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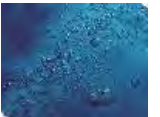
Flood Assessment: New High School in Bungendore



ENVIRONMENTAL



WATER



WASTEWATER



GEOTECHNICAL



CIVIL



PROJECT
MANAGEMENT



P2008007JR01V02
September 2021

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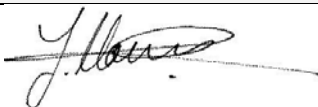
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All enquiries regarding this project are to be directed to the Project Manager.

Contents

1 OVERVIEW.....	5
1.1 Introduction	5
1.2 Proposal	5
1.3 Site Description	8
1.4 Project Scope and Objectives	9
1.5 Executive Summary of Findings	10
1.6 Relevant Guidelines	11
1.7 Definitions	11
2 BACKGROUND FLOODING DATA	12
2.1 Catchment Description	12
2.2 Site Flood and Overland Flow Mechanisms	12
2.3 Previous Flood Studies	12
3 HYDROLOGY MODELLING	14
3.1 Overview	14
3.2 Model Setup	14
3.3 Results	15
4 HYDRAULIC MODELLING.....	16
4.1 Overview	16
4.2 Scenarios	16
4.3 Terrain Data	16
4.4 Model Setup	17
4.5 Results	19
4.6 Discussion	21
5 PRELIMINARY FLOOD EMERGENCY RESPONSE PLAN COMMENTS.....	23
6 FLOODING COMPLIANCE ASSESSMENT AND DCP PLANNING CONSIDERATIONS	24
7 SUMMARY AND RECOMMENDATIONS	27
8 REFERENCES	28
9 ATTACHMENT A: SITE SURVEY	29
10 ATTACHMENT B: PROPOSED SITE LAYOUT	31
11 ATTACHMENT C: QPRC FLOOD INFORMATION CERTIFICATE	33
12 ATTACHMENT D: FLOOD ASSESSMENT MAPSET.....	37

1 Overview

1.1 Introduction

This flood assessment accompanies an Environmental Impact Statement (EIS) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) in support of an application for a State Significant Development (SSD No 14394209). The SSDA is for a new high school located at Bungendore.

This report addresses the Secretary's Environmental Assessment Requirements (SEARs), notably:

Table 1: Flooding related SEARs for the proposed development.

SEARs Requirement	Response
Identify any flood risk on-site in consultation with Council and having regard to the most recent flood studies for the development area and the potential effects of climate change, sea level rise and an increase in rainfall intensity.	A site-specific flood information certificate was obtained from Queanbeyan-Palerang Regional Council (Attachment C) which contained the necessary site flood risk information. In addition, Council's <i>Bungendore Flood Study 2002</i> and <i>Bungendore Floodplain Risk Management Study 2014</i> were accessed from Council's website and used for hydrologic and hydraulic comparison purposes (refer Section 2.3). Potential increase in rainfall intensity as a result of climate change has been included in the flood assessment, refer Section 3.2, Section 4.6 and Attachment D. Potential sea level rise is not relevant at the site.
Assess the impacts of the development, including any changes to flood risk on-site or off-site, and detail design solutions to mitigate flood risk where required.	Impacts of the development have been assessed and presented in Section 4.6.3 and Attachment D.
Relevant Policies and Guidelines: <ul style="list-style-type: none">NSW Floodplain Development Manual (DIPNR, 2005).	This flood assessment has been prepared in accordance with NSW Floodplain Development Manual

1.2 Proposal

The proposed development is for the construction of a new high school in Bungendore. The proposal has been designed as a stream 3 high school to initially provide for approximately 450 students with core 4 facilities aimed to future proof demand forecasted to 2036.

The site is located adjacent to the existing Bungendore Public School to the south enabling the creation of an education style precinct that will enable a cohesive connection between the two schools as well as the wider Bungendore community.

The proposal will include the demolition of the Bungendore Swimming Pool (to be relocated to Queanbeyan-Palerang Regional Council's

proposed new Bungendore Sports Hub) and the Bungendore Community Centre; repurposing of existing council buildings; and the construction of new school buildings. New facilities for the high school will comprise of 24 general learning spaces; dedicated science and technology spaces; a gymnasium; library; canteen; outdoor learning and play areas that include two games courts.

A new agricultural plot is also proposed to the north of the main school site including a new agricultural building and scout storage shed, adjacent to the existing scout hall.

The proposal will also provide for shared administration and staff facilities between the high school and existing primary school and construction of a warm shell for community facilities including a community library, council shopfront and community health hub.

Additionally, miscellaneous off-site works, including upgrades to nearby road intersections and infrastructure, crossings, footpaths and the like will be provided to encourage active transport opportunities and respond to changing traffic conditions.

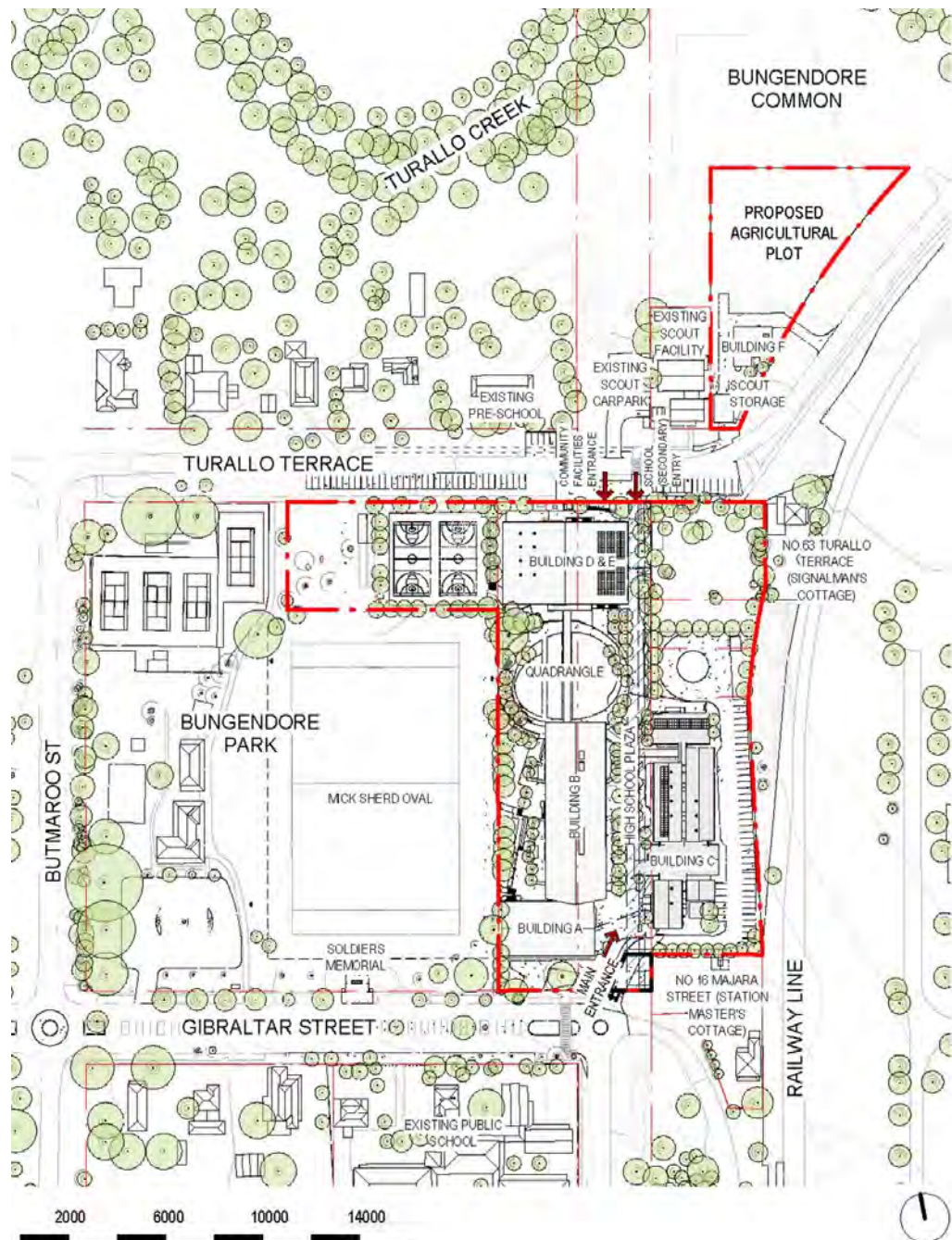


Figure 1: Proposed site plan. Source: TKD Architects

1.3 Site Description

The proposed development is located within the Bungendore Town Centre within the local government area of Queanbeyan-Palerang Regional Council. The proposal involves the use of land which includes Bungendore Park bounded by Gibraltar Street, Majara Street, Turallo Terrace and Butmaroo Street, the existing former Palerang Council site at 10 Majara Street, the Majara Street road reserve bounded by Turallo Terrace and Gibraltar Streets and Nos. 2, 4 and 6 Majara Street (Refer to Table 1 below).

The site is approximately 29,205m² in area and consists of a relatively flat topography. It contains part of Bungendore Park, existing Council buildings and maintained public open space areas. The land is mostly cleared of vegetation with some mature trees intersperse throughout subject lots.

The surrounding area generally includes low density residential developments to the north and west, an existing rail line to the east and Bungendore Public School and the Bungendore train station to the south and south west respectively.

Table 2: New High School in Bungendore legal descriptions.

Property Address	Lot Numbers
6-14 Butmaroo Street	Part Lot 701 DP1027107
2 Majara Street	Lot 12 DP1139067
4-6 Majara Street	Lot 13 DP1139067 Lot 14 DP1139067
10 Majara Street	Lot 3 DP830878
Butmaroo Street	Part Lot 701 DP96240
Portion of Majara Street (between Turallo Terrace and Gibraltar Street)	N/A



Figure 2: Site aerial depicting the land subject to the proposed High School. Source: TKD Architects.

1.4 Project Scope and Objectives

Project scope and objectives are:

1. Prepare a hydrologic model (RAFTS) for the 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 and validate against available flood data.

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 preliminary flood emergency response plan (FERP) comments.
6. Prepare a compliance assessment in accordance with Queanbeyan-Palerang Regional Council (QPRC) floodplain development controls.

The objective of this flood assessment is to address the following considerations for planned development of the site:

1. To ensure the development is compatible with the flood hazard of the land.
2. To ensure no significant adverse impacts on flood behaviour.
3. To ensure appropriate measures to manage risk to life from flood.

1.5 Executive Summary of Findings

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 area of the site is flood free in the 1% AEP flood (with and without climate change) and PMF events.
3. The proposed high school development would have acceptable offsite flood impacts.
4. Flood risks to life on site are low, and both evacuation and shelter-in-place emergency response strategies are available to further mitigate flood risks.
5. All building finished floor levels are above the FPL and PMF levels.
6. Compliance with Council flood planning level are achieved.

Whilst the proposed development is not affected by flood hazards during all floods up to and including the PMF event, we recommend that school

management subscribes to the relevant flood warning systems and maintain communication with SES and local police at all times with respect to flood emergency response.

1.6 Relevant Guidelines

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

1. Commonwealth of Australia (Geoscience 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. Palerang Council (2020), *Palerang Development Control Plan 2015*.

