Macquarie Health Corporation C/- John Simpson

Preliminary Flood Assessment: President Private Hospital, Kirrawee, NSW

P1907286JR02V03
February 2022

martens consulting engineers

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to provide a preliminary flood assessment at the subject site in accordance with the scope of services set out in the contract / quotation between Martens & Associates Pty Ltd and Macquarie Health Corporation C/- John Simpson (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

Martens & Associates Pty Ltd derived the data in this report primarily from a number of sources which included site inspections, correspondence regarding the proposal, examination of records in the public domain, interviews with individuals with information about the site or the project, and field explorations conducted on the dates indicated. The passage of time, manifestation of latent conditions or impacts of future events may require further examination / exploration of the site and subsequent data analyses, together with a re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, Martens & Associates Pty Ltd may have relied upon and presumed accurate certain information (or absence thereof) relative to the site. Except as otherwise stated in the report, Martens & Associates Pty Ltd has not attempted to verify the accuracy of completeness of any such information (including for example survey data supplied by others).

The findings, observations and conclusions expressed by Martens & Associates Pty Ltd in this report are not, and should not be considered an opinion concerning the completeness and accuracy of information supplied by others. No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings and conclusions are based solely upon site conditions, information and drawings supplied by the Client *etc*. in existence at the time of the investigation.

This report has been prepared on behalf of and for the exclusive use of the Client, and is subject to and issued in connection with the provisions of the agreement between Martens & Associates Pty Ltd and the Client. Martens & Associates Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

Head Office
Suite 201, 20 George Street
Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
Phone: +61-2-9476-9999
Fax: +61-2-9476-8767
Email: mail@martens.com.au
Web: www.martens.com.au

Document and Distribution Status

Author(s)	Reviewer(s)	Project Manager	Signature
Amir Abbasnia	Stanley Leung	Stanley Leung	

Revision No.	Description	Status	Release Date	Document Location			
				File Copy	Macquarie Health Corporation C/- John Simpson		
1	State Significant Development Application	Final	13.10.2020	1P, 1E	1P		
2	State Significant Development Application	Final	15.12.2021	1P, 1E	1P		
3	State Significant Development Application	Final	02.02.2022	1P, 1E	1P		

Distribution Types: F = Fax, H = hard copy, P = PDF document, E = Other electronic format. Digits indicate number of document copies.

All enquiries regarding this project are to be directed to the Project Manager.

Executive Summary

Martens & Associates Pty Ltd (MA) have prepared this preliminary flood assessment to support a State Significant Development Application (SSDA) for a proposed alteration and addition to an existing hospital at 369 – 381 President Avenue, Kirrawee, NSW (the site). This report has been updated to address the comments and request for additional information related to flood risk management in the response to submission received from the Department of Planning, Industry and Environment (dated 19 July 2021). The report documents the procedures and findings of hydrologic and hydraulic modelling of the site in existing and proposed conditions.

Assessment concluded that:

1. Proposed flood characteristics are largely consistent with existing conditions, and differences due to the proposed development are negligible.
2. The proposed design effectively renders the site development area flood free in all flood events up to and including PMF.
3. The proposed development would have no material offsite flood impacts.
4. Compliance with Council flood planning level requirements for building and car park levels are achieved.
5. The proposed development is compatible with the existing floodplain environment.
6. The compliance assessment demonstrates the site can be developed in accordance with Council flood planning requirements.

Contents

1 Introduction

1.1 Overview

Martens & Associates Pty Ltd (MA) have prepared this preliminary flood assessment to support a State Significant Development Application (SSDA) for proposed alterations and additions to an existing hospital at 369 – 381 President Avenue, Kirrawee, NSW (the site). This report has been updated to address the comments and request for additional information related to flood risk management received from the Department of Planning, Industry and Environment (dated19 July 2021).

1.2 Project Scope and Objectives

Project scope and objectives are:

1. Prepare a hydrologic model (RAFTS) for the site to determine the peak flow of the 5%, 1% annual exceedance probability (AEP) flood (with and without climate change) and probable maximum flood (PMF) events.

2. Prepare a hydraulic model (TUFLOW) for the site under existing and proposed conditions.

3. Prepare relevant flood maps including flood extents, depths, levels, velocities, hazards and impacts.

4. Comment on flood characteristics and model outcomes in existing and proposed conditions.

5. Prepare a preliminary flood emergency response plan (FERP) for the developed site.

6. Address Council's flood related comments in letter dated 29/01/21.

7. Address GRC Hydro's flood related comments in letter dated 18/07/21.

1.3 Summary of Agency Comments

The Council raised comments on the flood related aspects of the SSDA dated 29 January, 2021 (File Ref: DN20/0063). These comments are addressed in Table 8 in Section 7 of this report.

The Department of Planning, Industry and Environment (DPIE) has provided comments dated 19 July 2021 based on GRC Hydro's peer review of MA's 'Preliminary Flood Assessment: President Private Hospital, Kirrawee, NSW' (P1907286JR01V01, September 2020). These comments are addressed in Table 9 in Section 7 of this report.

1.4 Relevant Guidelines

This report has been prepared in accordance with the following guidelines and policies:

1. Commonwealth of Australia (Geoscience Australia) (2016), *Australian Rainfall and Runoff – A Guide to Flood Estimation.*
2. NSW Department of Infrastructure, Planning and Natural Resources (2005), *Floodplain Development Manual*.
3. Sutherland Shire Council (2015), *Sutherland Shire Local Environmental Plan (LEP)*.
4. Sutherland Shire Council (2015), *Sutherland Shire Development Control Plan (DCP)*.

1.5 Definitions

AEP	Annual exceedance probability: the probability of a flood event occurring within a year. A 1% AEP flood has a 1% chance of occurring in any given year.
ARI	Average recurrence interval: the average time between flood events occurring. A 100 year ARI flood occurs on average once every 100 years.
ARR	Australian Rainfall & Runoff
BOM	Bureau of Meteorology
Council	Sutherland Shire Council (SSC)
DA	Development application
FERP	Flood emergency response plan

FFL	Finished floor level
FPL	Flood planning level
IFD	Intensity frequency duration – design rainfall data for frequent and infrequent storm events.
MA	Martens & Associates Pty Ltd
PMF	Probable maximum flood – the most extreme flood event possible for a certain location, with an approximate ARI of 100,000 to 10,000,000 years.
PMP	Probable maximum precipitation – design rainfall data for extreme storm events.
SSDA	State significant development application

2 Site Description and Background Data

2.1 Location and Site Description

Existing site description summary is provided in Table 1.

Table 1: Existing site description summary.

Address	369 – 381 President Avenue, 61-65 Hotham Road, 2-4 Bidurgal Avenue, Kirrawee, NSW
Lot / DP	Lot 1 DP 841502, Lots 22-24A DP 26995, Lots 54-55 DP 29493
Site Area	9,519.86 m^2
Local Government Area (LGA)	Sutherland Shire Council (SSC)
Current Land Use	Hospital facility and urban residential
Current Zoning	SP1 – special activities & R2 – low density residential
Site Description	The site is primarily paved, with some grassed areas. There are several structures on the site including the existing President Private Hospital buildings and dwellings on 61-65 Hotham Road and 2-4 Bidurgal Avenue.
Surrounding Land Uses	Low density residential to the north, west and south, and medium density residential to the east.
Site Elevation	Approximately 66 mAHD at south-eastern site boundary rising to 72mAHD at the western site boundary and 76 mAHD at the northern site boundary.
Site Grading & Aspect	Approximately 5%, SE aspect.
Site Drainage	A 1050 mm diameter Council drainage easement pipe runs underneath the site from north-west to south-east and connects to the pit and pipe network on President Avenue.

2.2 Site Inspection

Site inspection was conducted on 10 March, 2020 and 27 October, 2021 and included:

- General walkover to identify local land forms and site characteristics to understand local drainage behaviour.
- Identification and observation of existing site stormwater infrastructure and natural drainage lines.

2.3 Catchment Description

We note the following regarding the catchment upstream of the site:

- The site is located within the Dents Creek catchment.

- Upstream catchment is primarily urban residential areas, and includes the suburb of Kirrawee.

- The local upstream catchment areas of the site are shown in Attachment C – Map 02. It should be noted that the catchment delineation has been updated according to the extended modelling area to encounter the effects of neighbour catchments.

2.4 Site Flood and Overland Flow Mechanisms

The site is likely affected by overland flows from the site itself and the local upstream catchment (refer Section 2.3).

2.5 Previous Flood Studies

A review of previous flood investigations was undertaken to assess likely local flood behaviour and characteristics for the site and the Dents Creek catchment. This review did not identify any flood studies adopted by SSC which would be relevant to this assessment, and this was confirmed by the phone discussion on 31/3/2020 between MA and SSC drainage and stormwater engineer, Jack Slater, who confirmed that no formal study had been undertaken for the site to inform us of flood levels or flow rates.

2.6 Proposed Development

2.6.1 Overview

Architectural drawings prepared by Imagescape Design Studios indicate that the proposed development will include:

- Demolition of existing residential dwellings on site, as well as the timber and rendered buildings in the south-west corner of the site.

- Construction and upgrade of the existing hospital, including a multi-storey west, east and north wing, a western and northern car park, and two driveway accesses.

- Construction of a four-level basement carpark beneath the buildings.

- Development of a landscape area in the south-western corner of the site.

MA also iteratively and holistically designed a 2 m wide swale in the landscape area at the south-western corner of the site to capture the upstream overland flows and redivert it away from the carpark and hospital buildings and discharges it to President Avenue to ensure project

objectives are met. Refer to Attachment B for the proposed earthworks of the swale.

3 Hydrology Modelling

3.1 Overview

The DRAINS software package (version 2020.061 – 22 December, 2020) was used with the RAFTS hydrological engine to assess the 5% AEP, 1% AEP, 1% AEP with incorporating potential impacts of climate change (CC) and PMF peak flow rates for a range of storm durations between 5 minutes and 6 hours.

3.2 Model Setup

Parameters used in the model are provided in

Table 2. Model inputs are as follows:

1. Sub-catchment delineation, flow paths and slopes were developed using LIDAR data provided by ELVIS Intergovernmental Committee on Surveying and Mapping (ICSM 2020) web site. Refer to Attachment C – Map 02 for site catchment plan.

2. Sub-catchment impervious areas were adopted based on recent catchment aerials obtained from Nearmaps (2020).

3. Roughness coefficients were determined using a weighted average based on the XP-RAFTS (1996) *User's Manual* and the sub-catchment's land use as per recent site aerials obtained from Nearmaps (2020).

4. Intensity Frequency Duration (IFD) data and rainfall temporal patterns were based on the Bureau of Meteorology (BOM 2020) *Rainfall IFD Data System* and the Australian Rainfall & Runoff (ARR 2020) *Data Hub*.

5. Probable Maximum Precipitation (PMP) intensities and temporal distributions were determined using the BOM (2003) *Generalised Short-Duration Method*.

6. RAFTS parameters have been derived from the suggested values in the XP-RAFTS (1996) *User Manual*. Sub-catchment surface soils are assumed to be loamy sand, based on the NSW Department of Planning, Industry and Environment (2020) *eSPADE – NSW Soil and Land Information* website.

Table 2: Details of sub-catchments used in RAFTS modelling.

Catchment Name	Area (ha) [1]	Catchment Slope (%) [1]	Impervious (%) [2]	PERN Roughness Coefficient [3]
A	15.06	3.4	63	0.021
B-1	3.55	4.4	60	0.019
B-2	4.04	9.3	51	0.02
B-3	3.07	1.3	66	0.018
C	11.02	3.7	66	0.018
D	6.28	4	52	0.02
E	2.23	5.09	60	0.019
F	27.48	2.56	67	0.018
G	8.93	3.17	58	0.019

Notes

1. Obtained based on LIDAR data provided by ELVIS ICSM (2020). Refer to MA planset Attachment C -Map 02 for site catchment plan.
2. Adopted based on recent catchment aerials obtained from Nearmaps (2020).
3. Obtained from the weighted average land use based on recent catchment aerial photographs obtained from Nearmaps (2020) and the XP-RAFTS User Manual (1996).

3.3 Results

3.3.1 Hydrology Results

Results of peak flow rates for catchments arriving at the site (ie. combined flows from Catchment B-1, B-2 and B-3) for the critical duration 5% AEP, 1% AEP, 1% AEP incorporating potential impacts of climate change flood events and PMF event are summarised in Table 3. The critical storm duration was determined to be 10 minutes for the 5% AEP, 1% AEP and 1% AEP climate change flood events and 15 minutes for the PMF event.

Table 3: Peak 5% AEP, 1% AEP, 1% AEP climate change and PMF flow rates for critical duration storms estimated by DRAINS modelling for sub-catchments arriving at the site.

