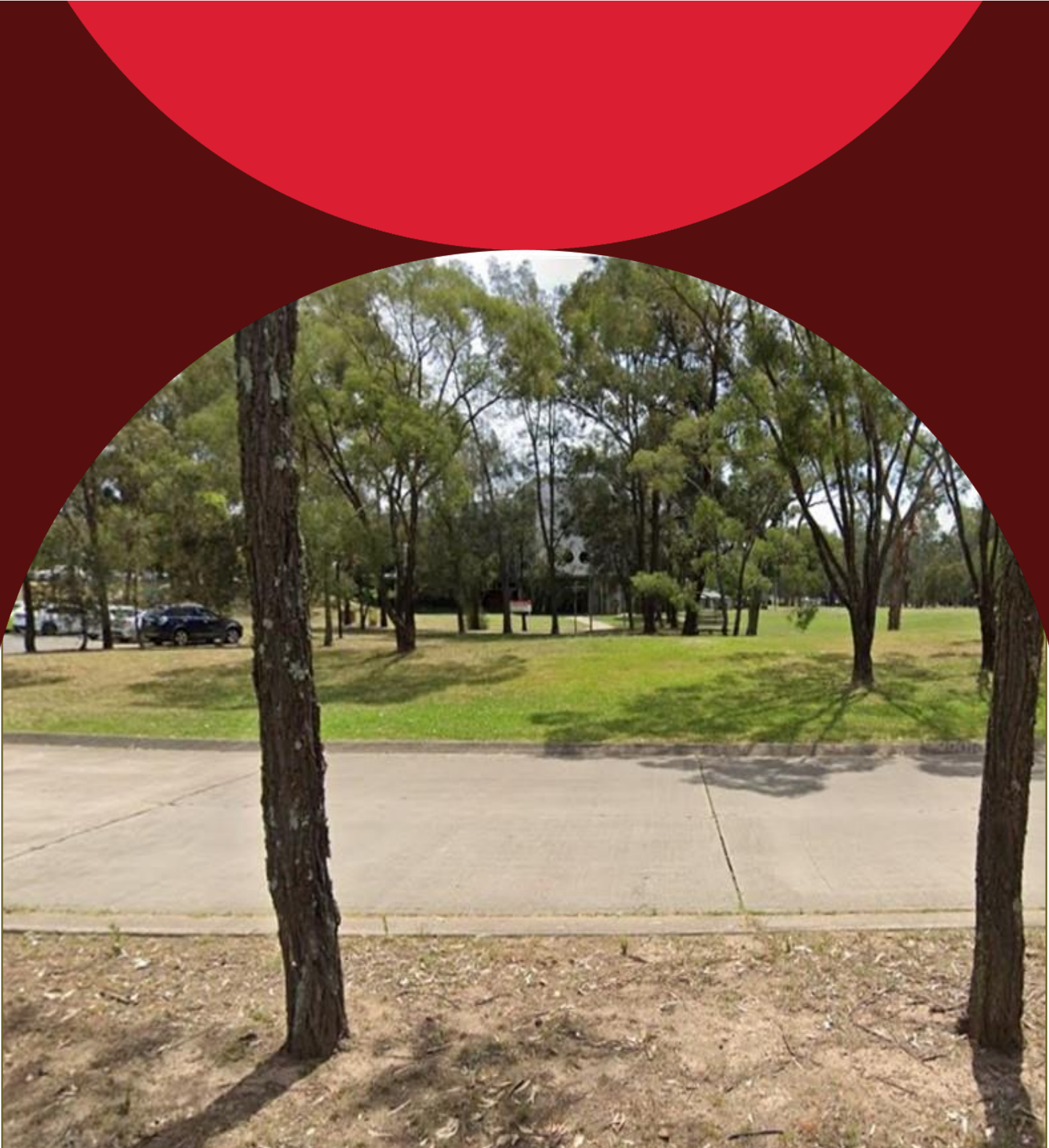


Mount Druitt Hospital Extension

Prepared for NSW Health Infrastructure

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Acronyms

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARR	Australian Rainfall and Runoff
BCC	Blacktown City Council
BoM	Bureau of Meteorology
DCP	Development Control Plan
DP	Deposited Plan
FFL	Finished Floor Level
FPA	Flood Planning Area
FPL	Flood Planning Level
FIRA	Flood Impact and Risk Assessment
FRMP	Flood Risk Management Plan
FRMS	Flood Risk Management Study
FRP	Flood Risk Precinct
HI	Health Infrastructure
HPC	Heavily Parallelised Compute
LEP	Local Environmental Plan
LGA	Local Government Area
m	Measure of length/ height/ distance (metres)
m AHD	Meters above Australian High Datum
NSW	New South Wales
PMF	Probable Maximum Flood
REF	Review of Environmental Factors
SES	State Emergency Service
TUFLOW	Two-Dimensional hydro-dynamic flood modelling software

Introduction

Northrop Consulting Engineers have been engaged by NSW Health Infrastructure, care of ACOR Consultants, to prepare a Flood Impact and Risk Assessment (FIRA) for the proposed development located at Mount Druitt Hospital, 75 Railway Street, Mount Druitt, NSW.

The purpose of this FIRA is to review the existing flooding behaviour at the site, the potential impact of the development on the existing flood behaviour and identify potential flood risks and potential mitigation measures for the proposed development.

This report is intended to accompany the Review of Environmental Factors (REF) submission in accordance with the Transport and Infrastructure (T&I) (2021) State Environmental Planning Policy (SEPP).

RELATED REPORTS AND DOCUMENTS

This correspondence has been prepared with consideration to the following guidelines, studies and documents:

- NSW Floodplain Risk Management Manual (DPHI / DECCEW, 2024);
- NSW Shelter in Place Guidelines (DPHI, 2025);
- Blacktown City Council (BCC) Local Environmental Plan (LEP);
- Blacktown City Council (BCC) Development Control Plan (2015) in particular Part A Section 9 – Development on Flood Prone Land and Section 10 – Local Overland Flooding;
- Australian Rainfall and Runoff 2019 Guidelines (AR&R 2019); and
- Blacktown City Local Flood Plan endorsed by the SES and dated August 2023.

This study has been prepared with consideration to the following plans and reports.

- Blacktown Local Overland Flow Path Study prepared by Catchment Simulations Solutions (CSS) and dated May 2020, herein referred to as the Blacktown Flood Study (CSS, 2020);
- Architectural Drawings prepared by Jacobs and dated the 29th of October 2025 (Rev C).
- Landscape Site Plans prepared by Site Image Landscape Architects (REV A) and dated 16th of October 2025.
- Landscape Site Plans prepared by Site Image Landscape Architects (REV C) and dated 29th of October 2025.
- Civil Plans prepared by ACOR Consultants and dated the 30th of October 2025
- Design surface prepared by ACOR Consultants and received on the 14th of October 2025
- Detailed Survey of the subject site prepared by Cardno and dated the 8th of April 2016
- Detailed Survey in the vicinity of the proposed extension prepared by RPS and dated the 18th of July 2025
- Utility Survey in the vicinity of the proposed extension prepared by RPS and dated the 17th of July 2025

Included herein is a description of the subject site and proposed development, a summary of the methodology used for our assessment, an overview of the existing and developed case flood behaviour in the vicinity of the site and a summary of the development compliance with respect to the aforementioned development controls.

This report has been prepared to accompany the Review of Environmental Factors (REF) submission in accordance with the Transport and Infrastructure (T&I) (2021) State Environmental Planning Policy (SEPP).

Subject Site and Proposed Development

EXISTING CHARACTERISTICS

The proposed development is located within the Blacktown City Council (BCC) Local Government Area (LGA) at the existing Mount Druitt Hospital, herein referred to as the “subject site” or “the site”. The subject site is recognised as 75 Railway Street, Mount Druitt and otherwise known as Lot 11 DP1268736. The subject site and locality is presented in the below Figure 1.

Mount Druitt Hospital is bound by Railway St to the east, Luxford Road to the north, CathWest College and the Aengus Kavanagh Education and Equity Centre to the south and Mt Druitt Central shopping centre to the west. The main entrance to the hospital is at the south-western corner of the existing building (refer to Figure 4). Access to the existing facility is via the main access driveways leading to the site from both Railway Street and Luxford Road.

The location of the proposed extension is located along the southern portion of the existing hospital in the existing landscape and open space area. A visitor’s carpark is situated in the vicinity of the proposed extension, on the southern side of the existing building, with an entrance into the carpark available from the Railway Street Access Road (refer to Figure 2).

The following Figure 2 to Figure 4 present photos of the subject site in the vicinity of the proposed development.



Figure 1 - Subject Site Locality (Six Maps)



Figure 2 - Subject Site and Adjacent Driveway Entrance - Looking North (©Google)



Figure 3 - Subject Site Driveway - Looking North-West (©Google)

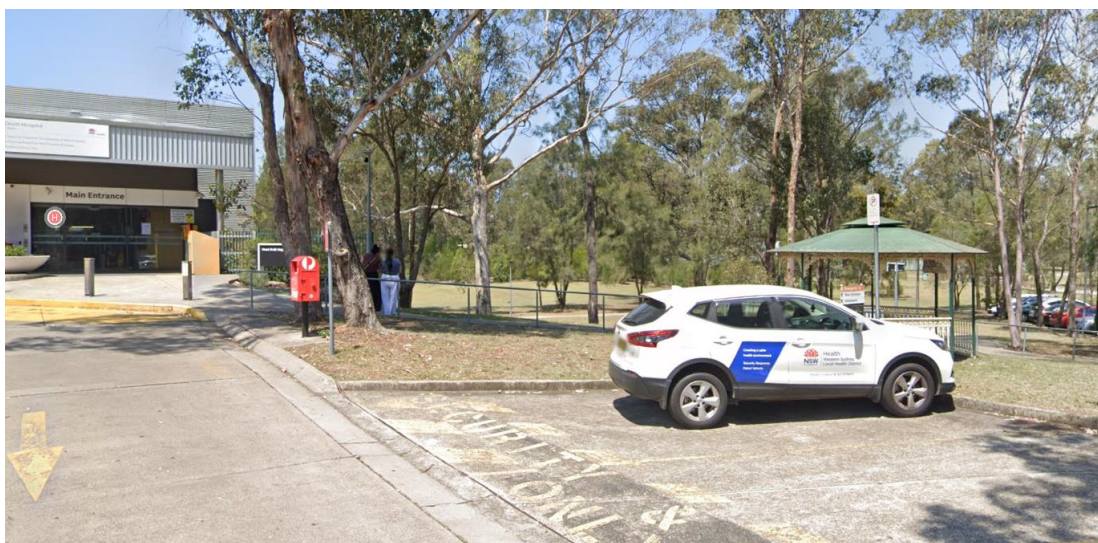


Figure 4 - Subject Site and Main Hospital Entrance - Looking East (©Google)

FLOODING MECHANISM

The site is subject to overland flow derived from the local upstream catchment. The upstream catchment is relatively small and extends approximately 250m south of the hospital into the existing CathWest College and the Aengus Kavanagh Education and Equity Centre. Overland flow derived from the upstream catchment travels in a northerly direction across the access road along the southern boundary of the site, continues around the southern portion of the existing building (in the vicinity of the proposed development) and continues around the eastern side of the hospital, across the existing heliport before connecting onto Railway Street in the north-eastern corner of the site.

The upstream catchment consists of an early learning centre, school, carparking, open space areas, trees, and roads with surrounding urban development. An area of industrial / commercial land use is also located to the west of the hospital which contributes overland flows, downstream of the proposed development.

Due to the relatively small upstream catchment, flood water is expected to rise and fall relatively quickly at the subject site with potentially limited warning time.

PROPOSED DEVELOPMENT

NSW Health Infrastructure (HI) proposes to provide 30 additional beds at Mount Druitt Hospital at 75 Railway Street, Mount Druitt as part of their delivery of infrastructure solutions and services to support the healthcare needs of the NSW communities.

To facilitate the provision of the additional beds the following works are proposed:

- Extension of the existing main hospital building across two levels at its southern-most extent:
 - Level 1 – extension to existing building
 - Relocation and Expansion of Outpatient Department (OPD) accommodating 23 separate rooms or points of care as well as ancillary rooms and spaces of about 833m².
 - New enclosed lobby of about 75m².
 - Future expansion zone (assumed as cold shell for future clinical or non-clinical purposes) of about 235m².
 - Level 2 – extension to existing building
 - New 20 bed with ensembles in-patient unit (IPU) and support spaces of about 1,085m² in area with external fire / access stairs to Level 1 / ground.
 - The 20 beds are set out in a 10 x 1-bedroom; 3 x 2-bedroom; and 1 x 4-bedroom configuration.

The works will also involve the following ancillary or supplementary works:

- Selected tree removal to accommodate the proposed development and its ancillary works, as further set out below.
- Demolition of the existing decommissioned helipad and make-good works.
- Civil and flood mitigation works to manage overland flow paths in the vicinity of the proposed extension and car park.
- Extension of the existing at-grade car park P1.
- New oxygen compound adjacent to the existing oxygen compound.
- Augmentation of the existing fire hydrant ring main adjacent to the western edge of the main hospital building and relocation and partial upgrade of the existing hydrant booster.
- Offset planting and new landscaping.

A below ground On-Site-Detention (OSD) tank is also proposed on the western side of the proposed building with landscaped garden bed above.

The extension is proposed to have a minimum Level 1 Finished Floor Level (FFL) of 61.76m AHD.

The proposed site plan is shown overleaf in Figure 5.

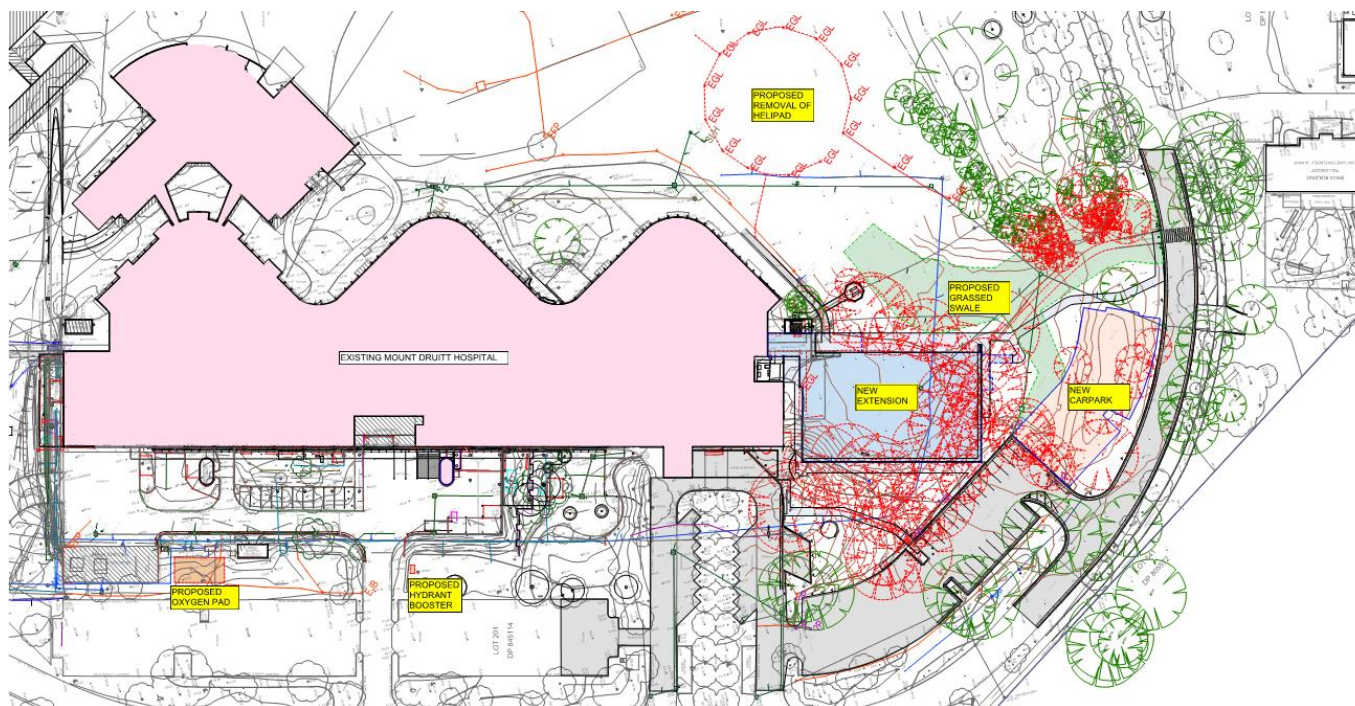


Figure 5 - Proposed Site Plan (Source: Jacobs, 2025)

Flood Mitigation Measures

DESIGN DEVELOPMENT

A series of options were investigated to mitigate flood impacts to the development and off site. The initial recommendation was to raise the building minimum Finished Floor Level (FFL) above the observed existing case flood behaviour. Through liaison with the design team including the project architect, project manager and Health Infrastructure NSW representatives, it recognised that this option was not feasible, as the extension was required to tie back into the existing FFL of the Hospital.

The alternative to raising the FFL was to modify the flood behaviour around the proposed building, to reduce flood levels and divert overland flows around the proposed building. The design criteria for this approach included a combination of:

- Eliminate the potential for local catchment overland flow across the proposed building location.
- Avoid adverse flood impacts associated with changes in flood levels (afflux); and
- Achieve an acceptable level of freeboard to the proposed building.