1.7 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	Queanbeyan-Palerang Regional Council
FERP	Flood emergency response plan
FFL	Finished floor 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.

2 Background Flooding Data

2.1 Catchment Description

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

- The site is located within the Turallo Creek catchment and is approximately 800 m upstream of the confluence with Halfway Creek.
- Upstream catchment is primarily bushland and agricultural areas, and includes the rural residential area of Bungendore.
- The total catchment area is 12,321 ha and is shown in Attachment D Map FL01.

2.2 Site Flood and Overland Flow Mechanisms

The site is likely affected by the following flood mechanisms:

- Overland flows from the site itself and the local upstream catchment.
- Flood overbank flows from Turallo Creek and Halfway Creek.

2.3 Previous Flood Studies

A review of previous flood investigations was undertaken to assess likely local flood behaviour and characteristics for the site, the Turallo Creek and Halfway Creek catchments. Review identified two flood assessments which would be relevant to this assessment.

2.3.1 *Patterson Britton & Partners (2002) Bungendore Flood Study*

Patterson Britton & Partners conducted a flood assessment for this catchment on behalf of Yarrawalumla Shire Council, and summarised the assessment in the report *Bungendore Flood Study (2002)*, hereafter referred to as the PBP flood study. As part of their study, PBP used RAFTS for hydrologic modelling and RMA-2 for hydraulic modelling.

The PBP RMA-2 flood model used irregular cells of varying size from approximately 0.5 x 0.5 m to 330 x 165 m, and included details of model inputs and results. We have relied upon the PBP flood study for hydrologic and hydraulic comparison purposes.

2.3.2 Worley Parsons (2014) Bungendore Floodplain Risk Management Study

Worley Parsons conducted a flood assessment for this catchment on behalf of Palerang Council, and summarised the assessment in the report *Bungendore Floodplain Risk Management Plan* (2014), hereafter referred to as the WP flood study. As part of their study, WP updated the PBP RMA-2 hydrodynamic model and incorporated topographic data acquired since 2002. We have relied upon the WP flood study for hydraulic validation and comparison purposes.

2.3.3 Flood Information Certificate

In addition, site flood information data has been acquired from QPRC (Attachment C). This information includes flood levels and hazards as well as flood mapping data. This document was sent as the outcome of correspondence with Council, and includes the most recent flooding information for the site.

3 Hydrology Modelling

3.1 Overview

The DRAINS software package (version 2016.03 – 22 December, 2020) was used with the RAFTS hydrological engine to assess the 1% AEP flood (with and without climate change) and PMF peak flow rates for a range of storm durations between 10 minutes and 18 hours.

3.2 Model Setup

Parameters used in the model are provided in Table 3. Model inputs are as follows:

1. Sub-catchment delineation, flow paths and slopes were developed using LIDAR data provided by Land and Property Information NSW (LPI 2014) and topographic data from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps. Refer to Attachment D Map FL01 for site catchment plan.
2. Sub-catchment impervious areas were adopted based on recent catchment aerals obtained from Nearmaps (2017) and Google Satellite (2021).
3. Roughness coefficients were determined using a weighted average based on the PBP and each sub-catchment's land use as per recent site aerals.
4. Intensity Frequency Duration (IFD) data and rainfall temporal patterns were based on the Bureau of Meteorology (BOM 2021) *Rainfall IFD Data System* and the Australian Rainfall & Runoff (ARR 2019) *Data Hub*.
5. 1% AEP rainfall intensities were increased by 20.2% for the worst-case climate change scenario in accordance with the (ARR 2019) *Data Hub* RCP 8.5 value for 2090.
6. Probable Maximum Precipitation (PMP) intensities and temporal distributions were determined using the BOM (2003) *Generalised Short-Duration Method*.
7. RAFTS parameters have been adopted based on the initial and continuing losses of the PBP flood study.

Table 3: Details of sub-catchments used in RAFTS modelling.

Sub-catchment ¹	Area (ha) ¹	Catchment Slope (%) ¹	Impervious (%) ²	PERN Roughness Coefficient ³
Catchment A	8,351	1.7	2.0	0.082
Catchment B	3,790	1.2	3.0	0.068
Site Catchment	180	1.0	30.0	0.040
Total	12,321			

Notes

1. Obtained based on survey data provided by PS (March 2021, Attachment A), contours from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website and LIDAR data provided by LPI (2014). Refer to Attachment D map FL01 for site catchment plan.
2. Adopted based on recent catchment aerals obtained from Nearmaps (2017) and Google Satellite (2021).
3. Obtained from the weighted average land use based on recent catchment aerial photographs obtained from Nearmaps (2017), Google satellite (2021) and PBP flood study.

3.3 Results

Results of peak flow rates for catchments arriving at the site for the critical duration 1% AEP flood event with and without climate change and PMF events are summarised in Table 4. The critical storm duration was determined to be 4.5 hours for the 1% AEP flood event, 3 hours for the 1% AEP flood event with climate change and 6 hours for the PMF event.

Table 4: Peak 1% AEP with and without 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 (hrs)	Peak Catchment Flow Rates (m ³ /s)			Total ¹
		Catchment A	Catchment B	Site Catchment	
1% AEP	4.5	319	165	14	498
1% AEP climate change ²	3.0	403	226	36	665
PMF	6.0	2129	1074	61	3264

Notes

1. The offset of the timing of each catchment's hydrograph means the total flow rate is not always equal to the sum of all catchment peak flow rates.
2. Based on 20.2% increased rainfall intensity in accordance with the ARR (2019) *Data Hub* RCP 8.5 value for 2090.

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 1% AEP flood with and without climate change and 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 1.1, 2.1 and 2.2.
2. Proposed condition: the catchment in its current state and the site in its proposed state as described in Section 1. In addition, the proposed condition model also included the proposed sports field at BPS (Lots 5 and 14 Section 9 DP758183).

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

1. 1% AEP 4.5 hour (critical duration) event.
2. 1% AEP with climate change (20.2% increased rainfall intensity) 3 hour (critical duration) event.
3. PMF 6 hour (critical duration) event.

In summary, a total of 6 scenarios were modelled as part of this assessment (2 flood condition scenarios and 3 flood events each).

4.3 Terrain Data

Catchment LIDAR data provided by LPI (2014) was merged with site survey data (Attachment A) provided by Project Surveyors (PS, May 2021) 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 preliminary site design grading provided by Meinhardt Bonacci. The design surface included earthworks on the site but excluded the proposed road design changes.

4.4 Model Setup

4.4.1 Existing Conditions

TUFLOW model construction for existing conditions consisted of:

1. A 2.5 m topographic grid based on the available survey and LIDAR data.
2. The model domain was defined from approximately 700 m upstream of the site at Turallo Creek and 700 m upstream of the site at Halfway Creek, to just downstream of the confluence of Turallo Creek and Halfway Creek approximately 750 m from the site. Model boundary extents were generally placed along catchment ridgelines and connecting catchment high points surrounding the study area.
3. A direct rainfall boundary condition based on the critical duration 1% AEP (with and without climate change) and PMF hyetographs from DRAINS. The boundary condition comprised the local site catchment and enabled automatic flood water routing.
4. Inflow boundary conditions based on the critical duration 1% AEP (with and without climate change) and PMF hydrographs from DRAINS for each of the two sub-catchments discharging to the study area.
5. Computed water slopes for downstream model extent boundary conditions based on the slopes from available LIDAR data.
6. Manning's zones based on Nearmaps (2017) aerial photography of the study area with roughness coefficients adopted as per Table 5 consistent with the PBP flood study.
7. Hydrologic loss coefficients for pervious and impervious catchment materials were consistent with hydrologic modelling (refer Section 3.2) and were adopted as per Table 5.
8. The railway bridge over Turallo Creek near Turallo Terrace, Molonglo Street bridge over Turallo Creek and Bungendore Road bridge over Halfway Creek were modelled as layered flow constrictions. Levels were adopted based on LIDAR data and structure blockages of 10-25% were adopted based on the assessment procedure in Australian Rainfall and Runoff (Weeks & Rigby, 2016).
9. A 1D network to model the relevant pit and pipe network:

- a. Pit and pipe system modelled include the pipe adjacent to Majara Street, the pit and pipe at the intersection of Butmaroo Street and Turallo Terrace, the culvert below Turallo Terrace at Turallo Creek and the pipe through the bund adjacent to Ellendon Street. 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 PS (2021) survey data (Attachment A) and LIDAR data.
- 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).

10. Existing dams are conservatively assumed to be full.

Table 5: Manning's roughness and hydrologic loss values for TUFLOW modelling.

Catchment Material Type	Manning's Roughness Coefficient ¹	Initial Loss (mm) ²	Continuing Loss (mm/hr) ²
Roof	0.015 when depth ≤ 0.05 m	0.0	1.8
	0.300 when depth > 0.10 m		
	0.015 – 0.300 when depth 0.05 m – 0.10 m		
Cultivated areas / Short grass	0.030	0.0	1.8
Defined channel	0.045	0.0	1.8
Pasture, no brush, high grass	0.038	0.0	1.8
Roads / Concrete	0.020	0.0	1.8
Village centre and scattered housing	0.040	0.0	1.8
Watercourse / Water Body	0.030	0.0	1.8

Notes

1. Obtained from the PBP flood study (Table 10). Where parameters were not provided in the PBP flood study, roughness coefficients were adopted based on typical values from similar catchments.
2. Hydrologic losses were consistent with the PBP flood study as detailed at Section 3.2.

4.4.2 Proposed Conditions

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

1. The 2.5 m topographic grid was updated to include the proposed site grading.

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.

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 1% AEP flood event with and without climate change and PMF events in existing and proposed conditions are provided in Attachment D, with drawing references summarised in Table 6.

Table 6: Flood map drawing references in Attachment D (MA mapset P2008007MS01). ¹

Flood Condition Scenario	Critical Duration Flood Event	Water Level & Depth	Water Velocity	Provisional Hydraulic Hazard Categories ²	Water Level Afflux
Existing Conditions	1% AEP	FL03	FL04	FL05	–
	1% AEP (CC ³)	FL06	FL07	FL08	–
	PMF	FL09	FL10	FL11	–
Proposed Conditions	1% AEP	FL12	FL13	FL14	FL21
	1% AEP (CC ³)	FL15	FL16	FL17	–
	PMF	FL18	FL19	FL20	–

Notes

1. Flood results have been filtered to show areas of greater than 100 mm depth.
2. ARR flood hazard categories are based on ARR flood hazard curve (2019) definitions and are shown in Figure 3.
3. Climate change scenario based on 20.2% increased rainfall intensity in accordance with the ARR Data Hub.

