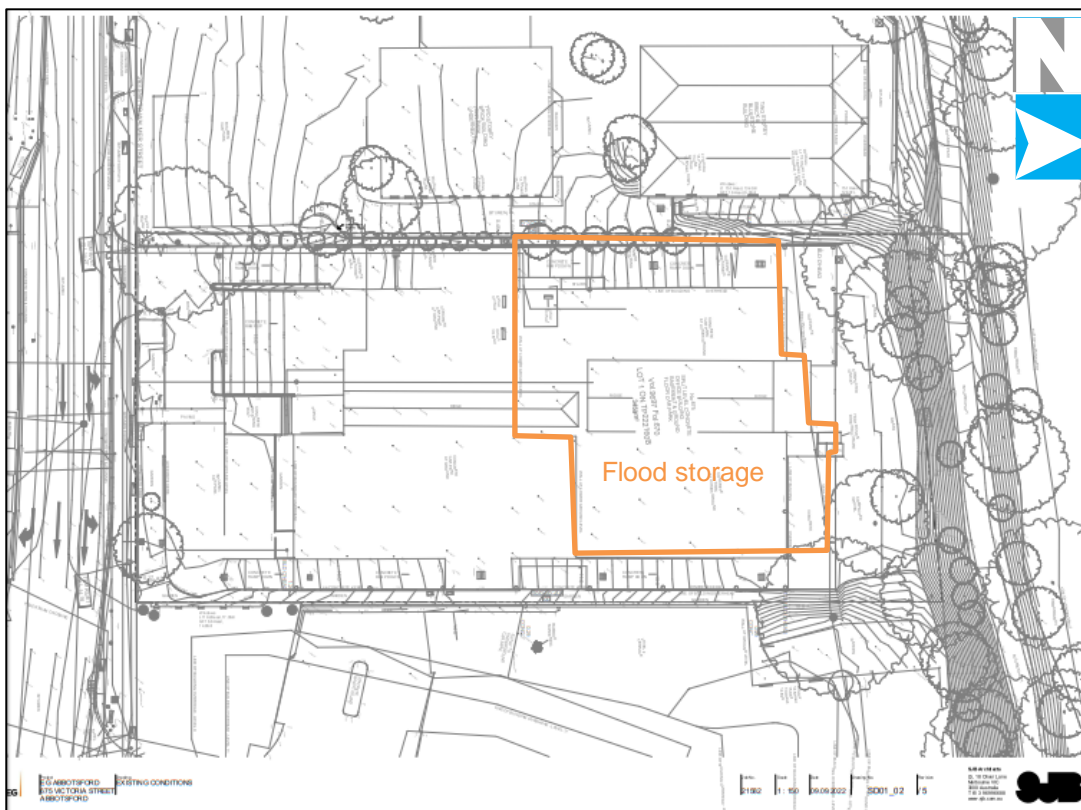


Figure 3-2: Existing conditions

3.1.2 Boundary Conditions

The inflow boundary for the TUFLOW model was set approximately 1000m upstream of the property. The 1% AEP flood contours for the Yarra River are illustrated below (Figure 3-3).

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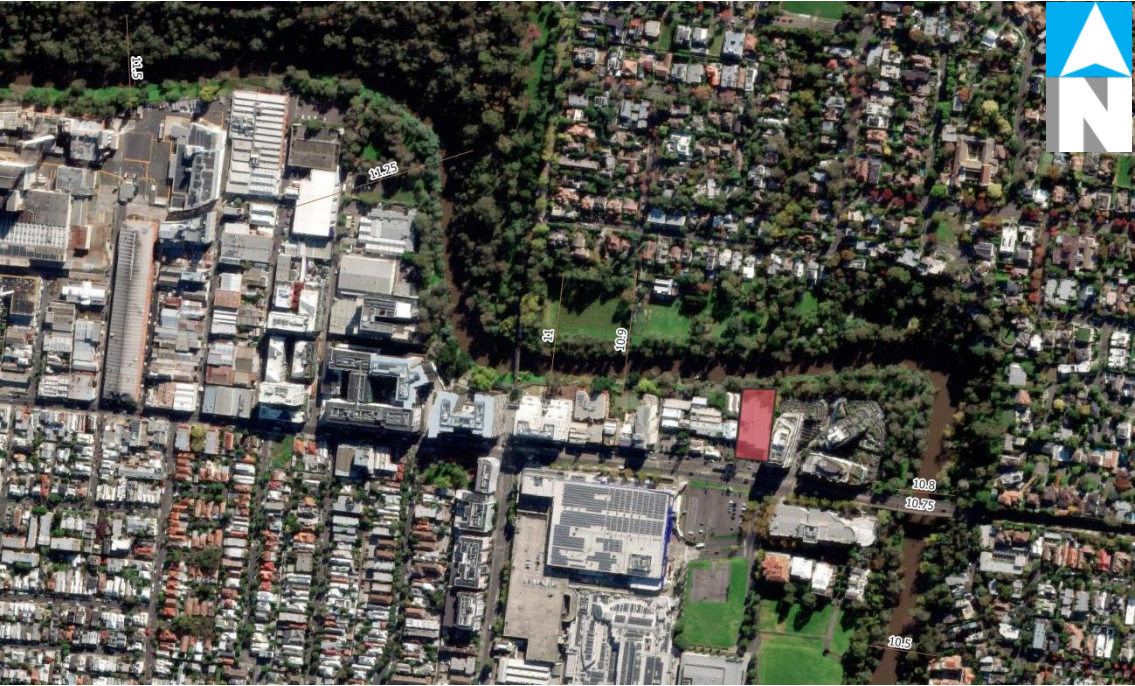


