martens

Flood Assessment

36-38 Maitland St, Muswellbrook, NSW

Final Report

P2309622JR01V01

January 2024

Prepared For Rohit Mahajan

environmental science & engineering

Project Details

Report Title	Flood Assessment: 36-38 Maitland St, Muswellbrook, NSW
Client	Rohit Mahajan
Document	P2309622JR01V01
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Document History

Issue	Issue Date	Status	Description / Comment	Author	Reviewer	Approved
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Executive Summary

Martens & Associates Pty Ltd (**MA**) have prepared this flood assessment to support a development application (**DA**) for a proposed childcare centre at 36-38 Maitland Street, Muswellbrook, NSW (the **site**). This 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 development would have acceptable offsite flood impacts.

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Glossary of Terms

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.
ARR	Australian Rainfall & Runoff
BoM	Bureau of Meteorology
Council	Muswellbrook Shire Council (MSC)
DA	Development Application
FFL	Finished Floor Level
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.

1 Introduction

1.1 Overview

Martens & Associates Pty Ltd (**MA**) have prepared this flood assessment to support a development application (**DA**) for a proposed childcare development at 36 – 38 Maitland St, Muswellbrook NSW (the **site**). Refer to Attachment A for site survey and Attachment B for proposed site layout.

1.2 Project Scope and Objectives

Project scope and objectives are:

1. Obtain catchment hydraulic model (TUFLOW) from Muswellbrook Shire Council (**MSC**) and determine site flood characteristics for the 1% annual exceedance probability (**AEP**) flood and probable maximum flood (**PMF**) events.
2. Import site survey data and proposed design layout to allow detailed hydraulic modelling of the site in 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.

1.3 Relevant Guidelines

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

1. Commonwealth of Australia (2019), *Australian Rainfall and Runoff – A Guide to Flood Estimation.*
2. NSW Department of Infrastructure, Planning and Natural Resources (2005), *Floodplain Development Manual*.
3. Muswellbrook Shire Council (2009a), *Muswellbrook Local Environmental Plan (LEP)*.
4. Muswellbrook Shire Council (2009b), *Muswellbrook Shire Development Control Plan (DCP)*.

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.

Item	Description
Address	36-38 Maitland St, Muswellbrook NSW
Lot / DP	Lot 7 DP 1098460 & Lot 8 DP 6758
Site Area	Approximately 2907 m^2
Local Government Area (LGA)	Muswellbrook Shire Council (**MSC**)
Current Land Use	Residential
Current Zoning	R1 – General Residential
Site Description	The site consists of two existing single storey residential dwellings surrounded by paved and grassed areas. There are several structures on site including three sheds and a pool at the northeastern site boundary.
Surrounding Land Uses	Maitland Street is to the southwest and Wilder Road to the northwest, with medium and low-density residential areas to the southeast and northeast.
Site Elevation	Approximately 145.5 mAHD at the western site boundary rising to 146.1 mAHD at southern site boundary.
Site Grading & Aspect	Approximately 0.6%, west aspect.
Site Drainage	The site itself drains from southeast to north west and flows towards Wilder Street. Muscle Creek also runs from east to west approximately 50 m east of the site and eventually flows to the Hunter River some 1400 m downstream.

2.2 Catchment Description

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

- The site is located within the Muscle Creek catchment (local) and the Hunter River catchment (regional).
- The upstream catchment of Muscle Creek catchment is primarily rural pasture, and is within the suburb of Muscle Creek.
- The total Muscle Creek catchment area is approximately 92 km^2.

2.3 Site Flood Mechanisms

The site is likely affected by the following flood mechanisms:

- Floodwater overbank flows from Muscle Creek near Bell Street, flowing through the residential lots southeast of the site and running towards the site.
- High tailwater conditions in the Hunter River causing upstream flows to back up onto the site.

2.4 Previous Flood Studies

A review of previous flood investigations was undertaken to assess likely local flood behaviour and characteristics for the site and the Muscle Creek catchment. The review identified one previous flood study which would be relevant to this assessment.

2.4.1 Royal HaskoningDHV (2019) Muswellbrook Flood Risk Management Study and Plan

Royal HaskoningDHV conducted a flood assessment for this catchment on behalf of MSC, and summarised the assessment in the report *Muswellbrook FRMS&P* (2019), hereafter referred to as the Royal HaskoningDHV flood study. As part of their study, Royal HaskoningDHV used RAFTS for hydrologic modelling and TUFLOW for hydraulic modelling.

Council has provided, subject to a paid 'flood model provision' agreement, the Royal HaskoningDHV TUFLOW model to MA. MA have used this model as the basis for undertaking detailed hydraulic modelling at the site.

2.4.2 Council Data

In addition, site flood modelling data has been acquired from MSC (Attachment C) and is based on the Royal HaskoningDHV flood study. This information includes flood levels, depths and hazards as well as flood mapping data in the 5% and 1% AEP events.

2.5 Proposed Development

The proposed site layout prepared by Sorensen Design & Planning (Attachment B) indicates that the proposed development will include:

- Demolition of the existing structures on site.
- Construction of a childcare centre at the finished floor level (FFL) above the PMF level on a suspended structure to allow floodwater conveyance underneath the structure.
- Construction of a suspended carpark above the 1% AEP flood level between the proposed childcare centre and Wilder Street. The undercroft of the proposed carpark is designed to convey floodwater through.

- Construction of a proposed flood diversion wall under the suspected carpark, which is designed to mimic the existing flow pattern through the site and offset discharge to mitigate offsite flood impacts.
- Construction of an on-grade outdoor play area at the eastern site boundary.

3 Hydraulic Modelling

3.1 Overview

The Royal HaskoningDHV TUFLOW model described at Section 2.4.1 has been used as the basis for undertaking detailed hydraulic modelling at the site.

3.2 Flood Events and Scenarios

The Royal HaskoningDHV TUFLOW model was interrogated to establish which scenarios were critical and should be modelled. Flooding from the local catchment model where Muscle Creek flows dominated the flooding was found to produce the highest water levels. Therefore, this scenario was selected as the basis for setting up the model to assess flooding for the following events and corresponding critical storm durations consistent with Royal HaskoningDHV TUFLOW model:

1. 1% AEP 36 hour (critical duration) local event.
2. PMF 4 hour (critical duration) local event.

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

3. Existing condition: the catchment and site in their current state as described in Sections 2.1, 2.2 and 2.3.
4. Proposed condition: the catchment in its current state and the site in its proposed state as described in Section 2.5.

3.3 Model Setup

3.3.1 Detailed Existing Conditions

The following changes were made to the Royal HaskoningDHV flood model to enable detailed modelling of existing site conditions:

1. Inclusion of survey data provided by MM Hyndes Bailey & Co. (2022, refer Attachment A). The survey data was merged with the Council 1m LIDAR data to create a more detailed 3D surface for the site.
2. Introduction of a ground modification layer to represent the existing building structures surrounding the site.
3. Amalgamated manning's values representing low/medium density urban of surrounding buildings were replaced with detailed manning's of surfaces.

All other model inputs and assumptions remained unchanged from the MSC adopted Royal HaskoningDHV model.

3.3.2 Detailed Proposed Conditions

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

1. The site buildings were removed in the model and replaced with proposed buildings, representing them as suspended structures. These were modelled as layer flow constriction structures, conservatively adopting a 50% blockage for the undercroft of the proposed suspended structure.

2. The proposed car park, designed as a suspended structure, was also modelled as a layered flow structure. A conservative 50% blockage was applied to the undercroft of this structure as well.

3. A proposed flood diversion wall, proposed to run diagonally under the proposed carpark, was modelled as a ground modification layer. Refer to Map 08, Attachment A for the proposed wall location.

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

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

3.4 Results

3.4.1 Flood Results

Flood mapping results (flood levels, depths, velocities and hazard categories and water level afflux) for the critical duration 1% AEP flood and PMF event in existing and proposed conditions are provided in Attachment D, with drawing references summarised in Table 2.

Table 2: Flood map drawing references in Attachment D.

Flood Condition Scenario	Critical Duration Flood Event	Water Level & Depth	Water Velocity	ARR Hazard Categories [1]	Water Level Afflux
Existing Conditions	1% AEP	Map 02	Map 03	Map 04	-
	PMF	Map 05	Map 06	Map 07	-
Proposed Conditions	1% AEP	Map 08	Map 09	Map 10	Map 11
	PMF	Map 12	Map 13	Map 14	-

[1] ARR hazard categories are based on ARR flood hazard curve (2019) definitions and are shown in Figure 1.

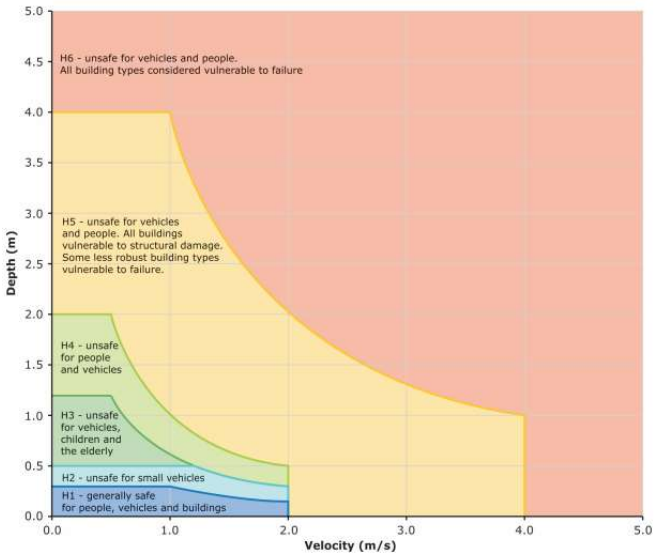


Figure 1: Flood Hazard Curves (Geoscience Australia, 2019).

3.4.2 Validation

Comparison between Royal HaskoningDHV (2019) and MA peak flood levels for the local catchment in the 1% AEP flood event and PMF events is given in Table 3.

The comparison shows the maximum flood levels as modelled by MA are generally consistent Royal HaskoningDHV modelling at the site. The differences between maximum modelled flood levels are likely due to the survey surface and raised polygons representing buildings surrounding the site These changes serve to increase the accuracy of the modelled flood levels at the site.

Table 3: Comparison between Royal HaskoningDHV (2019) and MA (2023) modelled peak water levels.

	Peak Site Flood Level (mAHD)		Difference	
Flood Event	Royal HaskoningDHV[1]	MA[2]	(m)	(%)
1% AEP	146.33	146.38	+0.05	+0.03
PMF	148.38	148.39	+0.01	+0.01

[1] Peak site flood level from MSC flood certificate (Attachment C).

[2] Refer to Map 08, Attachment A for the MA peak site flood level locations.

3.5 Discussion

3.5.1 Existing Conditions

1. Flood waters primarily flow northwest across the site in the flow direction of Muscle Creek.
2. Flood velocities across the site are intermediate with flows averaging approximately 0.55 m/s in the 1% AEP event.
3. The peak 1% AEP flood level at the site are 146.38 mAHD, and the peak PMF level at the site are 148.39 mAHD. Refer to Map 08 and Map 12, Attachment A for the proposed maximum level locations.
4. Hydraulic hazard across the site is high in both the 1% AEP flood and in the PMF event primary H2 – H3 and H5 – H6 respectively.
5. Hydraulic hazard in Maitland and Wilder Street are above H3 in both the 1% AEP and PMF event.

3.5.2 Proposed Conditions

1. The suspended structure design increases the available flood storage onsite, increasing the depths onsite.
2. Apart from shallow flood depths on the car park ramp, the car park slab is flood free in the 1% AEP event. Refer to Map 08, Attachment A for spot comparison points of the flood and carpark levels.
3. The peak 1% AEP flood level at the site is 146.30 mAHD.
4. The peak PMF flood level is 148.36 mAHD. The proposed FFL is at 148.40 mAHD, hence the building is flood free in all events up to and including the PMF.
5. Hydraulic hazard across the site is still high in both the 1% AEP flood and in the PMF event primary H2 – H3 and H5 – H6 respectively.

3.5.3 Offsite Impacts

1. The proposed development has negligible offsite impacts (less than 20mm increase in flood depth) on the local surrounding residential lots in the 1% AEP events.
2. The proposed development reduces flood levels up to 75mm at 40 Maitland Street near of the southern corner of the site in the 1% AEP event.

3. There are minor areas of offsite impacts, with an approximate average increase of 45 mm in flood depth over a small area of approximately 115 m^2 at the frontage onto Maitland Street. The hazard categories remain as H5 and H6 for the 1% and PMF events, respectively. Therefore, these impacts are not considered to have any material impact.

4 Summary and Recommendations

A detailed hydraulic model has been developed for the site using Council's accepted Royal HaskoningDHV and adding detailed site survey and proposed design elements to assess local flood characteristics. The hydraulic model accurately replicates Council adopted flows and flood characteristics.

The model was used to determine the existing and proposed flood conditions in the 1% AEP flood and PMF events. Assessment concluded that:

1. The suspended structure design increases the available flood storage onsite, increasing the depths onsite.
2. Apart from shallow flood depths on the car park ramp, the car park slab is flood free in the 1% AEP event.
3. The proposed childcare building is flood free in all events up to and including the PMF.
4. The proposed design effectively renders the site development area flood free in the 1% AEP flood, as well as several adjacent downstream properties.
5. The proposed development would have acceptable offsite flood impacts.

We recommend:

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 level of 148.40 mAHD are to be constructed using flood compatible materials.

5 References

Muswellbrook Shire Council (2009a), *Muswellbrook Local Environmental Plan (LEP)*.