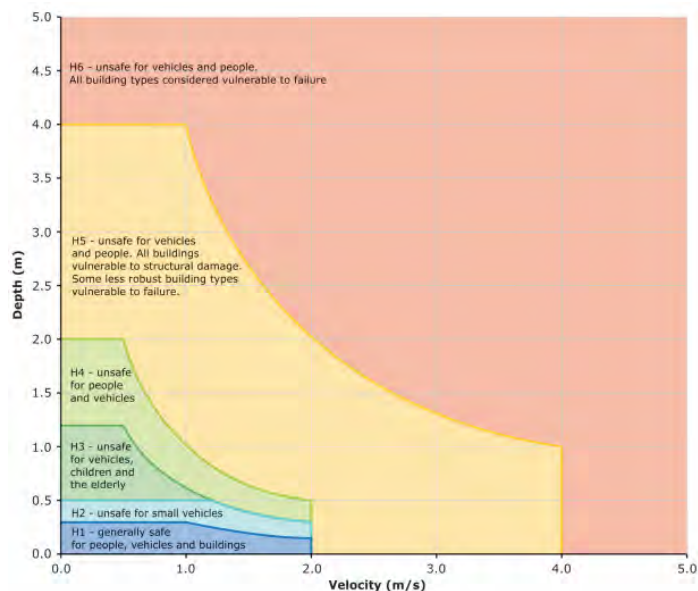


Figure 3a: Flood Hazard Curves (Geoscience Australia, 2019).

4.5.2 Validation

Comparison between WP (2014) and MA peak flood levels for various flood events is given in Table 7. Comparison is made for the peak flood levels in Turallo Creek at the locations shown in Attachment D Map FL02.

The comparison shows flood levels as modelled by MA agree well with WP modelling, and differences are $\leq \pm 0.08$ m in the 1% AEP event and $\leq \pm 0.11$ m in the PMF event. The differences between modelled flood levels are likely due to the changed modelling software (WP used RMA-2, MA used TUFLOW) and smaller grid cell size (WP used a varying cell size of approximately 0.5 x 0.5 m to 330 x 165 m, MA used a fixed grid of 2.5 m). These changes serve to increase the accuracy of the modelled flood levels at the site.

Further, flood levels and extents throughout the MA model domain were compared to those modelled by WP and were found to have close agreement. We therefore consider the MA model closely matches the Council adopted flood characteristics, slightly improving the accuracy of flood predictions at the site, and is considered adequate for the purposes of detailed site modelling.

Table 7: Comparison between WP (2014) and MA (2021) modelled peak water levels.

	1% AEP				PMF			
	Peak Flood Level (mAHD)		Difference		Peak Flood Level (mAHD)		Difference	
Location ¹	WP ²	MA	(m)	(%)	WP ²	MA	(m)	(%)
Point A	690.80	690.87	0.07	+0.0	693.10	693.04	-0.06	-0.0
Point B	691.10	691.10	0.00	+0.0	693.40	693.29	-0.11	-0.0
Point C	691.70	691.64	-0.07	-0.0	693.70	693.75	0.05	+0.0
Point D	692.00	692.06	0.06	+0.0	694.00	694.08	0.08	+0.0
Point E	692.30	692.38	0.08	+0.0	694.30	694.28	-0.02	-0.0
Point F	692.70	692.78	0.08	+0.0	694.60	694.63	0.03	+0.0

Notes

1. Calibration locations shown in Attachment D Map FL02.
2. Peak flood levels from the WP flood study (Figure 10 and 11).

4.6 Discussion

We note the following regarding modelled flood behaviour:

4.6.1 Existing Conditions

1. In all modelled flood events, flood waters break the banks of Turallo Creek and flow from west to east north of the site.
2. The site is primarily unaffected by flooding in all events up to and including the PMF. The only area of the site affected by flood waters is the agriculture plot to the north of the main school site (the Ag plot) in all modelled flood events (Attachment D Map FL09), and a small area north west of site at the existing tennis courts in the PMF event.
3. Peak flood depths at the Ag Plot range from 1.0 m in the 1% AEP event to 2.7 m in the PMF event, and flood hazards peak at H5 in the 1% AEP event and H6 in the PMF event.
4. Peak PMF flood depth adjacent to the tennis courts is 1.0 m, and flood hazards peak at H5 in this event.
5. Peak flood depths at BPS range from 0.25 m in the 1% AEP event to 0.40 m in the PMF event, and flood hazards peak at H1 in the 1% AEP event and H2 in the PMF event.
6. The 1% AEP climate change levels, depths and hazards are slightly elevated above the 1% AEP flood characteristics, however are below / lower than the PMF characteristics.

7. Within Majara Street and behind existing structures (Council building and the building at the intersection of Majara Street and Turallo Terrace) there are small areas of shallow water in all modelled events, as shown in Attachment D Map FL09. This is not considered to be flood water but rather shallow stormwater ponding, which is a consequence of the direct rainfall modelling approach and the presence of trapped low points.

4.6.2 Proposed Conditions

1. Proposed flooding conditions are largely unchanged from existing conditions, and the proposed earthworks do not materially affect local flood characteristics.
2. All the proposed development elements are raised above the floodplain on fill, and are not affected by flood waters in all events up to and including the PMF.
3. The peak PMF level is 694.65 mAHD, and all proposed building ground finished floor levels (FFL's) are above 697.20 mAHD, which indicates a shelter-in-place emergency response strategy is appropriate for the site.
4. As in the existing conditions, there are shallow areas of stormwater ponding which are not considered to be flood water.

4.6.3 Offsite Flood Impacts

1. As the proposed development area is flood free in the 1% AEP event, there are no offsite impacts to the floodplain environment in the 1% AEP event.
2. The proposed high school development does not cause offsite flood impacts and is considered acceptable.

5 Preliminary Flood Emergency Response Plan Comments

Whilst all the proposed development elements are not affected by flood events up to and including PMF, the following preliminary comments are provided to mitigate risks associated with flooding:

1. Access to flood free land is available for all site occupants on the ground floor and on all upper floor levels.
2. Both evacuation and shelter-in-place are recommended as emergency response strategies for site occupants.
3. The site is not subject to short duration overland flooding and hence there will be sufficient time for site management to receive flood warnings before site occupants are required to evacuate.
4. The proposed development will be affected by flooding caused by large-scale events. Such large-scale flood events will be widely anticipated several days in advance.
5. The proposed school access road is outside the PMF extents and hence reliable vehicular access is available. The proposed vehicular evacuation route is to travel via the Gibraltar Street access south on Majara Street and east on Malbon Street.
6. Site management will be subscribed to the following systems and may be alerted to flood warnings via the following mechanisms:
 - a. SES emergency alert telephone warning system.
 - b. BOM alerts and press releases.
 - c. Weather apps (e.g. 'Early Warning Network').
 - d. Media warnings (TV, radio, internet etc.).
 - e. Police and / or SES door knocking.

6 Flooding Compliance Assessment and DCP Planning

Considerations

Flood specific controls are provided in the Palerang Development Control Plan (2015) at Section B9 'Flooding Planning'. A compliance assessment for the proposed development based on Section B9 is summarised in Table 8 based on the controls for new residential development, since the Palerang Council DCP does not include specific land use requirements for schools, and new residential development flood planning requirements are more strict than other land uses.

Table 8 demonstrates that all the applicable flood planning requirements for the proposed development site are effectively addressed, and compliance with the Palerang Council DCP is achieved.

Further, we confirm the flooding related SEARs requirements have been addressed as summarised in Table 1.

Table 8: Compliance with Palerang Development Control Plan (2015) flood planning controls.

Palerang Council DCP Requirement	Compliance Assessment
B9.1 GENERAL	
1. Consideration will be given to development on land below the flood planning level, but only if it is not located within a floodway or high hazard area as stated in the Flood Planning Manual. Any portion of any building that may be subject to the effects of flood waters is to be built from flood compatible materials (see Appendix B for suggested materials).	(1) The proposed development is located above the flood planning level (FPL), and no proposed buildings will be subject to the effects of flood waters, hence this control is satisfied.
2. All services associated with the development are to be adequately flood proofed.	(2) The proposed development is not affected by flood events up to and including PMF, hence this control is not applicable.
3. No on-site sewage management system shall be located within a flood planning area.	(3) No on-site sewage management system is proposed.
B9.2 RESIDENTIAL – NEW DEVELOPMENT	
1. Developments designed to cater for vulnerable sections of the community (such as seniors housing) are not suitable for land identified as being a Flood Planning Area.	(4) The development can be considered to cater for vulnerable sections of the community (children). However, the proposed development area is not affected by flooding up to and including the PMF event, hence this control is not applicable.
2. Floor levels of habitable rooms are to be at or above the Flood Planning Level.	(5) The peak 1% AEP flood level adjacent to the site is 693.0 mAHD. As discussed at Section 4.6.2 ground FFLs are above 697.2 mAHD, hence this control is achieved.
3. Flood safe access and emergency egress for all flood events up to the 1% AEP event plus 500mm freeboard is to be provided.	(6) As discussed at (5).
4. Residential garages are to be at or above the 1% AEP level. Where this is impractical, garages are as to be as high as practical and electrical points are to be at or above the Flood Planning Level.	(7) No garages proposed.
B9.7 ALTERATIONS TO NATURAL SURFACE LEVELS	
1. Proposed earthworks are not to increase the flooding hazard or flood damage to other properties or adversely affect other properties during flood events.	(8) As discussed at Section 4.6.3 the proposed high school development does not cause offsite flood impacts and is considered acceptable. (9) The proposed BPS sports field does cause some offsite impacts in the 1% AEP event. Whilst outside the scope of this assessment, we recommend any future proposal associated with the sports field incorporate compensatory cut or a formalised swale design to mitigate offsite impacts.

Palerang Council DCP Requirement		Compliance Assessment
B9.8 FENCING		
1. Fencing construction and materials are to allow floodwaters to equalise on either side.	(10)	The proposed development is located above the PMF level, hence any proposed fencing will not impact on flood characteristics.
2. Fencing construction and materials are to safely allow floodwaters or debris to pass.	(11)	As discussed in (10).

Summary and Recommendations

A detailed hydrologic and hydraulic model has been developed for the site consistent with Council's accepted WP flood model and using detailed site survey and proposed design elements to assess local flood characteristics. The model accurately replicates Council adopted flood characteristics.

The model was used to determine the existing and proposed flood conditions in the 1% AEP flood (with and without climate change) and PMF events. 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 area of the site is flood free in the 1% AEP flood (with and without climate change) and PMF events.
3. The proposed high school development would have acceptable offsite flood impacts.
4. Flood risks to life on site are low, and both evacuation and shelter-in-place emergency response strategies are available to further mitigate flood risks.
5. All building finished floor levels are above the FPL and PMF levels.
6. Compliance with Council flood planning level are achieved.

Whilst the proposed development is not affected by flood hazards during all floods up to and including the PMF event, we recommend that school management subscribes to the relevant flood warning systems and maintain communication with SES and local police at all times with respect to flood emergency response.

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.

8

References

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) (2019), *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia.

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

Bureau of Meteorology (2021), *Rainfall IFD Data System*, www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016.

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

Palerang Council (2020), *Palerang Development Control Plan 2015*.

Patterson Britton & Partners (2002), *Bungendore Flood Study*.

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*.

Worley Parsons (2014), *Bungendore Floodplain Risk Management Plan*.