Figure 3-3: 1% AEP flood contours for the Yarra River

The downstream boundary for the model was set about 460m downstream of the property where the overland flow paths join with the main channel of the Yarra River. A steady water level of 10.5m AHD was applied at this boundary, corresponding to the 1% AEP0 water level.

3.1.3 Manning’s Roughness

Manning’s roughness values for the model domain were determined by assessing aerial imagery against relevant Manning’s roughness land use types. Table: 3-1 and Figure 3-4 illustrate the Manning’s roughness values that were assigned to the TUFLOW model.

Table: 3-1: Manning's Roughness Values Assigned to the TUFLOW Model

Land Use Description	Manning's n
Paved Roads and car parks	0.025
Gravelled surfaces	0.035
Parks and lawns	0.050
Treed landscapes	0.060
Overland flow	0.080

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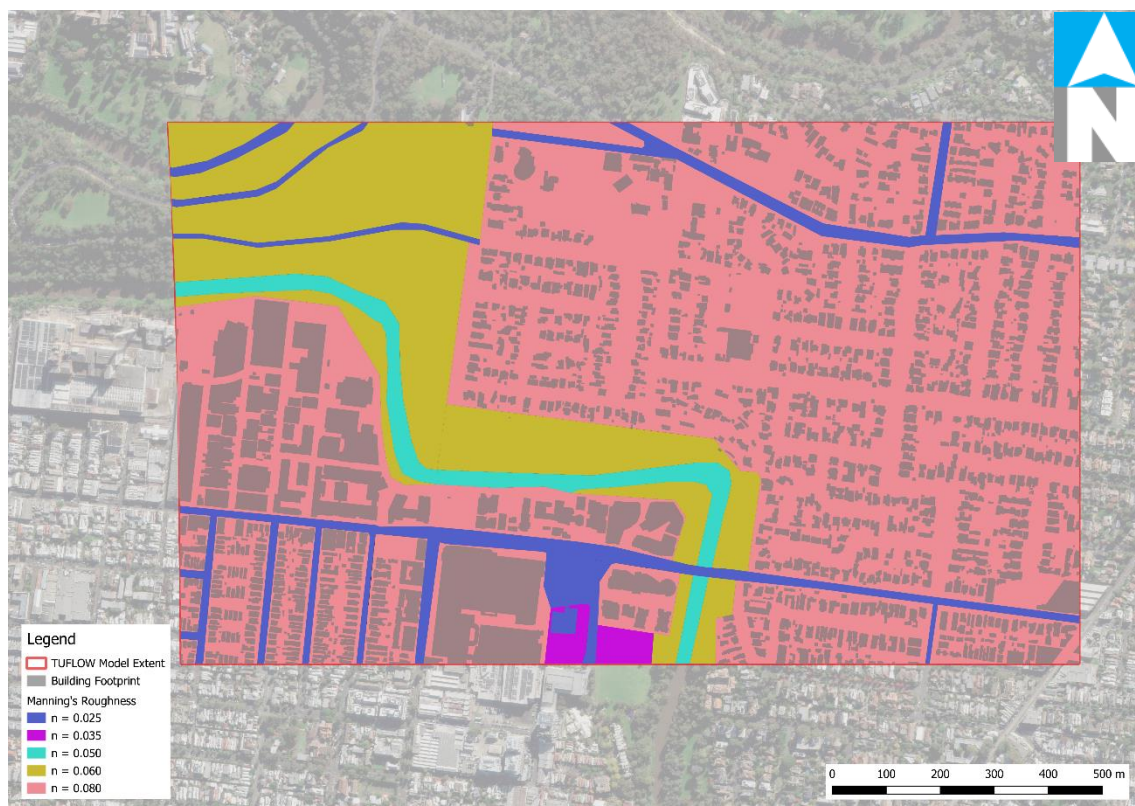