Muswellbrook Shire Council (2009b), *Muswellbrook Shire Development Control Plan (DCP)*.

Royal HaskoningDHV (2019), *Muswellbrook Flood Risk Management Study and Plan (FRMS&P).*

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*.

6 Attachment A: Site Survey

DIAL BEFORE YOU DIG
www.1100.com.au

IMPORTANT NOTE
THIS PLAN IS PREPARED FOR Mr ROHIT MAHAJAN
FROM A COMBINATION OF FIELD SURVEY AND EXISTING RECORDS
FOR THE PURPOSE OF DESIGN
AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE.
UTILITY PROVIDERS SHOULD BE CONTACTED PRIOR TO DEVELOPMENT
OR CONSTRUCTION ON THE SITE TO LOCATE UNDERGROUND SERVICES.

"DIAL BEFORE YOU DIG"

THIS NOTE IS AN INTEGRAL PART OF THIS PLAN.

MM HYNDES BAILEY & Co.
REGISTERED SURVEYORS - TOWN PLANNING - CIVIL DESIGN
Surveying the Hunter since 1920
Ph: 02 65432475 Email: office@hbsurveys.com.au
PO BOX 432, SCONE NSW 2337

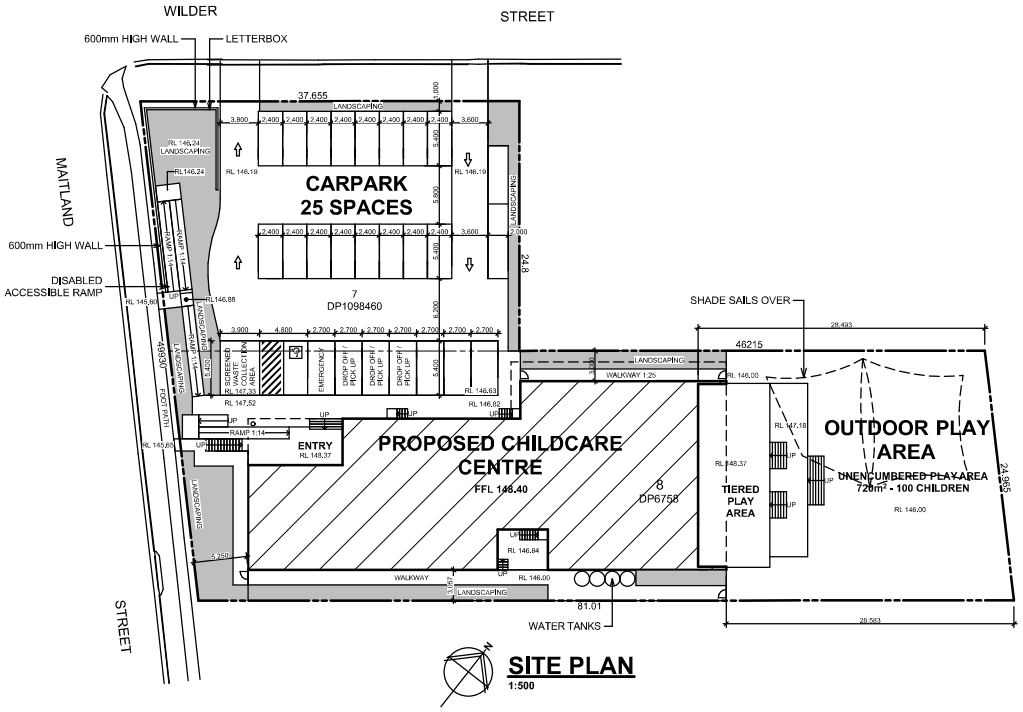
DETAIL & CONTOUR SURVEY
LOT 7 OF DP1098460 & LOT8 OF DP6758
MAITLAND ST, MUSWELLBROOK

H.SCALE 1:400	A3	CONT. INT: 0.2m	
V.SCALE		**DATUM: AHD (PM34435)**	
DATE 26/09/2022		FILE: 222273DT.dwg	

CLIENT: Mr ROHIT MAHAJAN

LGA: MUSWELLBROOK	SHEET 1	OF SHEETS 1
PARISH: BROUGHAM	JOB REF: 222273	
COUNTY: DURHAM		

7 Attachment B: Proposed Site Layout



SITE PLAN
1:500

CHILDCARE CENTRE REQUIREMENTS

UP TO 100 CHILD CARE PLACES

STAFF REQUIREMENTS
AGE 0-2YRS 1 EDUCATOR PER 4 CHILDREN
AGE 2-3YRS 1 EDUCATOR PER 5 CHILDREN
AGE 3-5YRS 1 EDUCATOR PER 11 CHILDREN
MORE THAN 80 PLACES - 2 EARLY CHILDHOOD TEACHERS

NOMINAL STAFFING REQUIRED
(Based on formal care attendance statistics (ABS 2018)

AGE 0-2YRS - 20 CHILDREN (4@0-1YRS, 16@1-2YRS) - 5 EDUCATORS
AGE 2-3YRS - 25 CHILDREN - 5 EDUCATORS
AGE 3+YRS - 55 CHILDREN (25@3-4YRS, 18@4-5YRS, 12@5-6YRS) - 5 EDUCATORS
EARLY CHILDHOOD TEACHERS - 2 TEACHERS

TOTAL STAFF REQ'D - 17

PARKING REQUIREMENTS
1 SPACE PER STAFF MEMBER
1 SPACE PER 15 CHILDREN
1 DISABLED ACCESIBLE SPACE
1 EMERGENCY SPACE
3 SETDOWN SPACES

STAFF PARKING SPACES - 17
CHILDREN & SETDOWN SPACES - 7
DISABLED ACCESIBLE SPACES - 1
EMERGENCY SPACES - 1

TOTAL REQUIRED - 26
TOTAL PROVIDED - 25

INDOOR PLAY AREA REQUIREMENTS
3.25m² PER CHILD

TOTAL REQUIRED - 325.0m²
TOTAL PROVIDED - 337.0m²

OUTDOOR PLAY AREA REQUIREMENTS
7.00m² PER CHILD

TOTAL REQUIRED - 700.0m²
TOTAL PROVIDED - 720.0m²

INDOOR STORAGE VOLUME RECOMMENDED
0.2m³ PER CHILD

TOTAL RECOMMENDED - 20.0m³
TOTAL PROVIDED - 29.6m³

OUTDOOR STORAGE VOLUME RECOMMENDED
0.3m³ PER CHILD

TOTAL RECOMMENDED - 30.0m³
TOTAL PROVIDED - 31.5m³

ISSUE	DETAILS
C	11/12/2023 - FLOOR LEVEL REVISED
B	03/02/2023 - DA ISSUE
A	12/10/2022 - CONCEPT ISSUE

SORENSEN DESIGN & PLANNING
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PROJECT: PROPOSED CHILDCARE CENTRE AT 36-38 MAITLAND ROAD MUSWELLBROOK
CLIENT: MAHAJAN
TITLE: SITE PLAN
FILE: 2103338 DATE: 12/10/2022 SHEET: 1 OF 4

A3

ISSUE	DETAILS
C	11/12/2023 - FLOOR LEVEL REVISED
B	03/02/2023 - DA ISSUE
A	12/10/2022 - CONCEPT ISSUE

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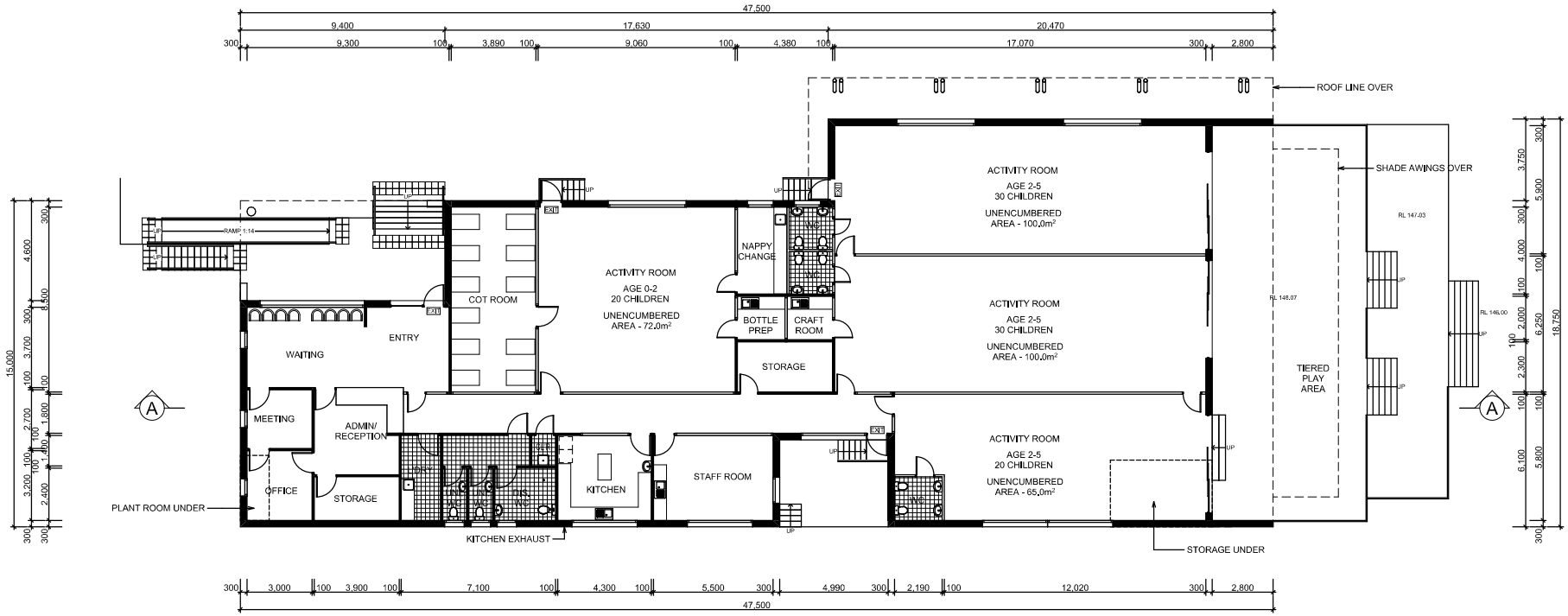
PROJECT: **PROPOSED CHILDCARE CENTRE AT 36-38 MAITLAND ROAD MUSWELLBROOK**

CLIENT: **MAHAJAN**

TITLE: **EXISTING SITE SURVEY**

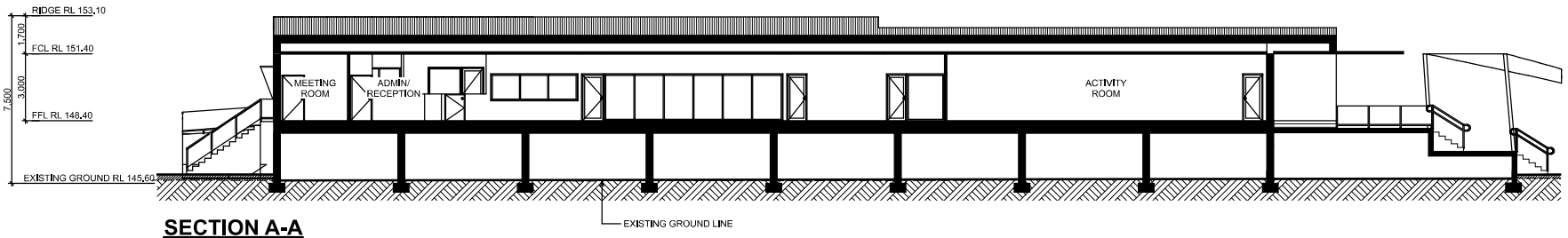
FILE: **2103338** DATE: **12/10/2022** SHEET: **2 OF 4**

A3



PROPOSED FLOOR PLAN

1:200



SECTION A-A

1:200

ISSUE	DETAILS
C	11/12/2023 - FLOOR LEVEL REVISED
B	03/02/2023 - DA ISSUE
A	12/10/2022 - CONCEPT ISSUE

SORENSEN DESIGN & PLANNING

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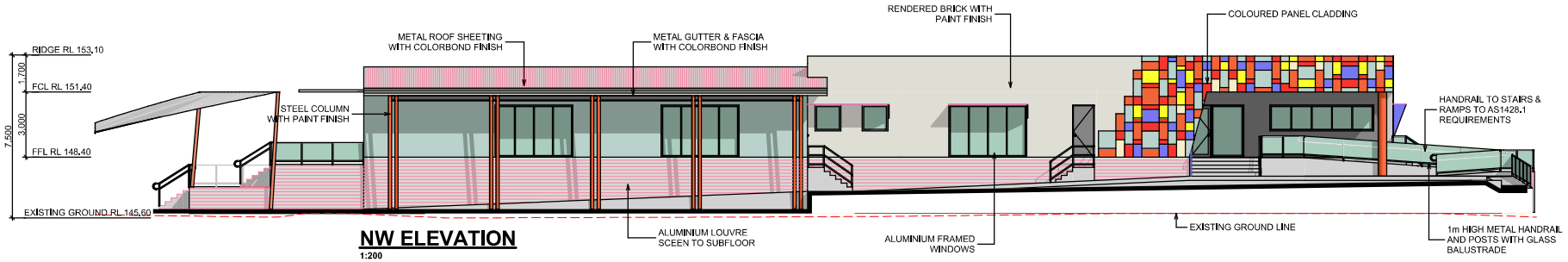
PROJECT: **PROPOSED CHILDCARE CENTRE AT 36-38 MAITLAND ROAD MUSWELLBROOK**