9 **Attachment A: Site Survey**



* THE LOT 2 SEC 9 DP 758183 TITLE NOTES
1. RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
2. LAND IS A RESERVE WITHIN THE MEANING OF PART 5 OF THE CROWN LANDS ACT 1989 AND THERE ARE RESTRICTIONS ON TRANSFER AND OTHER DEALINGS IN THE LAND UNDER THAT ACT, WHICH MAY REQUIRE CONSENT OF THE MINISTER

* THE LOT 4 SEC 9 DP 758183 TITLE NOTES
1. LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN
2. DEDICATED AS SITE FOR SCHOOL OF ARTS BY GOV. GAZ. 30.5.1890

* THE LOT 5 SEC 9 DP 758183 TITLE NOTES
1. LAND EXCLUDES MINERALS - SEE MEMORANDUM S700000A
2. RESERVE NO. R15432 FOR PUBLIC SCHOOL PURPOSES VIDE NOTIFIN. IN GOV. GAZ. DATED 2.4.1892 FOLIO 2745

* THE LOT 14 SEC 9 DP 758183 TITLE NOTES
1. LAND EXCLUDES MINERALS - SEE MEMORANDUM S700000A
2. RESERVE NO. R15432 FOR PUBLIC SCHOOL PURPOSES VIDE NOTIFIN. IN GOV. GAZ. DATED 26.9.1975 FOLIO 3957

* THE LOT 701 DP 1027107 TITLE NOTES
1. THE LAND IS A PRESERVE WITHIN THE MEANING OF PART 5 OF THE CROWN LANDS ACT 1989 AND THERE ARE RESTRICTIONS ON TRANSFER AND OTHER DEALINGS IN THE LAND UNDER THAT ACT, WHICH MAY REQUIRE CONSENT OF THE MINISTER
2. LIMITED TITLE. LIMITATION PURSUANT TO SECTION 28(4) OF THE REAL PROPERTY ACT, 1900. THE BOUNDARIES OF THE LAND COMPRISED HEREIN HAVE NOT BEEN INVESTIGATED BY THE REGISTRAR GENERAL.
3. THE LAND IS DEDICATED FOR A PUBLIC PURPOSE.

LEGEND				
ELP - ELECTRIC LIGHT POLE	SV - STOP VALVE	C - COMMUNICATION		
HYD - HYDRANT	TEL - TELSTRA PIT	W - WATER LINE		
TW - TOP WALL	VC - VEHICLE CROSSING	G - GAS LINE		
TK - TOP KERB	DP - DOWNPIPE	E - ELECTRICITY		
TG - TOP GUTTER	RDG - ROOF RIDGE	SW - STORMWATER PIPE		
PP - POWER POLE	EOT - END OF TRACE	OP - OVERHEAD POWER		
SMH - SEWER MANHOLE	UTO - UNABLE TO OPEN			
SP - SIGN POST	W - WATER PIT			
CONC - CONCRETE	GL - GRATED LID			
SL - SEALED LID				
STRING NAME	SERVICE TYPE	QUALITY LEVEL	ASSET OWNER	COMMENT
WM01	Water Main line	D	Icon	Water main approx depth of .4 to 1.2
WY01	Water - house connection	D	Private	Water service school feed approx 0.4m deep
GM01	Gas main	D	Evoenergy	1x63mm pe main approx 0.7m deep
YG01	Gas line	D	Private	Gas service school feed approx 0.5m deep
MT01	Communication	A	Telstra	1xp50mm conduit approx 0.4m deep empty conduit
IRR01	Irrigation	B	Private	Irrigation line located approx 0.3m deep
EU01	Electricity	B	Evoenergy	Electric line approx depth of .5 to 1.0
EU02	Electricity	B	Private	Shelter lights Electric line approx depth of 3 to .8
EU03	Electricity	B	Private	Oval flood lights electric line approx depth of .6 to 1.0
EU04	Electricity	B	Private	Car park light poles approx depth of .4 to .8
EU05	Electricity	B	Private	Memorial Electric line Approx depth of .3 to .7
TN01	Communication	B	Telstra	Telstra mains cables approx depth of .3 to 1.1
TN02	Communication	B	Telstra	Telstra line approx depth of .3 to .7
TN03	Communication	B	Telstra	Telstra / optic fibre approx depth of .3 to .9
GM01	Gas main	D	Evoenergy	Gas main approx depth of .3 to .9
GM02	Gas main	D	Evoenergy	Gas main approx depth of .3 to 1.0
GM03	Gas main	D	Evoenergy	Gas main approx depth of .3 to 1.0

NOTES :

- * BOUNDARIES HAVE NOT BEEN DEFINED BY SURVEY AND ARE DIAGRAMMATIC ONLY
- * LAND DIMENSIONS AND AREAS HAVE BEEN COMPILED FROM PLANS OBTAINED FROM LIMA
- * BEARINGS RELATE TO MGA NORTH ORIGINATING FROM SCIMS MARKS
- * LEVEL DATUM IS AHD ORIGINATING FROM PM40278 RL 696.187
- * THE EXISTENCE OF UNDERGROUND SERVICES HAS BEEN ESTABLISHED IN AGREED SCOPE.
- * EXISTENCE OF SERVICES MUST BE VERIFIED BY CONTACTING DIAL BEFORE YOU DIG (DBYD) 1100.COM.AU
- * CRITICAL SERVICES MUST BE EXPOSED AND LOCATED.
- * NEIGHBOURING HOUSES - WINDOWS AND ROOF POSITIONS ARE APPROXIMATELY ONLY
- * FLOOR LEVELS GENERALLY SURVEYED AT DOOR THRESHOLDS. INTERNAL ROOMS NOT SURVEYED.
- * CONTOURS SHOWN ARE INDICATIVE OF LAND FORM. SPOT LEVELS SHOULD TAKE PRECEDENCE.
- * REFER TO FACE OF PLAN FOR SUBJECT TITLE NOTATIONS.
- * THIS TITLEBLOCK IS AN INTEGRAL PART OF THIS DRAWING AND SHOULD NOT BE REMOVED.

LOCATING QUALITY LEVELS PURSUANT TO AS5488-2013

QL-A QUALITY LEVEL A. VISUALISATION / CONFIRMATION OF A SERVICE, POSITION AND DEPTH, BY NON DESTRUCTIVE DIGGING METHODS OR POINTS OF ENTRY TO PITS OR

QL-B QUALITY LEVEL B. LOCATING OF SERVICES USING RADIO DETECTION METHODS OR GROUND PENETRATION RADAR. ACCEPTABLE RANGE OF ACCURACY FOR QUALITY B IS 300mm FOR POSITION AND 500mm IN DEPTH.

QL-C QUALITY LEVEL C. SERVICES MARKED OUT USING ONLY SURFACE FEATURES THAT HAVE BEEN MEASURED IN THE FIELD. THIS INCLUDES HYDRANTS, GAS MARKERS, PITS LIDS ETC. NO INDICATION OF SERVICE LOCATION OR DEPTH CAN BE OBTAINED FROM QUALITY LEVEL C.

QL-D QUALITY LEVEL D. SERVICES MARKED UP USING DBYD PLANS ONLY. NO INDICATION OF SERVICE CONFIRMATION CAN BE GIVEN.

UNDERGROUND SERVICES ALONG HILL ROAD WERE DETECTED BY ASTREA PTY LTD ON 16.03.2021
SURVEY INFORMATION ABOUT SERVICES SHOULD BE READ TOGETHER WITH ASTREA REPORT: ASTREA-BUN-1.PDF, ASTREA-BUN-2.PDF,

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F	ADDITIONAL INFORMATION ADDED	26.05.2021
E	FENCE ALONG THE RAIL ADDED	
D	TRAIN TRACKS ADDED	12.05.2021
C	UNDERGROUND SERVICES INFORMATION ADDED	21.04.2021
B	AMENDMENTS	01.04.2021
REV	AMENDMENTS	DATE

SHEET 1 OF 7 - DETAIL SURVEY

CLIENT : HINDMARSH

JOB REF. :	B04901
DRAWING No.	B04901-BUN-A
SURVEYOR:	BC
CHECKED:	NM
	REGISTERED LAND SURVEYOR
DATE:	30/03/2021
DATUM:	A.H.D.
ORIGIN:	PM40278 RL 696.187
REFERENCE SYSTEM:	GDA 2020

PLAN OF: BUNGENDORE HIGH SCHOOL
300 Lanyon Drive ACT

SHOWING: GENERAL DETAIL AND SITE LEVELS

PURPOSE: ARCHITECTURAL DESIGN COUNCIL SUBMISSION

ABN 20 068 433 974

BELLA VISTA

PO Box 7419 BAULKHAM HILLS NSW 2153
SUITE 405, LEVEL 4 14 LEXINGTON DRIVE,
BELLA VISTA NSW 2153
PHONE : 9056 1900
email: office@projectsurveyors.com.au

www.projectsurveyors.com.au

PROJECT SURVEYORS
Professional Innovative... Results.

10 **Attachment B: Proposed Site Layout**

11 **Attachment C: QPRC Flood Information Certificate**

21 April 2021

Martens & Associates
Suite 201, Level 2/20 George St,
HORNSBY NSW 2077

Dear Martens & Associates,

**RE: FLOOD INFORMATION CERTIFICATE LOT 701 DP 1027107
LOT 701 DP 96240; BUNGENDORE PARK 6-14 BUTMAROO STREET
BUNGENDORE NSW 2621**

Please find enclosed the Flood Information Certificate for the above mentioned property.

Should you have any further enquiries please contact Council's Development team on (02) 6285 6244.

Yours faithfully,



Brendan Belcher
Program Coordinator – Utilities Technical
Queanbeyan-Palerang Regional Council

FLOOD INFORMATION CERTIFICATE: ENG.2021.1503

PROPERTY DETAILS:

Lot 701 DP 1027107

Lot 701 DP 96240

Bungendore Park 6-14 Butmaroo Street BUNGENDORE NSW 2621

APPLICANT DETAILS:

Name: Martens & Associates

Address: Suite 201, Level 2/20 George St,
HORNSBY Nsw 2077

CERTIFICATION:

I certify that the following information applies to the above mentioned property in relation to flooding -

Is the land flood liable?	Yes - Refer to Figure 1
Does the land lie within the Floodplain?	No
Flood Planning Level	692.3m AHD
Probable Maximum Flood (PMF) level	693.6m AHD
What is the defined Flood Hazard?	Low Hazard
Is the land within a Flood Storage area?	No
Does the land have reliable access for pedestrians and vehicles to safe refuge?	Yes

Signature



Name

Brendan Belcher

Designation

Program Coordinator – Utilities Technical

Date of Issue

21 April 2021

Certificate Number

ENG.2021.1503

OFFICES

144 Wallace St, Braidwood
10 Majara St, Bungendore
256 Crawford St, Queanbeyan

POSTAL

PO Box 348, Bungendore NSW 2621
PO Box 90, Queanbeyan NSW 2620

PHONE/FAX

Bungendore/Braidwood
P: 02 6238 8111
Queanbeyan
P: 02 6285 6000 F: 02 6285 6666

EMAIL/WEB

W: www.qprc.nsw.gov.au
E: council@qprc.nsw.gov.au

ABN 95 933 070 982

Any further information in regard to this certificate can be obtained from Council's Development team. This certificate should be presented to Queanbeyan-Palerang Regional Council as part of any development proposal for this property. A Registered Surveyor should be engaged to verify Australian Height Datum (AHD) site levels for comparison with the AHD flood height levels contained in this certificate.