Flood Event	Critical Storm Duration (mins)	Peak Catchment Flow Rates (m^3/s)
5% AEP	10	4.23
1% AEP	10	5.62
1% AEP (incorporating potential impacts of climate change)	10	6.75
PMF	15	24.26

4 Hydraulic Modelling

4.1 Overview

The TUFLOW hydraulic model was used to determine flood characteristics including flood extents, levels, depths, velocities and hydraulic hazard for the critical 5%, 1% , 1% AEP incorporating potential impacts of climate change flood and probable maximum flood (PMF) events for existing and proposed conditions.

4.2 Scenarios

The hydraulic model was setup to represent the following flood condition scenarios:

1. Existing condition: the catchment and site in their current state as described in Sections 2.1, 2.3 and 2.4.

2. Proposed condition: the catchment in its current state and the site in its proposed state as described in Section 2.6.

The hydraulic model was used to assess flooding for the following events:

1. 5% AEP 10 minute (critical duration) event for proposed condition.

2. 1% AEP 10 minute (critical duration) event for existing and proposed conditions.

3. 1% AEP incorporating climate change 10 minute (critical duration) event for proposed condition.

4. PMF 15 minute (critical duration) event for proposed condition.

4.3 Terrain Data

Site LIDAR data provided by ELVIS ICSM (2020) was used to create a 3D surface for the existing conditions site and the local floodplain environment used in the TUFLOW model.

The proposed conditions surface also included site design grading as shown in Attachment B for proposed conditions grading details.

4.4 Model Setup

4.4.1 Existing Conditions

TUFLOW model construction for existing conditions consisted of:

1. A 1.0 m topographic grid based on the available LIDAR data.

2. The model domain was defined from Bath Road 300 m upstream of the site to Talara Road 215 m downstream of the site. Model boundary extents were generally placed along catchment ridgelines and / or connecting catchment high points surrounding the study area, and are shown in Attachment C – Map 03.

3. Inflow boundary conditions based on the critical duration 5% AEP, 1% AEP, 1% AEP incorporating climate change and PMF hydrographs from DRAINS for the catchment discharging to the study area, with inflow location shown in Attachment C – Map 03.

4. Computed water slopes for downstream model extent boundary conditions based on the slopes from available LIDAR data, with locations shown in Attachment C – Map 03.

5. Manning's zones based on Nearmaps (2020) aerial photography of the study area, with roughness coefficients adopted as per Table 4.

6. Existing buildings immediately upslope of the site were assigned elevations above the floodplain to model as flow obstructions.

7. A 1D network to model the extended extent of local pit and pipe network based on the updated survey undertaken by Australian Location Services surveyor (Attachment A and Attachment C – Map 03):

    a. The trunk drainage pipes from the updated survey have been modelled as a 1D network. All other pits and pipes in the study area have conservatively been assumed to be 100% blocked.

    b. 1D network pipe sizes, invert levels and locations are based on Australian Locating Services (2021) CCTV survey data with conversative assumptions have been made on the pipes which cannot be surveyed.

    c. Pipe roughness coefficient of 0.013 (concrete) was adopted.

    d. Pipe blockages of 25% have been adopted based on the assessment procedure in Australian Rainfall and Runoff (Weeks & Rigby, 2016).

Table 4: Manning's roughness values for TUFLOW modelling.

Catchment Material Type	Manning's Roughness Coefficient [1]
Buildings	2.000
Grass	0.035
Residential / Urban Areas [2]	0.150
Roads / Concrete	0.020
Swale	0.040

Notes
1. Based on typical values from similar catchments.
2. Based on the weighted average land use of a representative urban lot area and the adopted roughness coefficients for pervious / impervious areas.

4.4.2 Proposed Conditions

The existing conditions model was modified as follows to simulate proposed conditions:

1. The 1.0 m topographic grid was updated to include the proposed site grading, as shown in Attachment B.

2. Site manning's zones were updated to represent design surfaces.

3. Site buildings were removed and replaced with proposed buildings to model as flow obstructions.

4. The proposed pedestrian footbridge and the southern edge of the carpark near over the swale near President Avenue were modelled as layered flow constrictions. Levels were adopted based on Imagescape Design Studios architectural plans and LIDAR data, and structure blockage of 25% was adopted based on the assessment procedure in Australian Rainfall and Runoff (Weeks & Rigby, 2016).

5. All the pits and pipes parameters are consistent with the existing conditions model.

All other model construction elements remained consistent with the existing conditions model.

4.5 Results

4.5.1 Flood Results

Flood mapping results (flood levels, depths, velocities and provisional hazard categories) for the critical duration 5% AEP, 1% AEP, 1% AEP incorporating climate change and PMF events in existing and proposed

conditions are provided in Attachment C, with drawing references summarised in Table 5.

Table 5: Flood map drawing references in Attachment C.

Flood Condition Scenario	Critical Duration Flood Event	Water Level & Depth	Water Velocity	Provisional Hydraulic Hazard Categories [1]	ARR Flood Hazard Categories [2]	Water Level Impact
Existing Condition	1% AEP	Map04&05	Map06	Map07	MAP08	Map14
	1% AEP (CC)	Map15&16	Map17	Map18	Map19	-
	PMF	Map25&26	Map27	Map28	Map29	-
	5%	Map35&36	Map37	Map38	Map39	Map45
Proposed Condition	1% AEP	Map09&10	Map11	Map12	Map13	-
	1% AEP (CC)	Map20&21	Map22	Map23	Map24	–
	PMF	Map30&31	Map32	Map33	Map34	–
	5% AEP	Map40&41	Map42	Map43	Map44	–

Notes

1. Provisional hydraulic hazard categories are based on NSW Floodplain Development Manual (2005) definitions and are shown in Figure 1.
2. ARR flood hazard categories are based on ARR 2019 combined flood hazard category definitions and are shown in Figure 2.

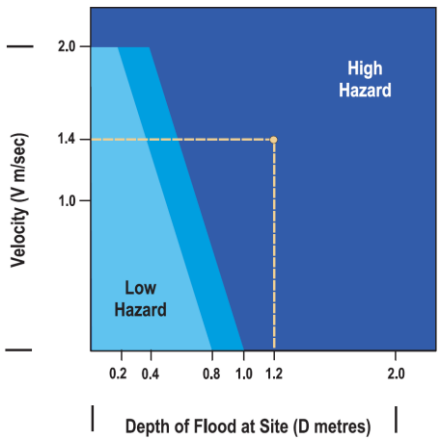


Figure 1: Provisional hydraulic hazard categories (*NSW Floodplain Development Manual*, 2005).

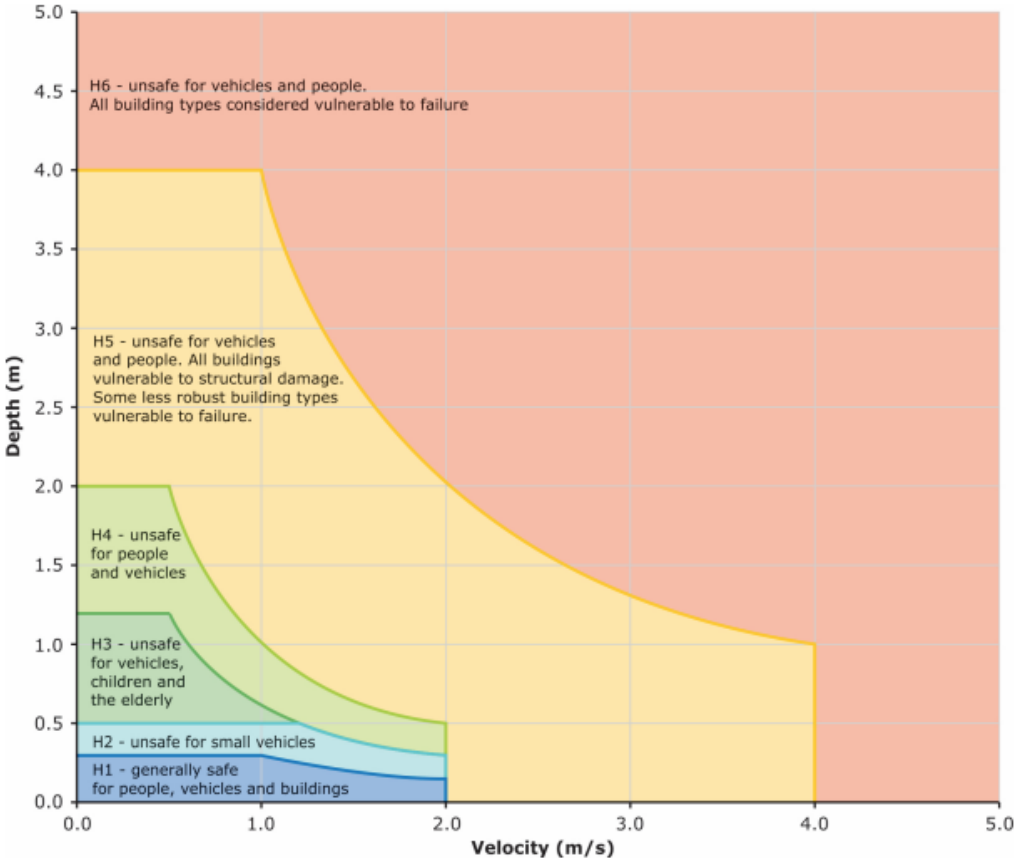


Figure 2: Combined flood hazard curves (*ARR, 2019*).

4.6 Discussion

We note the following regarding modelled flood behaviour:

4.6.1 Existing Conditions

1. Flood waters flow into the site from the west and is funnelled into the narrow flow paths between the timber and rendered buildings, through the south-western carpark, and onto President Avenue. Due to the constriction of the floodplain, water is temporarily backed up behind the timber buildings.

2. 1% AEP flood depths reach up to approximately 1 m between the buildings in the north-western corner of the site, and up to 0.3 m at the discharge location onto President Avenue at the southern boundary.

3. In the 1% AEP event, flood velocities on-site are relatively high, generally reaching up to 2.5 m/s in the main overland flow path, and up to 4.5 m/s in the narrow constriction between the buildings.

4. Hydraulic hazards on-site in the 1% AEP event are generally quite high in the primary flow path and in the constriction between the buildings. Elsewhere on the site hydraulic hazards are generally low.

5. PMF flood depths reach up to approximately 2.2 m between the buildings in the north-western corner of the site, and up to 0.55 m at the southern boundary.

6. PMF flood velocities on-site are very high, reaching up to and over 4 m/s across the entire flood affected portion of the site. Consequently, flood hazards are also high in the majority of the affected area.

4.6.2 Proposed Conditions

1. The proposed swale redirects the upstream overland flow and prevents inundation of the proposed south-western carpark, with the discharge location further east of the proposed driveway crossing onto President Avenue remains approximately the same as in existing conditions, hence the swale does not materially affect local flood characteristics and the overall range of flood depths, velocities and hazards remain the same as in existing conditions.

2. All flood events up to and including the 1% AEP event are fully contained within the proposed swale.

3. Apart from shallow flood depths in the south-western landscape area, the proposed development is completely flood free in the PMF event.

4. Floor level compliance:

    a. SSC classifies the site as an Initial Assessment Potential Flood Risk, which means there is no quantified flood risk for the site as of yet. However, as an "Essential Community Facility", the proposed development is required to be flood free in events up to and including the PMF. Therefore, the strictest flood level planning control requires floor levels to be set at a minimum of the PMF level or 1% AEP + 0.5 m freeboard, whichever is greater (Sutherland Shire DCP 2015).

    b. Table 6 and Figure 3 summarises proposed site building and flood planning levels, and demonstrates that the site achieves compliance with SSC floor level requirements.

Table 6: Comparison of flood planning levels within proposed swale and building ground floor levels.

	Flood Level (mAHD)				
Building [1]	**1% AEP [2]**	**PMF [3]**	**Flood Planning Level (mAHD) [4]**	**Ground Floor Level (mAHD) [1]**	**Complies?**
West Wing	69.62	69.85	70.12	70.30	Yes
Foyer	71.03	71.87	71.87	71.91	Yes
Existing Hydrotherapy Pool	71.03	71.87	71.87	71.91	Yes
East Wing	NA [5]	NA [5]	NA [5]	70.09	Yes

Notes

1. Refer to Imagescape Design Studios architectural plans for proposed site layout and ground floor levels (Attachment B)
2. Refer to Attachment C – Map 09 and Map 10 for modelled proposed 1% AEP flood levels.
3. Refer to Attachment C – Map 30 and Map 31 for modelled proposed PMF flood levels.
4. SSC requires the flood planning level to be the greater of the 1% AEP flood level + 0.5 m and the PMF level.
5. These buildings do not have nearby flood water in the proposed conditions 1% AEP flood event.