CLIENT: **MAHAJAN**

TITLE: **FLOOR PLAN & SECTION**

FILE: **2103338** DATE: **12/10/2022** SHEET: **3 OF 4**

A3



NW ELEVATION
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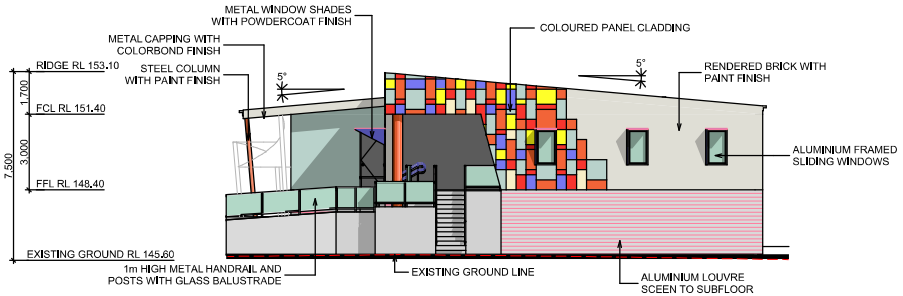
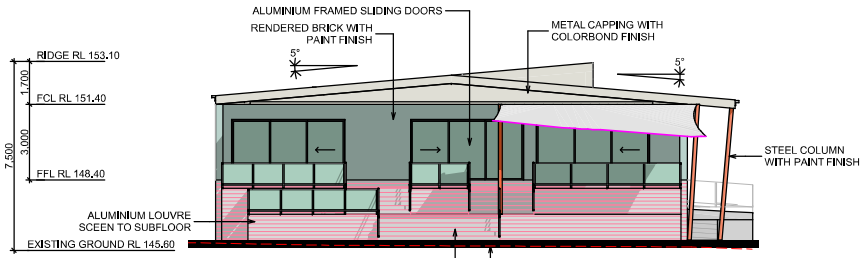


SW ELEVATION
1:200



NE ELEVATION
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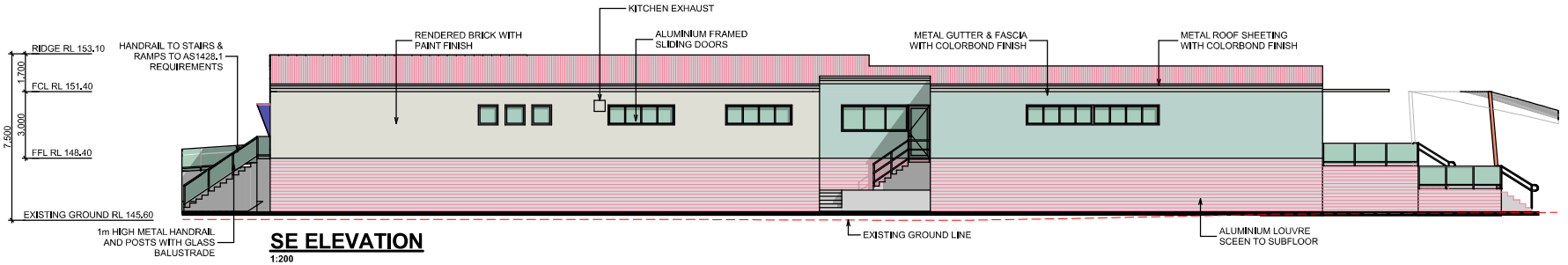

SE ELEVATION
1:200

MEMBER OF BUILDING DESIGNERS AUSTRALIA NSW

WINNER 2010 HIA Hunter Residential Building Designer of the Year

WINNER 2011 HIA Hunter Residential Building Designer of the Year

ISSUE	DETAILS
C	11/12/2023 - FLOOR LEVEL REVISED
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www.sorensendesign.com.au

PROJECT: **PROPOSED CHILDCARE CENTRE AT 36-38 MAITLAND ROAD MUSWELLBROOK**

CLIENT: **MAHAJAN**

TITLE: **ELEVATIONS**

FILE: **2103338** DATE: **12/10/2022** SHEET: **4 OF 4**

A3

8 Attachment C: Council Flood Certificates

Flood Information Certificate

Date: 24/08/2022 Created by: anuph

Curtis Gant Betts
Atten: Sue Clydsdale
PO Box 191 Muswellbrook

Issued by email: suec@cgblaw.com.au

Dear Sir/Madam,

Property:	**LOT 7 : SEC : DP 1098460**
Address:	**36 Maitland Street, Muswellbrook**

The information supplied in this certificate represents the most current flooding information held by Council at the time the certificate was created.

Please find attached flood information maps prepared in relation to the land subject to your enquiry. The maps have been prepared using data related to 1% AEP flood event as identified by Council's 2018 Flood Risk Management Study and Plan prepared by Royal Haskoning DHV. Information related to the 5% AEP flood event is also included in the tables accompanying the maps.

Maximum and minimum flood depth information included in the table accompanying the maps has been informed by LIDAR data held by Council in relation to the height of natural ground level at the site. The accuracy of LIDAR data or flood depth information for the site should not be relied on to inform the preparation of a development application for the site or any decision making related to the management of flood risks at the land. Council LIDAR data has been prepared on a Shire wide basis and may be inaccurate at particular sites or where cut and fill has occurred.

Accordingly, it will be necessary for a person using this information for the purpose of preparing a development application to engage Registered Surveyor to determine the actual natural surface levels, and flood depth information to AHD on the site to determine the extent ofinundation. Any person using this information to inform the preparation of a development application should also review Section 13 of the Muswellbrook Development Control Plan which includes controls relevant to the development of flood prone land

If you require any further clarification in relation to the above please contact Council's Planning, Environment and Regulatory Services Team on 02 6549 3745.

Yours Faithfully

SIGNATURE

(Anup Halder)
Development and Design Engineer

Definitions	Hazard Vulnerability Classification
AEP is the probability of an event being equaled or exceeded within a year. Typically the AEP is estimated by extracting the annual maximum in each year to produce an Annual Maxima Series (AMS); **Flood Level** elevation of the flood surface above Australian Height Datum (AHD) **Depth** is based on 2013 LiDAR aerial survey data **Velocity** is the speed of the flowing flood water **Hazard** is Hazard Vulnerability Classification as outlined in Section 7.2.7 of Australian Rainfall and Runoff 2016. Maximums relate to the highest value on the property parcel. See table below for further information.	**H1** Generally safe for vehicles, people and buildings. **H2** Unsafe for small vehicles. **H3** Unsafe for vehicles. Children and the elderly. **H4** Unsafe for vehicles and people. **H5** Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure. **H6** Unsafe for vehicles and people. All building types considered vulnerable to failure.

Fig 1: Flood Level Map 1% AEP

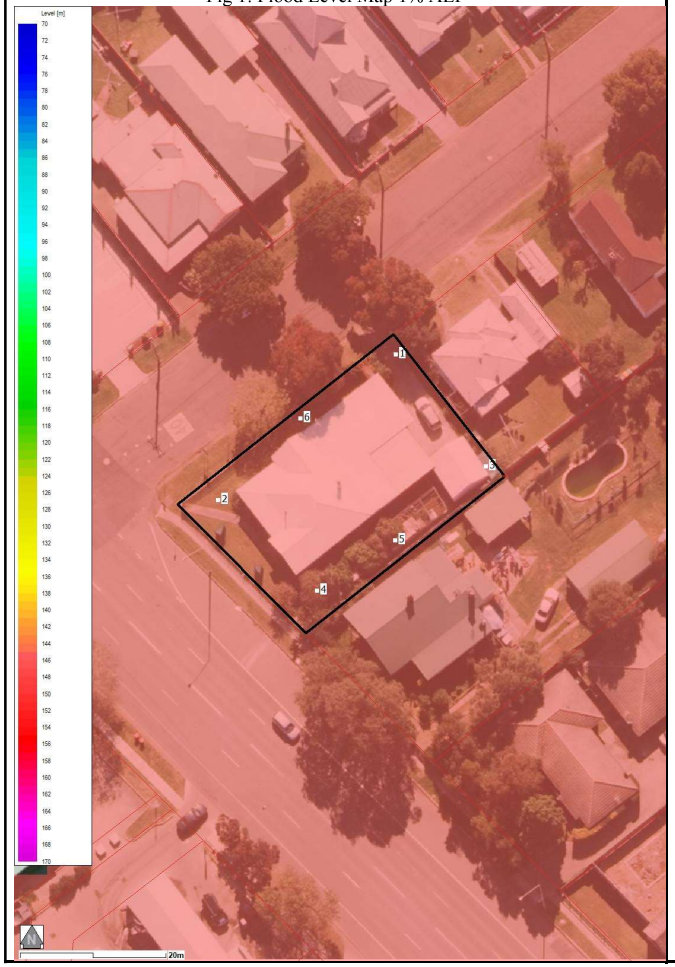

Fig 2: Flood Velocity Map 1% AEP

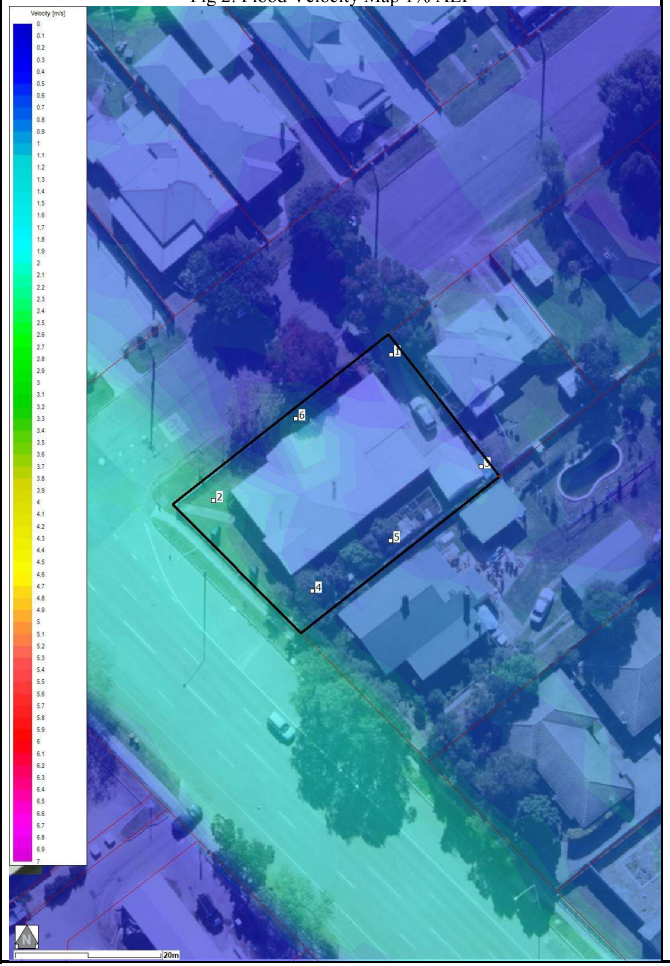

Fig 3: Flood Hazard Map 1% AEP

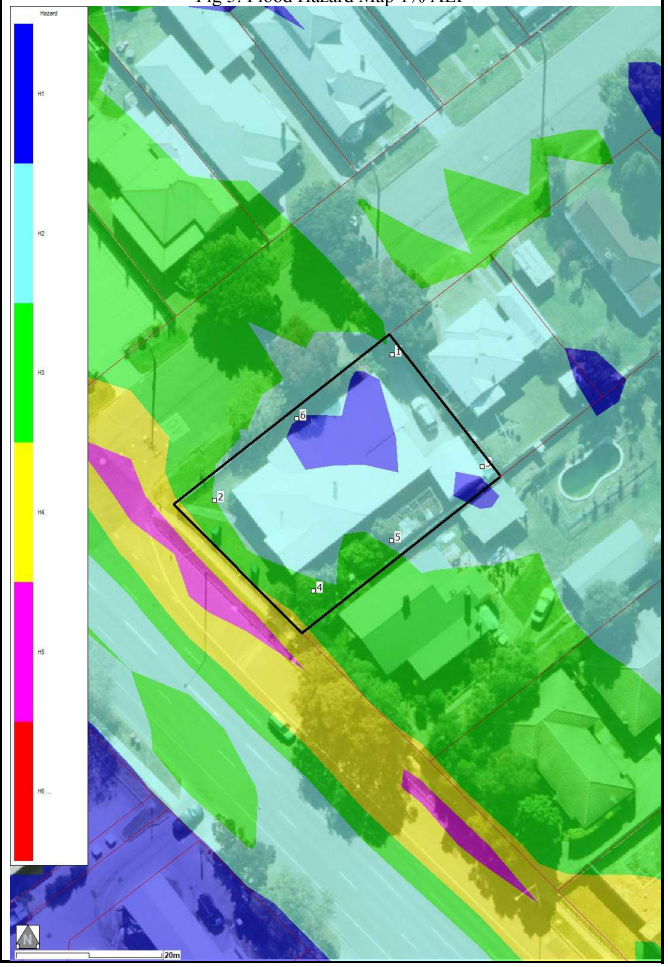

Table 1: Maximum and Minimum data

Flood Information	5% AEP Flood Data	1% AEP Flood Data
Max. Water Level (m AHD)	145.98	146.23
Min. Water Level (m AHD)	145.75	146.02
Max. Velocity (m/s)	1.19	1.57
Min. Velocity (m/s)	0.06	0.43
Max. Depth (m)	0.40	0.61
Min. Depth (m)	0.03	0.24

Table 2: Key Point location flood data

Location	5% AEP Level	5% AEP Velocity	5% AEP Hazard	1% AEP Level	1% AEP Velocity	1% AEP Depth	1% AEP Hazard
1	145.79	0.06	H1	146.05	0.67	0.45	H2
2	145.76	1.10	H1	146.05	1.20	0.41	H3
3	145.90	0.21	N/A	146.18	0.65	0.31	H2
4	145.93	0.50	H2	146.20	0.78	0.52	H3
5	145.95	0.36	H1	146.22	0.69	0.48	H2
6	145.84	0.29	H1	146.04	0.85	0.33	H2

Flood Information Certificate

Date: 24/08/2022 Created by: anuph

Curtis Gant Betts
Atten: Sue Clydsdale
PO Box 191 Muswellbrook

Issued by email: suec@cgblaw.com.au

Dear Sir/Madam,

Property:	**LOT 8 : SEC : DP 6758**
Address:	**38 Maitland St Muswellbrook**

The information supplied in this certificate represents the most current flooding information held by Council at the time the certificate was created.