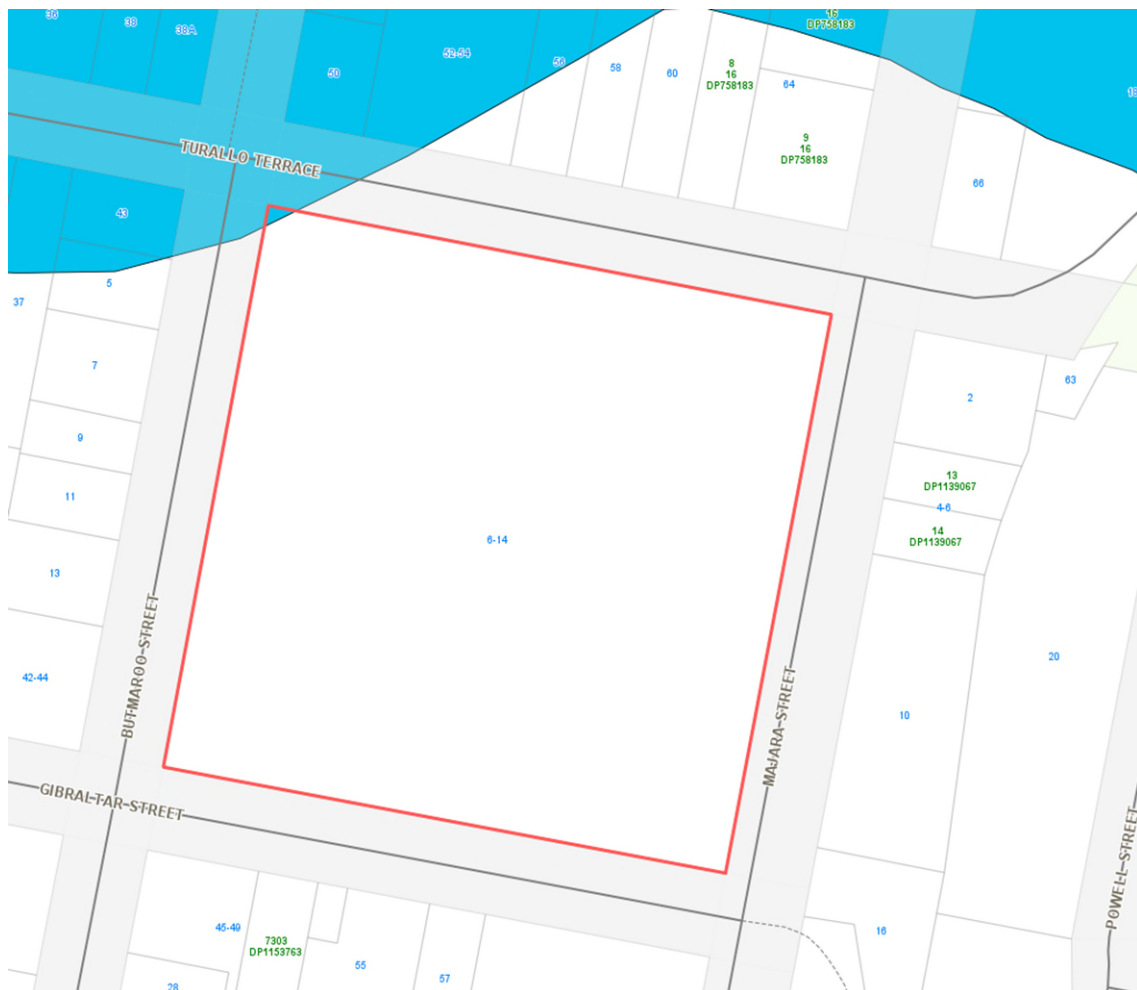
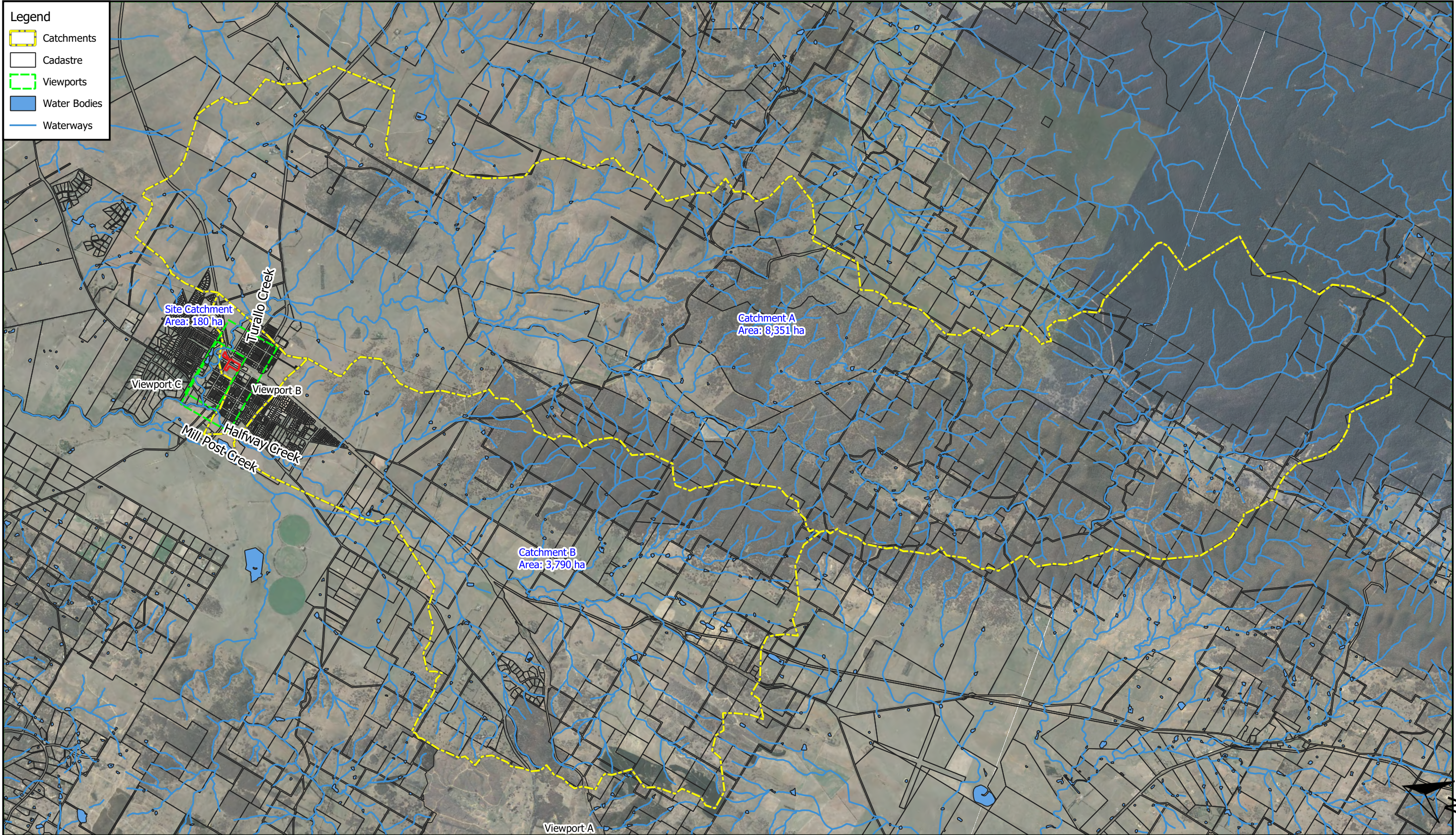


Figure 1 - Location of Property

12 **Attachment D: Flood Assessment Mapset**



0 700 1400 2100 2800 3500 m

1:60000 @ A3

Viewport A

Notes:
- Aerial from Google Satellite (2021).
- Cadastre, waterways and water bodies from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.


Map Title / Figure:


Catchment Plan

FL01	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessment	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



Legend

 Validation Points

 Cadastre

0 20 40 60 80 100 m

1:2500 @ A3

Viewport C

Notes:

- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.

Map Title / Figure:
TUFLOW Validation Points

FL02	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



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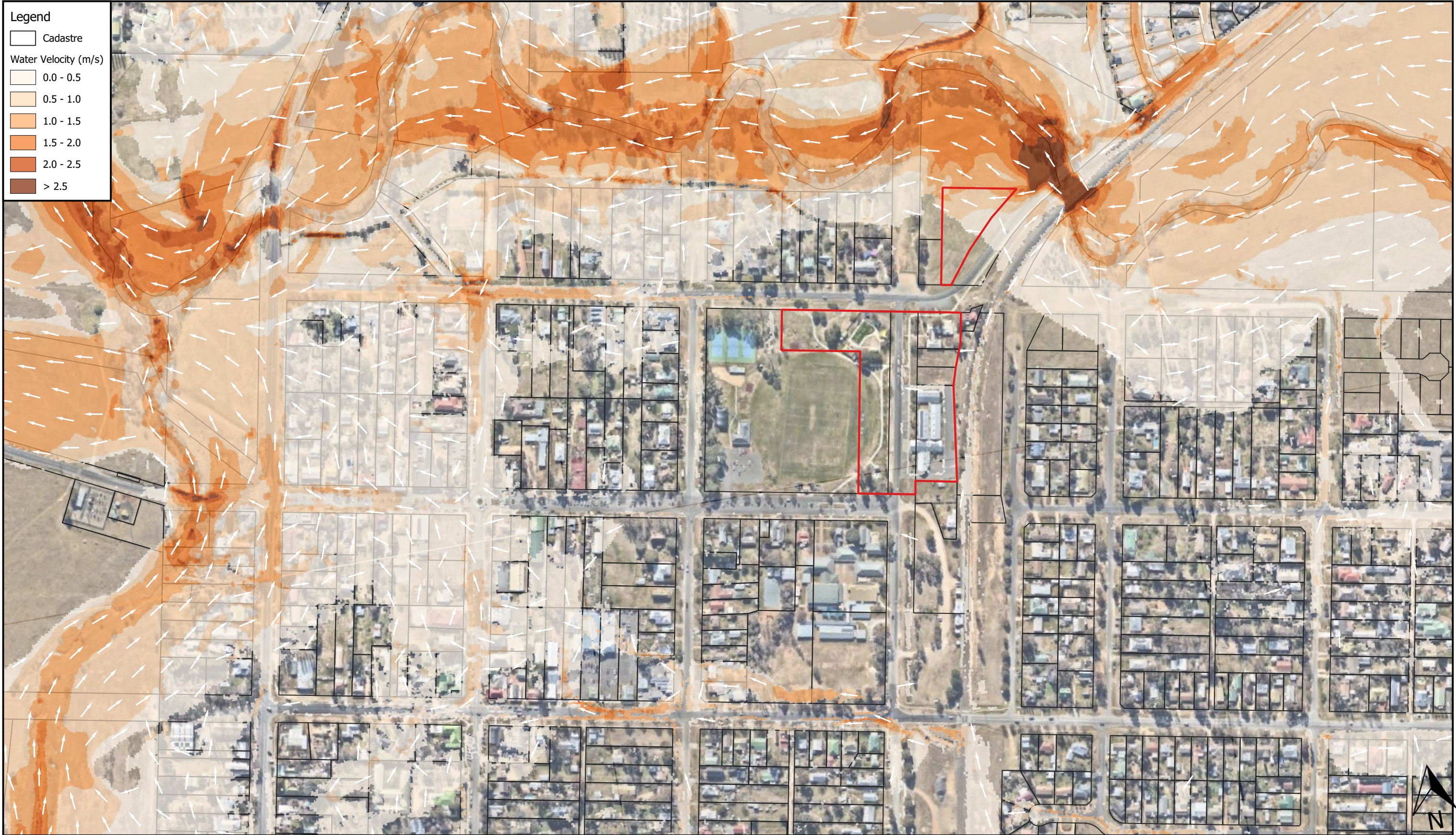
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