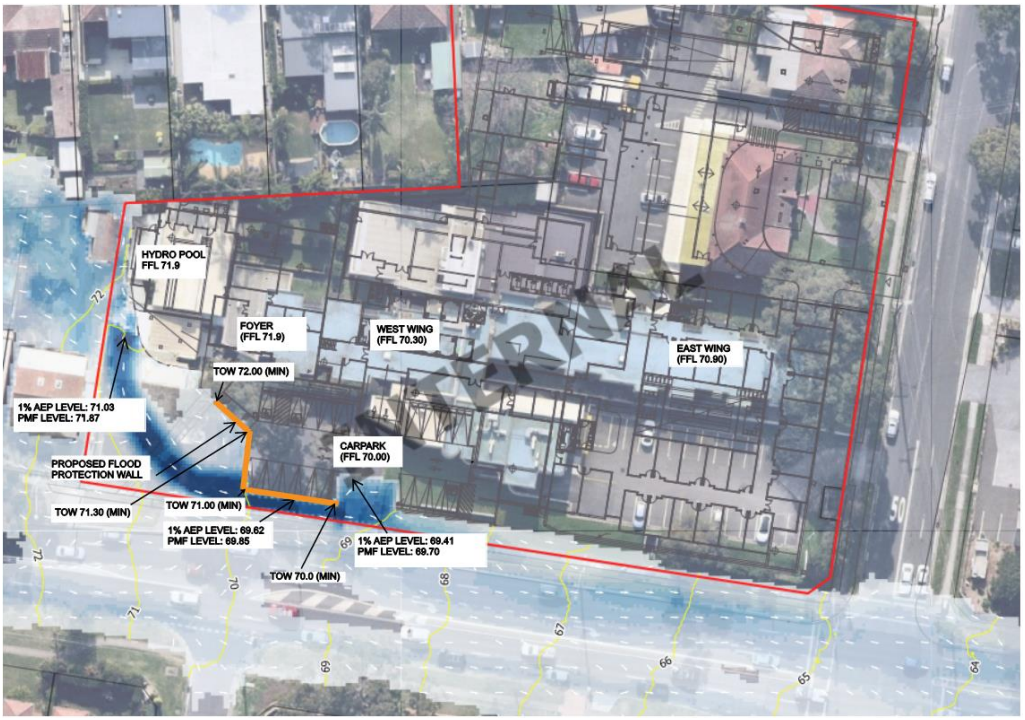


Figure 3: Comparison of flood levels within proposed swale and building ground floor levels.

4.6.3 Offsite Flood Impacts

1. The proposed development has negligible offsite impacts on the floodplain environment in the 1% AEP event.

2. These impacts do not affect any neighbouring residential lots or existing buildings (ie. <0.02m increase in flood water depth), and

only occur locally as a result of the concentration of the upstream overland flows due to the proposed swale.

3. Flood impacts affecting the President Avenue would be considered acceptable as they generally result in no increase in ARR2019 flood hazard category which could affect existing trafficability of the road.

4. Thus, the proposed development is considered to have no material off-site impacts.

5 Preliminary Flood Emergency Response Plan

5.1 Overview

This preliminary FERP makes recommendations to ensure that in the event of a flood at the site, risk to personal safety and the environment is appropriately managed. The plan provides strategic level advice and assumes that detailed design of various site controls will be undertaken prior to issue of construction certificate and implemented as part of the site's construction and on-going operation.

5.2 Flood Risk Action Plan (FRAP) Summary

The site FRAP has three phases: the prepare phase, the respond phase and the recovery phase. An overview of the FRAP is provided in Figure 4.

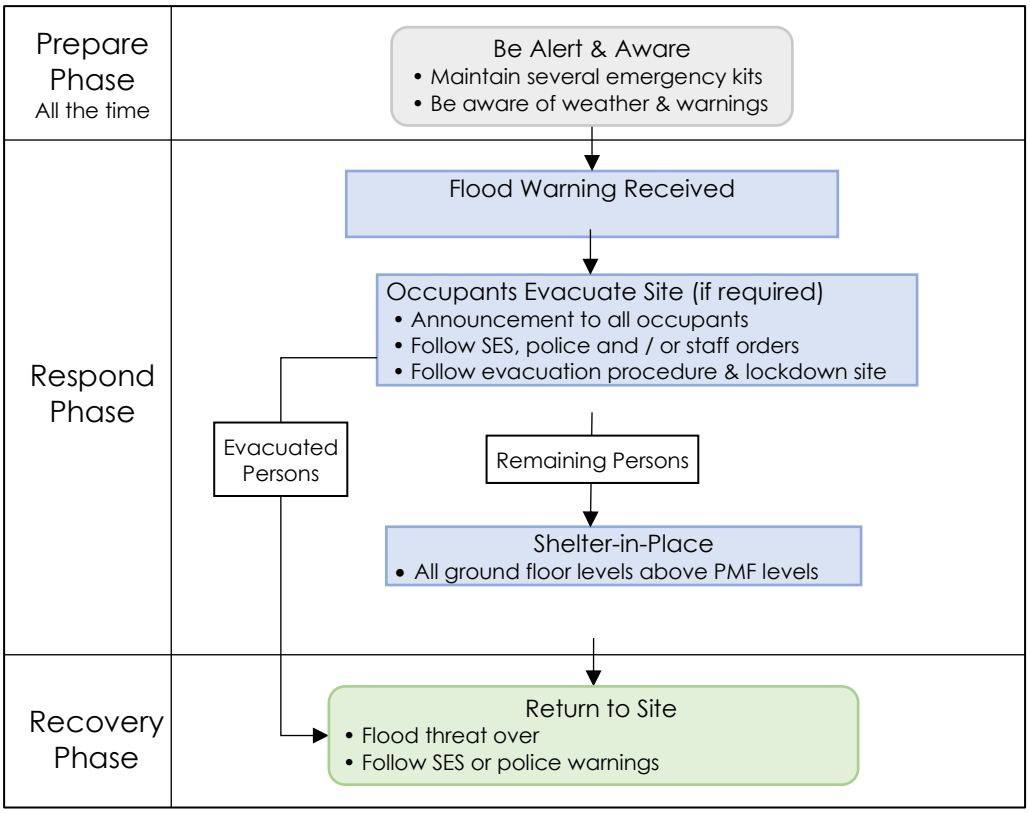


Figure 4: Overview of site flood risk action plan (FRAP).

5.3 Flood Emergency Response Procedures

5.3.1 General Risk Management Procedures

In general, the following primary flood emergency responses are rerecommended for the site:

1. A responsible flood officer shall be appointed to manage flood education and instructions for site management and all occupants. The officer will be subscribed to available warning systems.

2. The finished floor level (FFL) of all proposed and existing buildings is at least 500mm above the peak 1% AEP flood level, hence is not affected by flood events up to and including the PMF.

3. PMF refuge is available on the ground floor of each building.

4. Evacuation route is available for the site via the northern carpark which connects to Hotham Road.

5. An on-site flood alarm would be provided to enable warning for evacuation route from President Avenue is being cut off.

5.3.2 Flood Warning Mechanisms

Site management will be subscribed to the following systems and may be alerted to flood warnings via the following mechanisms:

- SES emergency alert telephone warning system.
- BOM alerts and press releases.
- Weather apps (eg. 'Early Warning Network').
- Media warnings (TV, radio, internet etc.).
- Police and / or SES door knocking.
- Visual observation of rising flood waters on site and President Avenue.

If site management receives a flood warning via any of the mechanisms described above, they should undertake the evacuation or shelter-in-place procedures immediately.

5.4 Evacuation

5.4.1 Evacuation Overview

The evacuation procedure is a step-by-step action plan to properly prepare the site during a major flood event after a flood warning is received. The aim of the procedure is to mitigate the risks to people. Trained staff must ensure the procedure is properly followed before they evacuate the site / or shelter-in-place.

5.4.2 Evacuation Route

Flood waters on President Avenue in front of the south western carpark entry of the site is inundated by high hazard flood waters and unsuitable for traffic during a flood event of 1% AEP or higher.

The northern carpark which connects to Hotham Road is not affected by flood waters under the 1% AEP events and would remain trafficable for both light vehicle and emergency service vehicles. For the PMF event, a small area near the intersection with Avery Avenue would be cut off for light vehicle access for no longer than 15 minutes. This route would allow for possible evacuation from the site to the north and then via Avery Avenue and Bath Road returning back on President Avenue to higher ground to the west that is outside the PMF extents.

5.4.3 Evacuation Procedure

We note that the site is affected by short duration overland flooding and is unlikely to have sufficient time for the site management to receive warnings before people on site to evacuate.

Ground floor of each building will be above the flood planning levels, occupants will not need to evacuate to escape rising floodwaters, and in fact would be safer not to evacuate. The preferred flood emergency response for the site is shelter in place. Evacuation will only be required if an evacuation order being issued by NSW SES.

In general, the following evacuation procedure is recommended:

1. Responsible flood officer to inform and direct evacuating people towards the evacuation route.
2. Staff should follow the advice of SES and police at all times with respect to timing and consequently update others on site until the site evacuation procedure is completed.
3. Lockdown the main site accesses e to prevent entry.
4. Responsible flood officer to be the last person to evacuate.
5. If at any point inundation of the evacuation route within the site occurs then direct any remaining people to shelter in place.
6. Staff and occupants can return to the site when safe (ie. when notified by police or SES).

5.5 Shelter–in–Place

The finished floor level (FFL) of all proposed and existing buildings is above the PMF flood level. This would enable shelter-in-place as a primary flood emergency response for occupants.

Modelling indicates the shelter-in-place duration in the critical duration PMF event is in the order of 20 minutes. It is possible that longer duration PMF events will cause a longer isolation time, however we expect this will be less than 3 hours, which is considered an acceptable duration to shelter in place.

The following is to be provided to enable safe shelter-in-place:

1. PMF refuge is available on the ground floor and levels above of each building.

2. A suitable number of trained staff will remain with people who shelter-in-place.

3. Proposed buildings will be designed to resist flood forces (water and debris) and any buoyancy forces up to the PMF level.

4. Facility management should maintain several emergency kits including torch with spare batteries, portable radio with spare batteries, first aid kit, high visibility vest, non-slip foot ware and megaphone

5. Any person's sheltering-in-place will follow the procedures associated with the flood warning device.

5.6 Flood Warning Device

A flood warning device will be provided at the site to warn the occupants that access route from President Avenue is being cut off and to shelter in place or evacuate via Hotham Road if necessary.

The site flood warning device is to be installed under the driveway crossing from President Avenue to the south western carpark. The device would be connected to an audible and visual alarm system linked by wiring or telemetry. Details of flood levels and timing will be provided at the detailed design stage and will ensure that site occupants can be safely evacuate the site or shelter-in-place.

6 Compliance Assessment

We note the following based on Sutherland Shire Council flood planning policies provided in Sutherland Shire LEP and DCP (2015):

1. A High Flood Risk Precinct is defined as the area below the 1% AEP flood level that is either subject to high hydraulic hazard or where there are significant evacuation difficulties.

2. A Medium Flood Risk Precinct is defined as the area below the 1% AEP flood level that is not subject to high hydraulic hazard or where there may be some evacuation difficulties.

3. A Low Flood Risk Precinct is defined as the area between the 1% AEP flood level and the PMF level.

4. Where existing knowledge is incomplete, areas are classified as "Initial Assessment Potential Flood Risk".

5. The site is classified as an "Initial Assessment Potential Flood Risk", which by SSC which indicates that SCC believes there is a high risk of flooding occurring on the site, however no formal studies have been undertaken to quantify and assess the risk.

6. The proposed development is an alteration and expansion of the existing private hospital which is categorised as an "Essential Community Facility" land use, and thus it is not permitted on any land classified as low, medium, or high flood risk.

7. In existing condition the site and the main hospital building is below the 1% AEP flood level. The hospital main building generally experiences low hydraulic hazard, however the south western carpark and timber buildings experience high hazard, thus the site would fall under the category of "high flood risk".

8. The proposed design renders the development area flood free for events up to and including the PMF.

Flood specific controls are provided in the DCP at Chapter 40 Part C 'Flood Risk Management'. A compliance assessment for the proposed development based on Table 5.5 and the planning considerations in Section 5.6 of the DCP for an essential community facility land use is summarised in Table 7, which demonstrates that all the applicable flood planning requirements for the proposed development site are effectively addressed, and compliance with the Sutherland Shire Council DCP is achieved.

Table 7: Compliance with Sutherland Shire DCP (2015) development matrix prescriptive controls.