Figure 3-4: Adopted Manning's coefficients for bed roughness

3.2 Developed-Case Model Setup

The baseline model (as set out in Section 3.1) was modified to include the proposed building envelope. The lower ground floor level was modelled as a form of flow obstruction as shown in Figure 3-5, noting that the existing conditions indicate that the underground car park is subject to flooding and is therefore viewed as flood storage.

The lower ground level footprint of the building was reduced in the north west corner to remove constrictions that were causing minor impacts on flood behaviour. The footprint provided in this model and report is the revised version.

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Figure 3-5: Model Schematisation – proposed building and works

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4. Model Results

Figure 4-1 shows the flood depths under existing conditions including the flooding that occurs in the car park beneath the building.

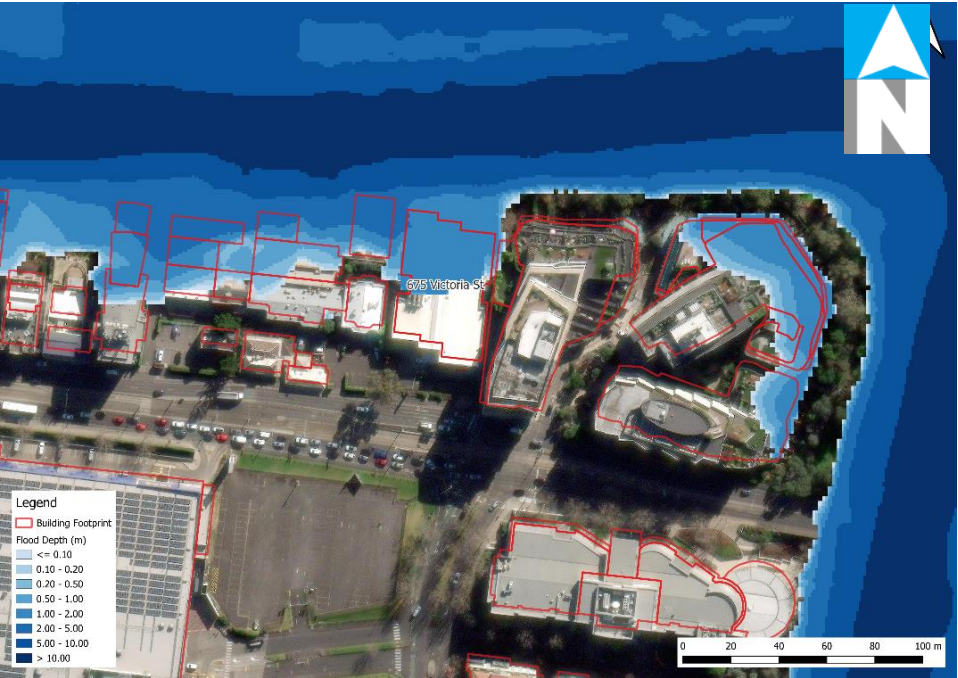


Figure 4-1: Flood depths near the existing building – existing conditions

Figure 4-3 shows the difference in flood depths from existing conditions to developed conditions. It can be seen that the change in flood levels associated with this development is negligible.