1% AEP Critical Duration Storm - Existing Scenario
Water Level & Water Depth

FL03	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessment	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



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1:4000 @ A3

Viewport B

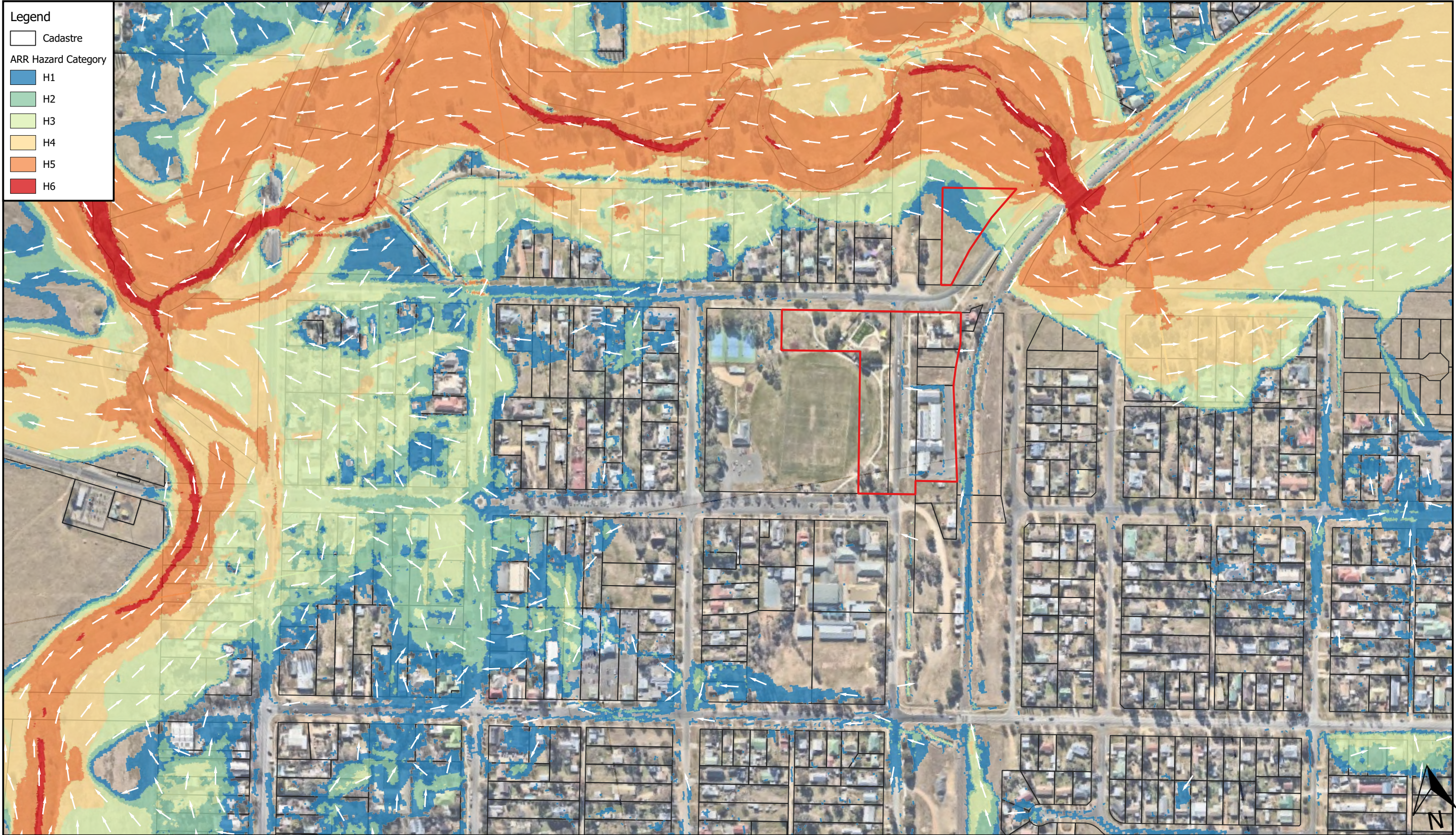
Notes:

- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

Map Title / Figure:
**1% AEP Critical Duration Storm - Existing Scenario
Water Velocity**

FL04
Majara St & Gibraltar St, Bungendore NSW
New High School in Bungendore
Flood Assessmentnet
School Infrastructure NSW
06/09/2021

Map
Site
Project
Sub-Project
Client
Date



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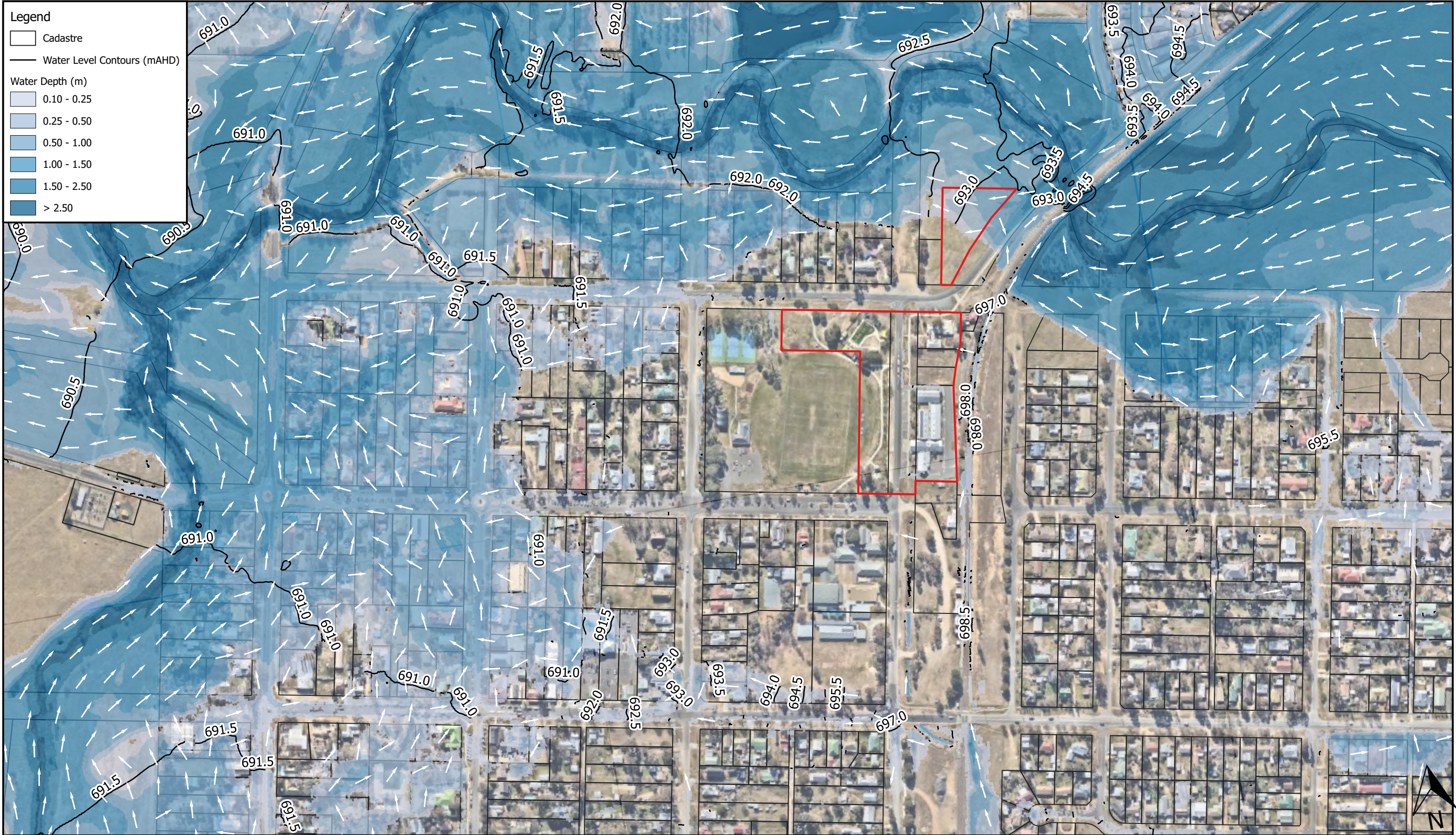
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood hazard categories based on Australian Rainfall and Runoff (2019) "A Guide to Flood Estimation" combined flood hazard categories.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

1% AEP Critical Duration Storm - Existing Scenario
ARR Flood Hazard Categories

FL05	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessment	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