Sutherland Shire DCP Requirement	Compliance Assessment
FLOOR LEVEL	
1. Habitable floor levels shall be no lower than the PMF level or the 1% AEP flood levels plus 500mm freeboard, whichever is higher.	The proposed floor levels comply with the DCP requirements. Refer to Table 6 in Section 4.6.2 for more details.
BUILDING COMPONENTS & METHOD	
1. All structures to have flood compatible building components below the PMF.	All structures up to the peak PMF level, are to be constructed from flood compatible building components. Details will be provided at detailed design stage.
STRUCTURAL SOUNDNESS	
1. An engineer's report is required to certify that the structure can withstand the forces of floodwater, debris and buoyancy up to and including a PMF level.	All structures are to be constructed from flood compatible building components and buildings shall be designed considering the forces of the floodwater, debris, buoyancy and inundation up to the PMF level. Details will be provided at detailed design stage.
FLOOD EFFECTS	
1. An engineer's report is required to certify that the development will not increase flood effects elsewhere, having regard to: i. Loss of flood storage; ii. Changes in flood levels, flows and velocities caused by alterations to flood flows;	The proposed swale offsets the loss in flood storage of the proposed south western carpark. The proposed development is not likely to materially affect flood levels, velocities or hazards as the swale does not increase the flows on site, it only redirects the flow. Therefore, we also do not expect there will be adverse environmental impacts such as erosion or siltation.
CAR PARKING AND DRIVEWAY ACCESS	
1. The minimum surface level of open car parking spaces shall be no lower than the 1% AEP flood level or the level of the crest of the road at the location where the site has access to the road.	The proposed open carpark has a flood protection wall along the south western edges which is more than 500mm above the 1% AEP peak levels within the swale. Proposed carpark level at 70.00 mAHD is higher than the 1% flood level of 69.41mAD and PMF level of 69.70 at the driveway crossing.

Sutherland Shire DCP Requirement	Compliance Assessment
2. Restraints or vehicle barriers shall be provided to prevent floating vehicles leaving a site during a 1% AEP flood. A flood depth of more than 200 mm will cause serious water damage to a typical vehicle and a depth of 300 mm is sufficient to cause a typical vehicle to float.	The carpark is not affected by the 1% AEP flood.
EVACUATION	
1. Reliable access for pedestrians or vehicles shall be provided during a 1% AEP flood.	The northern carpark access is available during events up to and including the PMF event.
2. Reliable access for pedestrians or vehicles shall be provided from the building commencing at a minimum level equal to the lowest habitable floor level to an area of refuge above the PMF level.	Ground floor levels of the existing and proposed buildings are above the PMF level. Evacuation from the site to an area of refuge above the PMF level is available through the no.
3. Adequate flood warning systems, signage and exits shall be available to allow safe and orderly evacuation without increased reliance upon the SES or other authorised emergency services personnel.	A more detailed preliminary FERP has been provided in Section 5 for the proposed flood warning system strategic level advice and assumes that detailed design of various site controls (ie. signage and exists) will be undertaken prior to issue of construction certificate.
4. The development shall be consistent with any relevant flood strategy, Floodplain Risk Management Plan adopted by Council or similar plan.	Preliminary FERP provided in Section 5 has been prepared consistent with the flood specific controls in Council's DCP Chapter 40 Part C 'Flood Risk Management'.
5. An engineer's report shall be provided to certify that an area of refuge is available if circumstances are possible where the evacuation of persons might not be achieved within an effective warning time.	PMF refuge is available on the ground floor and levels above of each building.
MANAGEMENT AND DESIGN	
1. Applicant shall demonstrate that area is available to store goods above the PMF level.	The ground floor levels of the proposed and existing buildings are above the PMF level.
2. No storage of materials which may cause pollution or be potentially hazardous during any flood is permitted below the 1% AEP plus 500 mm.	Ground floor of each building will be above the flood planning levels.

7 Response to Agency Comments

In response to the EIS submission of the alterations and additions to President Private Hospital, Council provided comments on the flood related aspects of the SSDA dated 29 January, 2021 (File Ref: DN20/0063) which MA have responded to in Table 8 below.

Table 8: MA response to SCC's comments (29/01/2021) regarding site flooding.

SCC Comments	MA Response
1. The catchment area measured used for the hydrological assessment has failed to include the catchment from the brick pit precinct. Flows from this catchment are conveyed toward the site via stormwater pipes crossing the train line at Bath Road. Therefore the assessment has underestimated flows arriving at the site and possibly underestimated flood levels.	As it is shown in Attachment C – Map 02 and Map 03, the corresponding upstream catchment for brick pit and the stormwater pipe crossing the train line at Bath Road have been added to the hydrology and hydraulic model.
2. The assessment has assumed a 1050 mm diameter stormwater pipe within the site whereas Council records show a 1200 mm diameter pipe. Further information on this should be provided.	The 1D pits and pipes network has been updated based on the survey undertaken by Australian Location Services surveyor. (Attachment A and Attachment C – Map 03)
3. The critical storm duration estimated for the hydrology model is too low. A rough calculation using the length of the catchment indicates that the critical duration would be >10 minutes. It should be noted that the critical duration used for the PMF is 15 minutes. It's expected that the duration for all storms should be the same.	The hydrologic model has been updated to include the surrounding catchments and also critical duration assessment has been undertaken. The critical duration for 1%, 5% and 1% CC AEPs have changed from 5 min to 10 min based on ensembled results for storm durations between 5 minutes and 6 hours and 10 temporal patterns. Catchment delineation and hydrology model details have been provided in Section 3.
4. The hydraulic model does not account for Council's requirement for all inlet pits to be assumed 50% blocked.	Pipe blockage has been directly applied to the pipe crossing the site which is a common flood modelling practise. 25% pipe blockage has been adopted based on the assessment procedure in Australian Rainfall and Runoff (Weeks & Rigby, 2016), which is considered to be appropriate.
5. The flood maps show flooding of the proposed car park in the PMF. Given the proposed development is an essential facility, greater protection from flooding is required. Hence, the basement driveway crest must be raised to the PMF level.	Updated flood modelling based on the amended grading design has shown that the proposed carpark is flood free in the PMF event. Refer to Attachment C – Map 31 to 34 for more details.
6. The flood difference map does not definitively show that the development does not result in offsite flood impacts. The flood difference maps should be provided with levels in 0.01 m increments. Council considers any offsite flood impacts greater than 10 mm to be unacceptable.	Flood difference maps (Attachment C – Map 14 & 45) have provided with levels in 0.01 m increments and show that the development does not result in offsite flood impacts to the neighbouring residential properties. Flood impacts affecting the road are localised and minor in nature, mostly along the footpath, and do not materially affect the ARR 2019 flood hazard category or change trafficability in any meaningful way.

SCC Comments	MA Response
7. For the preliminary flood emergency response plan (section 5) the report incorrectly states that the northern car park and Hotham Road are unaffected by flood waters, and recommend evacuation to the north during a flood event. However, in a PMF event there will almost certainly be flows down Hotham Road, possibly overtopping the kerb to be hazardous to pedestrians. Given that the report does not cover potential flooding down Hotham Road, the emergency response plan should consider alternative and safe methods of evacuation/refuge. Consideration should be made to the expected duration of flooding and risks of evacuation versus refuge on site.	the preliminary flood emergency response plan Section 5 of the report has been updated. Based on the updated flood modelling results, Hotham Road is not affected by flood waters under the 1% AEP events and would remain trafficable for both light vehicle and emergency service vehicles. For the PMF event, a small area near the intersection with Avery Avenue would be cut off for light vehicle access for no longer than 15 minutes. This route would allow for possible evacuation from the site to the north and then via Avery Avenue and Bath Road returning back on President Avenue to higher ground to the west that is outside the PMF extents.
8. The report should include a map showing flood levels that correspond with each proposed building element. The finished floor level should be determined based on the flood level most representative of the building location.	A map showing flood levels that correspond with each proposed building element has been provided in Figure 3 of this report.
9. The existing conditions versus the proposed conditions do not appear consistent. It is unclear how the wide floodway shown in the existing conditions is contained within the proposed swale/channel. It would be expected that diverting flows to the south at such a sharp angle would cause afflux onto properties to the west. The report should include more information about the assessment including P.O. lines from the model at critical locations, particularly at the south western corner of the site.	Proposed swale contains a wider section near the south western corner of the site, which provides some detention effects before discharging into a narrower swale running between the proposed carpark and southern site boundary. The swale has been sized and remodelled iteratively to ensure no adverse flood impacts occur on the properties to the west as demonstrated in the Flood difference maps (Attachment C – Map 14 & 45).
10. The flood maps show high hazard flooding of the proposed open car park in the PMF. Given the nature of the development, the open car park should be elevated so that it is not exposed to hazard causing damage to vehicles, hence should not fall within a hazard category higher than H2.	Updated modelling with the amended design has shown that the proposed carpark is flood free from the PMF.
11. The crest of the driveway providing access to the basement should be elevated to the PMF level to provide additional protection.	Updated modelling with the amended design has shown that the proposed carpark and the basement entrance are flood free from the PMF.

SCC Comments	MA Response
12. Details of the proposed channel/swale should be provided and must be consistent with what has been modelled. Additionally consideration should be made to continuing the channel to the east toward the intersection at Hotham Rd and President Ave. In doing so, the channel should contain high hazard flooding within the property for an extended length before discharging onto the carriageway. This would reduce the risk to life and property damage within President Avenue. The applicant should consult with the SES and NSW Police to confirm that this would assist during a flood emergency.	Details of the proposed channel/swale have been provided Attachment B and have been modelled consistently in the updated flood models. Proposed swale has been extended further to the east towards the intersection at Hotham Rd and President Ave.
13. The report has not referenced the permissibility of essential community facilities on flood affected land or the objectives of the DCP which should be used to assess the proposed development. The report must provide comment on this aspect.	A compliance assessment for the proposed development based on Table 5.5 and the planning considerations in Section 5.6 of the DCP for an essential community facility land use is summarised in Table 7, which demonstrates that all the applicable flood planning requirements for the proposed development site are effectively addressed, and compliance with the Sutherland Shire Council DCP is achieved.

As a peer reviewer and on behalf of the Department of Planning, Industry and Environment (DPIE), GRC Hydro has provided comments which MA have responded to in Table 8 below.

Table 9: MA response to GRC's comments (19/07/2021) regarding site flooding peer reviewing.

GRC Comments	MA Response
1. The stormwater survey is to be reviewed and verified to ensure that 'detailed survey of existing drainage infrastructure on the site' has been obtained as required by the project SEARs;	Survey discrepancies and details have been clarified by Australian Location Services surveyor (Attachment A). Additional survey on the downstream pits has been undertaken and the 1D pits and pipe network has been updated accordingly (Attachment C – Map 03)
2. The hydrologic model is required to be extended to ensure that all catchments that potentially influence flood and stormwater characteristics at the site, and surrounding roads, is adequately assessed. This includes catchments to the north of the rail line;	The updated hydrologic model has been extended to include all catchments including the area south of President Avenue, the area north of the site around Hotham Road, the area north of the railway line and the area east of the site. Catchment delineation and hydrology model details have provided in Section 3.2.
3. In addition to the 5% AEP, 1% AEP and PMF events, analysis for an 'increase in rainfall intensity' associated with climate change is required as per the project SEARs. The 1% AEP event should be modelled with allowance for ARR2019 RCP8.5 rainfall increases for an appropriate planning horizon;	Additional events consisting of the 5% and 1% AEP with climate change (ARR 2019 RCP 8.5 rainfall increases projected for the year 2090) events have been considered in the updated model.

GRC Comments	MA Response
4. The TUFLOW hydraulic model extent and boundaries should be extended away from the site (both upstream and downstream) to minimise boundary effects on model results. Alternatively, existing boundary conditions should be justified and documented through sensitivity analysis to ensure boundary assumptions do not influence stormwater and flood hydraulics at the site;	The TUFLOW hydraulic model extents and boundaries have been extended further away from the site both upstream and downstream. (refer to Attachment C – Map 03 for the updated model extent)
5. Flows from all catchments which potentially result in stormwater and/or overland flows to arrive at the site, and roads surrounding the site, should be applied to the model. This includes overland flows which may overtop the rail line during extreme events;	Flows from all catchments which could potentially result in stormwater or overland flows to arrive at the site and roads surrounding the site have been considered. These include stormwater pipe flow and overland flow north of the railway line. Stormwater pit and pipe details also have been added to the flood model according to the additional survey works (Attachment A)
6. The Mannings for the proposed swale should be applied as 0.04 (as opposed to 0.02) as is described in the Flood Assessment (2020) report;	Mannings for the proposed swale has been applied as 0.04 (as opposed to 0.02). Refer to Table 4 in Section 4.4.1 for more details.
7. Lateral stormwater lines that connect to the trunk stormwater system near the corner of Hotham Road and President Avenue may impact on stormwater conveyance capacity through the site and should be included in the model;	Additional stormwater lines as requested based on the additional survey information (Attachment A and Attachment C – Map 03) have been included in the updated model.
8. The stormwater trunk through the site should be updated to be consistent with the site stormwater survey (specifically the changes in pipe size). Energy losses associated with pits, bends, junctions and drop pits are to be applied to the model;	The stormwater trunk drainage through the site has been updated to be consistent with the additional survey information (Attachment A and Attachment C – Map 03), including all changes in pipe sizes and junction pits with the associated energy losses.
9. Stormwater characteristics (inverts, size) downstream of the site could significantly impact on stormwater conveyance through the site. Survey of this system to the outlet should be considered;	Stormwater network characteristics downstream of the site to the outlet have been included following additional survey works.
10. The 5% AEP, 1% AEP, 1% AEP + RCP8.5 increase in rainfall intensity, and PMF event should be modelled in TUFLOW for 'Existing' and 'Proposed' development conditions;	All four of these flood events have been modelled in TUFLOW for 'Existing' and 'Proposed' development conditions.
11. The design is required to meet the objectives of the SSLEP (2015) and SSDCP (2015). Comprehensive discussion of how the design meets these objectives is to be presented;	A compliance table has been provided in Section 6 and has been updated following these modelling updates.