Please find attached flood information maps prepared in relation to the land subject to your enquiry. The maps have been prepared using data related to 1% AEP flood event as identified by Council's 2018 Flood Risk Management Study and Plan prepared by Royal Haskoning DHV. Information related to the 5% AEP flood event is also included in the tables accompanying the maps.

Maximum and minimum flood depth information included in the table accompanying the maps has been informed by LIDAR data held by Council in relation to the height of natural ground level at the site. The accuracy of LIDAR data or flood depth information for the site should not be relied on to inform the preparation of a development application for the site or any decision making related to the management of flood risks at the land. Council LIDAR data has been prepared on a Shire wide basis and may be inaccurate at particular sites or where cut and fill has occurred.

Accordingly, it will be necessary for a person using this information for the purpose of preparing a development application to engage Registered Surveyor to determine the actual natural surface levels, and flood depth information to AHD on the site to determine the extent ofinundation. Any person using this information to inform the preparation of a development application should also review Section 13 of the Muswellbrook Development Control Plan which

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If you require any further clarification in relation to the above please contact Council's Planning, Environment and Regulatory Services Team on 02 6549 3745.

Yours Faithfully

SIGNATURE

(Anup Halder)
Development and Design Engineer

Definitions	Hazard Vulnerability Classification
AEP is the probability of an event being equaled or exceeded within a year. Typically the AEP is estimated by extracting the annual maximum in each year to produce an Annual Maxima Series (AMS); **Flood Level** elevation of the flood surface above Australian Height Datum (AHD) **Depth** is based on 2013 LiDAR aerial survey data **Velocity** is the speed of the flowing flood water **Hazard** is Hazard Vulnerability Classification as outlined in Section 7.2.7 of Australian Rainfall and Runoff 2016. Maximums relate to the highest value on the property parcel. See table below for further information.	**H1** Generally safe for vehicles, people and buildings. **H2** Unsafe for small vehicles. **H3** Unsafe for vehicles. Children and the elderly. **H4** Unsafe for vehicles and people. **H5** Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure. **H6** Unsafe for vehicles and people. All building types considered vulnerable to failure.

Fig 1: Flood Level Map 1% AEP

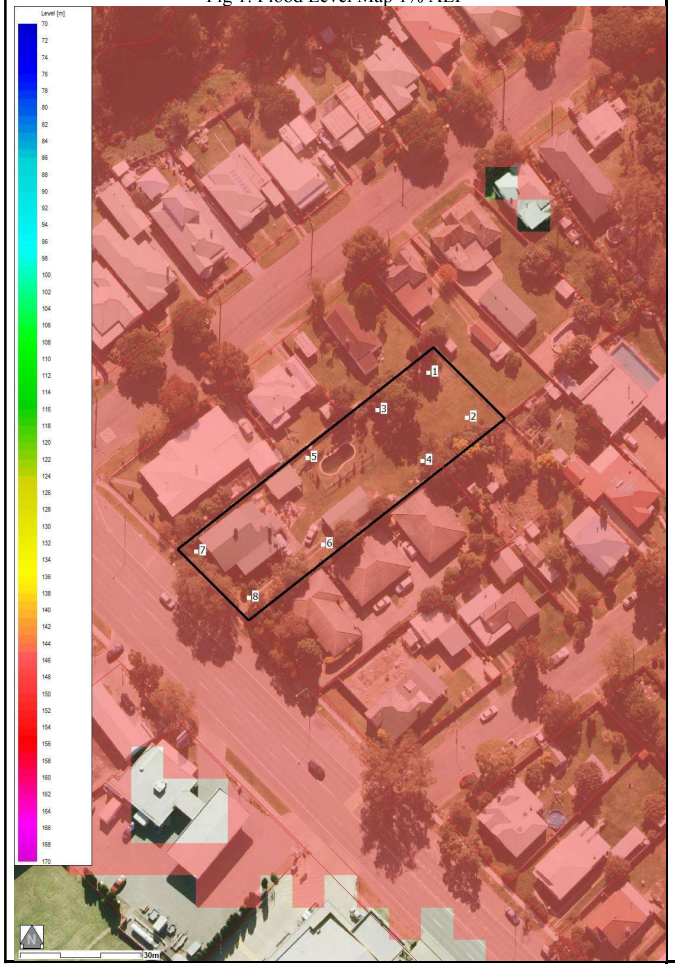


Fig 2: Flood Velocity Map 1% AEP

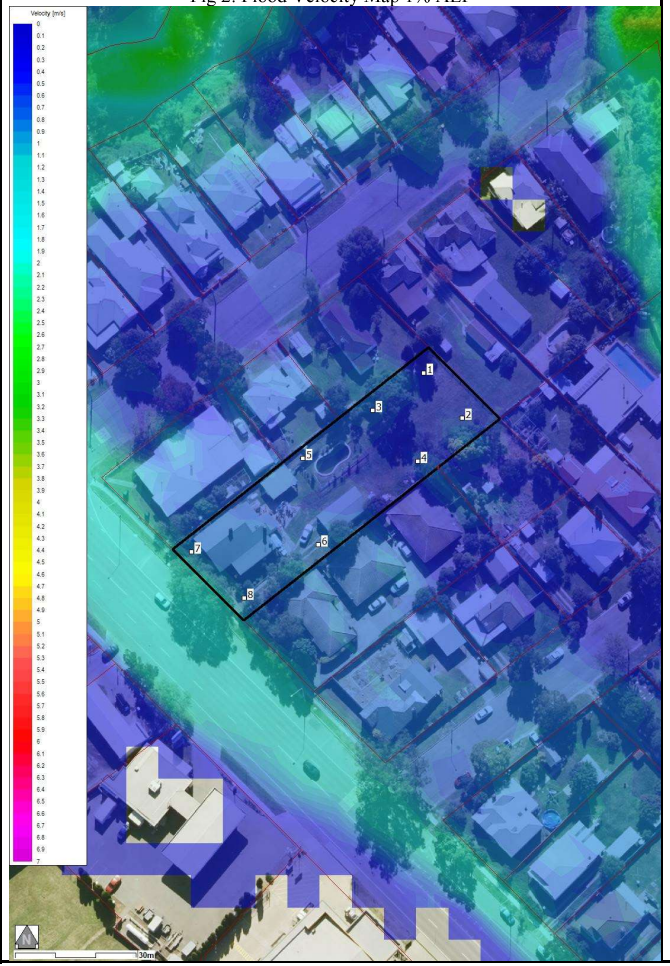


Fig 3: Flood Hazard Map 1% AEP

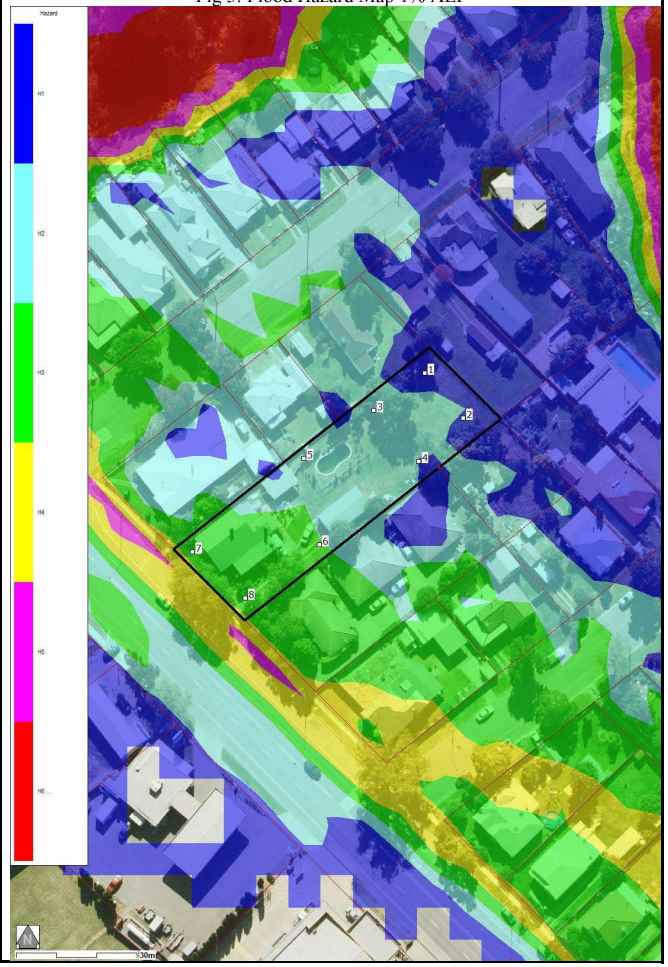


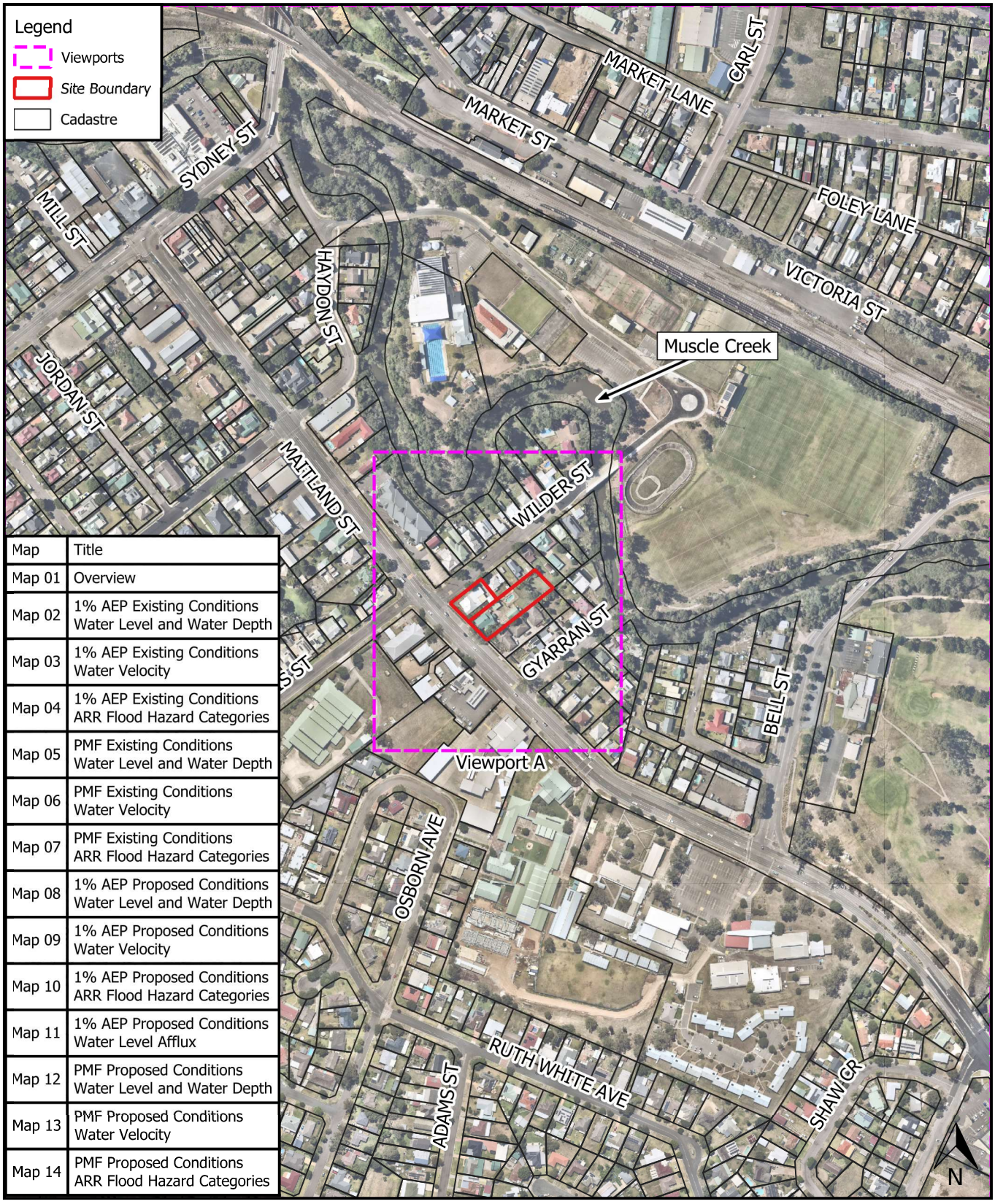
Table 1: Maximum and Minimum data

Flood Information	5% AEP Flood Data	1% AEP Flood Data
Max. Water Level (m AHD)	146.06	146.33
Min. Water Level (m AHD)	145.84	146.12
Max. Velocity (m/s)	1.35	1.23
Min. Velocity (m/s)	0.00	0.19
Max. Depth (m)	0.53	0.68
Min. Depth (m)	0.01	0.08