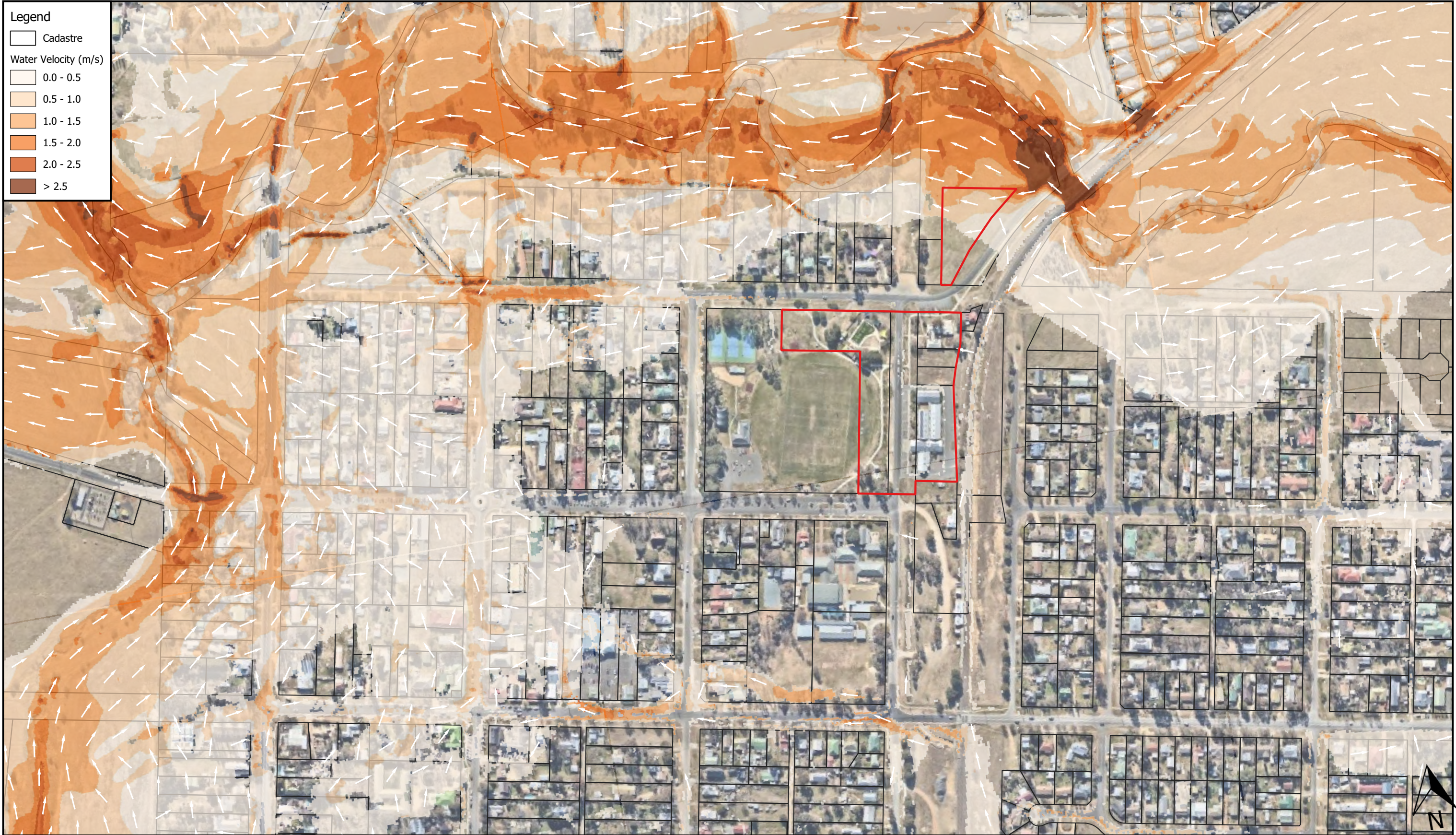
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

1% AEP Climate Change Critical Duration Storm - Existing Scenario
Water Level & Water Depth



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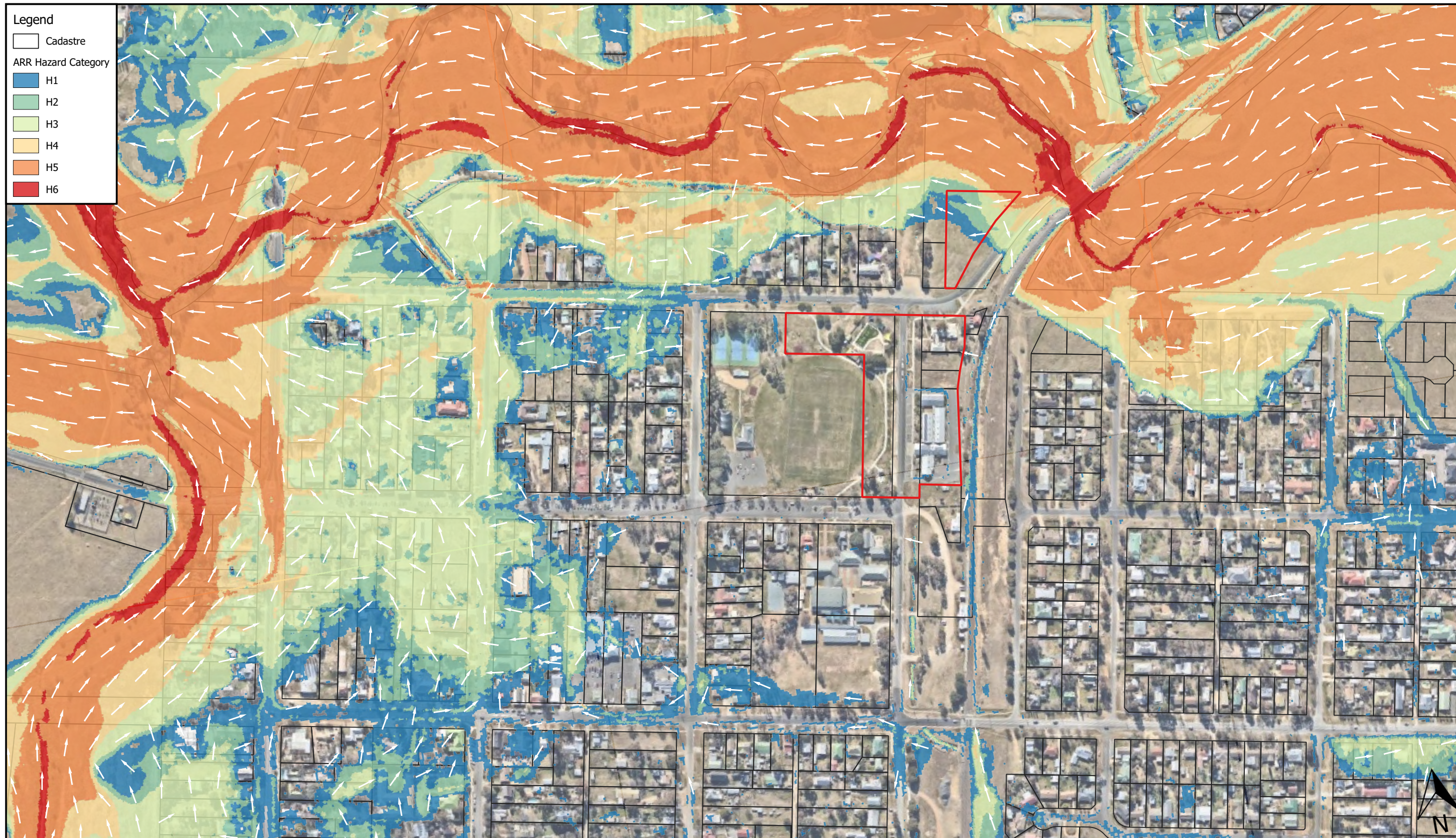
Viewport B

Notes:

- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

Map Title / Figure:
**1% AEP Climate Change Critical Duration Storm - Existing Scenario
Water Velocity**

FL07	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmentnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



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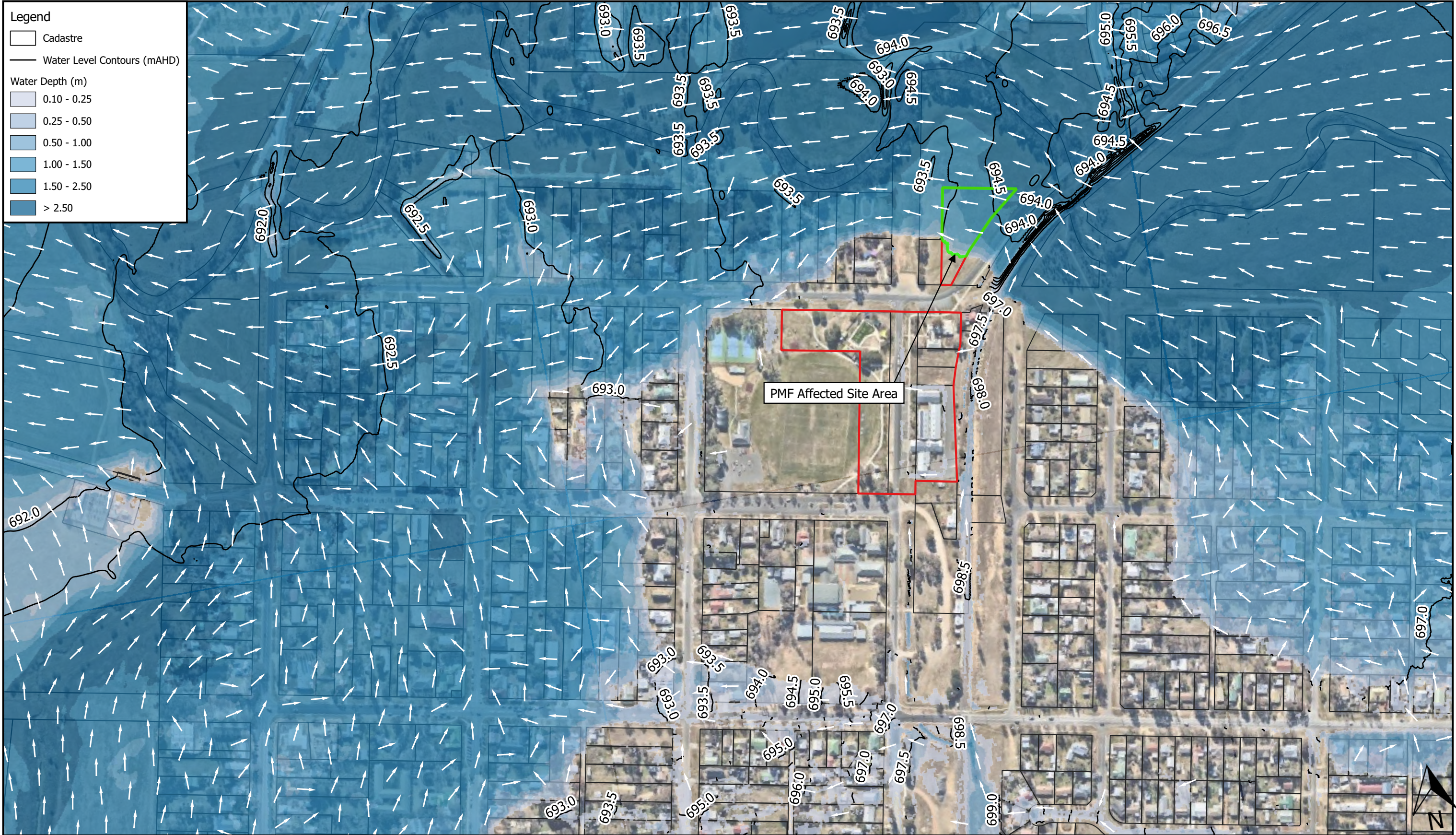
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Viewport B

Notes:

- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood hazard categories based on Australian Rainfall and Runoff (2019) "A Guide to Flood Estimation" combined flood hazard categories.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

1% AEP Climate Change Critical Duration Storm - Existing Scenario ARR Flood Hazard Categories