GRC Comments	MA Response
12. Basements are to be afforded protection for events up to and including the PMF. Passive protection of basements is required up to the 1% AEP + 0.5 m freeboard;	The southern basement and open space carpark have been modelled to be protected against the PMF event by a flood wall running along the south-western edge of the carpark. Basement carparking level is 70 mAHD which is 0.6 m higher than the 1% AEP flood level (69.4 mAHD) at the entrance. So passive protection is not required.
13. Offsite flood impacts should be mitigated to ensure that surrounding properties are not adversely affected by increases in flood level that exceed 0.01 m. Flood impacts affecting the road would only be considered if they are localised/minor in nature, associated with an overall reduction in flood risk, and result in no increase in ARR2019 flood hazard category which could affect trafficability;	As per the provided afflux map (Attachment C – Map 14) there is no impacts to neighbouring properties. Flood impacts affecting the road are localised and minor in nature, mostly along the footpath, and do not materially affect the ARR 2019 flood hazard category or change trafficability in any meaningful way.
14. Assessment of the duration of isolation and site-specific risks should be provided. A more detailed FERP is required to explain how the site can be safely developed to manage residual flood risk due to extreme flood events to confirm the emergency management approach;	A more detailed FERP has been provided in Section 5 showing additional details as requested.
15. Extending the swale further east should be investigated. This has the potential to replace lost flood storage, distribute discharge from the swale which may remove/reduce concentrated areas of H5 hazard, and improve access to the open carpark area. Widening of the swale may be feasible by cantilevering the carpark over a portion of the swale and should also be investigated.	The swale has been extended further east for additional flood storage.

8 Summary and Recommendations

A detailed hydrologic and hydraulic model has been developed for the site using proposed design elements to assess local flood characteristics.

The models were used to determine the existing and proposed flood conditions in the 5% AEP, 1% AEP, 1% AEP with incorporating potential impacts of climate change and PMF flood events. Modelling concluded that:

1. Proposed flood characteristics are largely consistent with existing conditions, and differences due to the proposed development are negligible.

2. The proposed swale effectively render the site development area flood free in all flood events up to and including the PMF.

3. The proposed development would have no material offsite flood impacts.

4. Compliance with Council flood planning level requirements for building and car park levels are achieved.

5. Ground floor of each building will be above PMF levels, occupants will not need to evacuate to escape rising floodwaters. The preferred flood emergency response for the site is shelter in place. Alternatively, evacuation via Hotham Road is available.

The following recommendations are made:

1. Piers are to be designed by a suitably qualified engineer to withstand the forces of floodwater, debris and buoyancy.

2. Structures below the site PMF flood level are to be constructed using flood compatible materials in accordance with Council requirements.

3. A more detailed flood risk management plan should be prepared at detailed design stage to outline shelter-in-place and evacuation requirements to minimise flood risk to life and property associated with the use of land.

The proposed development has been designed to ensure compatibility with the existing floodplain environment. As the proposed development has been designed to achieve Council requirements, no further recommendations are considered necessary.

9 References

Bureau of Meteorology (2003), *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method*.

Bureau of Meteorology (2020), *Rainfall IFD Data System*, www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016.

Commonwealth of Australia (Geoscience Australia) (2016), *Australian Rainfall and Runoff – A Guide to Flood Estimation.*

DRAINS (2019), *DRAINS Content Menu*.

NSW Department of Infrastructure, Planning and Natural Resources (2005), *Floodplain Development Manual*.

NSW Department of Planning, Industry & Environment (2020) *eSPADE – NSW Soil and Land Information,* www.environment.nsw.gov.au/eSpade2WebApp.

Sutherland Shire Council (2015), *Sutherland Shire Local Environmental Plan (LEP)*.

Sutherland Shire Council (2015), *Sutherland Shire Development Control Plan (DCP)*.

Weeks, W and Rigby, T (2016), *Blockage of Hydraulic Structures,* Chapter 6 of Book 6 in *Australian Rainfall and Runoff – A Guide to Flood Estimation*.

XP-RAFTS (1996), User's Manual.

10 Attachment A: Updated Utility Survey Plan (19/11/21)

NOTES

- UTILITIES HAVE BEEN LOCATED USING ELECTROMAGNETIC LOCATING AND GPR EQUIPMENT
- AS-5488-2019 QUALITY LEVELS HAVE BEEN ADOPTED
- LEVELS OF SURVEYED OBSERVATIONS ARE AT GROUND LEVEL UNLESS NOTED OTHERWISE
- NOTATION "-0.65m INV QL-B" REPRESENTS A QUALITY LEVEL B DEPTH TO THE INVERT OF A SERVICE AS PER AS-5488-2019 AND APPLIES TO THE POINT AND NOT THE LINE
- DIAMETERS AND MATERIALS HAVE BEEN OBTAINED FROM DBYD DRAWINGS UNLESS QL-A
- NO BOUNDARY DEFINITION HAS BEEN CARRIED OUT
- NON DESTRUCTIVE EXCAVATION IS RECOMMENDED BEFORE CARRYING OUT ANY CONSTRUCTION WORKS
- GPS (CorsNET) HAS BEEN USED TO ESTABLISH VERTICAL AND HORIZONTAL DATUM/CONTROL AND HAS BEEN ADJUSTED TO PM 50889
- UTILITIES HAVE BEEN SURVEYED USING TOTAL STATIONS
- PLEASE REFER TO UTILITY REPORT FOR FURTHER DETAILS ABOUT SERVICE LOCATION
- THIS SURVEY IS RELATED TO MGA2020 HORIZONTAL GRID AND AHD71 HEIGHT DATUM.
- BASE SURVEY PLACED APPROXIMATELY USING KERB LINE AND BUILDING POSITIONS.

A0

Rev	Drn	Revision/Issue	Date	Reference
C	DJB	STORMWATER PITS ADDED	19/11/21	205741
B	CH	STORMWATER TEXT CHANGED	09/03/21	
A	CH	BASE SURVEY ADDED	14/04/20	
–	CH	GENERAL ISSUE	06/04/20	

Australian Locating Services
18/75 Pacific Highway
Waitara NSW 2077
Ph: 02 9016 4235
EMAIL: admin@locating.com.au
ABN: 12 109 067 950

LEGEND

LH	SEWER LAMP HOLE	WF	WATER FOUNTAIN
LP	LIGHT POLE	WM	WATER METRE
TEL	TELECOM	PH	POTHOLE
OF	OPTIC FIBRE	FH	FIRE HYDRANT
DL	DRAINAGE LINE	SV	STOP VALVE
PP	POWER POLE	KO	KERB OUTLET
(OBV)	OBVERT OF SERVICE	GU	GULLY
		IO	INSPECTION OPENING

WATERMAIN	W	W
ELECTRICITY	E	E
TELECOMMUNICATIONS	T	T
GAS	G	G
GAS (HPG)	HPG	HPG
SEWER	S	S
STORMWATER	SW	SW
NBN LINE	NBN	NBN
OPTUS LINE	OP	OP
OPTICAL FIBRE LINE	OF	OF
NEXT GEN LINE	NEXTG	NEXTG
SLIT TRENCH		
FUEL LINE	FL	FL

UNKNOWN	UNK	UNK
TPG	TPG	TPG
FIRE	F	F
AAPT	AAPT	AAPT
COMMS	C	C

Vertical Datum

DATUM: AHD
BM ADOPTED: PM 50889
RL: 87.788

Drawing Title: EXISTING UTILITIES & SERVICES

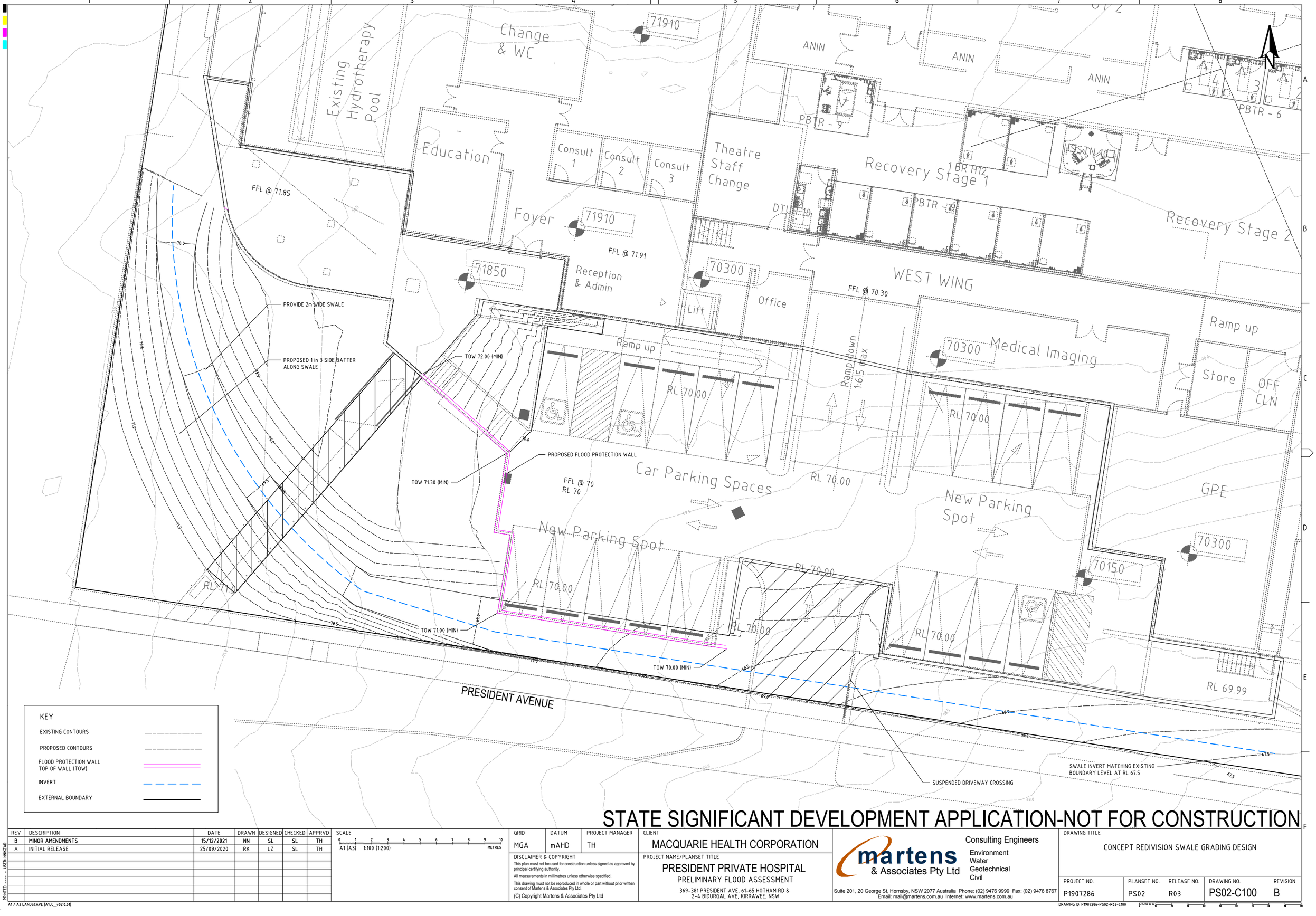
Client Details: IMAGESCAPE DESIGN STUDIOS

Project: PRESIDENT AVE & HOTHAM RD, GYMEA

Date	Drn	Chk	Pas
APRIL 2020	CH	DJB	DJB

Scale	Drawing No.	Rev.
NOT TO SCALE	203302	C

11 Attachment B: Proposed Earthwork Plan



STATE SIGNIFICANT DEVELOPMENT APPLICATION-NOT FOR CONSTRUCTION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
B	MINOR AMENDMENTS	15/12/2021	NN	SL	SL	TH
A	INITIAL RELEASE	25/09/2020	RK	LZ	SL	TH