Table 2: Key Point location flood data

Location	5% AEP Level	5% AEP Velocity	5% AEP Hazard	1% AEP Level	1% AEP Velocity	1% AEP Depth	1% AEP Hazard
1	145.99	0.00	N/A	146.21	0.37	0.22	H1
2	145.99	0.01	H1	146.27	0.50	0.28	H1
3	145.97	0.29	H1	146.20	0.69	0.36	H2
4	146.06	0.14	H1	146.28	0.57	0.30	H1
5	145.98	0.29	H1	146.21	0.69	0.40	H2
6	146.01	0.30	H1	146.31	0.72	0.52	H3
7	145.97	0.39	H2	146.23	0.85	0.57	H3
8	146.03	0.52	H2	146.31	0.81	0.59	H3

9 Attachment D: Flood Maps



Map	Title
Map 01	Overview
Map 02	1% AEP Existing Conditions Water Level and Water Depth
Map 03	1% AEP Existing Conditions Water Velocity
Map 04	1% AEP Existing Conditions ARR Flood Hazard Categories
Map 05	PMF Existing Conditions Water Level and Water Depth
Map 06	PMF Existing Conditions Water Velocity
Map 07	PMF Existing Conditions ARR Flood Hazard Categories
Map 08	1% AEP Proposed Conditions Water Level and Water Depth
Map 09	1% AEP Proposed Conditions Water Velocity
Map 10	1% AEP Proposed Conditions ARR Flood Hazard Categories
Map 11	1% AEP Proposed Conditions Water Level Afflux
Map 12	PMF Proposed Conditions Water Level and Water Depth
Map 13	PMF Proposed Conditions Water Velocity
Map 14	PMF Proposed Conditions ARR Flood Hazard Categories

Project No: P2309622 Map Set: MS01-R01 EPSG: 28356

0 60 120 180 240 300 m

1:5000 @ A4

Viewport

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

Map Title / Figure:
Overview

Map 01	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

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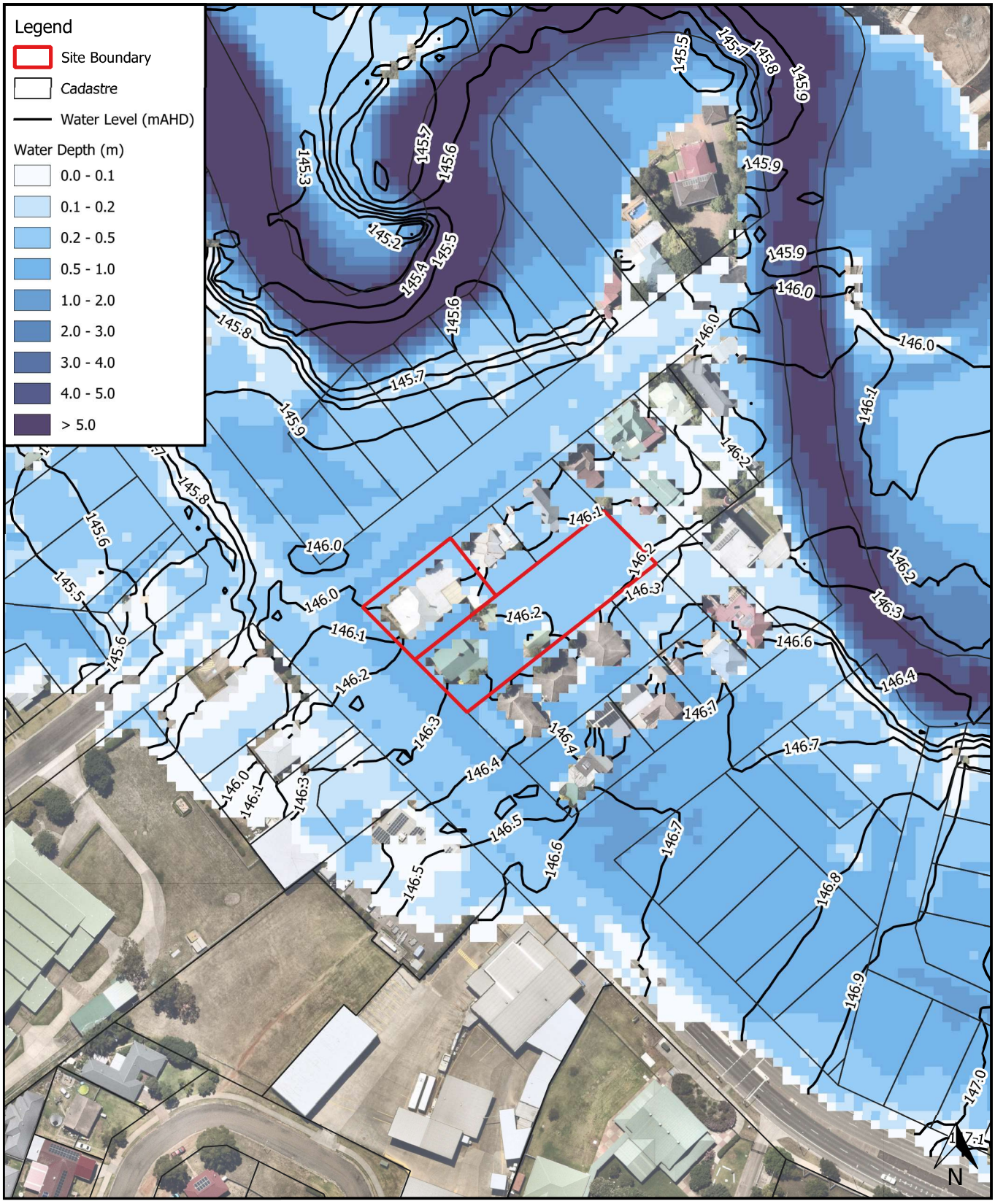

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1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

Map Title / Figure:

1% AEP Existing Conditions Water Level and Water Depth

Map 02	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

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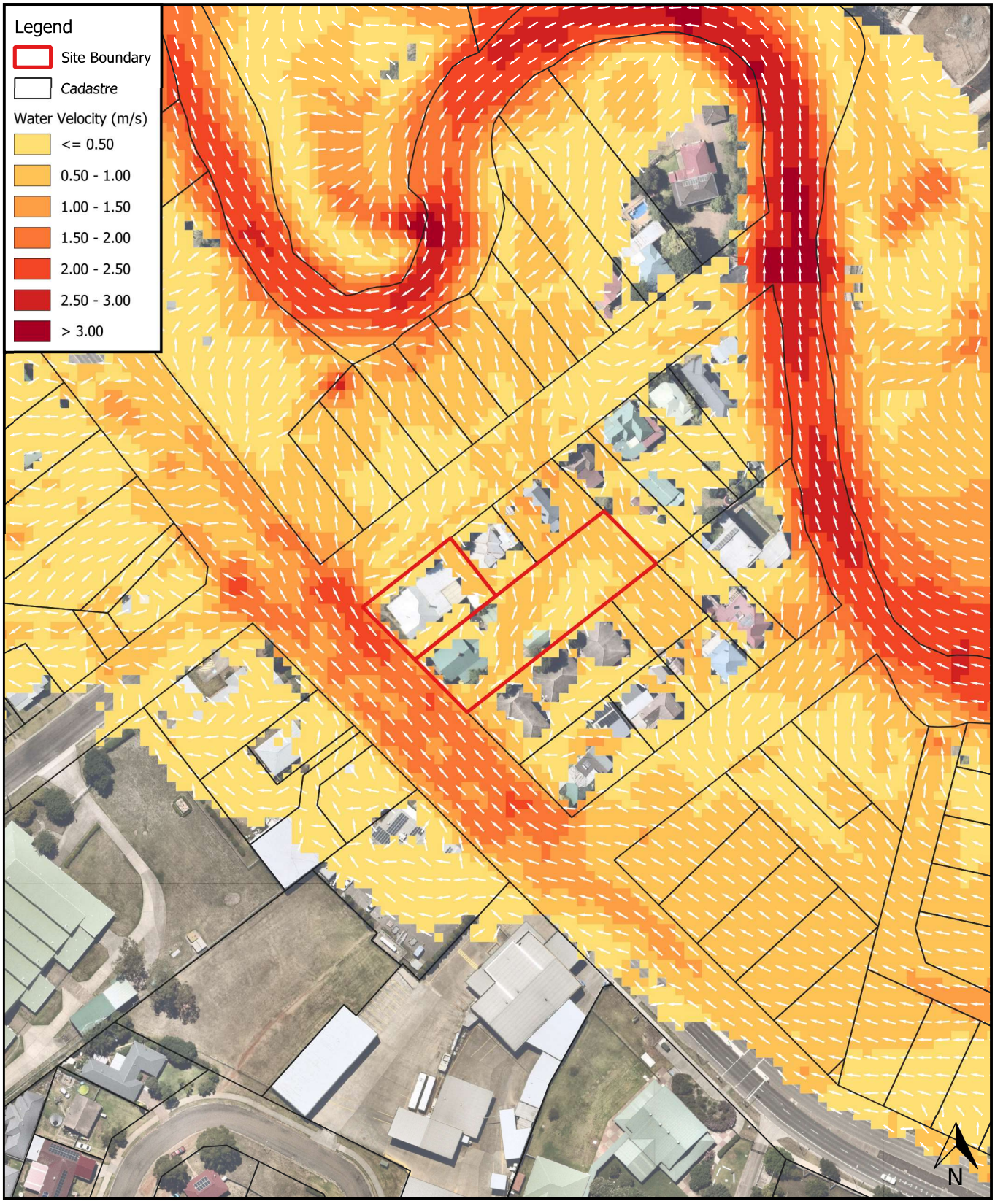
Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



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1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

Map Title / Figure:

1% AEP Existing Conditions Water Velocity

Map 03	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

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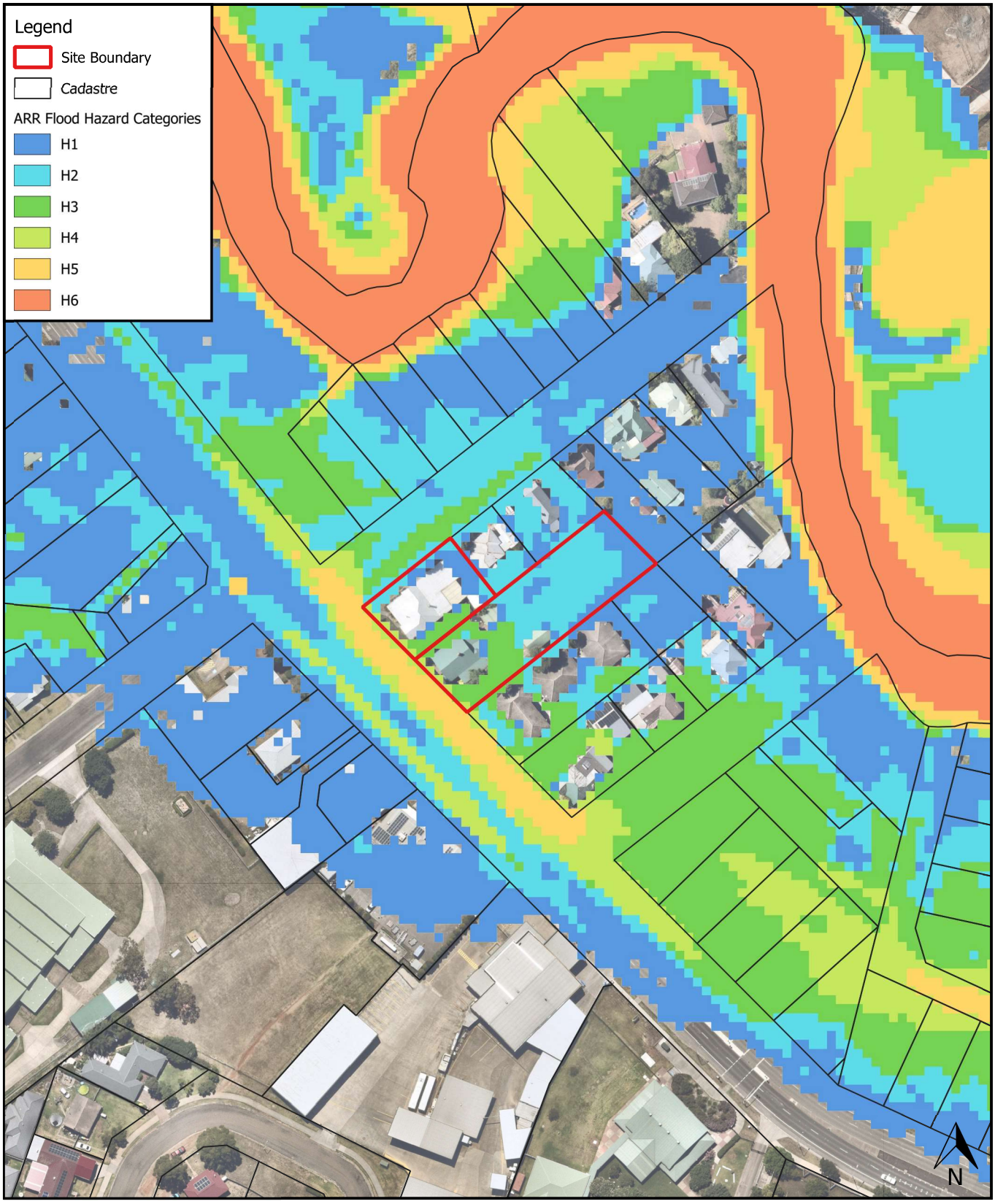
Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