A series of options were investigated which include:

1. The removal of a portion of the existing carpark and introduction of an overland flow path running west to east along the southern boundary of the proposed extension.
2. A raised threshold at the current driveway entrance to the existing carpark, to reduce the potential for overland flow to continue across the location of the proposed building
3. Introduction of an additional overland flow path running south to north from the existing driveway, passing along the eastern edge of the extension and discharging just upstream of the existing helipad.
4. Variable channel widths were investigated to review opportunities to achieve an acceptable level of freeboard
5. Variable heights for the carpark raised threshold were investigated to realise a balance between upstream impacts and overland flow in the vicinity of the proposed building.

The potential for an upsized below ground stormwater network was not pursued for the purposes of the analysis due to the magnitude of flows, likely cost associated with the upsized below ground infrastructure that would be required, the increased potential for blockage, and the capacity of the downstream stormwater network in Railway Street.

Initially the analysis involved a review of two separate options one with the raised threshold at the carpark entry, and a second diverting flood water away from the building via the proposed channels. Whilst the raised threshold realised a benefit with respect to reduced flows across the location of the proposed extension, it resulted in adverse flood impacts in the properties south of the site. From these results, it was clear increased overland flow capacity was required to reduce the potential for these impacts.

Similarly, modelling that adopted just the overland flow path without the raised threshold realised too much overland flow approaching the southern boundary of the building, driving Flood Planning Levels along the southern side of the building up. As a result, a third option was pursued which adopted a combination the two options.

Following completion of the above analysis, the carpark extension and Oxygen Storage Pad was introduced which realised slightly different results. The general flood mitigation strategy remained the same with the raised driveway crest and two primary overland flow paths maintained. The adopted flood mitigation strategy is summarised below.

ADOPTED FLOOD MITIGATION MEASURES

Following the above design development, the flood mitigation measures adopted for the proposed development are summarised below:

- A raised threshold at the carpark entrance with crest level at approximately 62.15m AHD. Representing an increase of approximately 0.4-0.5m when compared to existing levels.
- A 15m wide overland flow path running south to north from the existing driveway, passing along the eastern edge of the extension and discharging just upstream of the existing helipad. An approximate average longitudinal grade of 0.017m/m was adopted.
- A 6m wide overland flow path running west to east along the southern boundary of the proposed extension. An approximate average longitudinal grade of 0.013m/m was adopted.
- At the downstream of the proposed overland flows paths was a headwall and pipe that connects to existing underground drainage on the subject site.

- A high kerb is also proposed around the existing carpark located to the south of the proposed extension as well as along the western edge of the proposed building.
- Protection of the proposed building FFL to the PMF flood event.
- The proposed Oxygen Storage Pad is to be protected to a minimum level of the 1% AEP + 500mm or the PMF (whichever is greater).

Refer to Figure A2 of Appendix A for further details.

Study Methodology

This study has been prepared generally following the below methodology:

- Desktop review of available previous investigations and information including Council adopted flood studies, proposed design plans, LiDAR, survey data, land use classifications and boundary conditions.
- Modification of the Blacktown Flood Study (CSS, 2020) TUFLOW model to include site specific elements such detailed survey and updated land use, creating the Existing Case Model.
- Modification of the updated Existing Case Model to include the proposed development. Modifications generally include the introduction of the proposed extension and terrain amendments within the TUFLOW model.
- Run updated Existing Case and Developed Case TUFLOW model for the 1% AEP and PMF design storm events.
- Prepare a comparison of the Existing and Developed case results to review the impact the proposed development has on the existing flood behaviour both on the subject site and in adjacent properties.
- Review the proposed development with respect to the flood related requirements set out by the NSW Flood Risk Management Manual (DPHI, 2023) and Blacktown City Council's LEP and DCP,

Please refer to the Model Parameters section of this report for further information with respect to the updates / amendments made to the original Blacktown Flood Study (CSS, 2020) TUFLOW model files.

Model Parameters

Detailed flood modelling presented herein is based on the Blacktown Local Overland Flow Path Study (CSS, 2020) model files provided by Council under a license agreement for the purposes of this project. The Blacktown Flood Study (CSS, 2020) TUFLOW model was used as the base model for the analysis, which was then truncated to capture the subject site and vicinity. Updated modelling presented herein included additional site-specific elements such as detailed survey, design surfaces and observations made from aerial imagery.

The below provides a summary of the updates made to the original Blacktown Flood Study (CSS, 2020) TUFLOW model. For any design parameters not outlined below, please refer to the original Blacktown Flood Study (CSS, 2020).

Hydrology

The original Blacktown Flood Study (CSS, 2020) TUFLOW model adopted a Rainfall-On-Grid (RoG) approach which has been retained for the purposes of this analysis. The RoG approach applies rainfall directly to the 2D grid and routes the runoff within the hydraulic model rather than through a separate hydrological model. The RoG approach does not couple TUFLOW with a traditional hydrologic model (such as XP-RAFTS), the hydrology is modelled within the TUFLOW model.

The RoG hydrological modelling methodology is relatively “new” with ARR 2019 recommending the results of RoG models be verified with a comparison to the results of a traditional hydrological model. This analysis was performed as part of the Blacktown Flood Study (CSS, 2020) which included a review of peak flows using a separate XP-RAFTS model. As the validation procedure and RoG methodology was adopted by the Blacktown Flood Study (CSS, 2020) this methodology is also considered suitable for the purposes of the analysis.

Hydraulics

TUFLOW SOLVER

Hydraulic modelling presented herein has maintained the TUFLOW hydraulic modelling methodology adopted by the Blacktown Flood Study (CSS, 2020). TUFLOW version 2018-03-AA-iSP-w64 was run with the Heavily Parallelised Compute (HPC) engine to maximise run time efficiency, generally in accordance with the Blacktown Flood Study (CSS, 2020). The original 2m grid size adopted by the Blacktown Flood Study (CSS, 2020) was also maintained while, Sub Grid Sampling (SGS) was not used in accordance with the Blacktown Flood Study (CSS, 2020).

GRID SIZE AND EXTENT

To increase efficiency, and to reduce model run time, the original TUFLOW model extent was truncated from a total area of approximately 20.5 km² to 0.19 km². The truncated model extent is presented in Figure A1 of Appendix A and included the local catchment area upstream of the site and extended to Railway Street, just downstream of the site.

TERRAIN

The original Blacktown Flood Study (CSS, 2020) TUFLOW model terrain was updated to include available detailed survey and surveyed pit and pipe data. The updated Existing Case model terrain is presented in Figure A1 of Appendix A.

During the Developed Case scenario, Figure A2 of Appendix A shows the design surface prepared by ACOR Consultants and received on the 14th of October 2025 was incorporated into the model. In addition, the proposed building was raised manually in the model to level above the expected flood levels to represent a total obstruction to overland flows.

A 300mm high kerb was burnt into the model manually to represent the proposed high kerb along the northern side of the existing carpark and around the western edge of the proposed building.

The proposed Oxygen Storage Pad was included in the model using a similar methodology to the proposed building, by manually raising the terrain above the limit of flooding. It is noted that a 3D survey surface around the Oxygen Storage Pad was not available at the time of preparation of this study. For the purposes of this assessment LiDAR elevation data has been used in this area. It is recommended this area continue to be reviewed during Detailed Design phase

STORMWATER NETWORK

Figures A1 and A2 of Appendix A presented the Existing and Developed Case stormwater network. The original Blacktown Flood Study (CSS, 2020) did not incorporate any underground drainage across the subject site. The site stormwater presented in Figure A1 was included in the model based on detailed survey.

A typical blockage factor of 50% and 25% was adopted for modelled pits and pipes respectively. Although the stormwater network was included in the model, the size of the pit and pipe system is relatively small in comparison to the overland flows observed during the major (1% AEP) and extreme (PMF) events considered. As such, the network is not expected significantly alter the results presented herein.

LAND USE AND SURFACE ROUGHNESS

Land use and surface roughness for both the existing and developed case scenarios are presented in Figures A3 and A4 of Appendix A.

The land use and surface roughness presented in the Blacktown Flood Study (CSS, 2020) across the subject site was generally maintained for the Existing Case modelling presented herein. During the Developed Case the site land use was updated to include the proposed building, oxygen storage zone, additional trees, the proposed channels and nearby footpaths. It is noted that the trees have been based on Revision A of the Landscape Plans dated 16th of October 2025. The latest plans (REV C) have amended the location of the trees to be located outside major overland flow paths. It is recommended the new location of trees be reviewed during future design phases to confirm more favourable results.

A pedestrian bridge is also proposed, crossing the east-west channel adjacent to the south-eastern corner of the proposed building. This was added into the flood model as a layered flow constriction with a 50% blockage beneath the bridge soffit, 100% blockage at the bridge deck (assumed 300mm thick) and 50% blockage above the bridge deck (assumed 1.2m depth) for proposed handrails.

Model Results

Model Verification

The existing case results presented herein have been validated against the results presented in the original Blacktown Flood Study (CSS, 2020). For the purposes of the verification a comparison of flood levels has been prepared for the 1% AEP. Figure A5 of Appendix A shows the flood elevation difference between the two models, while the below Figure 6 and Table 1 presents a comparison of flood depths across the site.

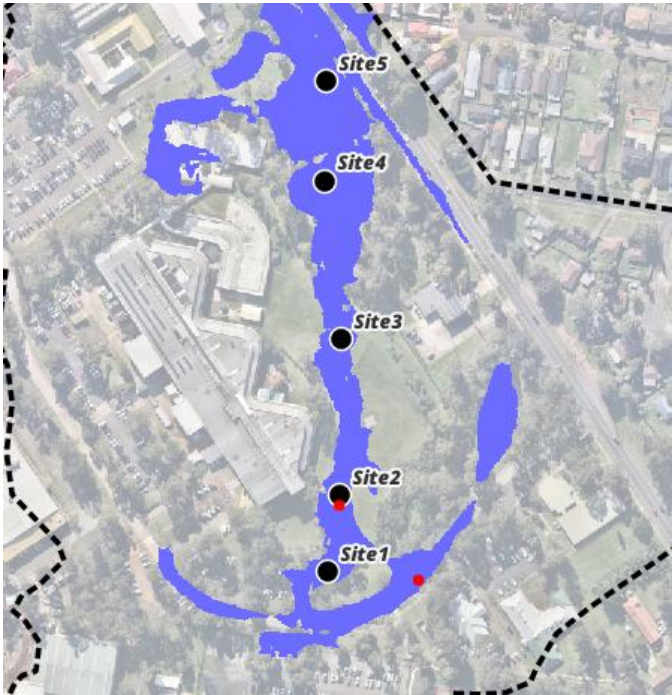


Figure 6 - Reporting Points

Table 1 - Summary Table for Comparison of Council Existing Model Results

Reporting Points (Refer to Figure 6)	1% AEP Depths Blacktown Flood Study (CSS, 2020)	1% AEP Depths Model rerun, by Northrop	Difference
	(m)	(m)	(m)
Site 1	0.34	0.31	-0.03
Site 2	0.22	0.23	0.01
Site 3	0.19	0.18	-0.01
Site 4	0.35	0.33	-0.02
Site 5	0.61	0.61	0.00

The results presented in Figure A5 of Appendix A and the above Table 1 demonstrate the Existing Case flood modelling presented herein is generally consistent with results presented by the adopted Blacktown Flood Study (CSS, 2020). The largest differences, in the order of approx. 30mm (as noted for Reporting Site 1 in Table 1), are observed around the proposed development and are attributed to the inclusion of detailed survey in this location. Elsewhere, a difference that is generally less than 10-20mm is observed across the subject site.

Critical Duration

The original Blacktown Flood Study (CSS, 2020) noted a series of critical durations for the sub-catchment that covered the site. These events included 16 events for the 1% AEP (i.e. 6 durations with varying temporal patterns) and 7 durations for the PMF event. All the abovementioned events were run for the current study with a maximum envelope of all events used for the results presented herein.

During the 1% AEP, generally the 20-minute duration was determined to be critical in the vicinity of the proposed extension. Downstream of the proposed development, in the vicinity of Railway Street, a slightly longer duration of the 30-minute and 60-minute durations were observed to be critical. This was generally consistent with the findings of the Blacktown Flood Study (CSS, 2020) which noted a 30-minute critical duration at reporting point "W_EC_41" just downstream of the subject site.

During the PMF all durations ranging from the 15-minute to the 180-minute were run with generally the 15-minute observed to be critical in the vicinity of the proposed works and the 45-minute observed downstream.

Flood Depth and Elevation

The Existing Case flood depth and elevation figures for the 1% AEP and PMF design storm events are presented in Figures A6 and A7 of Appendix A respectively. Similarly, the Flood Depth and Elevation Contours for the Developed Case 1% AEP and PMF design storm events is presented in Figures A10 and A11 of Appendix A respectively.

During the existing case 1% AEP design storm event, Figure A6 shows flood levels range from approximately 61.8m AHD to 61.2m AHD across the extent of the proposed development. These levels correspond to a depth of approximately 300mm in the vicinity of the proposed development.

During the existing case PMF design storm event, Figure A7 shows flood levels range from approximately 62.0m AHD to 61.4m AHD with depths in the order of approximately 300-500mm.

During the Developed Case 1% AEP design storm event, Figure A10 of Appendix A shows a flood level of approximately 61.4m AHD at the south-western corner of the proposed building, which decreases to approximately 61.10m AHD around the eastern side of the building. Flood depths around the southern portion of the building remain relatively shallow with generally less than 100mm observed. Flood depths increase as they continue around the eastern side of the building with depths in the order of 500mm to 1m during the 1% AEP. Around the proposed Oxygen Storage Pad, flood levels during the 1% AEP range from approximately 61.3 to 62.5m AHD.

During the Developed Case PMF design storm event, Figure A11 of Appendix A shows flood elevations around the proposed building range from approximately 62.0m AHD around the southern boundary of the building to 61.35m AHD around the east. Flood depths also range from less than 100mm to in the order of 1m during the PMF. Around the proposed Oxygen Storage Pad, flood levels during the PMF range from approximately 62.0 to 62.6m AHD.

Flood Hazard

Modelled flood hazard categories for the Existing and Developed Case scenarios during the 1% AEP and PMF design storm events are presented in Figures A8-A9 and A14 and A15 of Appendix C2.

Hazard categories are based on latest ARR2019 guidelines (based on work by prepared by Smith et al, 2014). The hazard categories are determined based on a combination of velocity and depth with each category defined by the relationships shown in Figure 7 overleaf.

Figure A8 of Appendix A shows the Existing Case hazard conditions in the vicinity of the proposed extension during the 1% AEP are generally H1 with small patches of H2 and H3. Typical H1 is safe for pedestrians and vehicles. A large ponding zone is observed in the access driveway with a relatively large portion of H2 observed as well. This suggests the entrance driveway has the potential to become non-trafficable for small vehicles under existing conditions, during the 1% AEP.

During the PMF, Figure A9 shows hazard conditions in the vicinity of the proposed extension increase to H3 and H4 which are unsafe for pedestrians and vehicles. Hazard conditions of up to H3 is observed in the access driveway, suggesting the road is no longer trafficable for small and large vehicles.