SCALE: A1 (A3) 1:100 (1:200) — 0 1 2 3 4 5 6 7 8 9 10 METRES

GRID	DATUM	PROJECT MANAGER
MGA	mAHD	TH

CLIENT: MACQUARIE HEALTH CORPORATION

PROJECT NAME/PLANSET TITLE: PRESIDENT PRIVATE HOSPITAL
PRELIMINARY FLOOD ASSESSMENT
369-381 PRESIDENT AVE, 61-65 HOTHAM RD & 2-4 BIDURGAL AVE, KIRRAWEE, NSW

martens & Associates Pty Ltd
Consulting Engineers
Environment
Water
Geotechnical
Civil
Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE: CONCEPT REDIVISION SWALE GRADING DESIGN

PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1907286	PS02	R03	PS02-C100	B

DRAWING ID: P1907286-PS02-R03-C100

PRINTED: ---- - USER: NWK2AD

A1 / A3 LANDSCAPE (A1LC_v02.0.01)

12 Attachment C: Updated Flood Result (Mapset P1907286MS02-R01)

Map 01: Site Overview Map
Map 02: Catchment Map – (Viewport 4)
Map 03: Tuflow Model Setup – (Viewport 3)
Map 04: 1% AEP Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 05: 1% AEP Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 06: 1% AEP Existing Condition Water Velocity (m/s) – (Viewport 1)
Map 07: 1% AEP Existing Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 08: 1% AEP Existing Condition Provisional ARR Flood Hazard Categories – (Viewport 1)
Map 09: 1% AEP Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 10: 1% AEP Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 11: 1% AEP Proposed Condition Water Velocity (m/s) – (Viewport 1)
Map 12: 1% AEP Proposed Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 13: 1% AEP Proposed Condition ARR Flood Hazard Categories – (Viewport 1)
Map 14: 1% AEP Afflux (To Proposed Surface) – (Viewport 2)
Map 15: 1% AEP Climate Change Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 16: 1% AEP Climate Change Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 17: 1% AEP Climate Change Existing Condition Water Velocity (m/s) – (Viewport 1)
Map 18: 1% AEP Climate Change Existing Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 19: 1% AEP Climate Change Existing Condition ARR Flood Hazard Categories – (Viewport 1)
Map 20: 1% AEP Climate Change Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 21: 1% AEP Climate Change Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 22: 1% AEP Climate Change Proposed Condition Water Velocity (m/s) – (Viewport 1)
Map 23: 1% AEP Climate Change Proposed Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 24: 1% AEP Climate Change Proposed Condition ARR Flood Hazard Categories – (Viewport 1)
Map 25: PMF Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 26: PMF Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 27: PMF Existing Condition Water Velocity (m/s) – (Viewport 1)
Map 28: PMF Existing Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 29: PMF Existing Condition ARR Flood Hazard Categories – (Viewport 1)
Map 30: PMF Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 31: PMF Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 32: PMF Proposed Condition Water Velocity (m/s) – (Viewport 1)
Map 33: PMF Proposed Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 34: PMF Proposed Condition ARR Flood Hazard Categories – (Viewport 1)
Map 35: 5% AEP Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 36: 5% AEP Existing Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 37: 5% AEP Existing Condition Water Velocity (m/s) – (Viewport 1)
Map 38: 5% AEP Existing Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 39: 5% AEP Existing Condition ARR Flood Hazard Categories – (Viewport 1)
Map 40: 5% AEP Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 2)
Map 41: 5% AEP Proposed Condition Water Level (mAHD) & Water Depth (m) – (Viewport 1)
Map 42: 5% AEP Proposed Condition Water Velocity (m/s) – (Viewport 1)
Map 43: 5% AEP Proposed Condition Provisional Hydraulic Hazard Categories – (Viewport 1)
Map 44: 5% AEP Proposed Condition ARR Flood Hazard Categories – (Viewport 1)
Map 45: 5% AEP Afflux (To Proposed Surface) – (Viewport 2)

Legend

- Site Boundary
- Cadastre
- Viewports

Viewport 4

Viewport 3

Viewport 2

Viewport 1

N

0 90 180 270 360 450 m

1:7500 @ A3

Map Title / Figure:

Site Overview Map

Map 01	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Catchments
- Existing Contour (mAHD)

Catchment A

Catchment B-1

Catchment B-2

Catchment B-3

Catchment C

Catchment D

Catchment E

Catchment F

Catchment G

N

0 60 120 180 240 300 m

1:5000 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

Catchment Map (Viewport 4)

Map 02	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Active Area

Line Boundary Conditions

- Slope (HQ)
- Inflow (QT)

Point Bounady Conditions

- Slope (HQ)
- Inflow (QT)
- Pits
- Pipe Diameter (m)

Box Culvert 4m x 1.5m (Approx. Only)

0 30 60 90 120 150 m

1:2500 @ A3

N

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Map Title / Figure:

Tuflow Model Setup
Boundary Conditions - (Viewport 3)

Map 03	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 20 40 60 80 100 m

1:2000 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

1% AEP Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 04	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

0 6 12 18 24 30 m

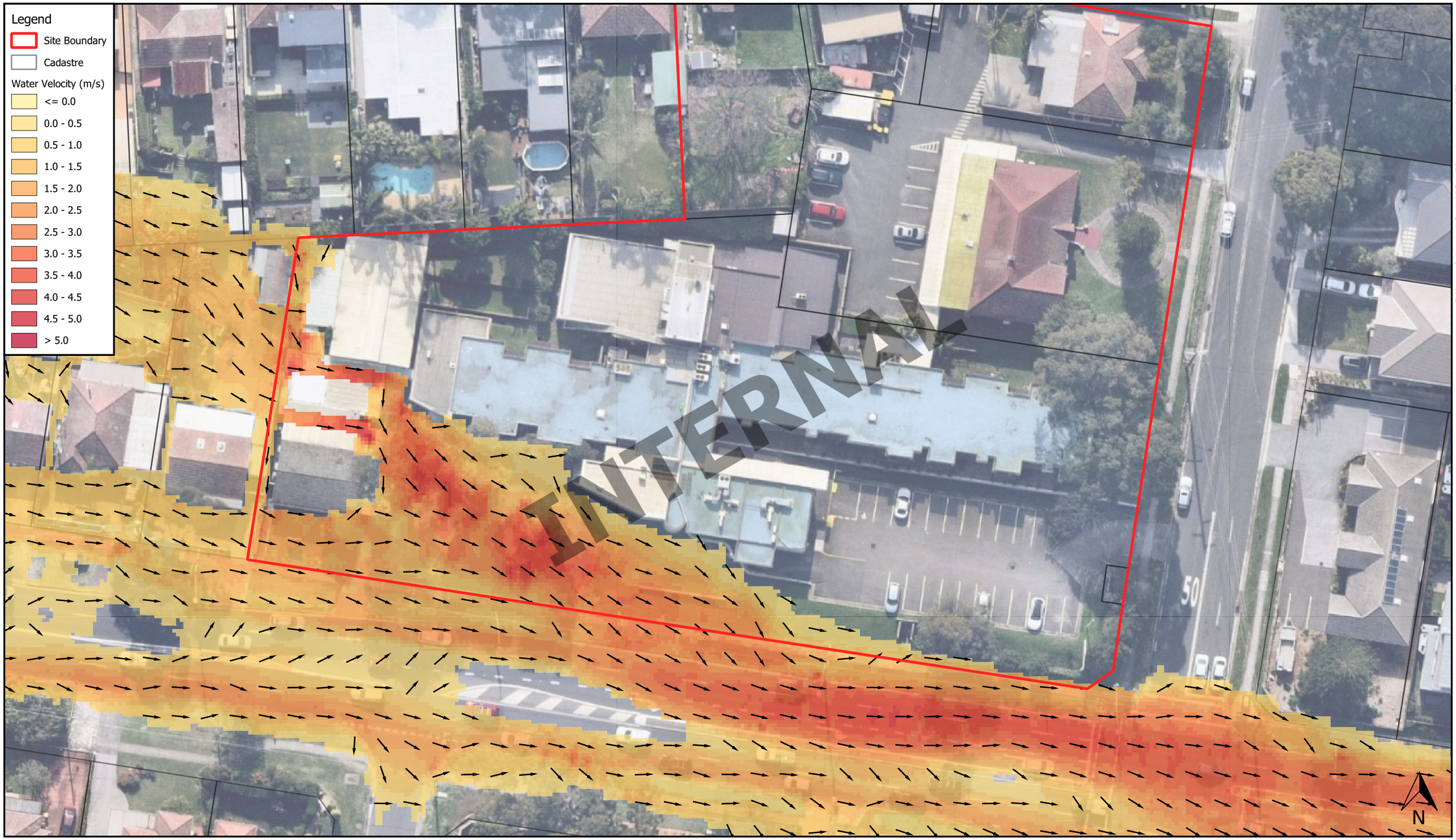
1:500 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

1% AEP Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 05	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date



0 6 12 18 24 30 m

1:500 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

1% AEP Critical Storm Duration
Existing Condition Water Velocity (m/s) - (Viewport 1)

Map 06	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre

Provisional Hazard

- Low Hazard
- Intermediate Hazard
- High Hazard

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

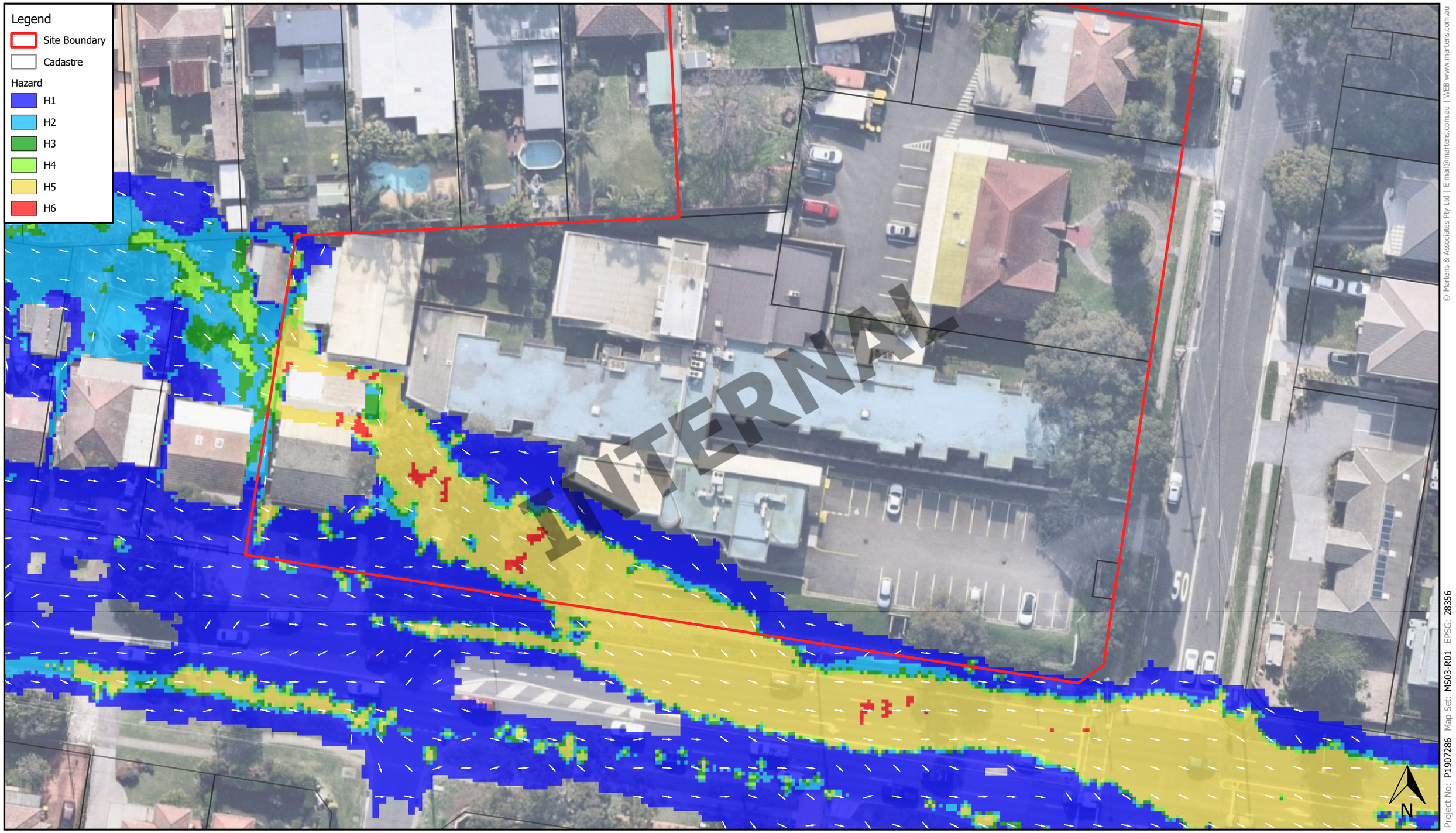
1:500 @ A3

Map Title / Figure:

1% AEP Critical Storm Duration
Existing Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 07	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 6 12 18 24 30 m

1:500 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

1% AEP Critical Storm Duration
Existing Condition Provisional ARR Flood Hazard Categories - (Viewport 1)

Map 08	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

0 20 40 60 80 100 m

1:2000 @ A3

Map Title / Figure:

1% AEP Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 09	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 10	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Water Velocity (m/s)

- <= 0.0
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Critical Storm Duration
Proposed Condition Water Velocity (m/s) - (Viewport 1)

martens
Environment | Water | Geotechnics | Civil | Projects

Map 11	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Provisional Hazard

- Low Hazard
- Intermediate Hazard
- High Hazard

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Critical Storm Duration
Proposed Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 12	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Critical Storm Duration
Proposed Condition ARR Flood Hazard Categories - (Viewport 1)

Map 13	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

0 20 40 60 80 100 m

1:2000 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

1% AEP Afflux (To Proposed Surface) - (Viewport 2)

Map 14	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 20 40 60 80 100 m

1:2000 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 15	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 16	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Water Velocity (m/s)

- <= 0.0
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Existing Condition Water Velocity (m/s) - (Viewport 1)

Map 17	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Provisional Hazard

- Low Hazard
- Intermediate Hazard
- High Hazard

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Existing Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 18	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Existing Condition ARR Flood Hazard Categories - (Viewport 1)

Map 19	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

0 20 40 60 80 100 m

1:2000 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 20	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

0 6 12 18 24 30 m

1:500 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 21	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Water Velocity (m/s)

- <= 0.0
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

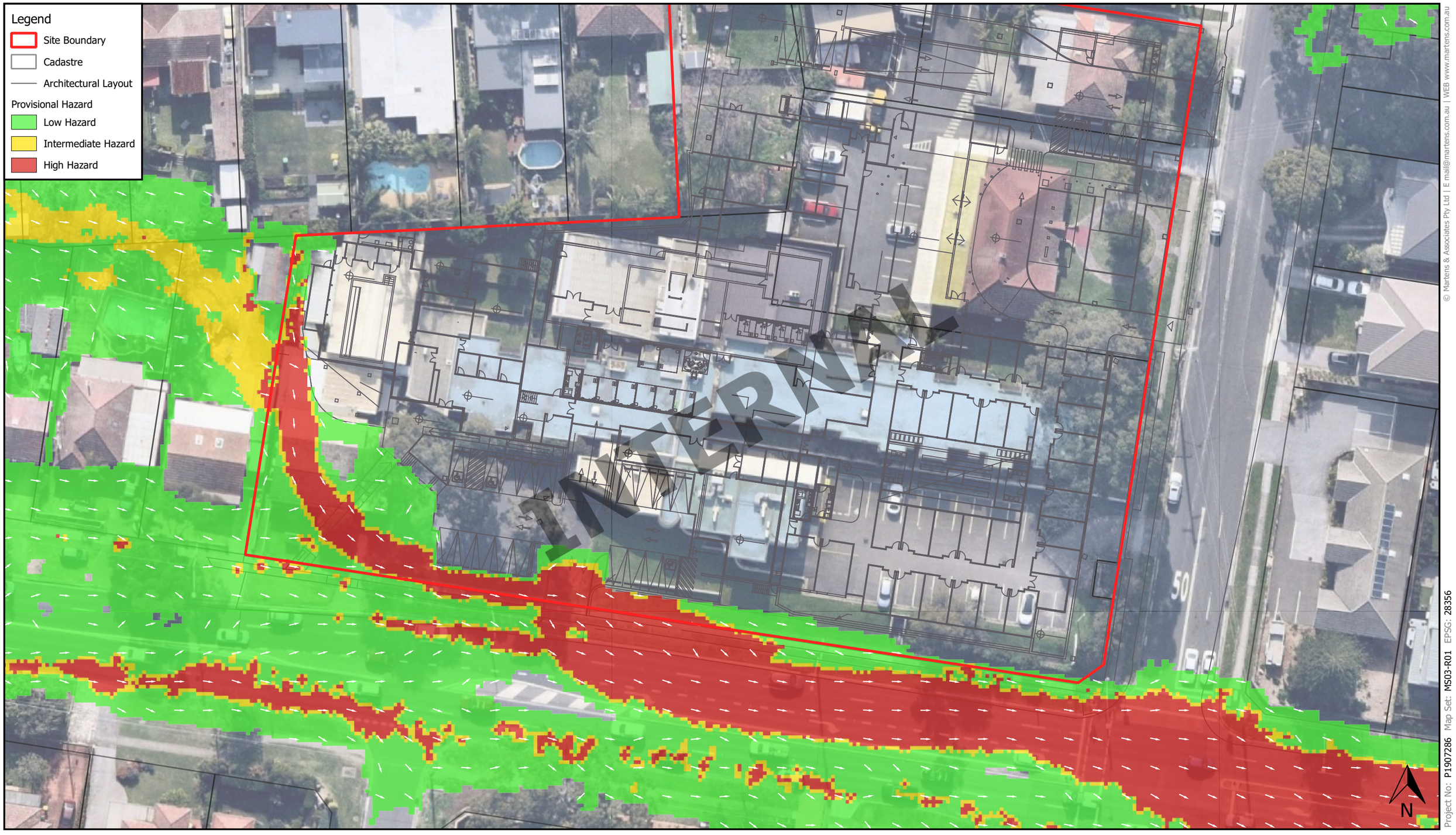
1:500 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Proposed Condition Water Velocity (m/s) - (Viewport 1)

Map 22	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Proposed Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 23	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

N

0 6 12 18 24 30 m

1:500 @ A3

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Map Title / Figure:

1% AEP Climate Change Critical Storm Duration
Proposed Condition ARR Flood Hazard Categories - (Viewport 1)

Map 24	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 20 40 60 80 100 m

1:2000 @ A3

Map Title / Figure:

PMF Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 25	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

PMF Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 26	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Water Velocity (m/s)

- <= 0.0
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

N

0 6 12 18 24 30 m

1:500 @ A3

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Map Title / Figure:

PMF Critical Storm Duration
Existing Condition Water Velocity (m/s) - (Viewport 1)

Map 27	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Provisional Hazard

- Low Hazard
- Intermediate Hazard
- High Hazard

N

0 6 12 18 24 30 m

1:500 @ A3

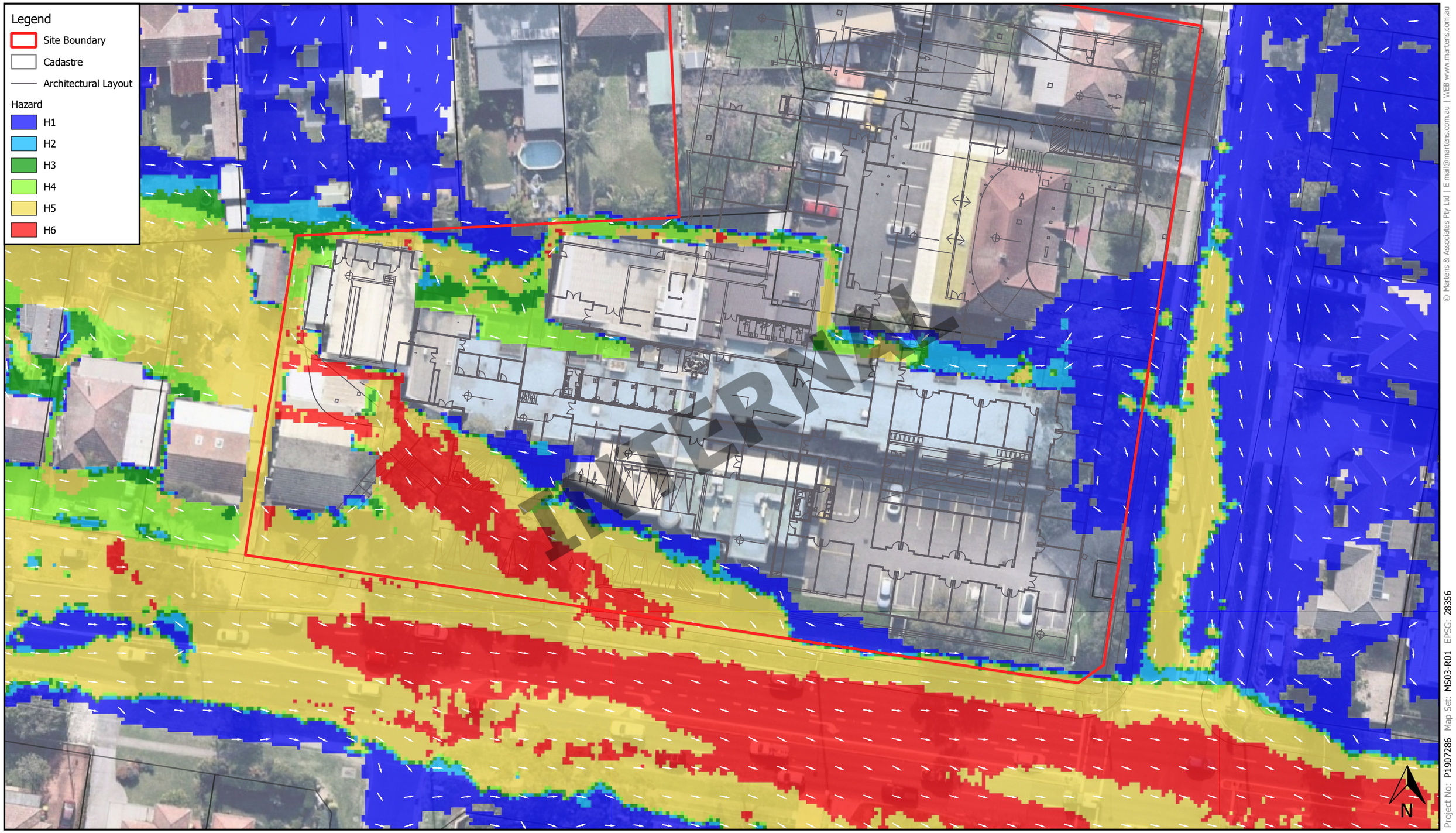
Map Title / Figure:

PMF Critical Storm Duration
Existing Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 28	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356



Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

PMF Critical Storm Duration
Existing Condition ARR Flood Hazard Categories - (Viewport 1)

Map 29	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 20 40 60 80 100 m

1:2000 @ A3

Map Title / Figure:

PMF Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 30	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

PMF Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 31	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Water Velocity (m/s)

- <= 0.0
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

N

0 6 12 18 24 30 m

1:500 @ A3

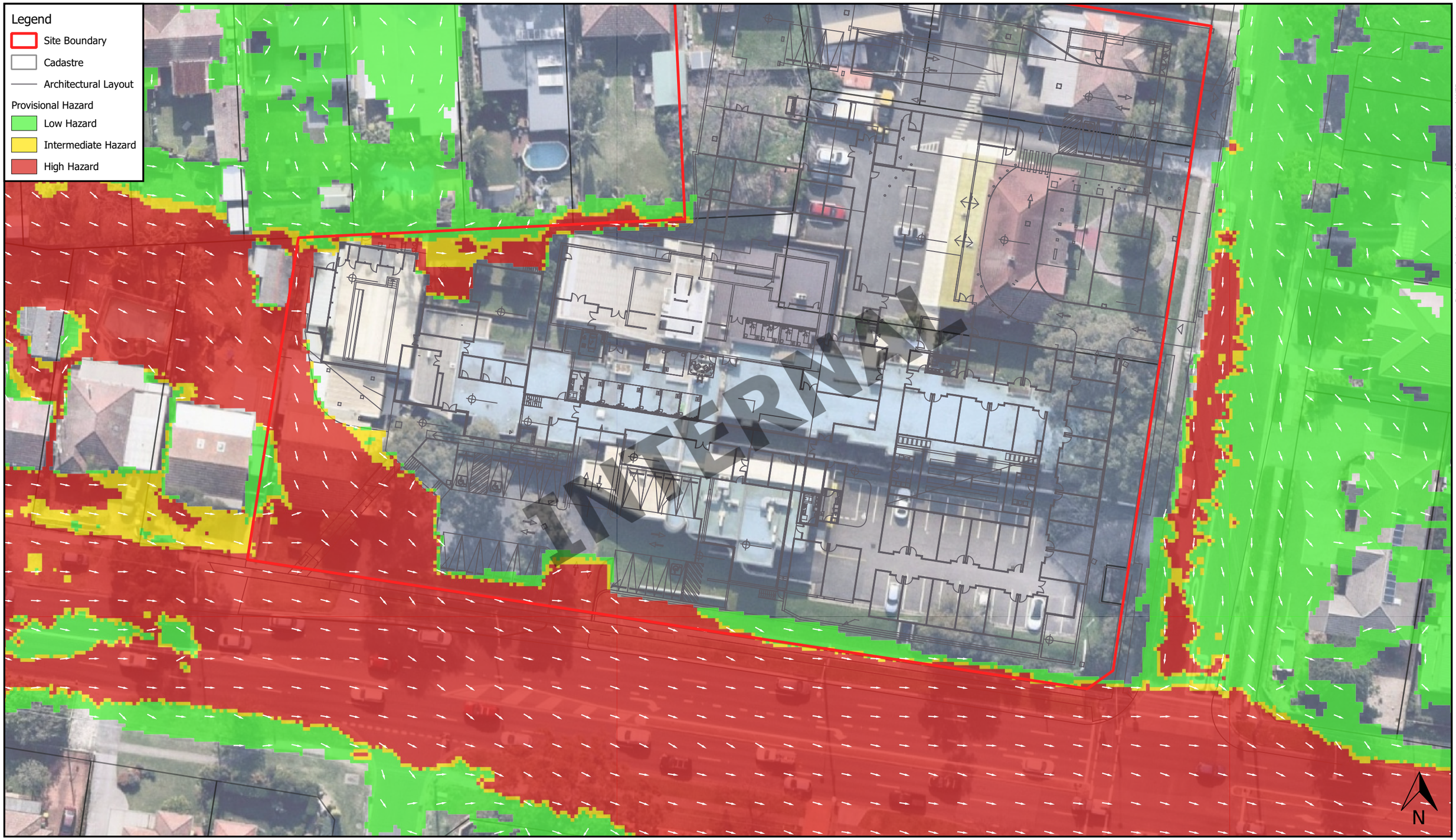
Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Map Title / Figure:

PMF Critical Storm Duration
Proposed Condition Water Velocity (m/s) - (Viewport 1)

Map 32	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 6 12 18 24 30 m

1:500 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

PMF Critical Storm Duration
Proposed Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 33	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

N

0 6 12 18 24 30 m

1:500 @ A3

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Map Title / Figure:

PMF Critical Storm Duration
Proposed Condition ARR Flood Hazard Categories - (Viewport 1)

martens
Environment | Water | Geotechnics | Civil | Projects

Map 34	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

0 20 40 60 80 100 m

1:2000 @ A3

Map Title / Figure:

5% AEP Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 35	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

5% AEP Critical Storm Duration
Existing Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 36	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Water Velocity (m/s)

- <= 0.0
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

0 6 12 18 24 30 m

1:500 @ A3

N

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Map Title / Figure:

5% AEP Critical Storm Duration
Existing Condition Water Velocity (m/s) - (Viewport 1)

Map 37	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Provisional Hazard

- Low Hazard
- Intermediate Hazard
- High Hazard

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

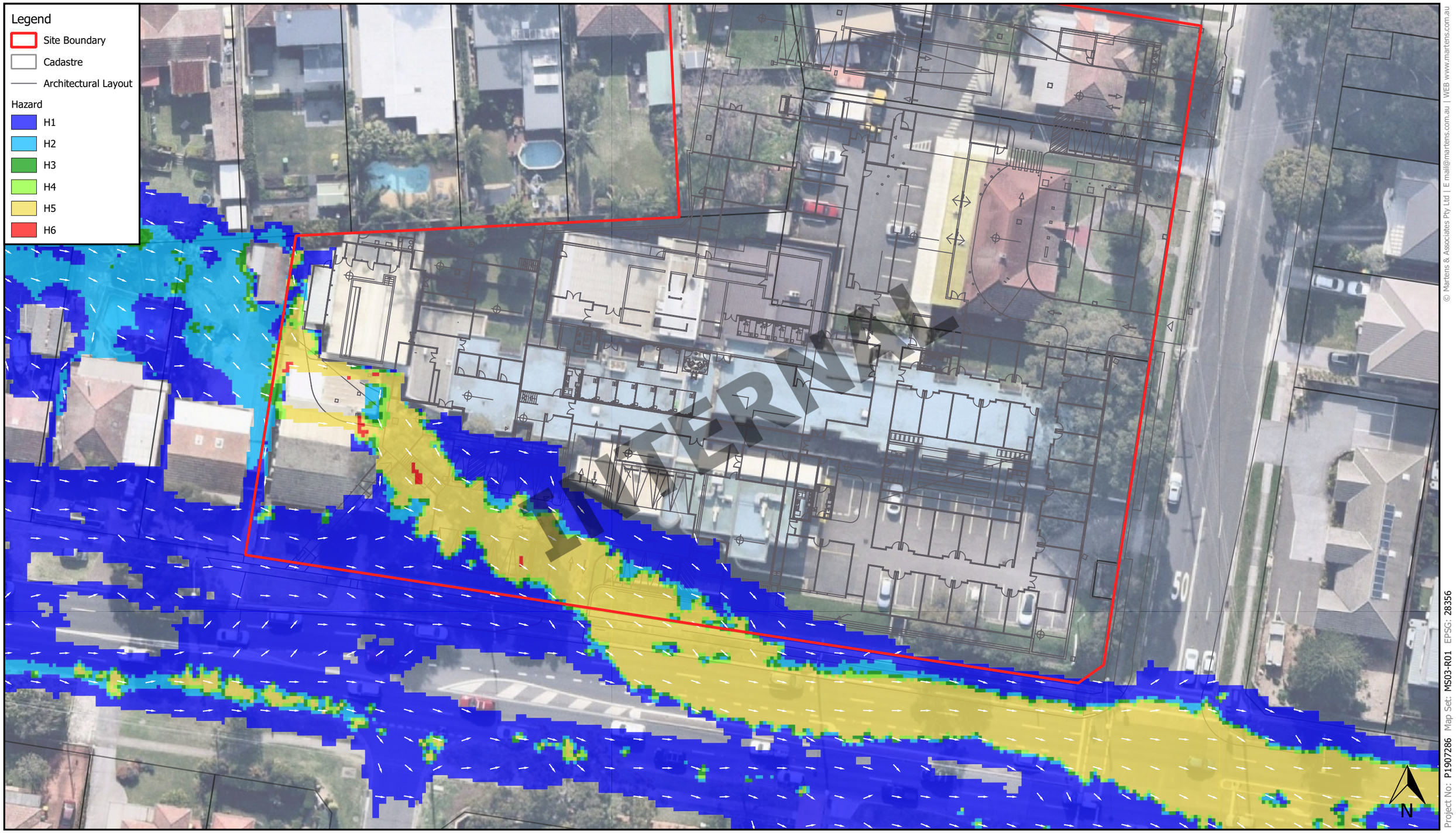
1:500 @ A3

Map Title / Figure:

5% AEP Critical Storm Duration
Existing Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 38	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects



0 6 12 18 24 30 m

1:500 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

5% AEP Critical Storm Duration
Existing Condition ARR Flood Hazard Categories - (Viewport 1)

Map 39	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

0 20 40 60 80 100 m

1:2000 @ A3

Map Title / Figure:

5% AEP Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 2)

Map 40	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout
- Water Level (mAHD)

Water Depth (m)

- <= 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- > 0.9

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

5% AEP Critical Storm Duration
Proposed Condition Water Level (mAHD) & Water Depth (m) - (Viewport 1)

Map 41	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Water Velocity (m/s)

- <= 0.0
- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 2.5
- 2.5 - 3.0
- 3.0 - 3.5
- 3.5 - 4.0
- 4.0 - 4.5
- 4.5 - 5.0
- > 5.0

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 6 12 18 24 30 m

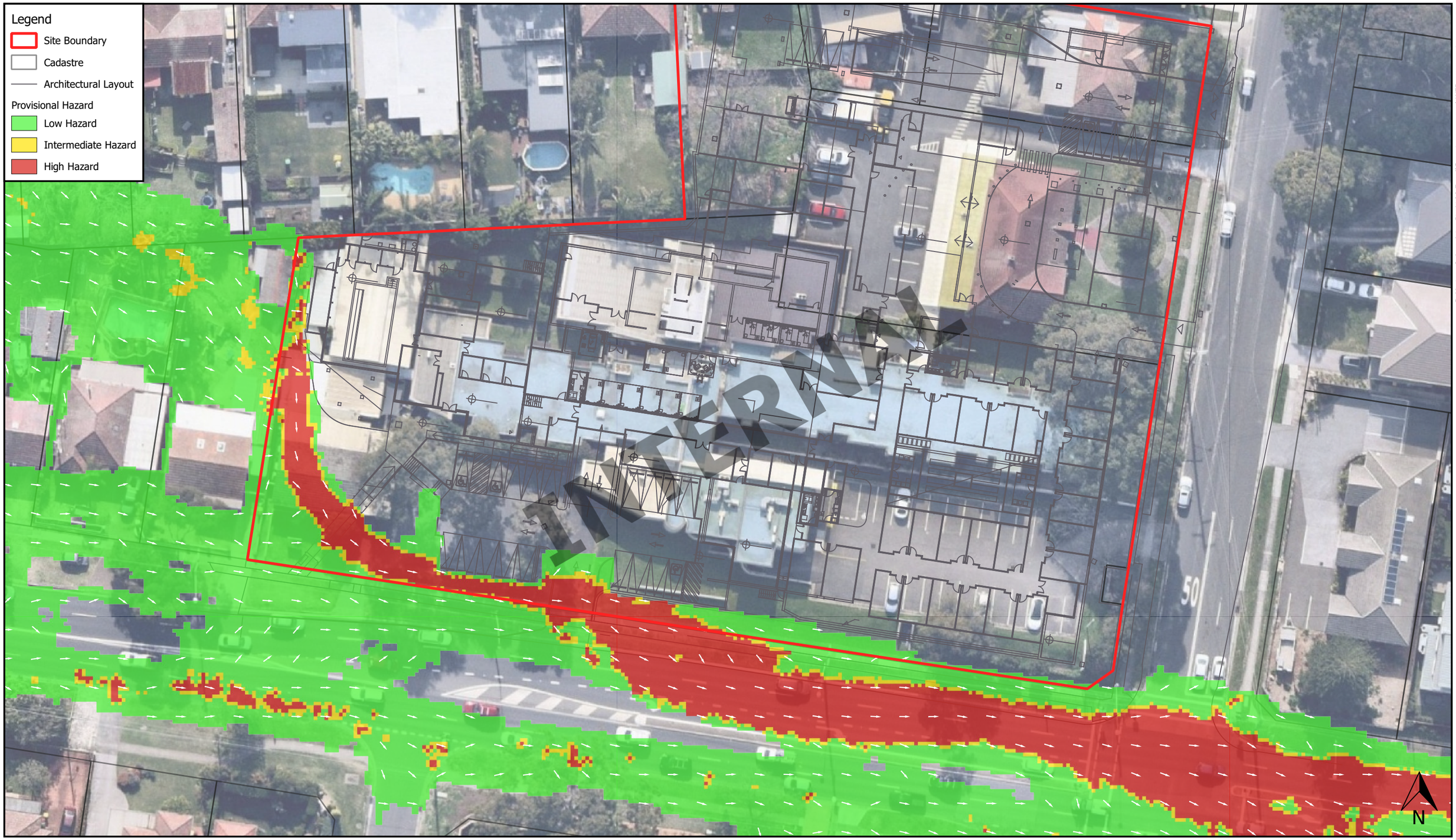
1:500 @ A3

Map Title / Figure:

5% AEP Critical Storm Duration
Proposed Condition Water Velocity (m/s) - (Viewport 1)

martens
Environment | Water | Geotechnics | Civil | Projects

Map 42	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date



0 6 12 18 24 30 m

1:500 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

5% AEP Critical Storm Duration
Proposed Condition Provisional Hydraulic Hazard Categories - (Viewport 1)

Map 43	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Hazard

- H1
- H2
- H3
- H4
- H5
- H6

N

0 6 12 18 24 30 m

1:500 @ A3

Map Title / Figure:

5% AEP Critical Storm Duration
Proposed Condition ARR Flood Hazard Categories - (Viewport 1)

Map 44	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date

martens
Environment | Water | Geotechnics | Civil | Projects

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

Legend

- Site Boundary
- Cadastre
- Architectural Layout

Flood Impact

- < -1.00
- -1.00 - -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- 0.50 - 1.00
- > 1.00

Project No: P1907286 Map Set: MS03-R01 EPSG: 28356

N

0 20 40 60 80 100 m

1:2000 @ A3

martens
Environment | Water | Geotechnics | Civil | Projects

Map Title / Figure:

5% AEP Afflux (To Proposed Surface) - (Viewport 2)

Map 45	Map
President Private Hospital, Kirrawee, NSW	Site
President Private Hospital	Project
Updated Preliminary Flood Modelling Results	Sub-Project
Macquarie Health Corporation C/- John Simpson	Client
22/02/2022	Date