Project No: P2309622 Map Set: MS01-R01 EPSG: 28356

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1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023).
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website.
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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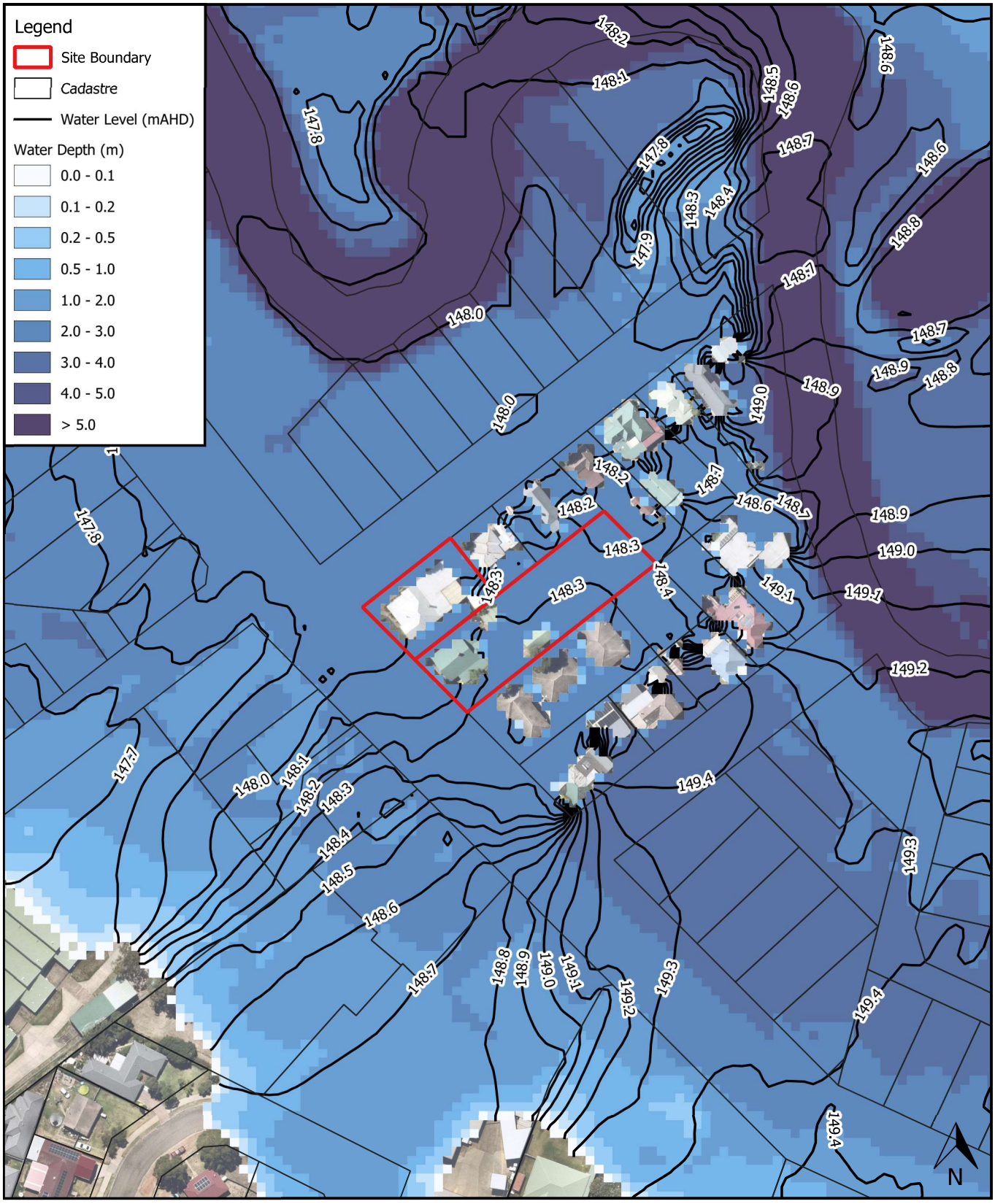
Map Title / Figure:

1% AEP Existing Conditions ARR Flood Hazard Categories

Map 04	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date



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1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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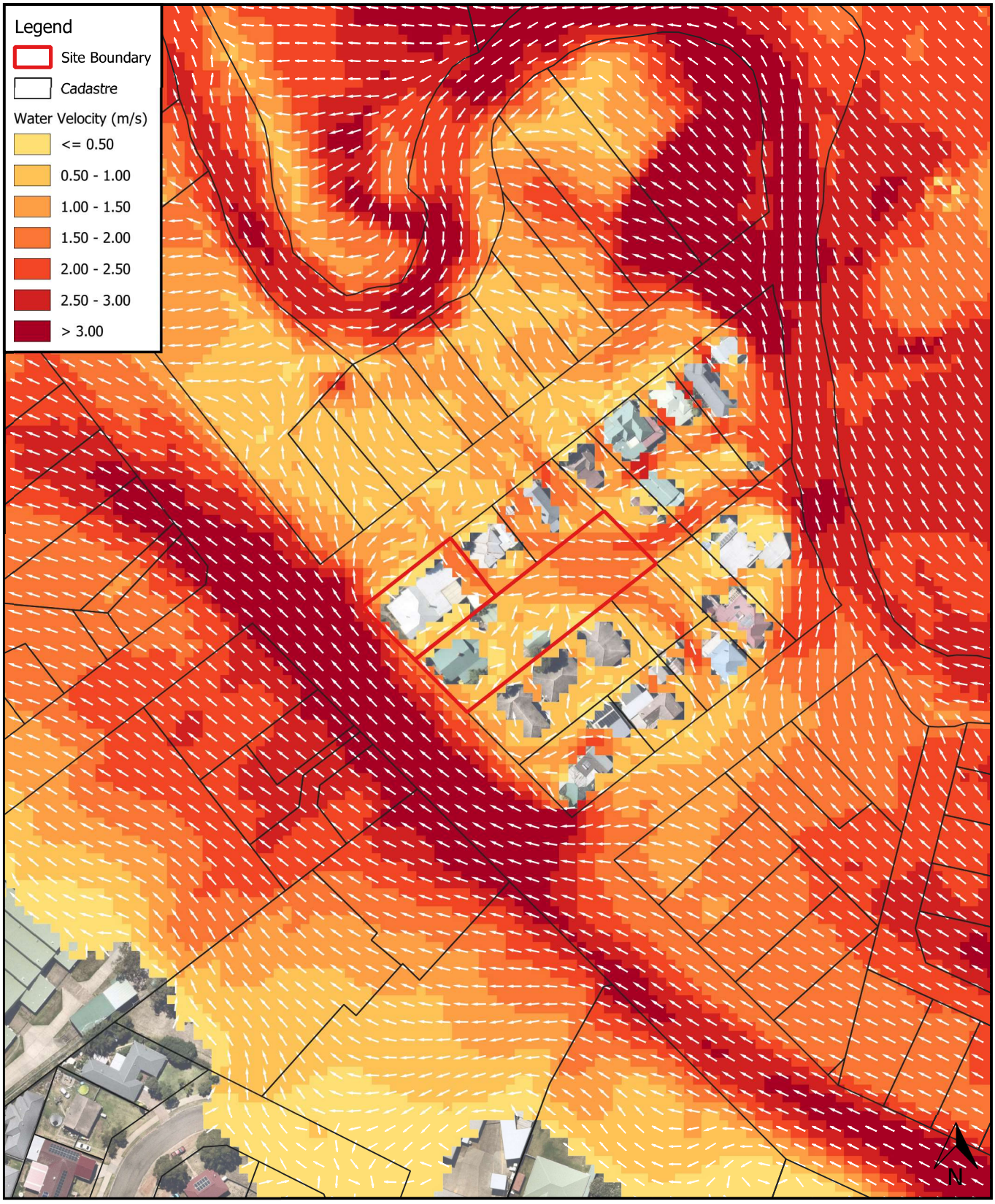
Map Title / Figure:

PMF Existing Conditions Water Level and Water Depth

Map 05	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



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1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

Map Title / Figure:

PMF Existing Conditions Water Velocity

Map 06	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

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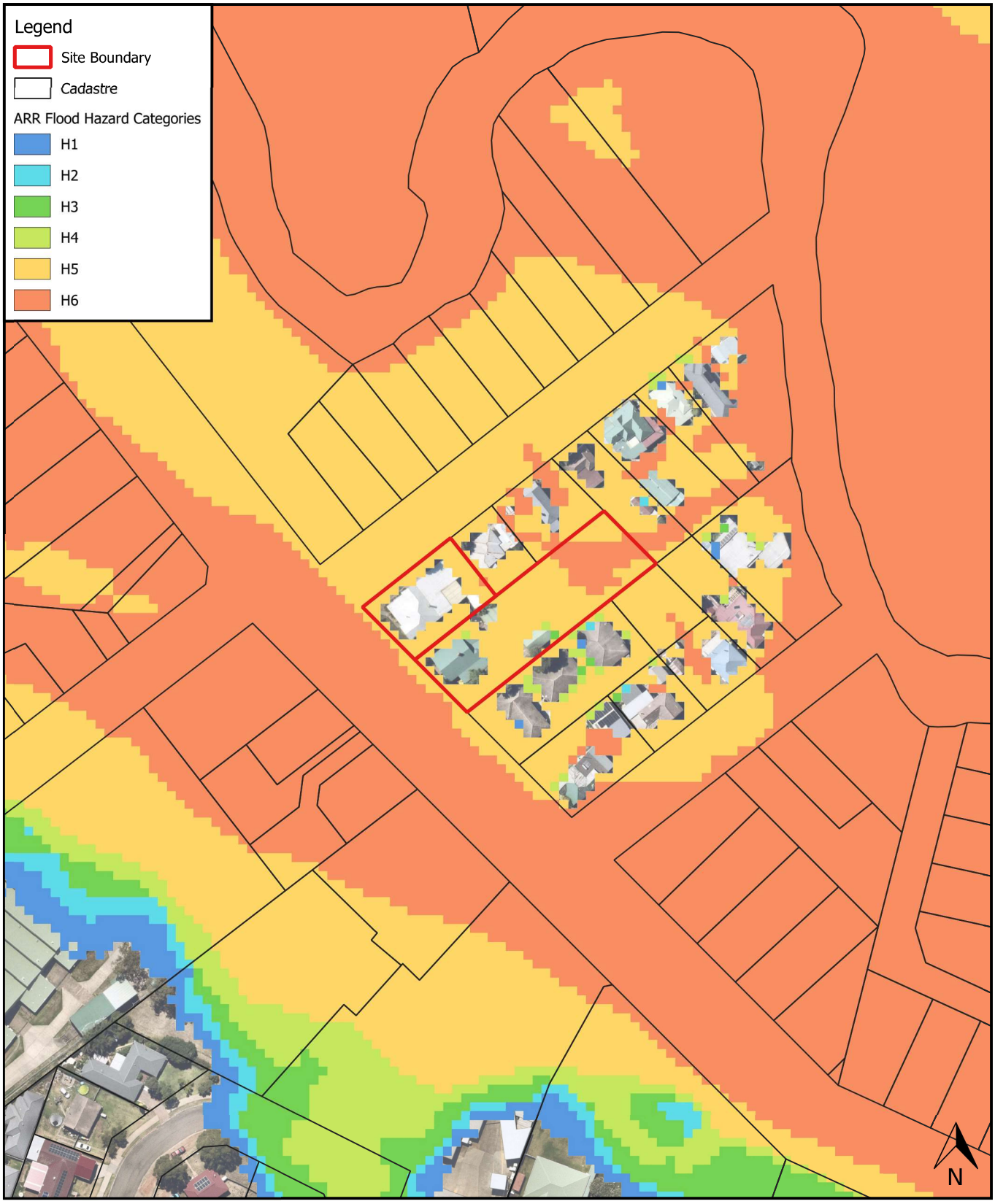
Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