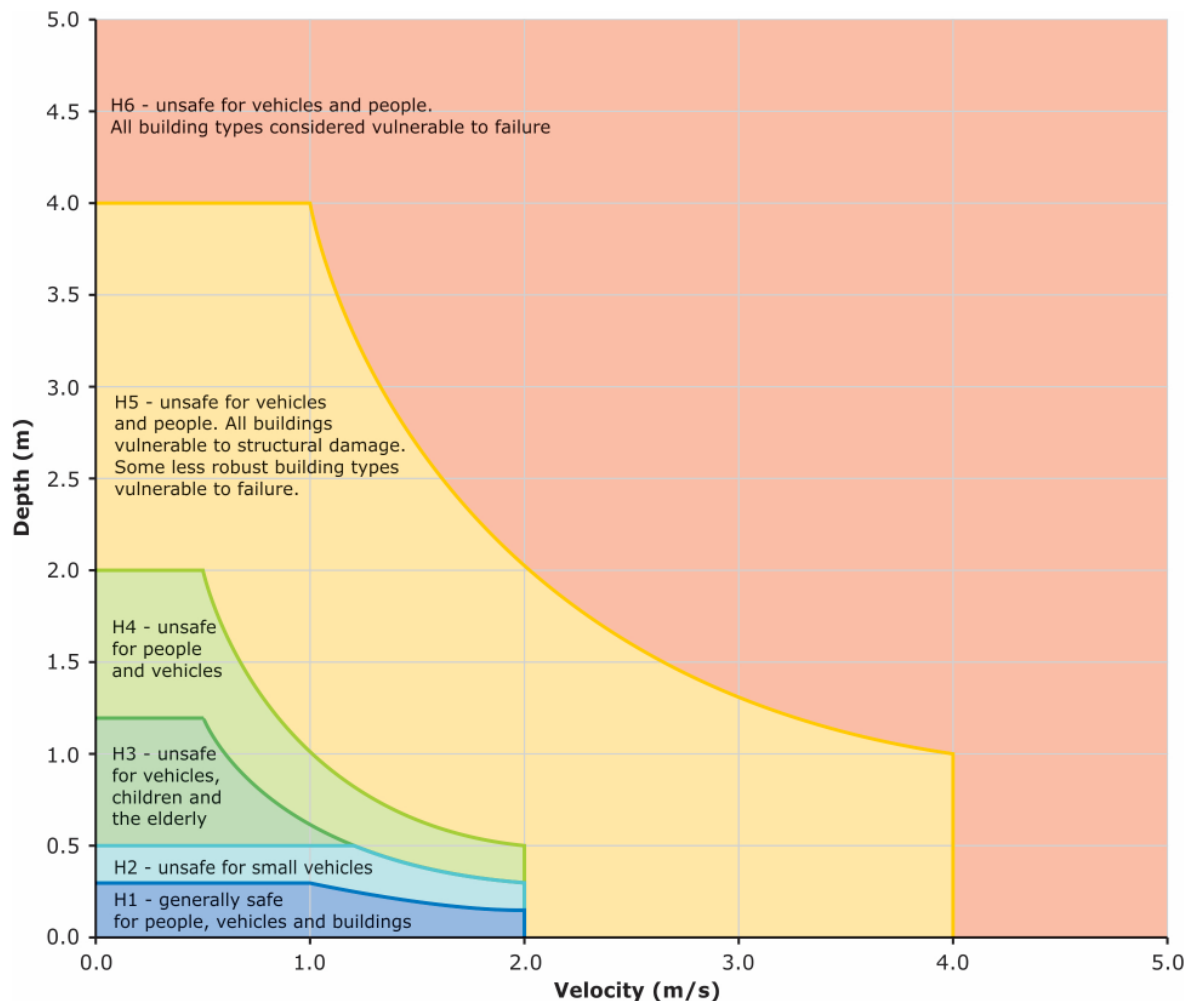


Figure 7 - ARR2019 Flood Hazard Categories (source ARR, 2019)

During the Developed Case Scenario, Figure A14 shows the extent of H2 hazard conditions in the access driveway has reduced while H1 is generally observed around the southern side of the proposed building. Up to H3 hazard conditions are observed in the channel suggesting this area is unsafe for children and elderly during the 1% AEP design storm event. Hazard conditions in the carpark extension are observed to be a maximum of H1 during the 1% AEP and as such, are expected to remain safe for pedestrians and vehicles during this event.

During the PMF, the extent of H3 in the access driveway has also reduced when compared to existing conditions with H1 generally observed in the adjacent carpark. Around the eastern side of the building, hazard conditions increase to H3 and H4 before dissipating and returning back to generally H2 as overland flows continue over the existing Helipad. In the proposed carpark extension, hazard conditions increase to H2 suggesting flows are no longer safe for small vehicles.

Flood Effects

Flood effects during the 1% AEP and PMF design storm events are presented in Figures A18 and A19 of Appendix A. A summary of the afflux impacts is provided below:

- Increases at the heliport during the 1%AEP and PMF are in the order of 0.08m and 0.13m respectively. It is understood that this helipad will be de-commissioned and as such, no impact to accessibility to the hospital is expected to be created.
- Increases in the order of 0.018-0.090m are also observed around the existing buildings along the eastern edge of the hospital including the Palliative Care Unit. An initial review of likely Finished Floor Levels around these buildings

suggests these increases have the potential to impact Flood Planning Levels to these parts of the existing facility. These increases are likely to be created by the introduction of the proposed additional trees around these facilities and as such, it is recommended these proposed trees be relocated elsewhere during future project phases to reduce these impacts.

- Similarly, increases in the order of 0.023m are observed at the southern boundary of the hospital, which is expected to be created by the introduction of the additional trees, adjacent to the boundary. It is recommended these proposed trees be relocated elsewhere during future project phases to reduce these impacts.
- Reductions are observed around the proposed building and upstream with the proposed mitigation measures successfully reducing flood levels around the proposed building.
- Localised increases in flood level are observed immediately south of the raised threshold. Approximately 0.10m in 1% AEP, and 0.15m in PMF flood event. These increases are expected to be a factor of the raised terrain more so than the elevated flood levels.
- Elsewhere, increases in flood levels are restricted to within the lot boundary with no increases observed in adjacent public and private properties.

Based on the results presented in Figures A18 and A19 and the summary above, the location of the proposed trees should continue to be reviewed during future project phases to ensure they do not create a significant adverse flood impact on the subject site or in adjacent properties.

Discussion

Potential Opportunities for Future Flood Mitigation Measures

This report recommends consideration to the following opportunities for enhanced mitigation measures during future project phases and prior to construction:

- Adjusting the location of the proposed trees to reduce the potential for adverse flood impacts to be created around the existing hospital facility and in adjacent properties.
- Adjusting the location of the proposed pedestrian footpath and crossing adjacent to the south-eastern corner of the proposed building. This footpath encourages users of the facility to enter / exit in the direction of the overland flow paths.
- If the aforementioned footpath cannot be moved / adjusted, raise the proposed bridge soffit above the limit of flooding (i.e. approx. 61.6m AHD in the area) to reduce the risk of debris blockage adjacent to the building (increasing flood levels adjacent to the building). The footpath should also rise to a location above the PMF adjacent to the proposed carpark extension to provide an opportunity for refuge, if required.
- The Oxygen Storage Area is considered an essential service for the hospital and will need to be designed to be located above the PMF, or the 1% AEP + 500mm (whichever is higher) with any pipework / service connections to this facility to be designed to withstand flood forces.
- Additional detailed survey (with 3D surface) should be obtained around the proposed Oxygen Storage Pad and added to the flood model during detailed design phase to confirm the min FFL of the Oxygen Storage area.
- As the detail around the carpark grading landscape and flood wall / kerb is refined through DD phase, the flood model should be rerun if any significant changes to terrain levels occur in the area. The flood levels are quite close to the FFL and terrain / layout updates have the potential to influence the flood levels around the building.
- Floodway signage and depth indicators are recommended to be installed around the proposed and existing channels to provide users real-time information on the potential flood depth and risk.

It is noted that additional recommendations are also noted throughout this report which should also be considered during future project phases.

Finished Floor Level

Council's Development Control Plan (Part A - Section 9.4) doesn't provide specific guidance with respect to the placement of critical or sensitive development, however it does note a minimum FFL for habitable building to be at the 1% AEP + 500mm. As the proposed development includes an extension is a public hospital and expected that the facility will need to remain operable during an extreme flood event. As such, a higher than typical habitable Flood Planning Level (FPL) is considered appropriate for the facility. For the purposes of this facility, the extension and Oxygen Storage Pad are proposed to be protected above the PMF.

As noted above, the extension is proposed to have a minimum Finished Floor Level of 61.76m AHD. This FFL has been adopted to ensure the extension ties back into the existing facility without the requirement for internal ramping. This minimum FFL was adopted following discussions with the architect, project manager and Health Infrastructure NSW and was due to limitations with respect to the operation of a split-level hospital.

As presented in the Flood Behaviour section of this report, flood levels around the proposed building during the 1% AEP design storm event range from approximately 61.40m AHD to 61.10m AHD during the 1% AEP. Similarly, during the PMF, flood levels range from approximately 62.0m AHD around the southern boundary of the building to 61.35m AHD around the east.

It is noted that the 300mm high kerb that is proposed around the southern boundary of the building provides in the order of approximately 300mm freeboard to the FFL during the 1% AEP and in the order of 150mm during the PMF. Around the eastern side of the extension, the FFL remains 750mm above the 1% AEP and 400-500mm above the PMF.

It is noted that the proposed FFL remains below a typical habitable Flood Planning Level of the 1% AEP + 500mm at the south-western corner of the building, it also remains protected above the PMF flood level. In this case, a risk-based approach has

been considered whereby, although the FFL may be below the 1% AEP + 500mm, it remains protected above the worst case PMF design storm event (i.e. remains protected above the anticipated limit of flooding).

Similarly, the proposed development is an extension to an existing facility, with limited opportunity to raise the FFL. The development has also incorporated measures to reduce the flood risk as much as practicable, with diversion channels and flood protection walls have been introduced. Further works have the potential to adversely impact access requirements into the facility and as such, a balance between the necessary flood protection and access requirements is sought.

Based on the above, the proposed FFL is considered to adopt a reasonable balance between access and flood protection requirements for the facility.

Similarly, the proposed Oxygen Storage Pad is to be protected to a level at or above the 1% AEP + 500mm or the PMF (whichever is greater) which corresponds to a minimum level of 63.0m AHD around the western edge of the pad and approx. 62m AHD around the eastern side of the pad. As noted above, a 3D survey surface around the Oxygen Storage Pad was not available at the time of preparation of this study, and as such, it is recommended this level be reviewed during Detailed Design phase.

Flood Emergency Response Measures

As previously noted, with a critical duration of 20 minutes for the 1% AEP and 15 minutes for the PMF, flooding at the subject site is expected to rise and fall over a short period of time. Events of this nature are considered flash floods and can occur with limited warning time. As such, evacuation / closure of the facility is unlikely to be possible with the anticipated warning time. It is anticipated that evacuation would likely only be required if the facility itself becomes inoperable during a flood event.

It is understood that the existing facility already includes backup measures in the event of loss of mains power and stores additional emergency supplies, if required. Additional recommended Flood Emergency Response measures may include (but are not limited to):

- The preparation of a Flood Emergency Response Plan (FERP) for the entire facility, inclusive of the proposed extension. If one already exists, the FERP shall be updated to include the proposed development;
- Connection of the proposed building to existing hospital backup systems such as backup generators / sewer / potable water etc (or introduction of these backup systems if they aren't already installed);
- Design of the proposed Oxygen Storage Pad and any connecting services to be flood proofed for all storm events up to and including the PMF design storm event.
- Development of emergency shut down & evacuation procedures, in the event that the hospital may become inoperable during a flood emergency (if not already included in an existing FERP). This may include identifying similar emergency facilities nearby where patients and staff may be relocated.
- Registration to BoM / Hazards Near Me / Early Warning Network apps / services to receive timely flood emergency warnings.
- Procedures and provisions in the event where shelter in place may be required during a flood emergency (i.e. storage of sufficient consumables, identification of on-site emergency refuge location/s etc.)
- The inclusion of floodway signage and depth indicators around the proposed channels and existing overland flow path along the eastern edge of the existing building to inform users of the facility of the potential flood risk.

In the event where the facility requires resupply, the Blacktown City Local Flood Plan (SES, 2023) notes that the SES are responsible for restocking and supply for local hospitals. It is strongly recommended the FERP for the site be prepared / updated in consultation with the SES.

Should resources become short, then re-supply will be required for the facility. A potential access and egress route to and from the hospital may be via the northern access road which connects to Luxford Road. The access road to Railway Street is expected to be hazardous for vehicles during both the 1% AEP and the PMF.

It is recommended to maintain a supply of resources to last several days in the event where Shelter in Place is required. The capacity of the hospital to provide on-going operations has not been assessed by this study and should be reviewed through the preparation / update of the existing site Flood Emergency Response Plan.

Development Compliance

State Government Requirements

The proposed development has been assessed based on the State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021 and the NSW Flood Risk Management Manual (DPE, 2023). These items are discussed in more detail below.

SEPP (TRANSPORT AND INFRASTRUCTURE) (2021)

The proposed development has been reviewed with respect to the flood related clauses presented in the State Environmental Planning Policy (SEPP) (Transport and Infrastructure) 2021, in particular Division 1 – Consultation. The following Table 2 presents the flood related requirements set out in (SEPP) (Transport and Infrastructure) 2021 as well as a response.

Table 2 - SEPP (Transport and Infrastructure) and Compliance

Reference Clause	Requirement	Development Response	Compliant?
2.12.2	A public authority, or a person acting on behalf of a public authority, must not carry out, on flood liable land, development that this Chapter provides may be carried out without consent and that will change flood patterns other than to a minor extent unless the authority or person has		
(a)	Given written notice of the intention to carry out the development (together with a scope of works) to the council for the area in which the land is located.	The REF, including the findings of this report, should be issued to Blacktown City Council during the REF notification period to provide Council the opportunity to respond to the proposal.	Expected to comply through REF submission
(b)	Taken into consideration any response to the notice that is received from the council within 21 days after the notice is given.	Responses from Blacktown City Council should be taken into consideration through the REF process.	Expected to comply through REF submission
2.13.1	A public authority, or a person acting on behalf of a public authority, must not carry out development on flood liable land that may be carried out without development consent under a relevant provision unless the authority or person has		
(a)	Given written notice of the intention to carry out the development (together with a scope of works) to the State Emergency Service, and	The REF, including the findings of this report, should be issued to the Local State Emergency Service during the REF notification period to provide the SES an opportunity to respond to the proposal.	Expected to comply through REF submission
(b)	Taken into consideration any response to the notice that is received from the State Emergency Service within 21 days after the notice is given.	Responses from the State Emergency Service should be taken into consideration through the REF process.	Expected to comply through REF submission

FLOOD RISK MANAGEMENT MANUAL (DPE, 2023)

The proposed development has been assessed using the Objectives of the latest Flood Risk Management Manual (DPE, 2023) as presented in the following Table 3.

Table 3 - Objectives of the Flood Risk Management Manual (DPE, 2023) and Compliance

Objective	Development Response
To reduce the impacts of flooding and flood liability on communities and individual owners and occupiers of flood prone property, and to reduce private and public losses resulting from floods, utilising ecologically positive methods wherever possible.	The proposed development has been designed to prevent flood water ingress for all events up to an including the PMF design storm event. As such, the proposed development aims to reduce public losses due to flooding and aims to minimise the flood risk for the proposed development, where possible. It is recommended that a FERP be prepared / updated for the proposed development to assist with further reducing residual flood risk at the subject site. The proposed development is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing / revising current site flood emergency management procedures.
Achieved Through:	
Use a merit-based approach in preparing and implementing flood risk management (FRM) plans to address riverine and local overland flooding.	A merit-based approach is sought for the proposed development. The proposal aims to minimise the existing risk on the subject site, where possible. This includes protecting the Finished Floor Level of the proposed building to a height that is above the PMF, protecting the Finished Floor Level of the Oxygen Storage Pad to the 1% AEP + 500mm or the PMF (whichever is higher), designing the carpark to maintain maximum H1 hazard during the 1% AEP and preparing / updating a FERP for the site. The proposed development is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing current site flood emergency management procedures.
Reduce the impact of flooding and flood liability on existing developed areas identified in FRM plans through flood mitigation works and measures including ongoing emergency management (EM) measures, the raising of houses where appropriate and by development controls.	The proposal aims to minimise the existing risk by protecting the Finished Floor Level of the proposed building to a height that is above the PMF, protecting the Finished Floor Level of the Oxygen Storage Pad to the 1% AEP + 500mm or the PMF (whichever is higher), designing the carpark to maintain maximum H1 hazard during the 1% AEP and preparing / updating a FERP for the site. This strategy is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing / revising current site flood emergency management procedures.
Adopt a merit-based approach for all development decisions in the floodplain, taking into account social, economic and ecological factors, as well as flooding considerations.	A merit-based approach sought for the proposed development. The proposal aims to minimise the existing risk on the subject site, where possible. This includes protecting the Finished Floor Level of the proposed building to a height that is above the PMF, protecting the Finished Floor Level of the Oxygen Storage Pad to the 1% AEP + 500mm or the PMF (whichever is higher), designing the carpark to maintain maximum H1 hazard during the 1% AEP and preparing / updating a FERP for the site. The proposed development is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing current site flood emergency management procedures.

Objective	Development Response
Limiting the potential for flood losses in all areas proposed for development or redevelopment by the application of ecologically sensitive planning and development controls.	The proposal aims minimise the existing risk by protecting the Finished Floor Level of the proposed building to a height that is above the PMF, protecting the Finished Floor Level of the Oxygen Storage Pad to the 1% AEP + 500mm or the PMF (whichever is higher), designing the carpark to maintain maximum H1 hazard during the 1% AEP and preparing / updating a FERP for the site. This strategy is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing / revising current site flood emergency management procedures.

In addition to the Objectives, the proposed development has been reviewed with respect to the supporting guideline – Understanding and Managing Flood Risk (FB01). Section 3.6 of FB01 outlines additional recommendations to assist with managing the flood risk for Community Hospitals. These are summarised in Table 4 overleaf.