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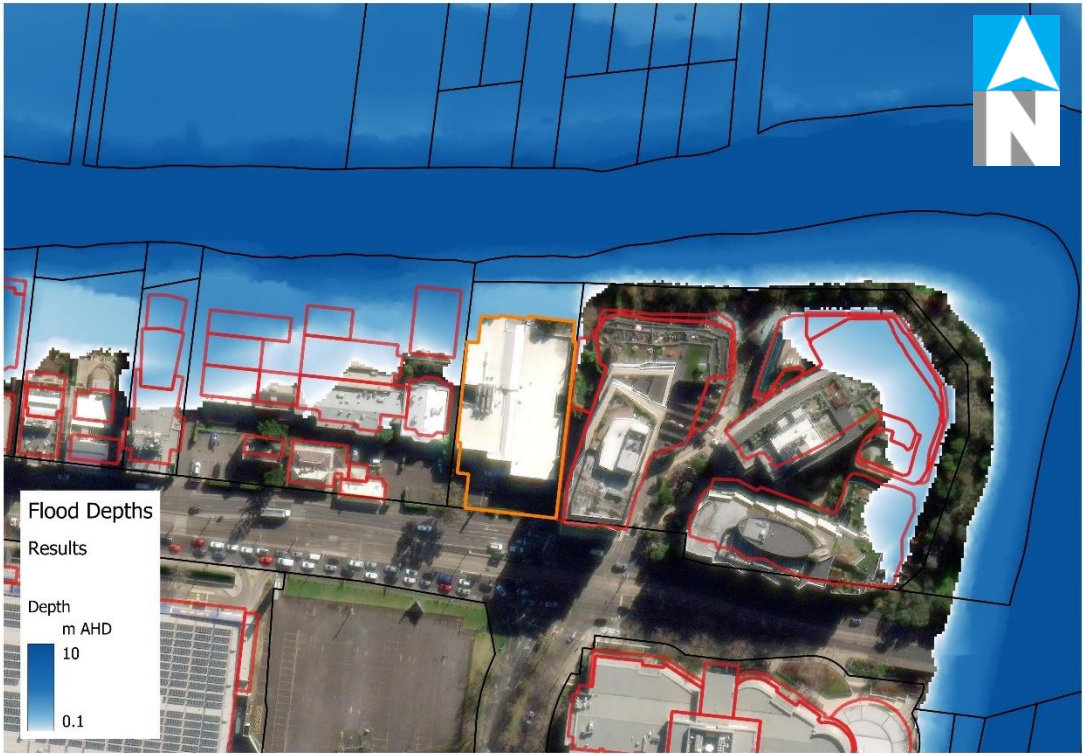


Figure 4-2: Flood depths near the proposed development – future conditions

It can be seen in Figure 4-3 below that the model shows there is no change in flood depth or off-site impacts as a result of the proposed development. The model numbers itself demonstrated no change within the limitation and bounds of TUFLOW.

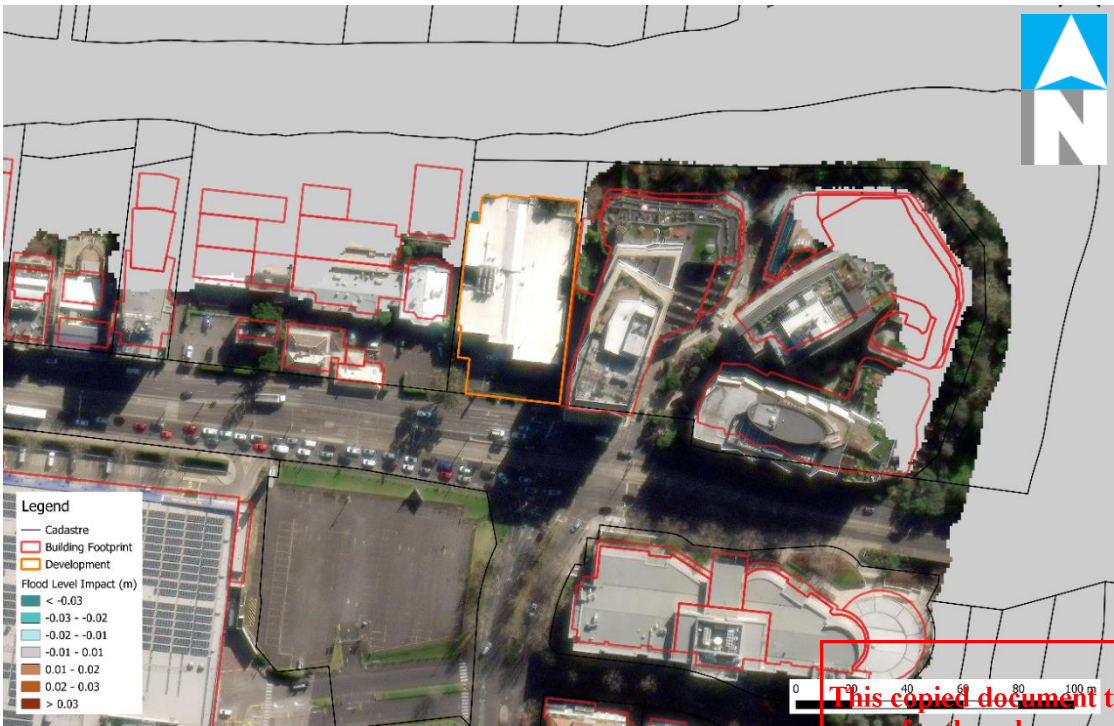


Figure 4-3: Depth difference between the proposed development and existing conditions

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Figure 4-4 shows the existing flood hazard classes at and in the vicinity of the property, while Figure 4-5 shows the expected flood hazard classes under proposed development conditions. These figures demonstrate that there is no change in flood hazard on surrounding properties as a result of the proposed development.