Project No: P2309622 Map Set: MS01-R01 EPSG: 28356

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1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023).
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website.
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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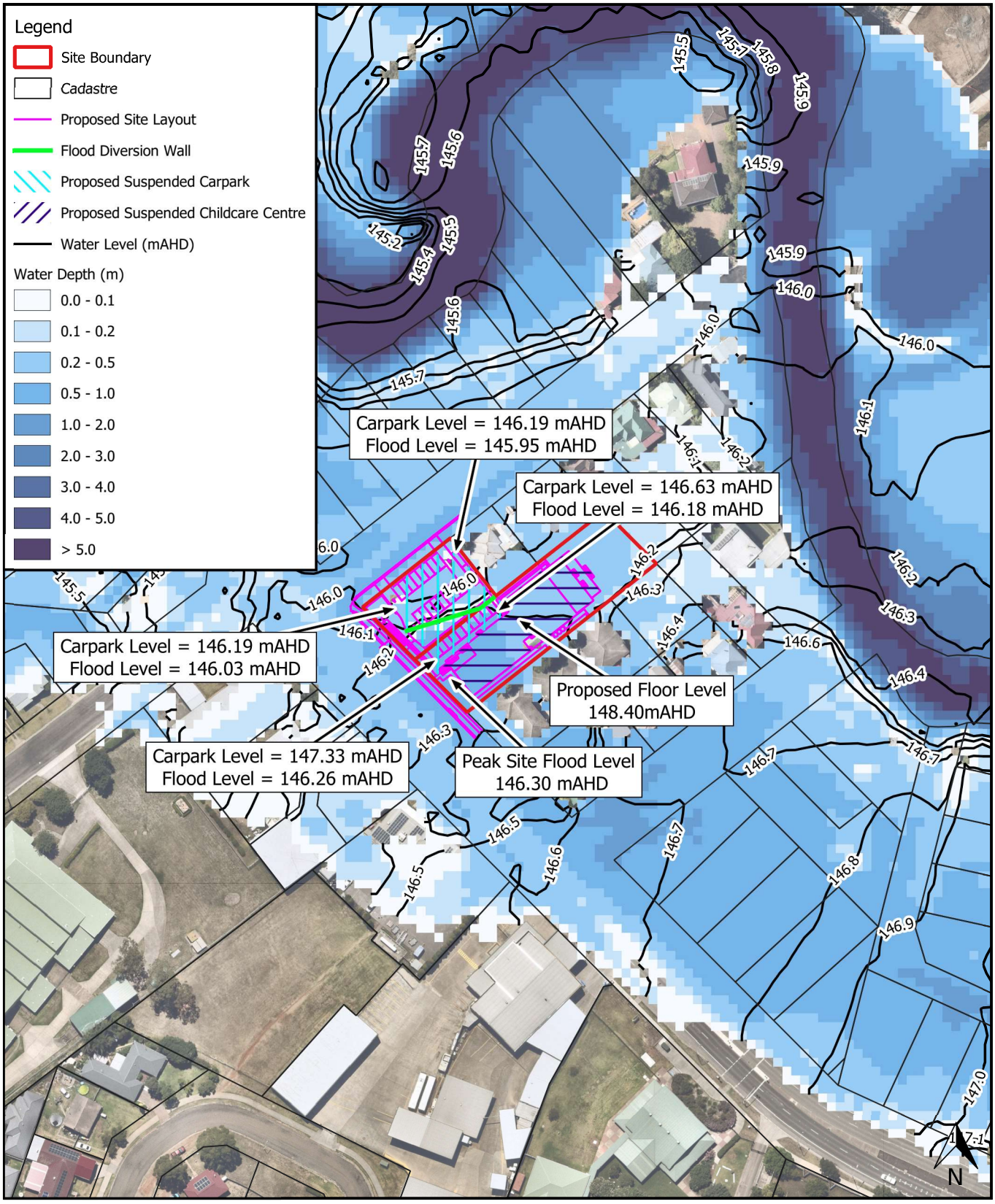
Map Title / Figure:

PMF Existing Conditions
ARR Flood Hazard Categories

Map 07	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date



Project No: P2309622 Map Set: MS01-R01 EPSG: 28356

0 20 40 60 80 100 m

1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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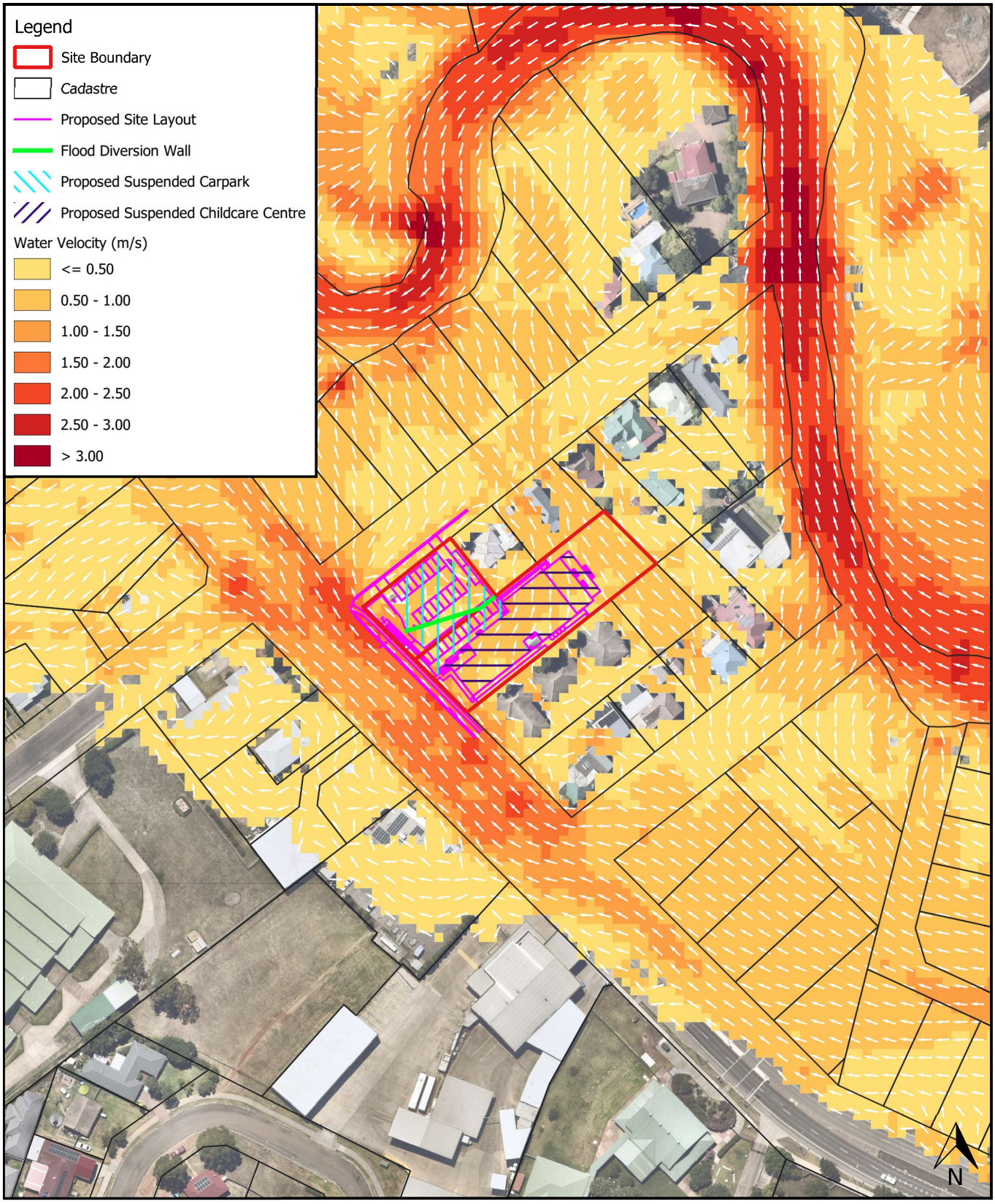
Map Title / Figure:

1% AEP Proposed Conditions Water Level and Water Depth

Map 08	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date



0 20 40 60 80 100 m

1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

Map Title / Figure:

1% AEP Proposed Conditions Water Velocity

Map 09	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

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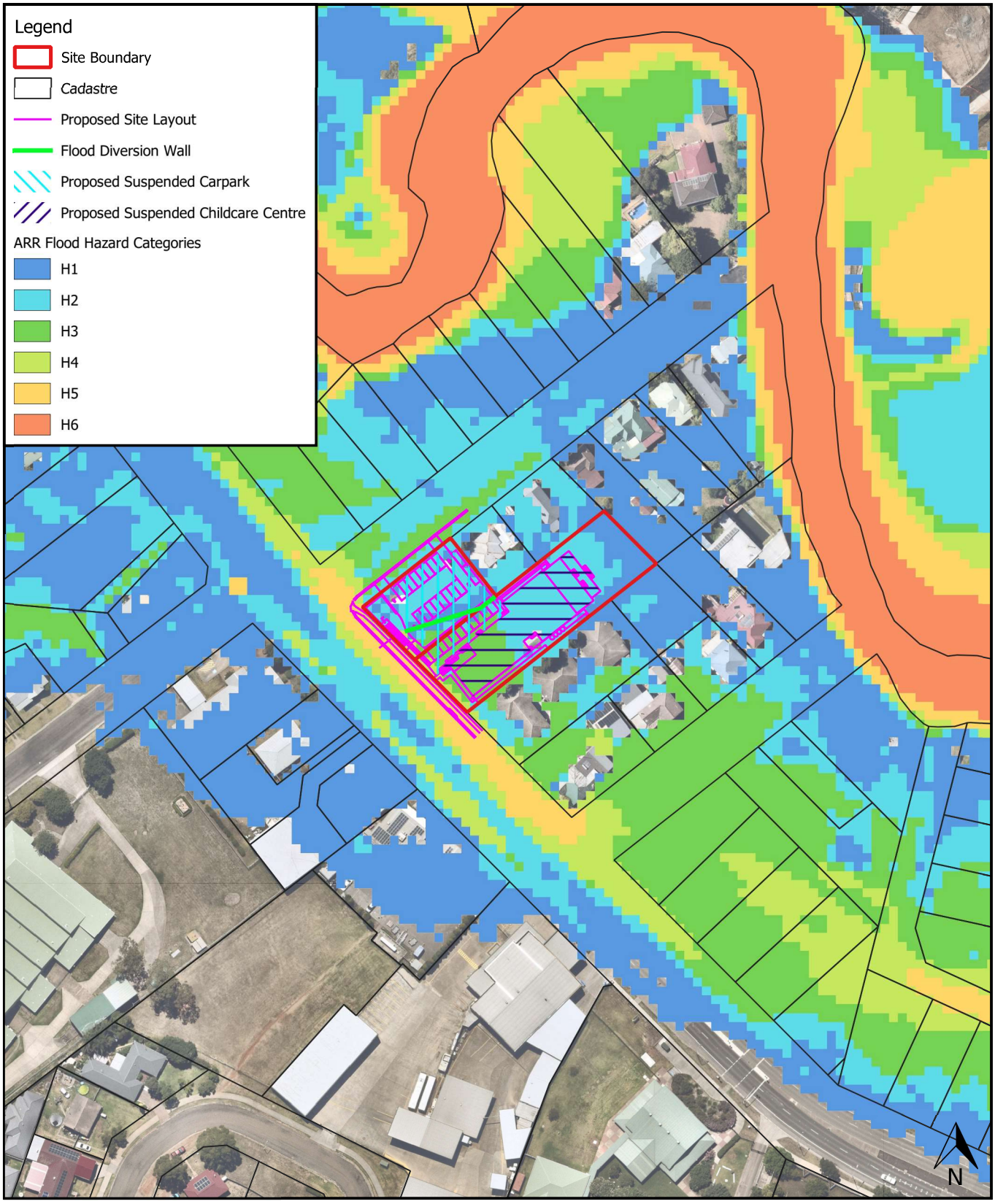
Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



Project No: P2309622 Map Set: MS01-R01 EPSG: 28356

0 20 40 60 80 100 m

1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023).
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website.
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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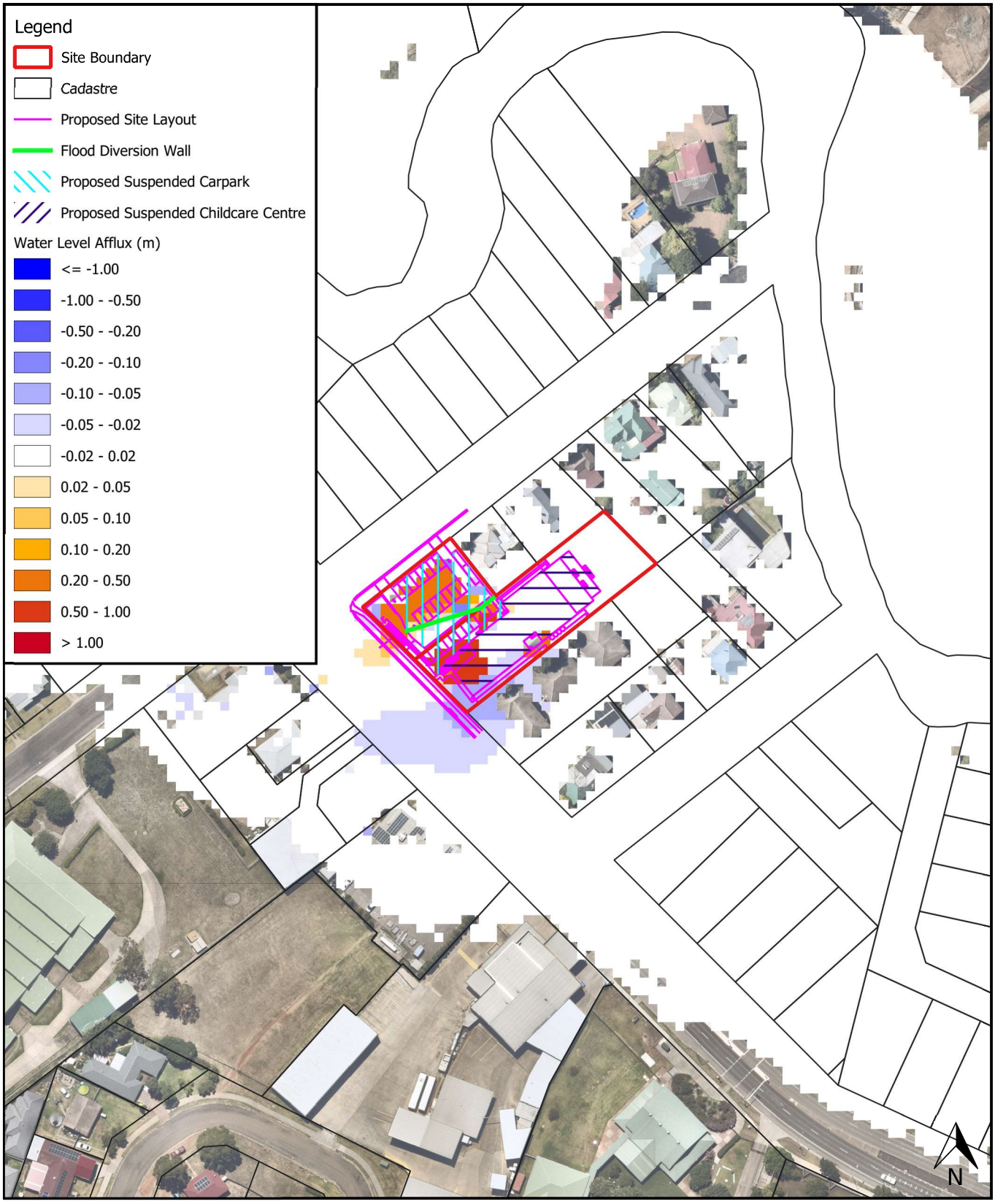
Map Title / Figure:

1% AEP Proposed Conditions ARR Flood Hazard Categories

Map 10	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date



0 20 40 60 80 100 m

1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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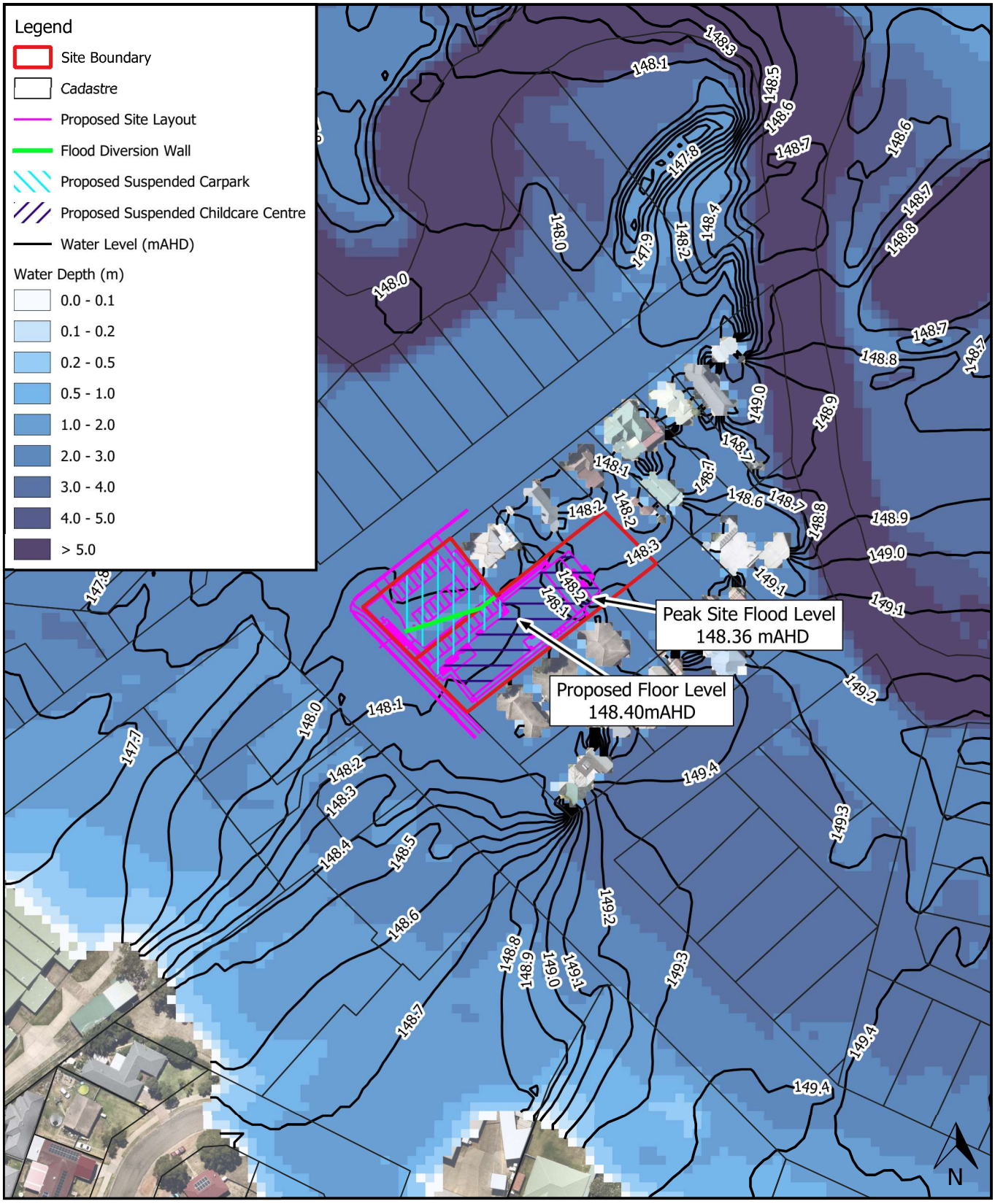
Map Title / Figure:

1% AEP Proposed Conditions Water Level Afflux

Map 11	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



0 20 40 60 80 100 m

1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

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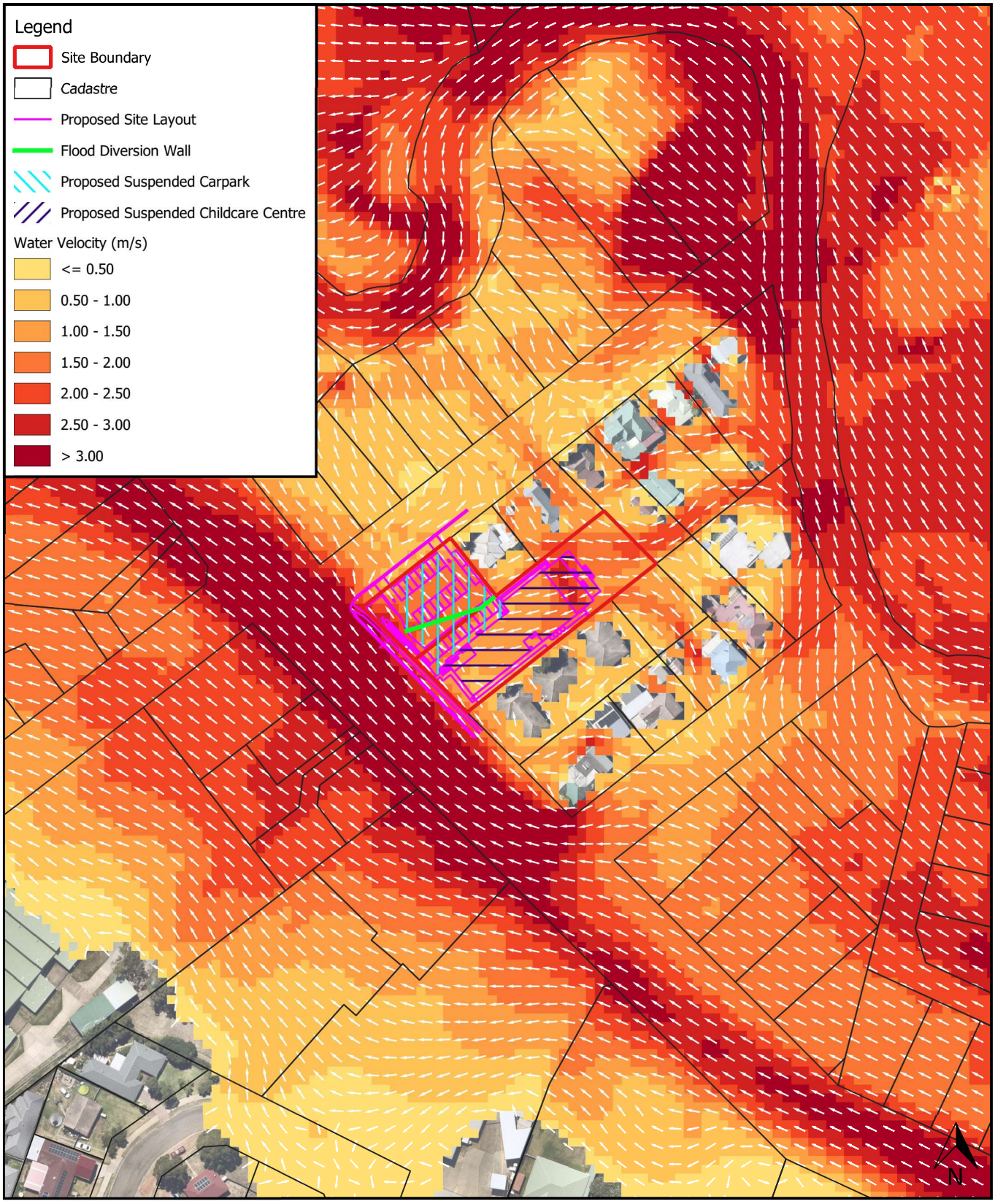
Map Title / Figure:

PMF Proposed Conditions Water Level and Water Depth

Map 12	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



0 20 40 60 80 100 m

1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023)
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website

Map Title / Figure:

PMF Proposed Conditions Water Velocity

Map 13	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

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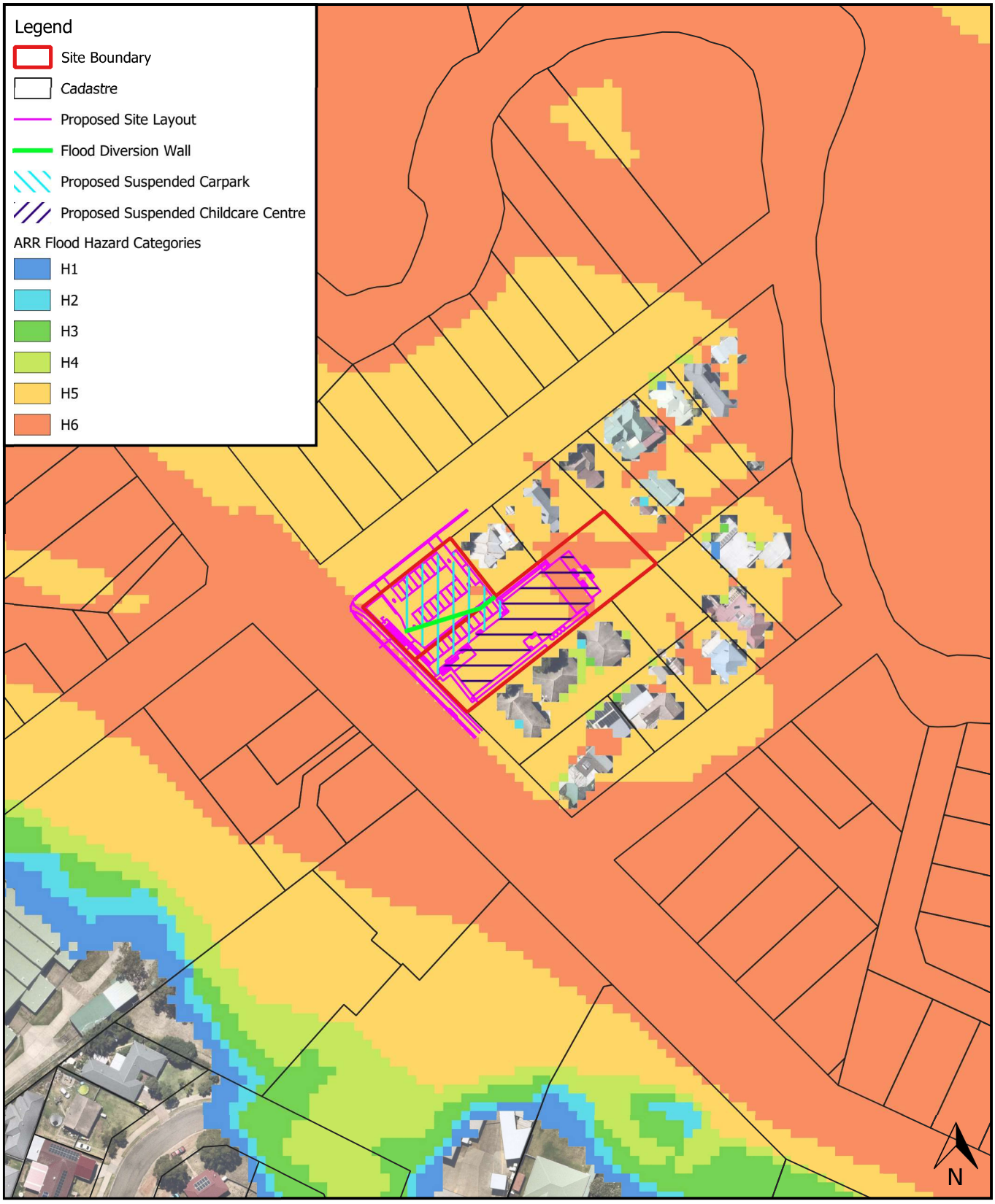
Project No: P2309622 Map Set: MS01-R01 EPSG: 28356



0 20 40 60 80 100 m

1:1750 @ A4

Viewport A

Notes:
- Aerial from Nearmap (2023).
- Cadastre from NSW Spatial Services (2023) 'Clip & Ship' SIX Maps website.
- Flood hazard based on Australian Rainfall and Runoff (ARR 2019) 'A Guide to Flood Estimation' combined flood hazard curves.

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Map Title / Figure:

PMF Proposed Conditions
ARR Flood Hazard Categories

Map 14	Map
36-38 Maitland Street, Muswellbrook, NSW	Site
Proposed Childcare Centre	Project
Flood Impact Assessment	Sub-Project
Rohit Mahajan	Client
19/01/2024	Date

Project No: P2309622 Map Set: MS01-R01 EPSG: 28356