Table 4 - Floodplain Development Manual (LU01 - Section 3.6)

Reference	Requirement	Development Response	Compliant?
1	Where the facility cannot be located outside the floodplain, it is best located in areas of limited flood impacts, such as flood planning constraint category (FPCC) 4 or potentially FPCC3	The proposed development is limited to the proposed location as it is an extension to an existing hospital facility. The proposed extension is expected to be located within Flood Planning Constraint Category 3 (FPCC3) as it is below the Flood Planning Level (but above the PMF). As it is located in FPCC3, it is considered compliant.	Yes
2	Floor levels of emergency medicine areas and patient wards above an extreme flood level (such as the PMF) may mean these do not need to be evacuated if services can be maintained.	The FFL of the proposed building is protected to a level above the PMF while the proposed Oxygen Storage Pad is protected above the 1% AEP + 500mm or the PMF (whichever is higher). Similarly, service connections to the proposed Oxygen Storage Pad are to be designed be flood proofed for all events up to and including the PMF design storm event, As such, the proposed development is considered compliant with this requirement. Should services be maintained no evacuation is required.	Yes
3	The location and protection of backup utility services so they can be operational and accessible and are available during floods	The proposed Oxygen Storage Pad is protected to a level above the 1% AEP + 500mm or the PMF (whichever is higher). Similarly, service connections to the proposed Oxygen Storage Pad are to be designed be flood proofed for all events up to and including the PMF design storm event, Furthermore, it is recommended the existing location of backup utility services and their operating capacity during the PMF, be reviewed to ensure the existing and proposed facility can remain operational during a PMF.	TBC

Reference	Requirement	Development Response	Compliant?
4	Resupply of essential goods, equipment and materials during floods so the facility can continue to operate.	Access and egress to / from Mt Druitt hospital is expected to be limited, but possible via from Luxford Road during events up to and including the PMF. Access from Railway Street is possible in the 1% AEP only for larger vehicles. Any resupply would need to be delivered via high ground such as via the emergency department which is outside the PMF flood extent. As outlined in the Blacktown Local Flood Plan (SES, 2023) it is the responsibility of the SES to resupply community hospitals (if required) during a flood emergency. Regardless, it is recommended that enough materials and equipment be stored on-site to enable continued operation during a flood event for at least 72 hours (in case of a power outage). This should be revised if resupply takes longer.	Yes (1% AEP) Needs to be carefully managed by the operator (PMF)
5	Adequate room for storage of waste products away from floodwaters to avoid contamination	Location for storage of waste products within the proposed extension is expected to be protected the PMF (as the FFL is protected above the PMF) and as such, the proposed development is expected to satisfy this requirement. Location of storage elsewhere on the site is to be confirmed. If situated above FFL which is above PMF then the storage of waste is not expected to be flooded and therefore would avoid contamination.	Yes
6	Design of the site to maximise accessibility of emergency and staff entries into the hospital during floods. This may affect the location and design of the entrance	Access and egress to / from the proposed new building by pedestrians is expected to be possible from within the existing facility. Externally, limited access may be possible surrounding the proposed building with doorways fronting the proposed channel and floodwaters on the eastern and southern side of the building. It is recommended access and egress to and from the proposed extension be achieved from inside the existing facility rather than externally during the peak of a flood event.	Yes
7	Likelihood of some staff having their homes affected by flooding and their need to look after family members.	There is the potential for many staff's homes to be affected by flooding during a flood event. Staffing will need to be carefully managed by the operator during a flood event. Alternative arrangements may need to be organised including accommodation for existing workers, or re-distribution of resources from other nearby similar facilities. It is noted that re-distribution of resources puts more people at risk and in the potential path of the hazard. It is recommended redistribution of	Needs to be carefully managed by the operator

Reference	Requirement	Development Response	Compliant?
		resources only occur prior to or after a flood event.	

Local Government Requirements

LOCAL ENVIRONMENTAL PLAN

The proposed development has been assessed with respect to the Blacktown City Council Local Environmental Plan (LEP) (2015). The following Table 5 presents the flood related requirements set out by the LEP and the development response to the requirements.

Table 5 - Blacktown Council Local Environmental Plan (2015) and Development Compliance.

Reference Clause	Requirement	Development Response	Compliant?
5.21(2)	Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development		
(a)	Is compatible with the flood function and behaviour on the land.	The proposed building has been sited to be protected to a level above the PMF event. Similarly, the proposed Oxygen Storage Pad is to be protected above the 1% AEP + 500mm or the PMF (whichever is higher). It is recommended the location of the proposed trees is expected to continue to be reviewed during future project phases to ensure they do not adversely impact existing flood behaviour on the subject site or in adjacent properties. It is noted that since the preparation of the modelling presented herein, the trees have been adjusted to be located outside major flow paths, which is recommended to be tested during Detailed Design. The proposed development is considered compatible with the flood function of the land.	Likely to be possible, subject to future review of impacts.
(b)	Will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties.	As presented in the Flood Effects section of this report, the location of the proposed trees is expected to continue to be reviewed during future project phases to ensure they do not adversely impact existing flood behaviour on the subject site or in adjacent properties. It is noted that since the preparation of the modelling presented herein, the trees have been adjusted to be located outside major flow paths, which is recommended to be tested during Detailed Design.	Likely to be possible, subject to future review of impacts.

Reference Clause	Requirement	Development Response	Compliant?
(c)	Will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood.	As shelter in place is expected to be available within the proposed development, impacts on existing evacuation routes is not expected to occur. It is recommended the existing site FERP be updated to include the proposed development or a new FERP be prepared for the subject site. Further liaison with the SES is recommended to ensure the proposed strategy is consistent with, and will not impact on, the existing regional emergency management measures already in place for the area.	Yes Further Liaison with SES Recommended
(d)	Incorporates appropriate measures to manage risk to life in the event of a flood.	The proposal aims minimise the existing risk by raising the Finished Floor Level of the proposed building to a height that is above the PMF, raising the Finished Floor Level of the Oxygen Storage Pad to the 1% AEP + 500mm or the PMF (whichever is higher), designing the carpark to maintain maximum H1 hazard during the 1% AEP and preparing / updating a FERP for the site. It is recommended the existing site FERP be updated to include the proposed development or a new FERP be prepared so as to reduce residual flood risk on the subject site. This strategy is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing / revising current site flood emergency management procedures.	Yes

Reference Clause	Requirement	Development Response	Compliant?
(e)	Will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.	As presented in the Flood Effects section of this report, the location of the proposed trees is expected to continue to be reviewed during future project phases to ensure they do not adversely impact existing flood behaviour on the subject site or in adjacent properties. It is noted that since the preparation of the modelling presented herein, the trees have been adjusted to be located outside major flow paths, which is recommended to be tested during Detailed Design.	Likely to be possible, subject to future review of impacts.
5.21(3)	In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters		
(a)	The impact of the development on projected changes to flood behaviour as a result of climate change.	The proposed FFLs are raised above the PMF and is well above Sea Level Rise projections. As such, potential impacts due to climate change are not expected to significantly adversely affect the proposed development.	Yes
(b)	The intended design and scale of buildings resulting from the development.	As presented in the Flood Effects section of this report, the location of the proposed trees is expected to continue to be reviewed during future project phases to ensure they do not adversely impact existing flood behaviour on the subject site or in adjacent properties. It is noted that since the preparation of the modelling presented herein, the trees have been adjusted to be located outside major flow paths, which is recommended to be tested during Detailed Design.	Likely to be possible, subject to future review of impacts.

Reference Clause	Requirement	Development Response	Compliant?
(c)	Whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood.	The proposal aims minimise the existing risk by raising the Finished Floor Level of the proposed building to a height that is above the PMF, raising the Finished Floor Level of the Oxygen Storage Pad to the 1% AEP + 500mm or the PMF (whichever is higher), designing the carpark to maintain maximum H1 hazard during the 1% AEP and preparing / updating a FERP for the site. This strategy is expected to minimise risk by improving the current site understanding of the existing hazard and will assist to minimise risk by enhancing / revising current site flood emergency management procedures.	Yes
(d)	The potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.	Opportunities to relocate the facility are expected to be limited as the proposed development includes an extension to the existing hospital.	Yes

DEVELOPMENT CONTROL PLAN

The proposed development has been assessed with respect to the Blacktown City Council Development Control Plan in particular Part A – Section 9.4 – Control of Development on Flood Prone Land. The following Table 6 presents the flood related requirements set out by the DCP and the development response to the requirements.

Table 6 – Development Compliance with BCC DCP Part A, Section 9.4.

Reference Clause	Requirement	Development Response	Compliant?
9.4.1	In determining any application for development on land designated as being within the floodway or flood fringe, Council will take into consideration those matters listed under Section 79C of the Environmental Planning and Assessment Act 1979 as appropriate. Council shall also take into consideration the following:		
(a)	Whether the proposed building materials are suitable	The proposed building is protected from flooding for all events up to and including the PMF. Similarly, the proposed Oxygen Storage Pad is to be protected to a level above the 1% AEP + 500mm or the PMF (whichever is higher) with any service connections flood proofed for all events up to and including the PMF.	Yes
(b)	Whether the buildings are to be sited in the optimum position to avoid flood waters and allow evacuation	The proposed building has been sited with consideration to the connectivity to existing building elements. Vertical evacuation / shelter in place is expected to be possible within the proposed building during all events up to and including the PMF. Similarly, the proposed Oxygen Storage Pad is to be protected above the 1% AEP + 500mm or the PMF (whichever is higher).	Yes
(c)	Whether proposed structures or the filling of land are likely to affect flood flows	As presented in the Flood Effects section of this report, the location of the proposed trees is expected to continue to be reviewed during future project phases to ensure they do not adversely impact existing flood behaviour on the subject site or in adjacent properties. It is noted that since the preparation of the modelling presented herein, the trees have been adjusted to be located outside major flow	Likely to be possible, subject to future review of impacts.

Reference Clause	Requirement	Development Response	Compliant?
		paths, which is recommended to be tested during Detailed Design.	
(d)	Whether consultation with other authorities is considered necessary (e.g. NSW Office of Water)	Consultation with authorities noted in the SEPP (TI) is expected to occur through submission of the REF.	Expected to comply through REF submission
(e)	The NSW Government Floodplain Development Manual 2005	A response to the requirements set out in the latest Flood Risk Management Manual (2023) is present in the above Table 3 and Table 4.	Yes
9.4.2	Development within the Floodway	The extent of the development is subject to low hazard flood behaviour during the Defined Flood Event (i.e. 1% AEP). As such, it is not expected to be located within the floodway.	Yes
9.4.3	Development within the flood fringe	The development is located within low flood hazard conditions during the DFE and as such is considered to be located within Flood Fringe.	Yes
(a)	An application for the erection of new buildings or the raising or rebuilding of existing buildings (other than buildings ancillary to the use of the land for agriculture and cultivation purposes, excluding poultry farming and pig keeping) must be accompanied by a survey plan	Survey has been captured over the extent of the proposed building.	Yes
(b)	Prior to determining the application, Council may require the submission of the details referred to under Section 9.4.2 above	The requirements set out in 9.4.2. have been addressed herein.	Yes
(c)	For residential buildings, habitable floor levels should be at a level at least 500mm above the designated flood level	The proposed building is protected from flooding for all events up to and including the PMF. Similarly, the proposed Oxygen Storage Pad is to be protected at or above the 1% AEP + 500mm or the PMF (whichever is higher).	Merits Based Approach

Reference Clause	Requirement	Development Response	Compliant?
		Please refer to the above Finished Floor Level Section of this report for details.	
(d)	Floor levels, other than habitable floor levels, will be determined by Council on the basis of each individual case. For industrial and commercial buildings, the floor level should be at least 300mm above the designated flood level	The proposed building is protected from flooding for all events up to and including the PMF. Similarly, the proposed Oxygen Storage Pad is to be protected at or above the 1% AEP + 500mm or the PMF (whichever is higher). Please refer to the above Finished Floor Level Section of this report for details.	Merits Based Approach
(e)	The maximum height between the natural ground level (i.e. ground level prior to any filling of the land) and the habitable floor level shall be 3m.	Filling beneath the proposed FFLs do not exceed 3m.	Yes
(f)	Where additions are proposed to an existing building which is located below the designated flood level, Council will generally permit additions to a maximum of 10% of the existing floor area. The finished floor level of such additions should be 500mm above the designated flood level, but Council will consider each application on its merits having regard for the proposed use of the additions, the existing levels and flood behaviour	The proposed extension has been sited to be protected from flooding for all events up to and including the PMF. Please refer to the above Finished Floor Level Section of this report for details.	Yes
(g)	The rebuilding of existing buildings shall comply with (a) to (e) inclusive above	The development does not propose to rebuild an existing building. As such, this item is Not Applicable.	N/A
(h)	Council will consider any application for the rezoning of flood prone land on its merits. Generally, Council will not support a Planning Proposal which, once development has occurred, would result in an increase in the potential for personal and/or property damage	Rezoning is not proposed. As such, this item is Not Applicable.	N/A
(i)	Where an application is made to Council for the subdivision of land creating additional lots, Council will only grant consent if it is satisfied that future development on that land could be undertaken in accordance with the	Subdivision is not proposed. As such, this item is Not Applicable.	N/A

Reference Clause	Requirement	Development Response	Compliant?
	provisions of this DCP in relation to development on flood prone land. Where subdivision is approved in industrial and commercial zones, the land must be filled to 300mm above the designated flood level. For subdivision in residential zones, Council will require land to be filled to 500mm above the designated flood level		
(j)	The filling of land, whether to permit the erection of buildings or otherwise, shall be to the satisfaction of Council's Development Services staff in addition to Council's Investigation and Design staff. Applicants are advised that, in considering the acceptable habitable floor level, Council will have regard for the depth of filling above natural ground level and its stability, together with possible interference with the flow of flood waters	Filling beneath the proposed FFLs do not exceed 3m. As presented in the Flood Effects section of this report, the location of the proposed trees is expected to continue to be reviewed during future project phases to ensure they do not adversely impact existing flood behaviour on the subject site or in adjacent properties. It is noted that since the preparation of the modelling presented herein, the trees have been adjusted to be located outside major flow paths, which is recommended to be tested during Detailed Design.	Likely to be possible, subject to future review of impacts.
(k)	Buildings are to be constructed with approved materials, resistant to damage by immersion by flood waters for prolonged periods, to the satisfaction of Council.	The proposed building is protected from flooding for all events up to and including the PMF. Similarly, the proposed Oxygen Storage Pad is to be protected at or above the 1% AEP + 500mm or the PMF (whichever is higher).	Yes

Conclusion

Northrop Consulting Engineers have been engaged by NSW Health Infrastructure, care of ACOR Consultants, to prepare a Flood Impact and Risk Assessment (FIRA) for the proposed development located at Mount Druitt Hospital, 75 Railway Street, Mount Druitt, NSW. The proposed development is situated on the southern portion of the existing hospital between the hospital and the southern carpark as well as in the western carpark.

Flood modelling has been prepared herein to review the potential impact the proposed development has on the existing flood behaviour on the subject site and in the vicinity. A comparison between the Existing and Developed case results for the 1% AEP and PMF has been prepared herein.

The modelling presented herein concludes that the location of the proposed trees has the potential to impact existing Flood Planning Levels on the subject site, and increases flood levels in adjacent properties by up to 23mm. As such, it is expected these impacts will and the location of the proposed trees will continue to be reviewed during future project phases to ensure they do not adversely impact existing flood behaviour on the subject site or in adjacent properties.

It is noted that since the preparation of the modelling presented herein, the trees have been adjusted to be located outside major flow paths, which is recommended to be tested in the flood model during Detailed Design.

The developed case includes measures to avoid the proposed development from being inundated with floodwater during events up to and including the PMF. The modelling presented herein suggests that the proposed building extension will have a freeboard of approximately 150mm on the southern side in the PMF. On the eastern side of the building a freeboard of approximately 400-500mm during the worst case PMF event.

Similarly, the Oxygen Storage Pad is proposed to be protected to a minimum level of the 1% AEP + 500mm or the PMF (whichever is higher). Further modelling is recommended to occur during future project phases to include 3D survey around the Oxygen Storage Pad and to confirm the Flood Planning Levels for the Pad as noted herein.