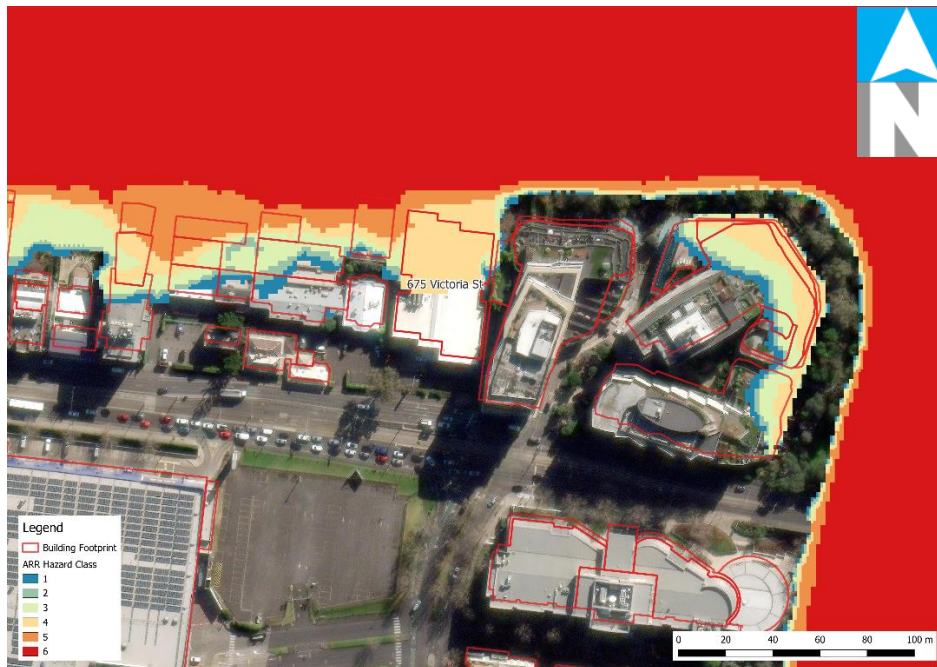


Figure 4-4: Hazard class under existing conditions

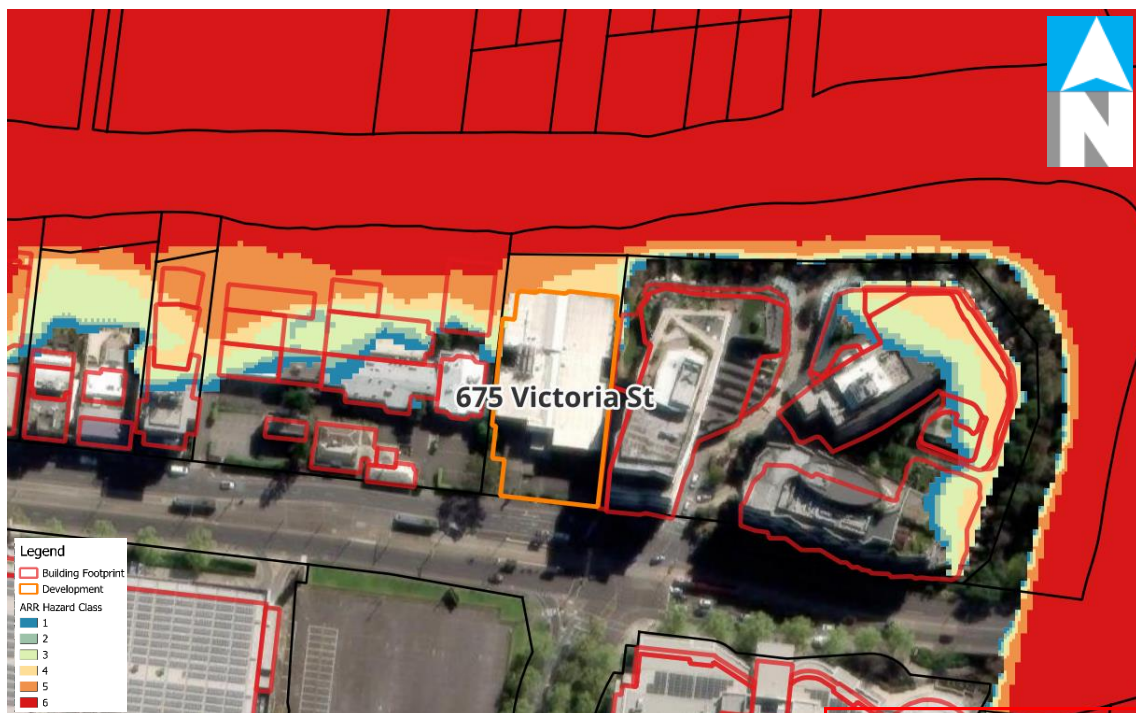


Figure 4-5: Hazard class for proposed development conditions

4.1 Model Assumptions

With respect to the modelling approach, it should be noted that:

- The buildings are considered impervious to the flows as this is the most conservative approach.
- Only the Yarra River was modelled as part of this assessment. No local drainage or overland flow (from Victoria Street) has been assumed as a part of the Yarra River model.

4.2 Model Output Discussion

The results of the modelling have shown that the impacts of the proposed development *on surrounding properties* are negligible. Negligible is considered to be less than 10mm. However, close analysis of the flood hazard mapping indicated a minor change in flood hazard extent (rating 5) *on the site*, as shown in Figure 4-5 above. This is due to a small change (i.e. increase) in velocity adjacent to the rear of the development. The total velocities are no more than 0.5m/s with no change in flood level at this location; thus, only a minor change in the flood hazard rating. This change at this location is considered insignificant.

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5. Response to Council Development Engineering Referral

Council requested a flood analysis to determine the peak flood level at the crossover location.

The results of the local overland stormwater flow modelling described in Section 2 indicate that the 1% AEP flood level (100-year ARI) for the local overland flows at the crossover is a maximum of 14.45m AHD and the 10% AEP flood level (10-year ARI) is 14.4m AHD:

As such, it is recommended that the apex of the crossover and basement car park entrance is no lower than 300mm above the applicable local flood level at 14.75m AHD, or as agreed with Council.

Council requested that the applicant provide the marked-out catchment area. This can be seen in Figure 2-3. Council also requested:

- Cross sectional drawings showing the peak water level
 - Existing and design ground level
 - The grading across these sections
 - The apex

The drawings will be provided by the applicant.

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6. Melbourne Water Grounds of Objection:

Melbourne Water's letter of objection stated that:

1. The development is inconsistent with State Planning Policy relating to floodplain management, particularly Clause 13.03-1 – Floodplain Management as the development will impact on the natural flood carrying capacity and flood storage function of the adjacent waterway which could intensify the impact of flooding on adjacent properties.
2. The proposed development is inconsistent with the purpose and decision guidelines set out in the Land Subject to Inundation Overlay (LSIO) within the Yarra City Council Planning Scheme.
3. The proposed development is inconsistent with the 'Guidelines for Development in Flood Affected Areas' (DELWP 2019) in relation to freeboard, flow conveyance, flood storage and flood safety.

6.1 Melbourne Water assessment against the Guidelines (2019)

The following assessment is the basis of the objection by Melbourne Water to the development.

A) Freeboard

Freeboard is the difference between the floor level of a building and the 100-year buildings, their contents and the people in them are safely above the 100-year flood level. Melbourne Water requires any new buildings (including the lower levels/ basements carparking) to be constructed with finished floor levels set a minimum of 600mm above the applicable flood level.

B) Flood impacts - Flow conveyance & Storage

The Guidelines state that the natural function of floodplains and overland flow paths to convey and store floodwater must not be compromised, such that new development should not divert floodwaters to the detriment of adjacent properties or increase flood levels/velocities on adjacent properties. Large buildings (relative to the size of the floodplain or overland flow path) reduce flood storage, as does landfill.

The current proposed building extends into the floodplain which presents an impact to the current flood storage capacity and impacting the flow conveyance within the subject site.

C) Flood Safety

The property is subject to high flood risk, Melbourne Water does not support parts of the development where the depth and flow of floodwater affecting access and egress to a property is hazardous. Need to ensure that people moving about on a property or accessing within the property during a flood event are not endangered by deep or fast flowing water.