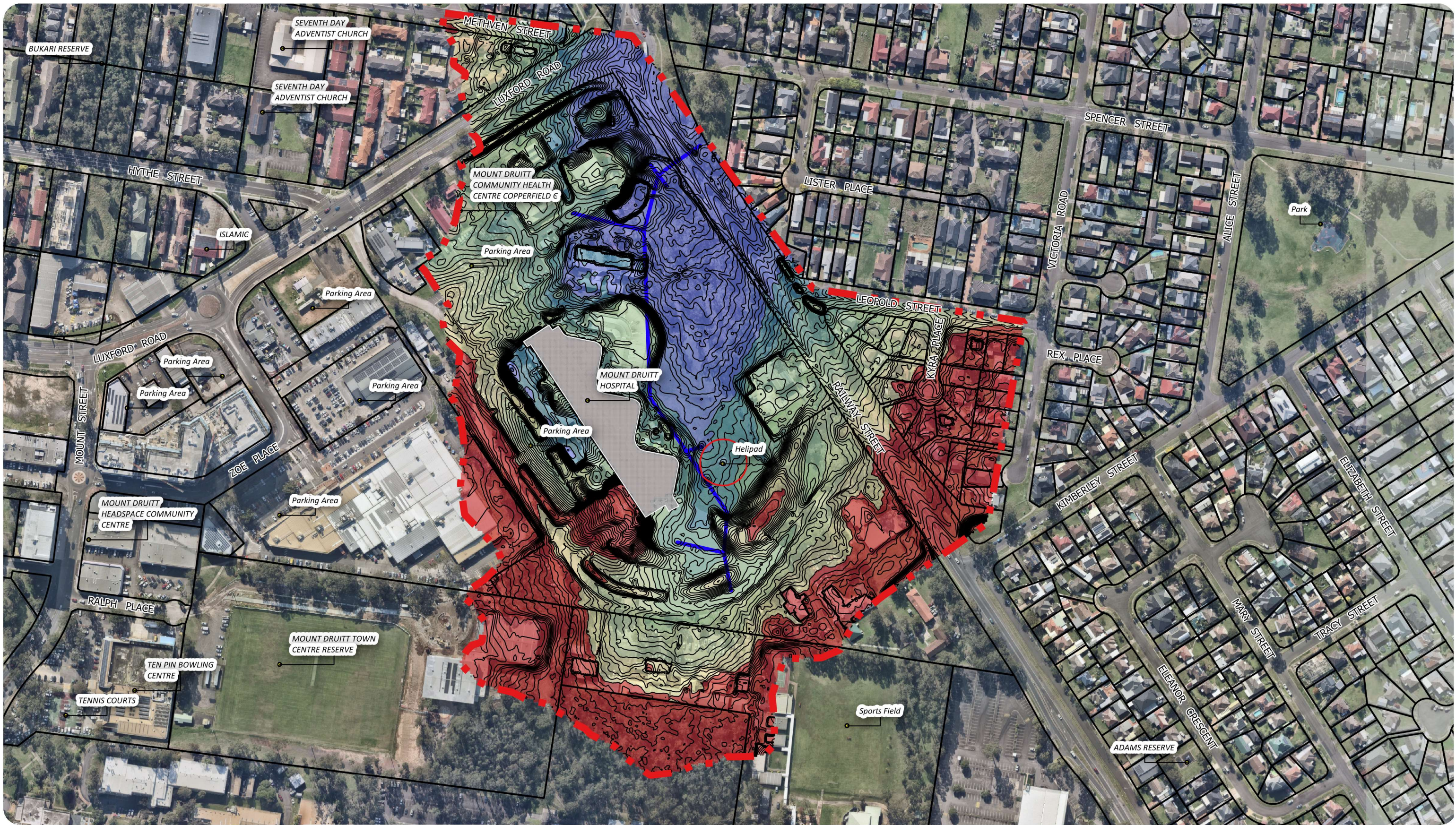
Furthermore, the existing flood emergency response strategy at the site is recommended to be updated to include the proposed development. Through the introduction of hard engineered flood mitigation measures (e.g. protecting the FFL at or above the limit of flooding) and the enhancement of existing on-site behavioural measures (e.g. updating the existing FERP / preparing a new one), flood risk on the subject site is considered to be managed appropriately for the proposed development.

NORTHROP



Appendix A – Flood Figures

Maps Category	Reference
TUFLOW Model Setup	Refer to Figures A1 - A4
Verification with Adopted Study	Refer to Figure A5
Existing Case Flood Behaviour	Refer to Figures A6 - A9
Developed Case Flood Behaviour	Refer to Figures A10 - A15
Peak Flows	Refer to Figures A16-A17
Flood Effects	Refer to Figures A18-A19



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NORTHROP

- Model boundary
- Property Boundary
- Existing Heliport Site
- Existing Hospital Building
- Existing drainage

Level (m AHD)			
	60.5 - 61.0	62.0 - 62.5	
 	61.0 - 61.5	62.5 - 63.0	
 	61.5 - 62.0	> 63.0	
 			

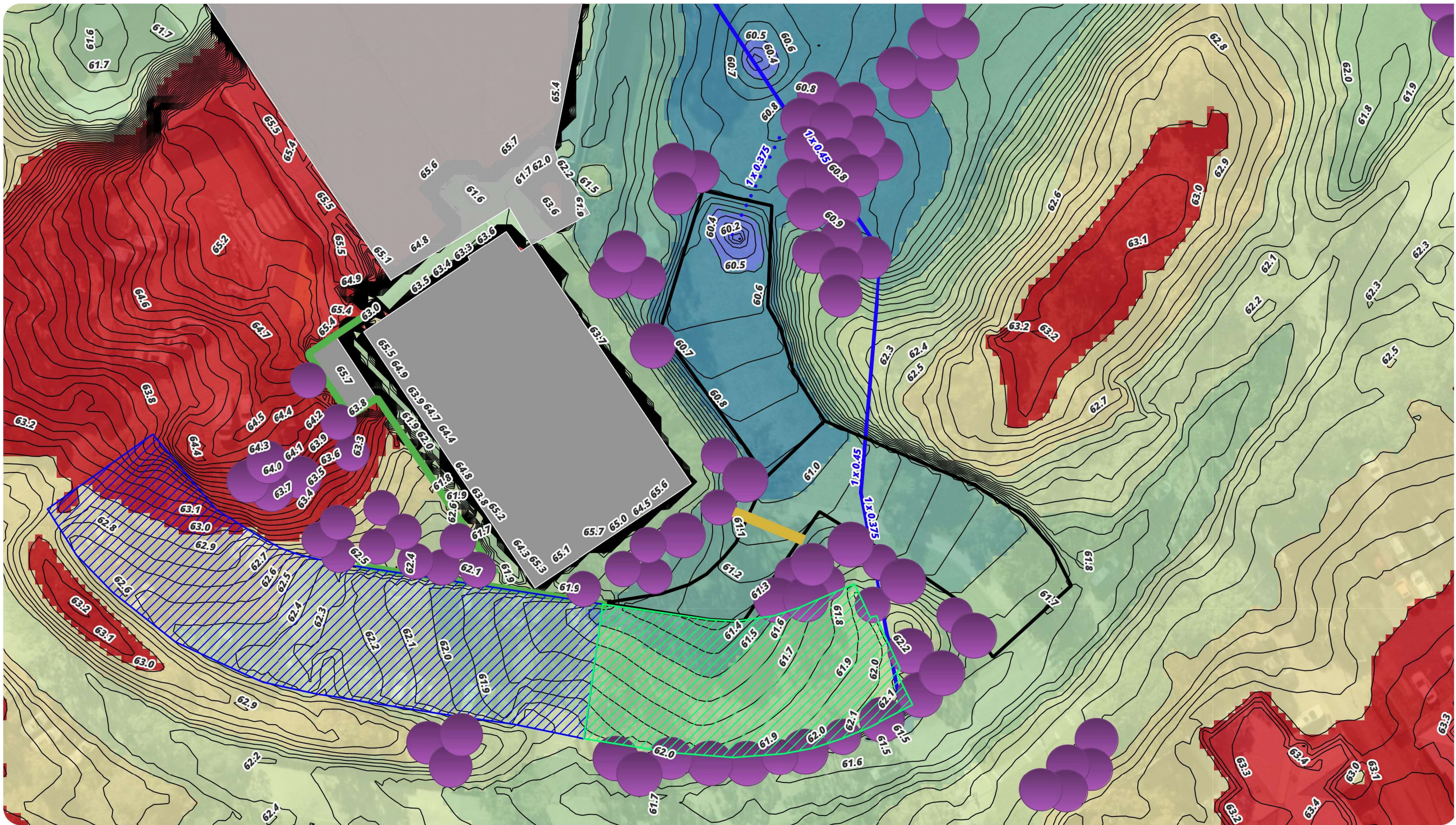
A3 scale 1:3000
EPSG:28356

N

0 30 60 90 m

Existing Case

Terrain and Stormwater Network
Figure A1



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- | | |
|----------------------------|----------------------|
| Model boundary | Proposed Channel |
| Property Boundary | Proposed Building |
| Existing Hospital Building | Existing Carpark |
| Existing drainage | Proposed New Carpark |
| New drainage | Proposed Tree |
| Proposed Floodwall | Proposed Footbridge |

Level (m AHD)	60.5 - 61.0	62.0 - 62.5
<= 60.0	61.0 - 61.5	62.5 - 63.0
60.0 - 60.5	61.5 - 62.0	> 63.0

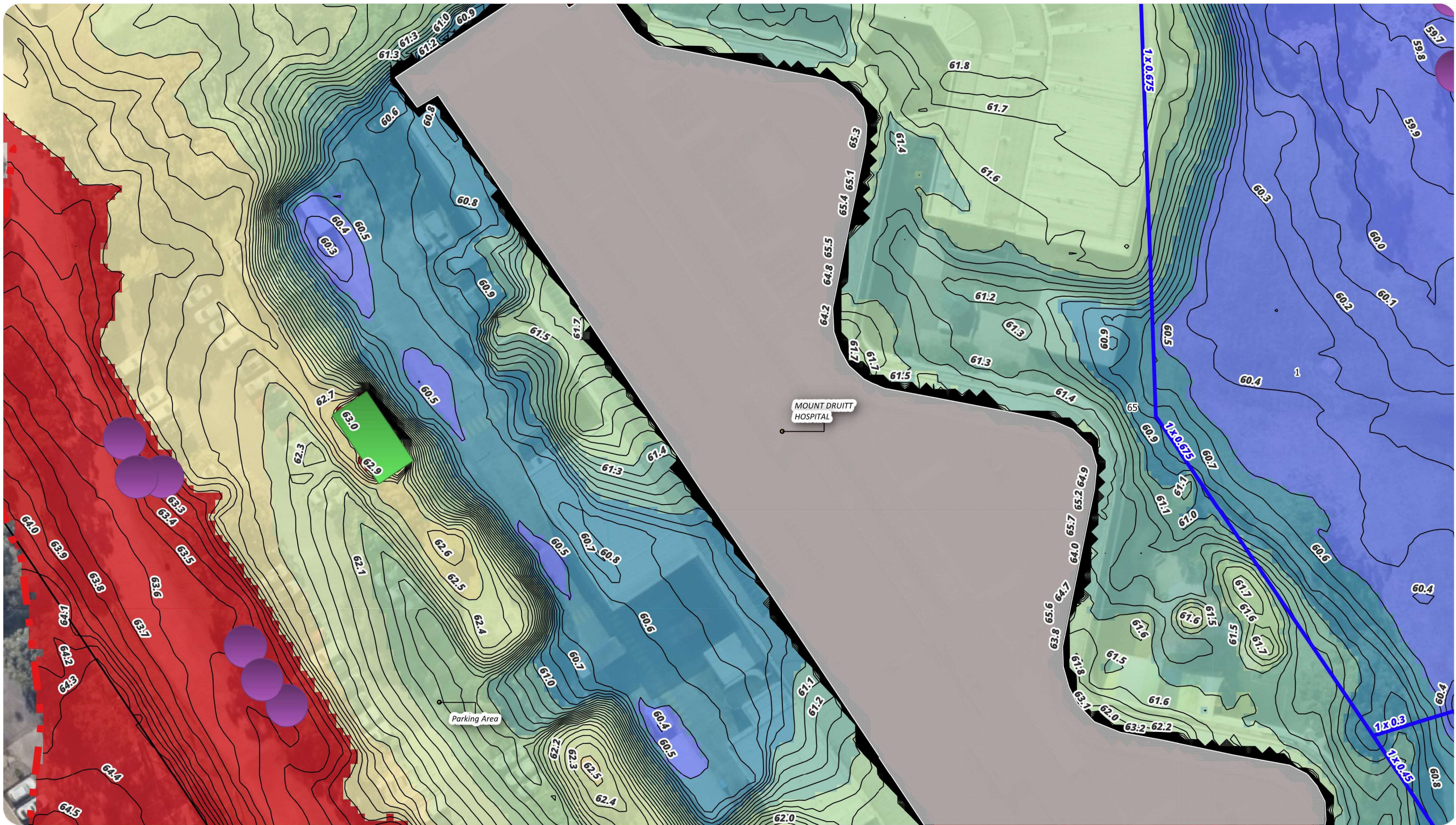
A3 scale 1:500
EPSG:28356

N

0 6 12 18 m

Developed Case

Terrain and Stormwater Network
Figure A2



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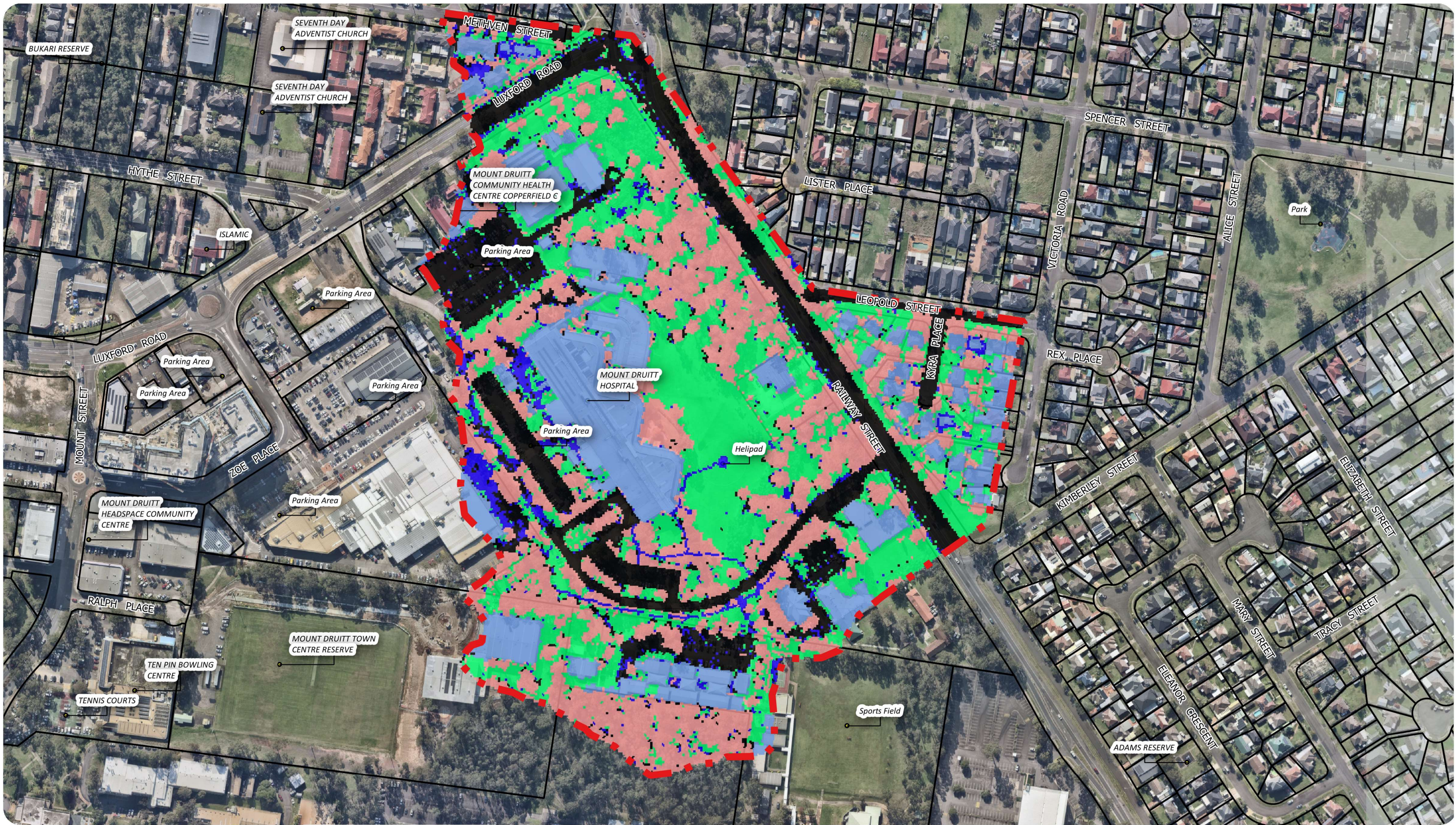


A3 scale 1:500
EPSG:28356



Developed Scenario

Terrain and Stormwater Network
Figure_A2_b



Model boundary
 Property Boundary

Land Use
 Building
 Trees
 Grass/ Open Space
 Concrete
 Road

A3 scale 1:3000
 EPSG:28356



0 30 60 90 m

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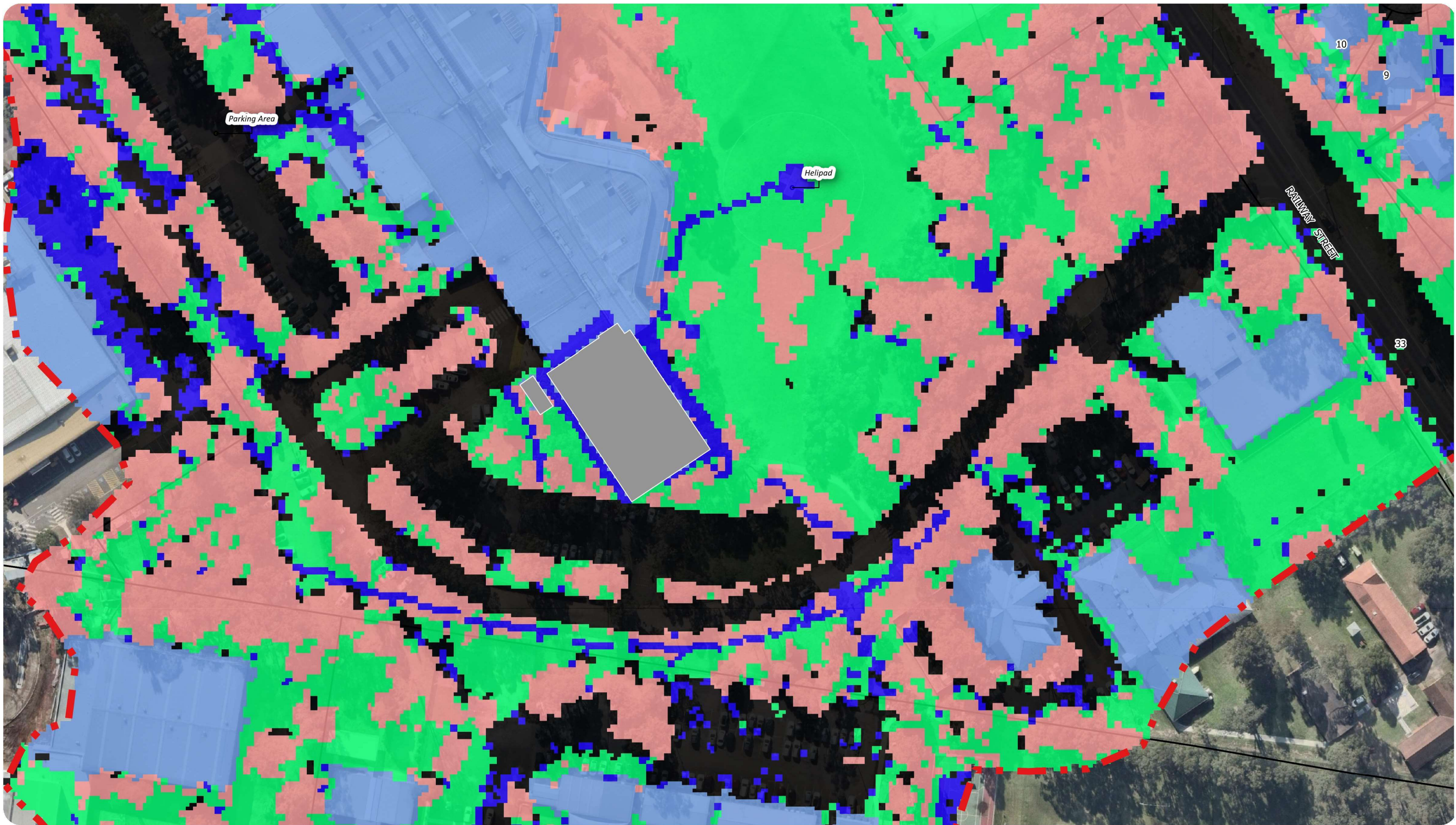
JOB NAME
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Existing Case

Landuse and Roughness

Figure A3

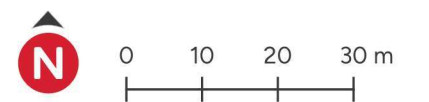
NORTHROP



 Model boundary
  Proposed Building
 Property Boundary

Land Use
 Trees
 Grass/ Open Space
 Building
 Road
 Concrete

A3 scale 1:1000
 EPSG:28356

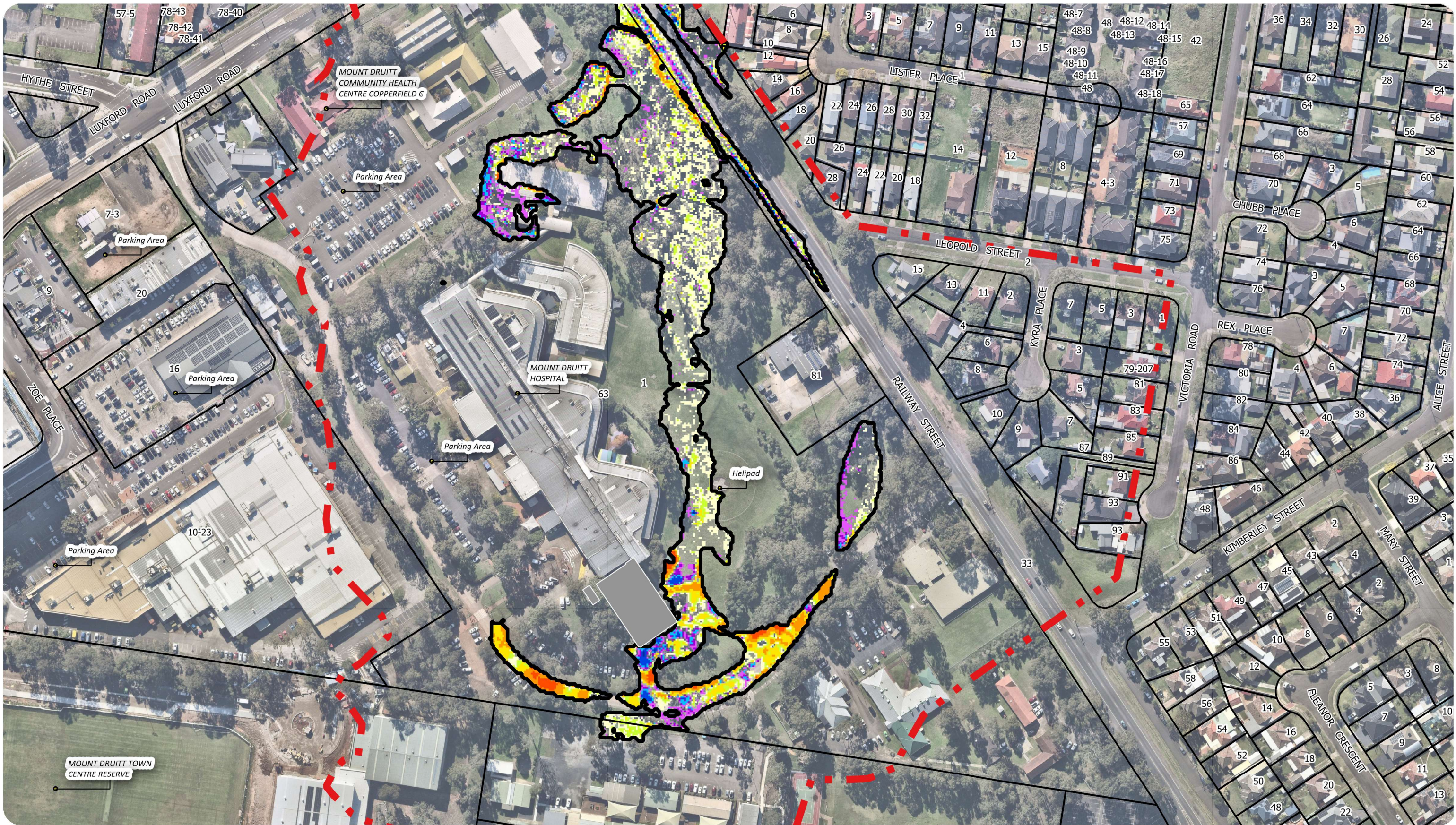


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Developed Case

Landuse and Roughness
 Figure A4



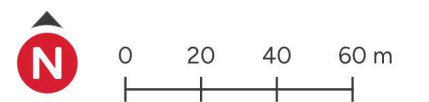
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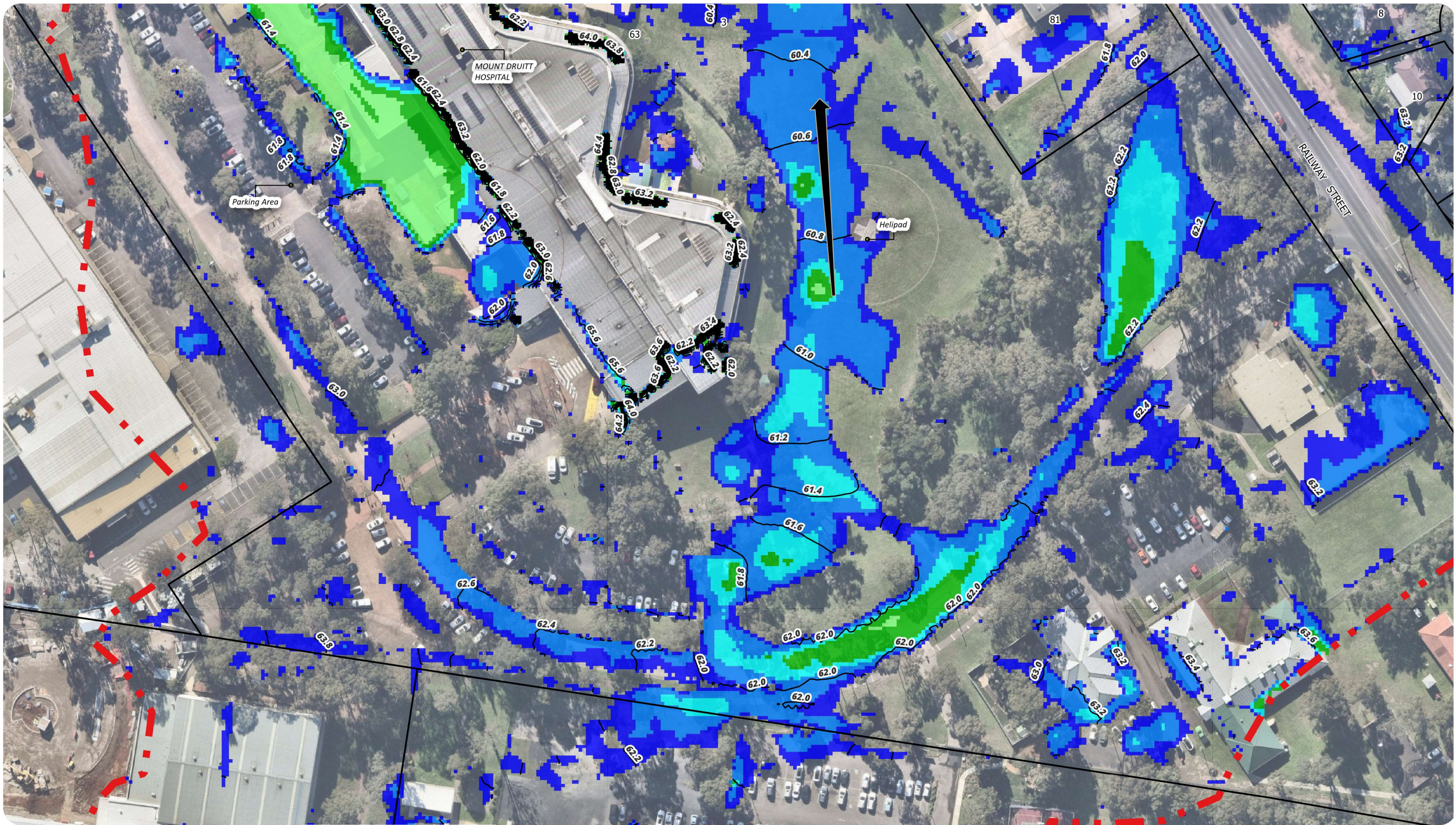
- Model boundary
- Property Boundary
- Proposed Building

Difference in Depth (m)					
	<= -0.50		-0.03 - -0.02		0.03 - 0.5
	-0.50 - -0.10		-0.02 - -0.01		0.05 - 0.10
	-0.10 - -0.05		-0.01- 0.01		0.10 - 0.50
	-0.05 - -0.03		0.01 - 0.02		>0.50
			0.02 - 0.03		

A3 scale 1:2000
EPSG:28356



Existing Case
1% AEP
Flood Depth Difference (Revised minus Original)
Figure A5



JOB NUMBER
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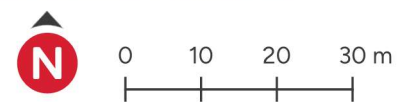
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NORTHROP

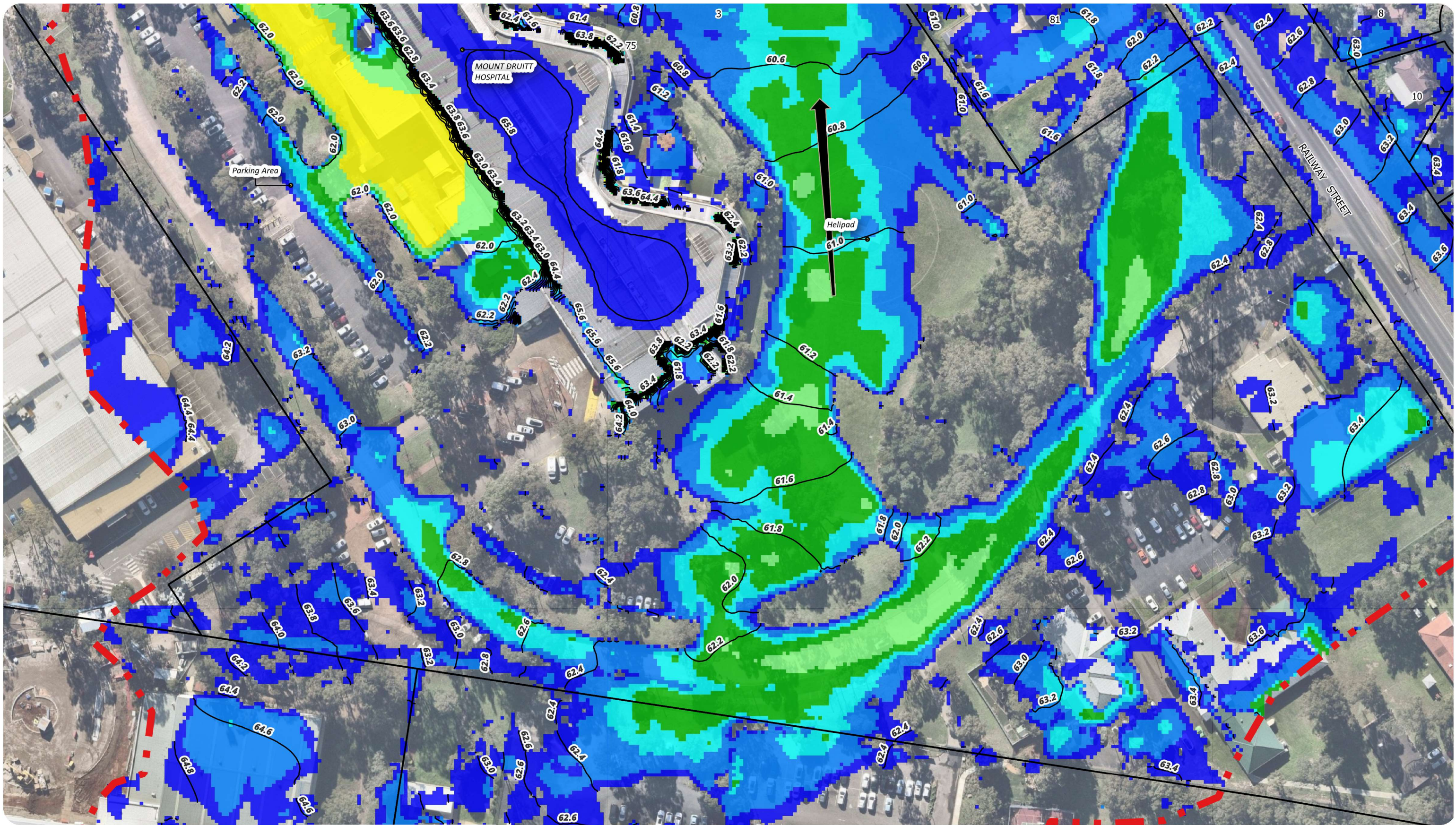
- Model boundary
- Property Boundary
- direction of flow
- Water Level Contour (m AHD)

Depth (m)	
■	Less than 0.1
■	0.1 - 0.2
■	0.2 - 0.3
■	0.3 - 0.5
■	0.5 - 1.0
■	1.0 - 2.0
■	2.0 - 5.0
■	5.0 - 7.5
■	7.5 - 10.0
■	Greater than 10.0

A3 scale 1:1000
EPSG:28356



Existing Case
1% AEP
Flood Depth and Elevation
Figure A6



JOB NUMBER
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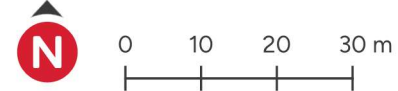
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- Model boundary
- Property Boundary
- ➔ direction of flow
- Water Level Contour (m AHD)