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7. Response to Melbourne Water Grounds of Objection:

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7.1 Freeboard

The proposed finished floor level of the lower ground floor has been set at 11.5m AHD. This provides a freeboard of 600mm from the applicable flood level of 10.5m AHD and thus achieves the nominated flood protection level (NFPL). Below this level are the basement car parks that are fully protected from flooding from the Yarra River. There are no points of flood ingress to the basement, with no vents, stairwells, doors or entry point located below flood level. The vehicular entry point to the car park is located off Victoria Street (outside the floodplain) and the apex for the access point must be set no lower than 14.75m AHD to ensure adequate protection from local ponding of overland stormwater flows in Victoria Street. The property street frontage is located above the Yarra River 1% AEP flood level.

This satisfies the criteria against which Melbourne Water's assessment was made:

- **State Planning Policy:** Aims to assist the protection of life, property and community infrastructure from flood hazard, including coastal inundation, riverine and overland flows.

Response: This is achieved by ensuring that property and infrastructure is either out of the floodplain or by raising floor levels a minimum of 600mm above the flood level. Finished floor levels meet this requirement. Further, the basement car park is protected by an apex on the entry ramp that is above the 1% AEP flood level plus freeboard. There are no points of flood ingress below the 1% AEP flood level.

- **LSIO Decision Guidelines:** These guidelines require consideration of the existing use and development of the land and also the susceptibility of the development to flooding and flood damage.

Response: The location of the proposed development is in the same location as the existing development. The building extent into the floodplain is limited by a Design and Development Overlay (DDO1) that sets a minimum setback line. The design complies with this setback. The car park associated with the existing development is located underneath the building and is currently subject to flooding during a 1% AEP flood event. The proposed development removes this risk of damage to cars and property by creating a basement car park free from flooding. Furthermore, and as outlined above, finished floor levels are minimum of 600mm above the flood level.

- **DELWP 2019 Guidelines criteria for Flood Damages:** The guidelines aim to minimise flood damage to property and associated infrastructure by setting floor level requirements as a condition of permit.

Response: The NFPL is the Nominal Flood Protection Level and is flood level plus freeboard. In this case the NFPL is 11.5m AHD (10.9m AHD flood level plus 600mm

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freeboard). The lower ground floor of the development meets this criterion. Further, the entry/access to the underground car park also achieves the NFPL.

7.2 Flood impacts - Flow conveyance & Storage

The building footprint in the north west corner of the proposed building has been reduced to remove constriction of flood waters. The revised flood modelling demonstrates no impacts on flood levels. The modelling demonstrates that there is no change in flow conveyance and flood hazard on surrounding properties as a result of the proposed development. The flood hazard classes have remained unchanged off site.

This proposed development satisfies the criteria against which Melbourne Water's assessment was made:

- **State Planning Policy:** This aims to preserve the natural flood carrying capacity of rivers, streams and floodways and the flood storage function of floodplains and waterways.

Response: The Yarra River floodplain is a large floodplain and covers a great deal of land in the Melbourne area. Flood modelling has demonstrated no impacts on flood storage.

- **LSIO Decision Guidelines:** These consider the effect of the development on redirecting or obstructing floodwater, stormwater or drainage water and the effect of the development on reducing flood storage and increasing flood levels and flow velocities.

Response: The flood modelling undertaken has indicated no increase on flood levels as a result of negligible changes in flood storage. There are no offsite impacts or changes in flood hazard.

- **DELWP 2019 Guidelines:** The guidelines aim to maintain the free passage (i.e. conveyance) and temporary storage of floodwaters. Assessment criteria include ensuring there is no diversion of floodwaters onto adjoining properties, no increase in velocities on adjoining properties and no increase in flood levels on adjoining properties.

Response: The flood modelling undertaken has indicated no impacts on flood levels associated with changes in flood storage. Flood extents are not impacted and flows are not diverted onto other properties. There are no offsite impacts for flood levels or velocities and no off-site changes in flood hazard.

7.3 Flood Safety:

The proposed development is located in the same location as the existing building and does not encroach further into the active flood path of the Yarra River floodplain. The design complies with the minimum setback line in the Yarra River Corridor as required by the Design and Development Overlay (DDO1) of the Yarra Planning Scheme. The existing building's car park underneath the building is currently subject to flooding during a 1% AEP flood event. The proposed development removes this safety risk to people by creating a basement car park free

from flooding. The proposed development provides flood free access and egress for pedestrian and vehicles to and from both the site and the basement car park. The finished floor level of the lower ground floor is at the NFPL.

The proposed development satisfies the criteria against which Melbourne Water's assessment was made:

- **State Planning policy:** Aims to protect life from flood hazard, including coastal inundation, riverine and overland flows.