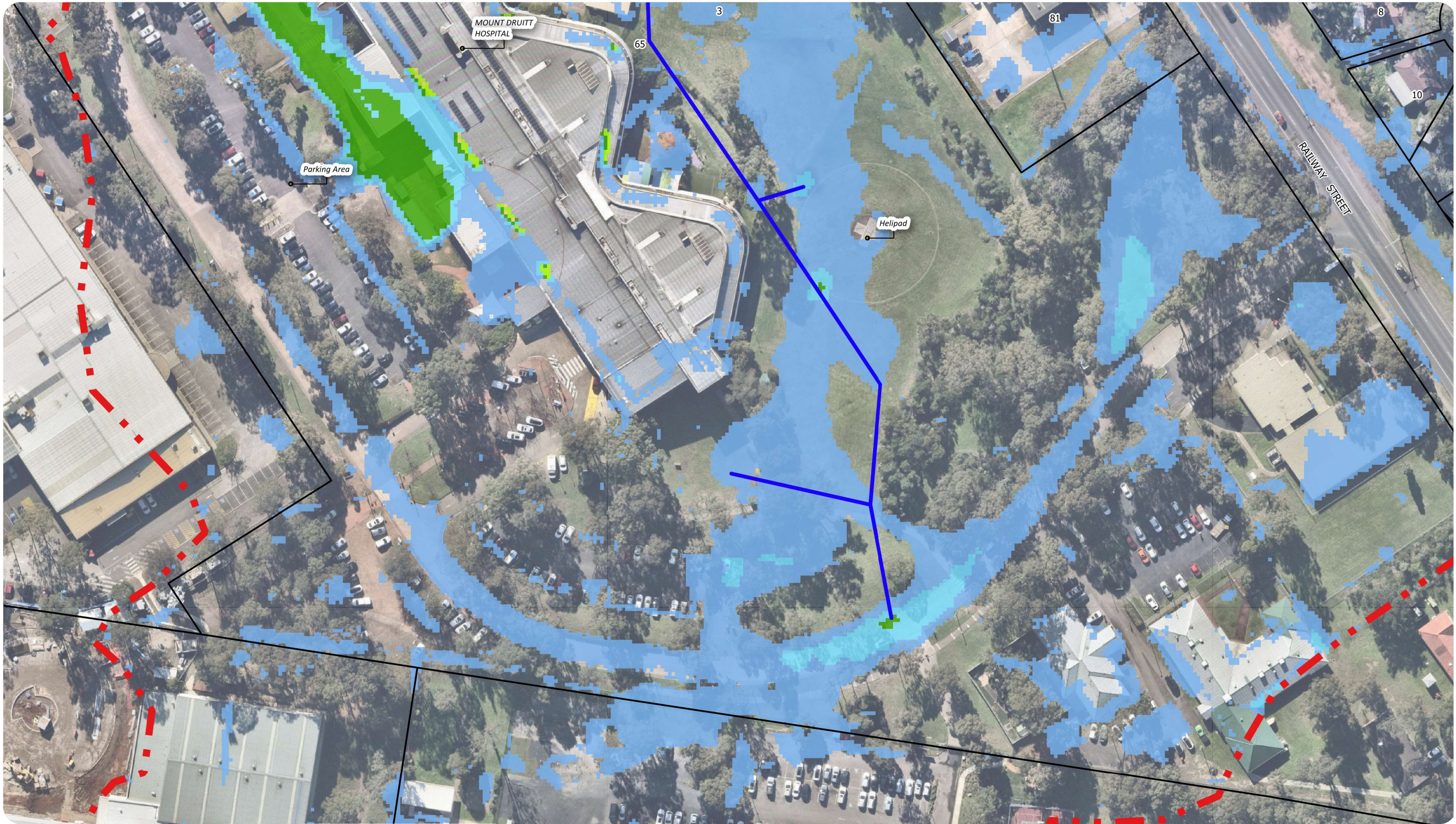
Depth (m)	
■ Less than 0.1	■ 0.3 - 0.5
■ 0.1 - 0.2	■ 0.5 - 1.0
■ 0.2 - 0.3	■ 1.0 - 2.0
	■ 2.0 - 5.0
	■ 5.0 - 7.5
	■ 7.5 - 10.0
	■ Greater than 10.0

A3 scale 1:1000
EPSG:28356



**Existing Case
Probable Maximum Flood (PMF)
Flood Depth and Elevation**

Figure A7



JOB NUMBER
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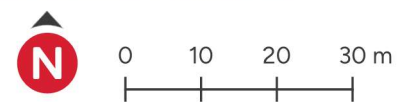
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NORTHROP

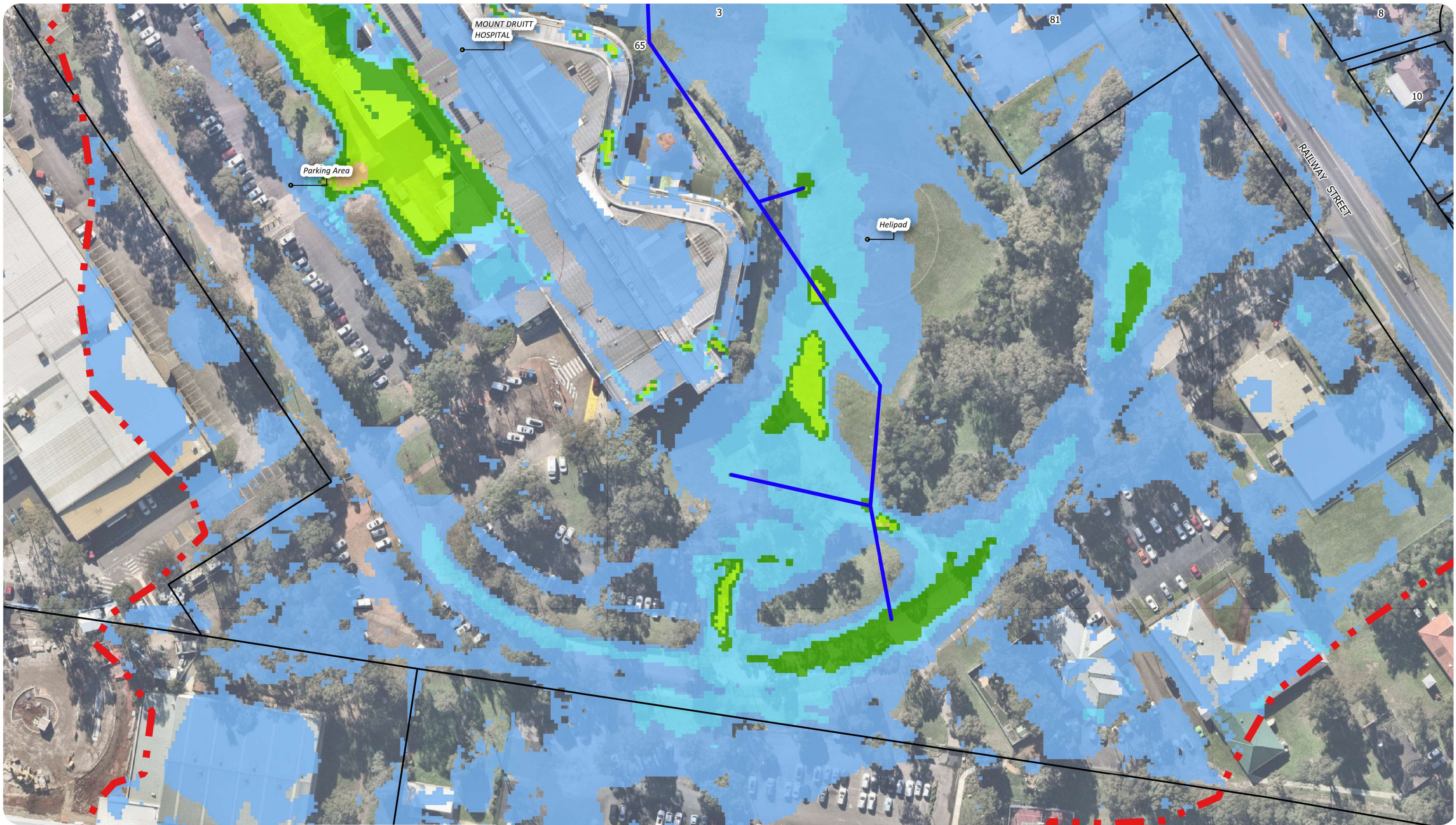
- Model boundary
- Property Boundary
- Existing drainage

Hazard Rating		H2	H5
H1	H3	H6	
	H4		

A3 scale 1:1000
EPSG:28356



Existing Case
1% AEP
Flood Hazard
Figure A8



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- Model boundary
- Property Boundary
- Existing drainage

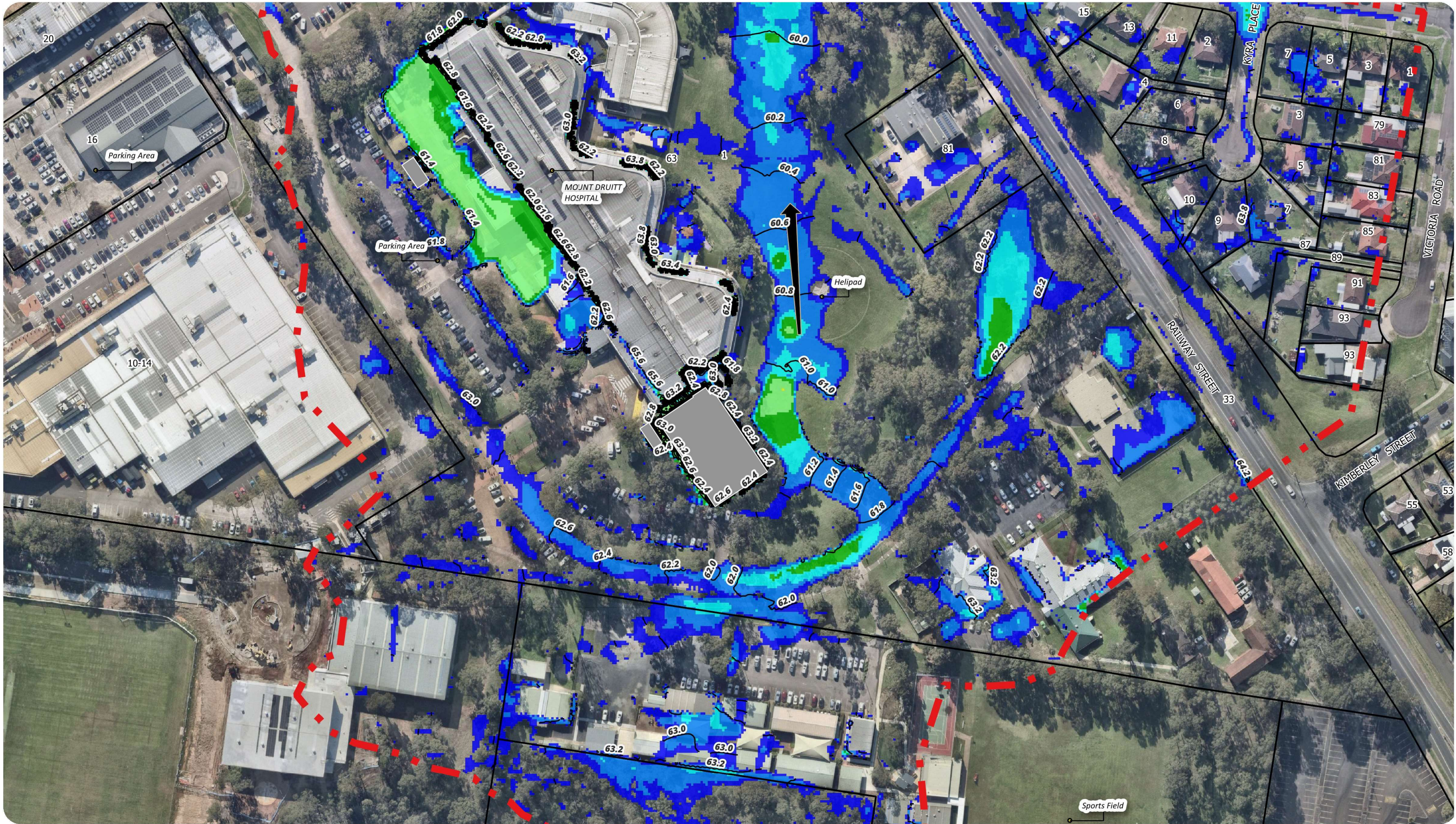
Hazard Rating		H2	H5
H1	H3	H6	
	H4		

A3 scale 1:1000
EPSG:28356



0 10 20 30 m

Existing Case
Probable Maximum Flood (PMF)
Flood Hazard
Figure A9



- Model boundary direction of flow
- Property Boundary — Water Level Contour (m AHD)
- Proposed Building

Depth (m)			
	Less than 0.1		0.3 - 0.5
	0.1 - 0.2		0.5 - 1.0
	0.2 - 0.3		1.0 - 2.0
			2.0 - 5.0
			5.0 - 7.5
			7.5 - 10.0
			Greater than 10.0

A3 scale 1:1500
EPSG:28356

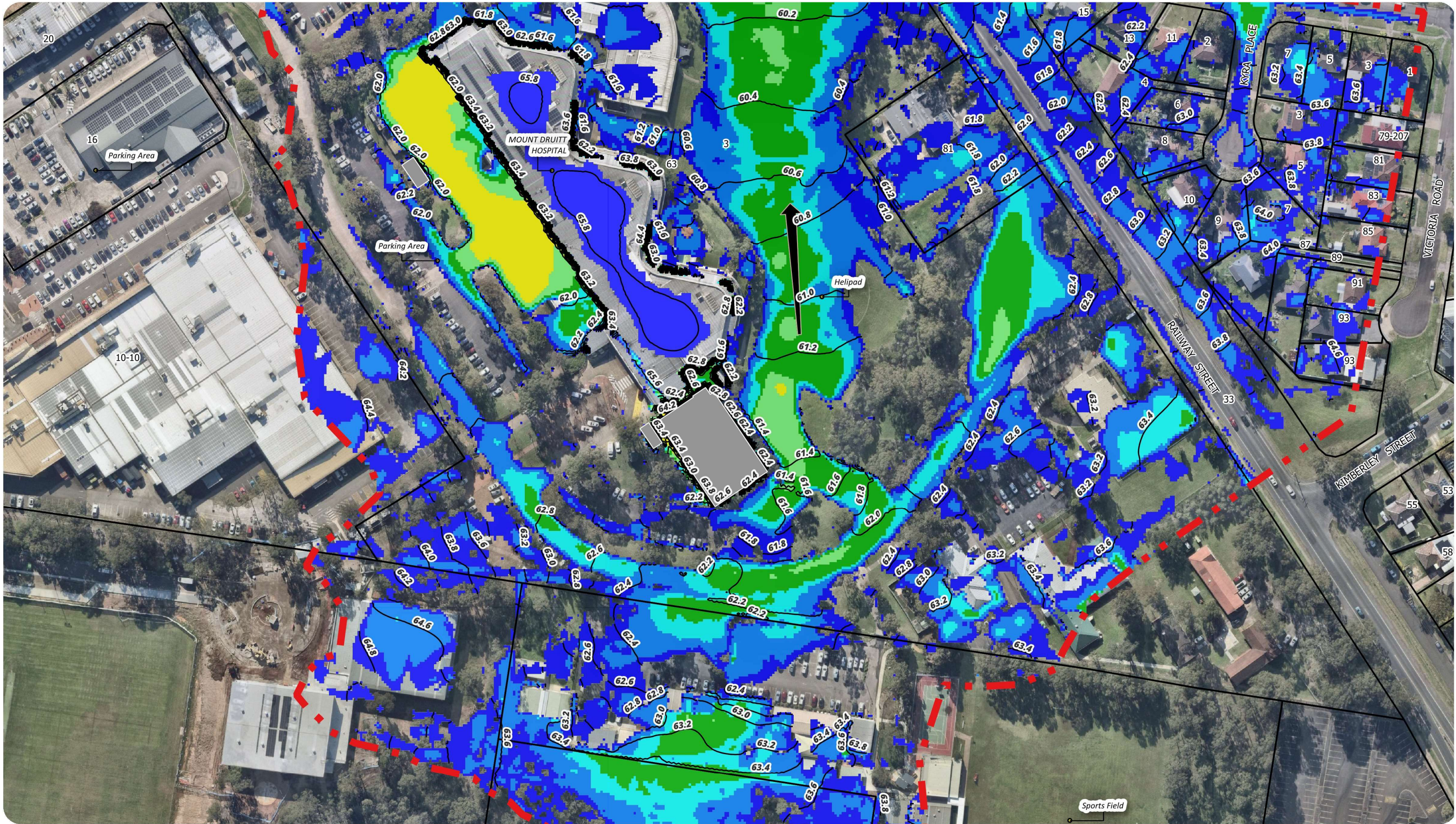


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Developed Case
1% AEP
Flood Depth and Elevation
Figure A10

NORTHROP



- Model boundary direction of flow
- Property Boundary — Water Level Contour (m AHD)
- Proposed Building

Depth (m)			
 Less than 0.1	 0.3 - 0.5	 5.0 - 7.5	
 0.1 - 0.2	 0.5 - 1.0	 7.5 - 10.0	
 0.2 - 0.3	 1.0 - 2.0	 Greater than 10.0	
	 2.0 - 5.0		

A3 scale 1:1500
EPSG:28356



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Developed Case
Probable Maximum Flood (PMF)
Flood Depth and Elevation

Figure A11



 Model boundary
  Proposed Building
 Property Boundary

Velocity (m/s)
  1.0 - 1.5
  2.5 - 5.0
 ≤ 0.5
  1.5 - 2.0
  > 5.0
 0.5 - 1.0
  2.0 - 2.5

A3 scale 1:1500
 EPSG:28356



0 10 20 30 m

Developed Case
 1% AEP
 Flood Velocity
 Figure A12

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 Model boundary
  Proposed Building
 Property Boundary

Velocity (m/s)
  1.0 - 1.5
  2.5 - 5.0
 ≤ 0.5
  1.5 - 2.0
  > 5.0
 0.5 - 1.0
  2.0 - 2.5

A3 scale 1:1500
 EPSG:28356



0 10 20 30 m

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Developed Case
 Probable Maximum Flood (PMF)
 Flood Velocity