Response: The proposed development is located in the same location as the existing building. It improves the safety on the site by removing the flood hazard associated with the car park underneath the building. The proposed underground car park can only be accessed via Victoria Street, with the entry located out of the Yarra River floodplain and well above flood level.

- **LSIO Decision Guidelines:** Considers the frequency, duration, extent, depth and velocity of flooding of the site and accessway and the danger to occupants of the development, other floodplain residents and emergency personnel if the site or accessway is flooded. It also considers whether the proposed use or development could be located on flood-free land or land with a lesser flood hazard outside this overlay

Response: The proposed development is located in the same location as the existing building. It does not change the level of flood hazard. It's current use and location imply an existing use right. The proposed development improves the safety on the site by removing the flood hazard associated with the car park underneath the building and provided safe (flood free) pedestrian and vehicular access from the site. There will be no increase in danger to residents because safe access is provided to and from the site and there is no change in the needs for emergency services personnel.

- **DELWP 2019 Guidelines:** The guidelines criteria aim to protect human life and health and provide safety from flood hazard. Site access requirements for children is a maximum depth of 0.5m (with a maximum velocity of 3m/s and VxD product of $0.4m^2/s$) and for small vehicles 0.3m (with a maximum velocity of 3m/s and a VxD product of $0.3m^2/s$).

Response: The proposed development achieves the safety criteria by providing flood free access for pedestrian and vehicles via Victoria Street and ensuring that the proposed basement car park has flood protection from the Yarra River. All floors from the lower ground level and upwards (above the basement car park) are set a minimum of 600mm above the applicable flood level.

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Table 7-1: Response to DELWP 2019 Guidelines Objectives and Criteria

DELWP Objectives	Criteria	Development Response	Met
Site Safety	Development and access should be located on land with the lowest overall hazard <ul style="list-style-type: none"> ▪ Depth < 0.3m ▪ Velocity < 2.0m/s ▪ VxD < 0.3m³/s 	<ul style="list-style-type: none"> ▪ The development is located in the same building envelope as the current building. ▪ The existing underground car park that is currently subject to flooding will be removed resulting in improved site safety and a reduction in potential damage. ▪ The development has pedestrian access and vehicular access to Victoria Street that is located outside the Yarra River floodplain. 	✓ ✓
Flood Damage	Freeboard must be 600mm above 1% AEP	<ul style="list-style-type: none"> ▪ The finished floor levels of the development are a minimum of 600mm above the applicable 1% AEP flood level. ▪ The apex of the entry to the basement car park is a minimum of 600mm above the Yarra River 1% AEP flood level ▪ There are no points of ingress for floodwaters into the basement. 	✓
Flood Impacts	<ul style="list-style-type: none"> ▪ Development should not increase flood levels on any adjoining properties. ▪ Development (including earthworks) should not increase the flood velocity on any adjoining property ▪ Development (including earthworks) should not divert floodwaters to the detriment of any adjoining property. 	<ul style="list-style-type: none"> ▪ The proposed development has been modelled and demonstrates no impact on flood levels and flood hazard on adjacent properties with no detriment to those properties. 	✓

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8. Conclusion

The proposed commercial and residential development has undergone assessment against State Planning Policy, the Decision Guidelines for the Land Subject to Inundation Overlay and the DELWP Guidelines for Development in Flood Affected Area (2019).

Flood modelling was undertaken to determine the potential impacts of the proposed development on flood storage and conveyance within the adjacent Yarra River corridor and floodplain. The modelling demonstrates no off-site flooding impacts with no change in flood hazard, no change in flood depths and no detrimental impact on surrounding properties.

The lower ground floor has a floor level that is set at the nominal flood protection levels for the site. The basement access and pedestrian access is located outside the Yarra River floodplain on Victoria Street. This both minimises flood damages and ensure the safety of people and community.

Flood modelling to determine localised overland stormwater flows in Victoria Street has identified ponding that occurs in the street and suggests that the crossover to be set at a minimum level of 14.75m AHD (or as specified by Council) to protect the basement car park from local stormwater flows.

The proposed development satisfies all requirements outlined in Melbourne Water's 'Grounds of objection' in their letter dated 28 July 2023. It also meets the requirements for Council with regards to local overland stormwater flows within Victoria Street.

As a final point, the proposed development achieves a reduction in existing flood risk and potential flood damage through two mechanisms: viz, the setting of finished floor levels for the lower ground floor that are no lower than the 1%AEP flood level plus freeboard and construction of a basement car park that has no openings below the 1%AEP flood level plus freeboard.

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