Figure A13



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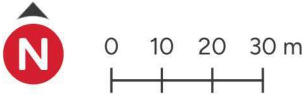
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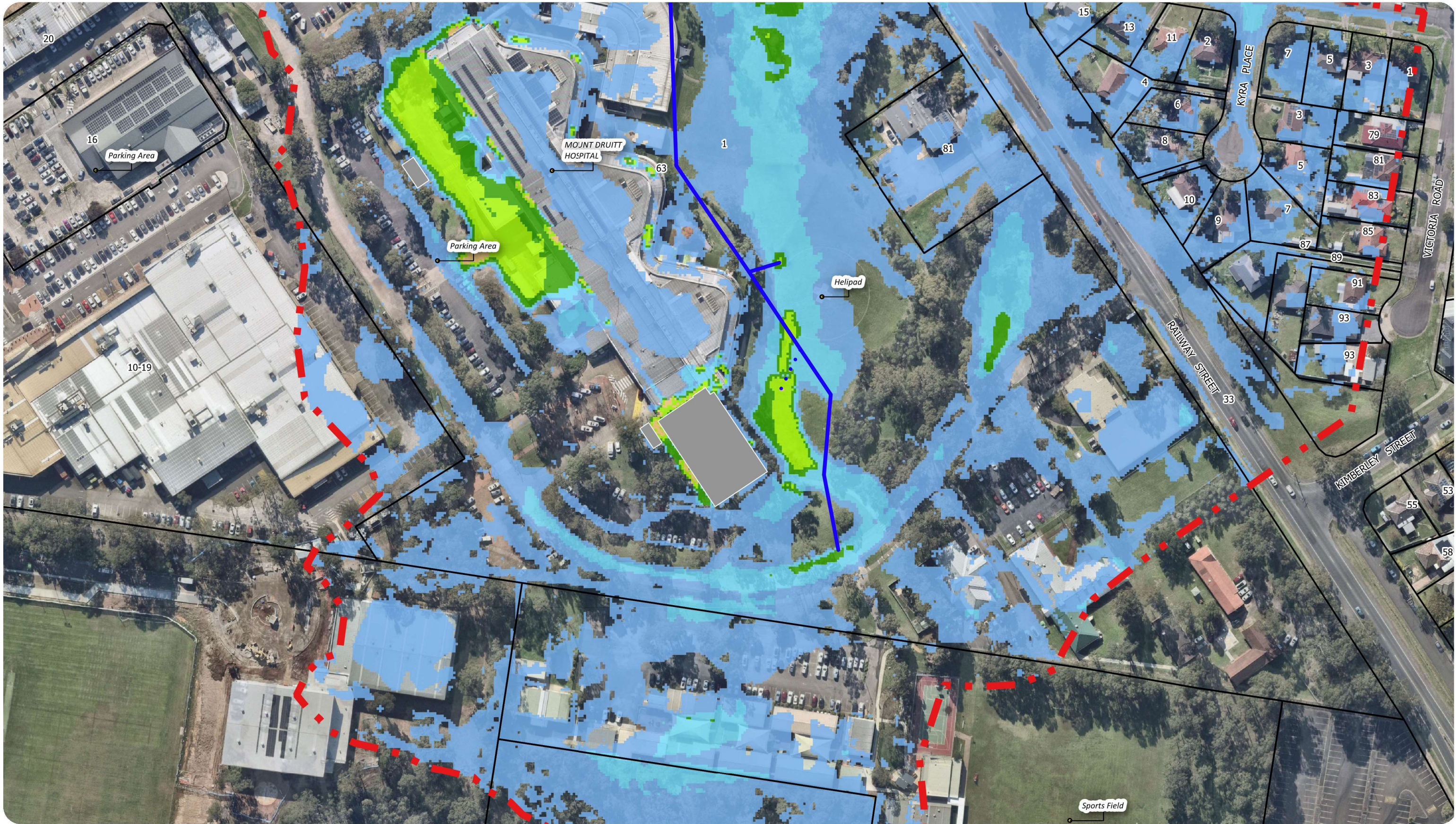
- Model boundary
- Property Boundary
- Existing drainage
- New drainage
- Proposed Building

- Hazard Rating
- | | | |
|----|----|----|
| H1 | H3 | H6 |
| H2 | H4 | |
| | H5 | |

A3 scale 1:1500
EPSG:28356



Developed Case
1% AEP
Flood Hazard
Figure A14



- Model boundary
- New drainage
- Property Boundary
- Proposed Building
- Existing drainage

- Hazard Rating
- | | | |
|--|--|---|
| H1 | H3 | H6 |
| H2 | H4 | H5 |

A3 scale 1:1500
EPSG:28356

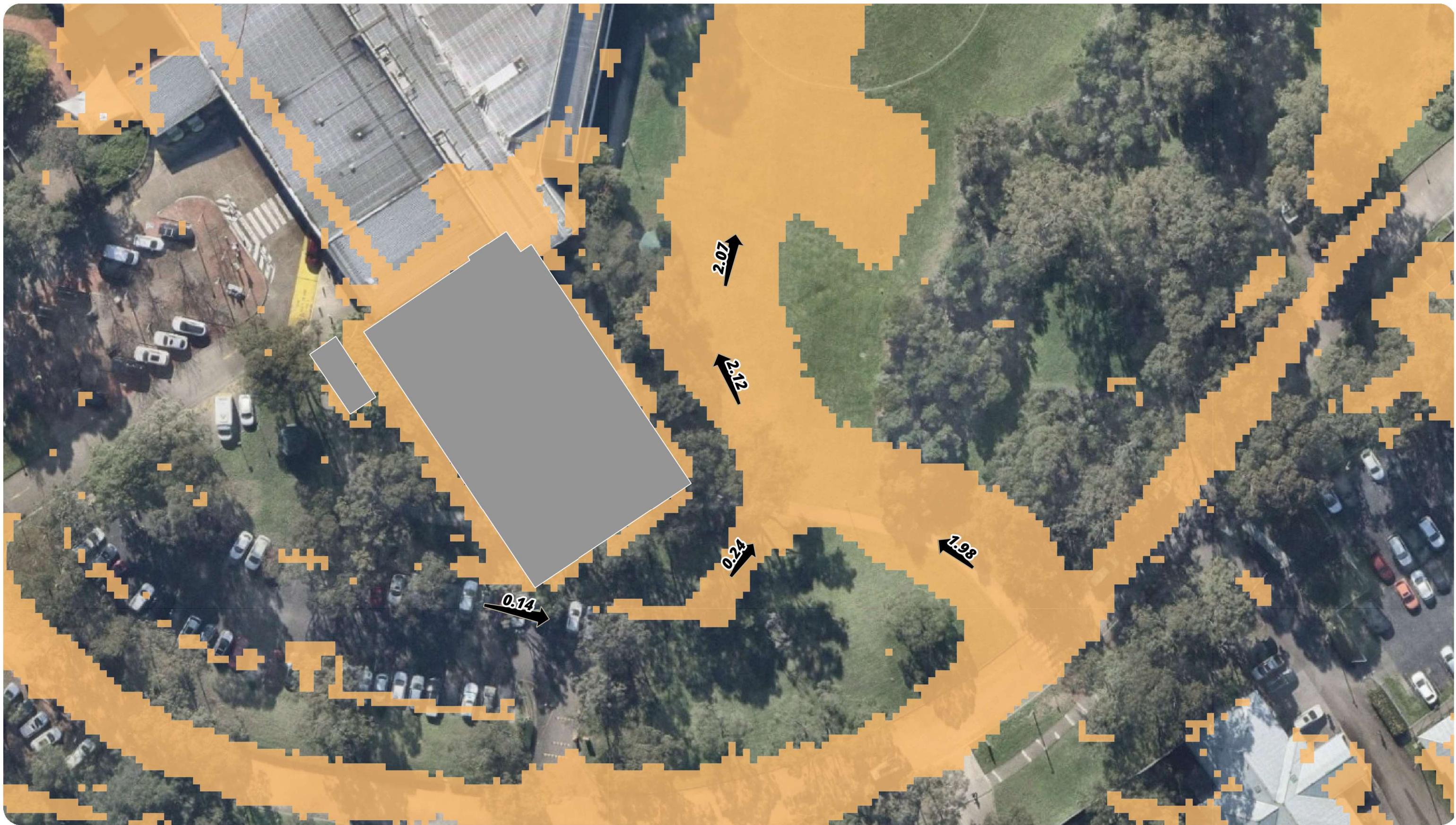


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Developed Case
Probable Maximum Flood (PMF)
Flood Hazard

Figure A15



Model boundary Proposed Building
Property Boundary Peak Flowrates (m3/s)
1%AEP
Flood Extent

A3 scale 1:500
EPSG:28356

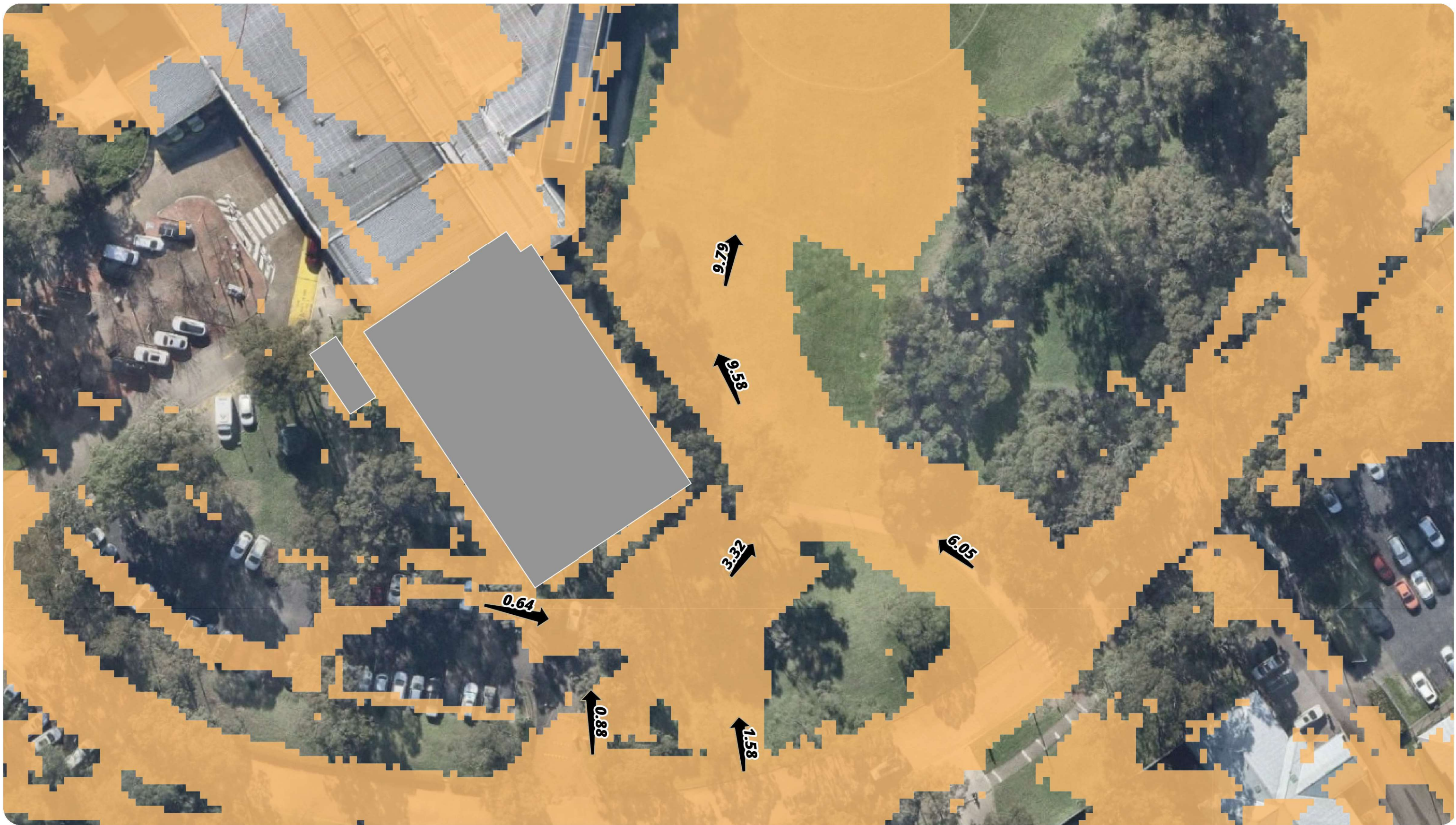


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Developed Case
1% AEP
Peak Flow Rates
Figure A16

NORTHROP



■ Model boundary Proposed Building PMF
 Property Boundary ➔ Peak Flowrates (m3/s) Flood Extent

A3 scale 1:500
 EPSG:28356

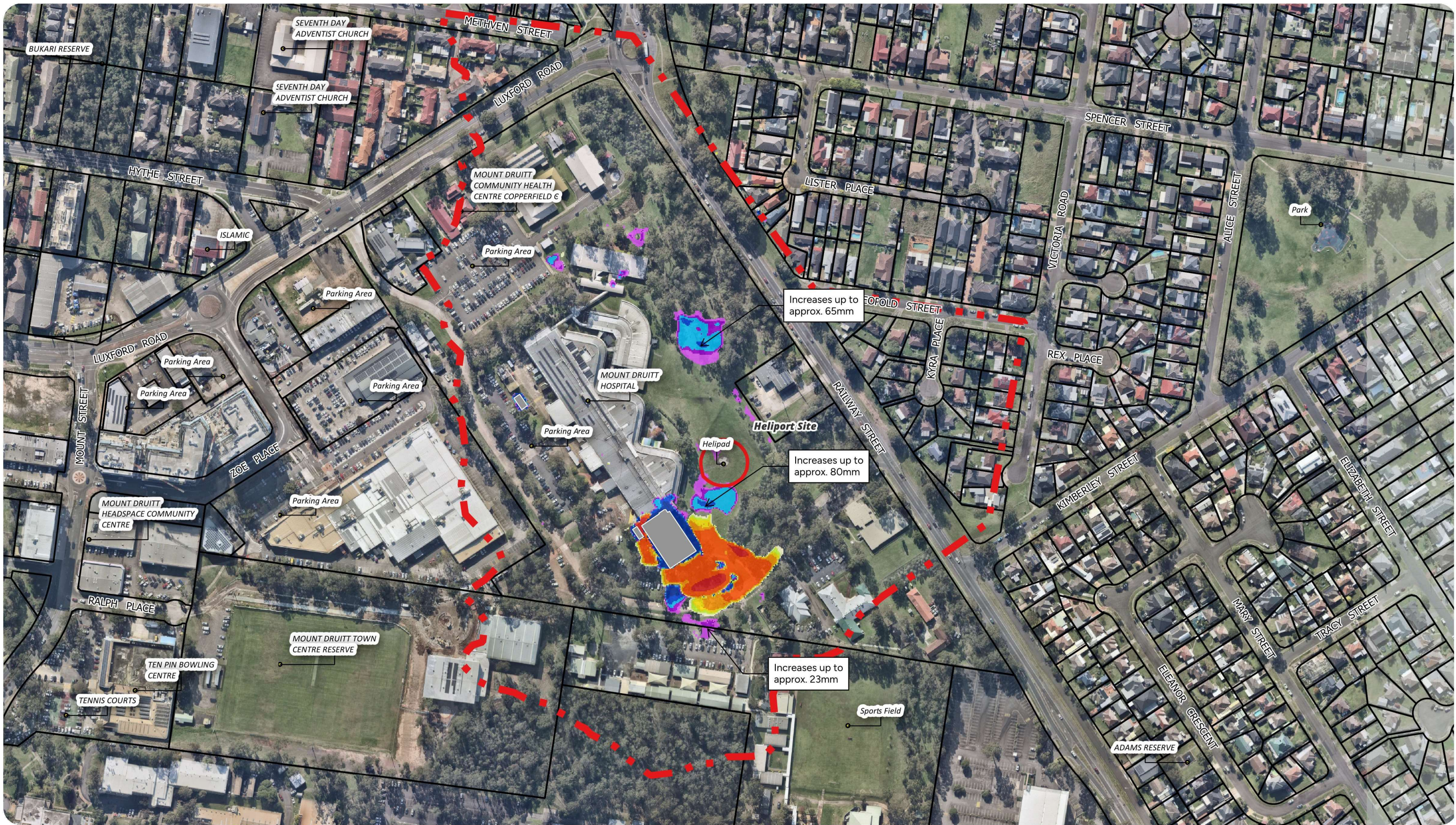


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Developed Case
 Probable Maximum Flood (PMF)
 Peak Flow Rates

Figure A17



- Model boundary
- Existing Heliport Site
- Property Boundary
- Proposed Building

Afflux (m)	
■	<= -0.50
■	-0.50 - -0.10
■	-0.10 - -0.05
■	-0.05 - -0.03
■	-0.03 - -0.02
■	-0.02 - -0.01
■	-0.01 - 0.01
■	0.01 - 0.02
■	0.02 - 0.03
■	0.03 - 0.5
■	0.05 - 0.10
■	0.10 - 0.50
■	>0.50

A3 scale 1:3000
EPSG:28356



0 30 60 90 m

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**Flood Effects
1% AEP
Flood Elevation Difference**

Figure A18_wideview



- Model boundary
- Existing Heliport Site
- Property Boundary
- Proposed Building

Afflux (m)					
	<= -0.50		-0.03 - -0.02		0.03 - 0.5
	-0.50 - -0.10		-0.02 - -0.01		0.05 - 0.10
	-0.10 - -0.05		-0.01- 0.01		0.10 - 0.50
	-0.05 - -0.03		0.01 - 0.02		>0.50
			0.02 - 0.03		

A3 scale 1:3000
EPSG:28356



0 30 60 90 m

Flood Effects
Probable Maximum Flood (PMF)
Flood Elevation Difference

Figure A19_wideview

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