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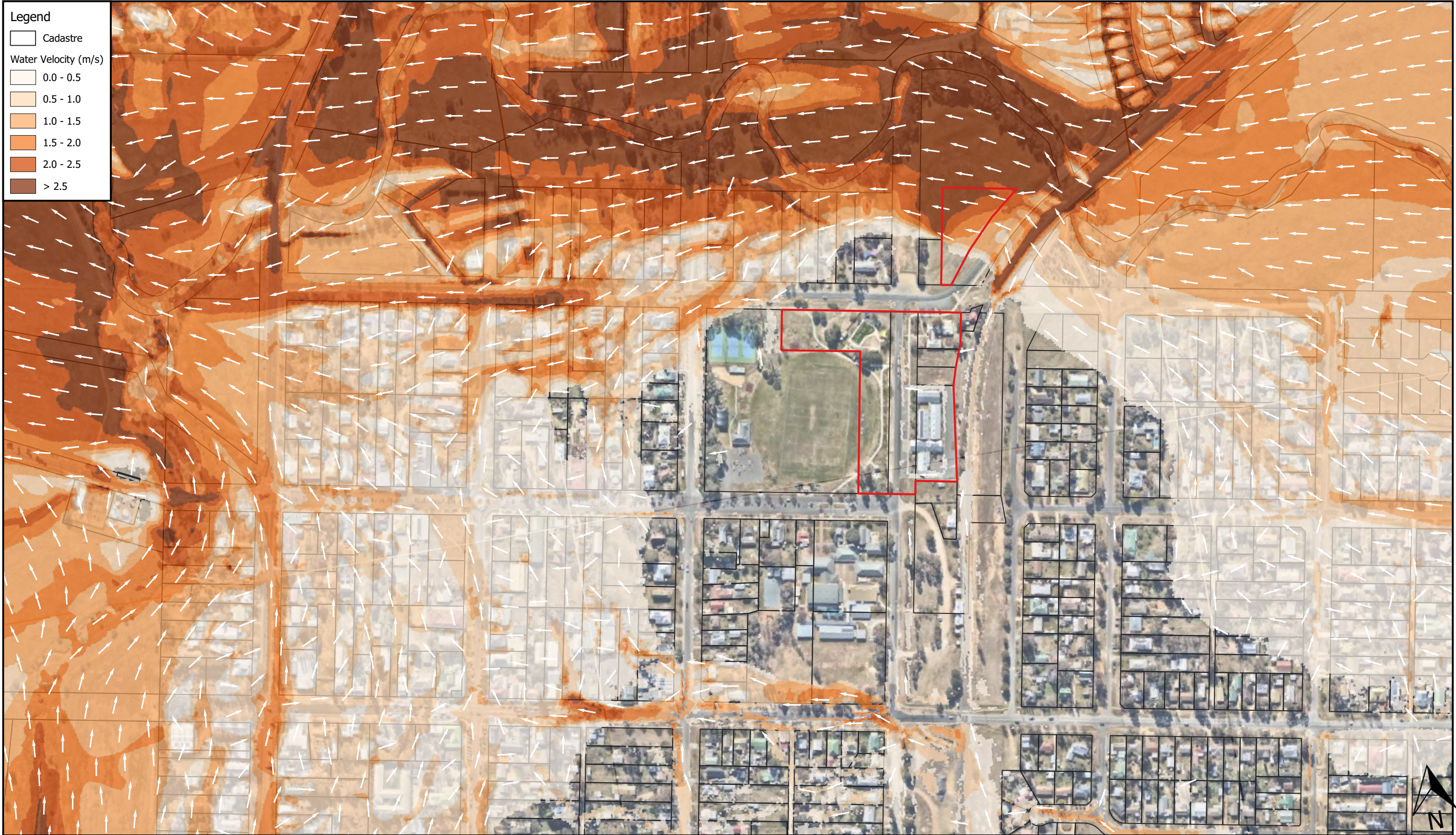
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

PMF Critical Duration Storm - Existing Scenario
Water Level & Water Depth

FL09	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmentnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



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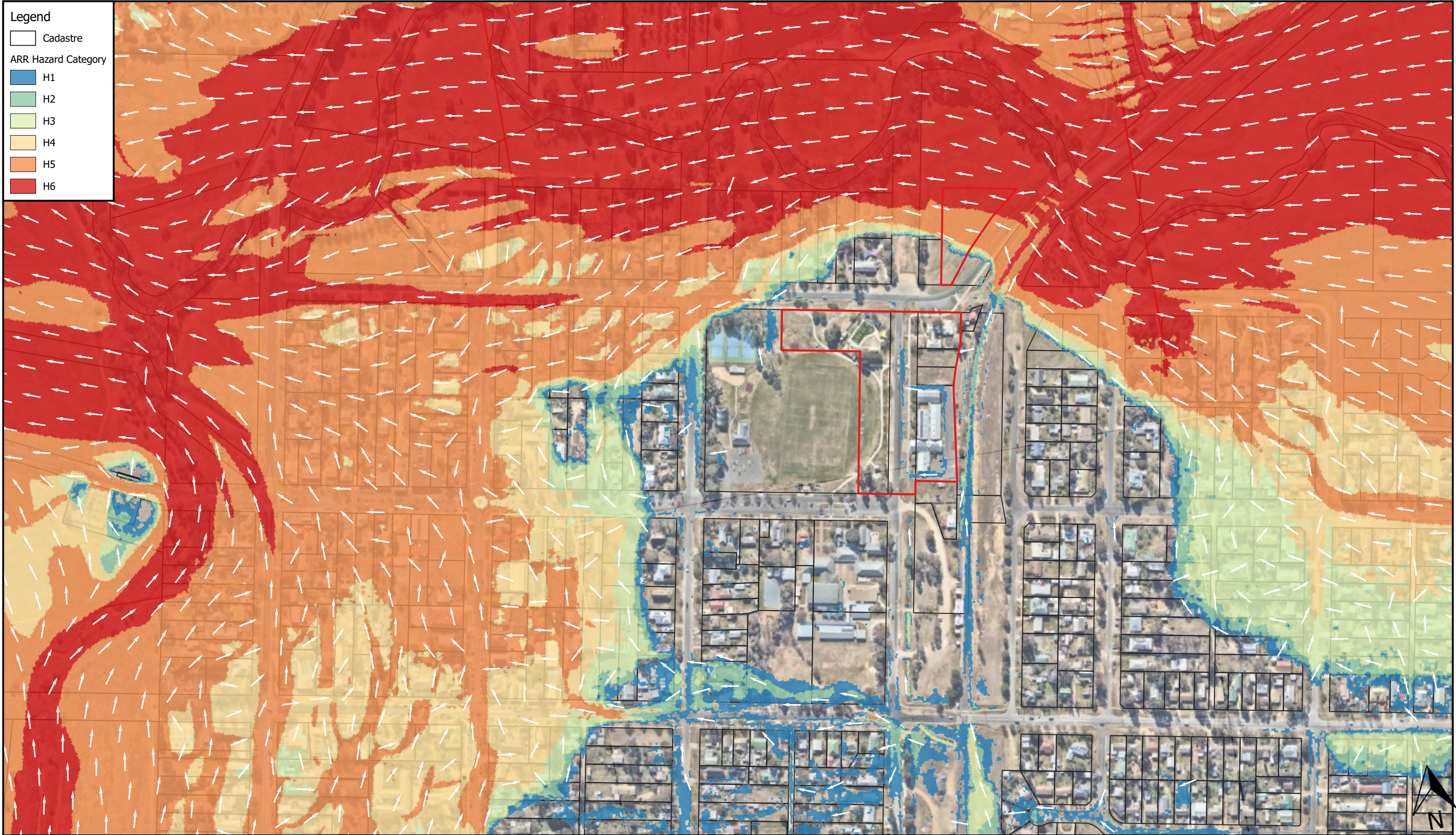
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

Map Title / Figure:
**PMF Critical Duration Storm - Existing Scenario
Water Velocity**

FL10	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmentnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



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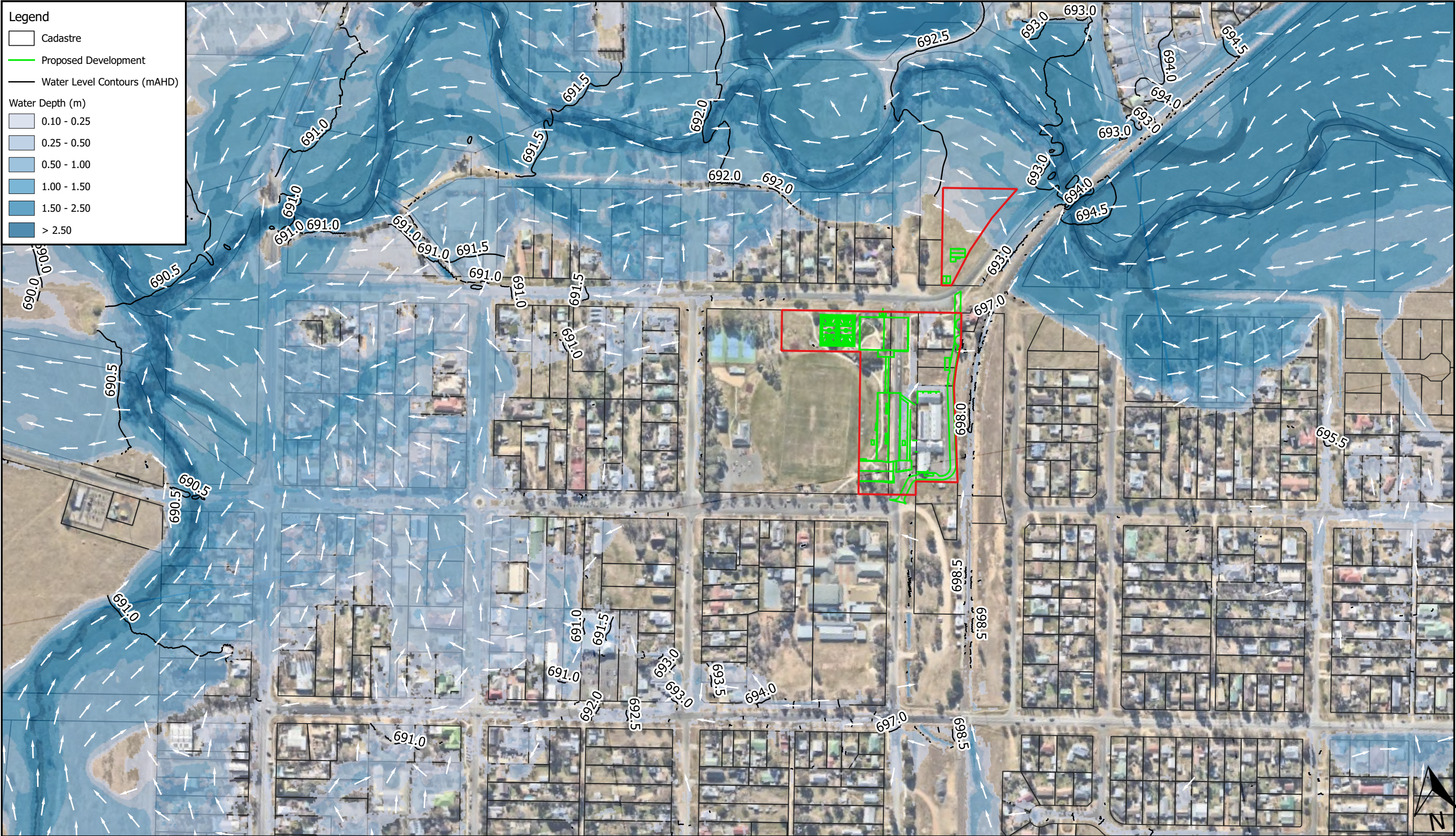
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood hazard categories based on Australian Rainfall and Runoff (2019) "A Guide to Flood Estimation" combined flood hazard categories.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

Map Title / Figure:
**PMF Critical Duration Storm - Existing Scenario
ARR Flood Hazard Categories**

FL11	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessment	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



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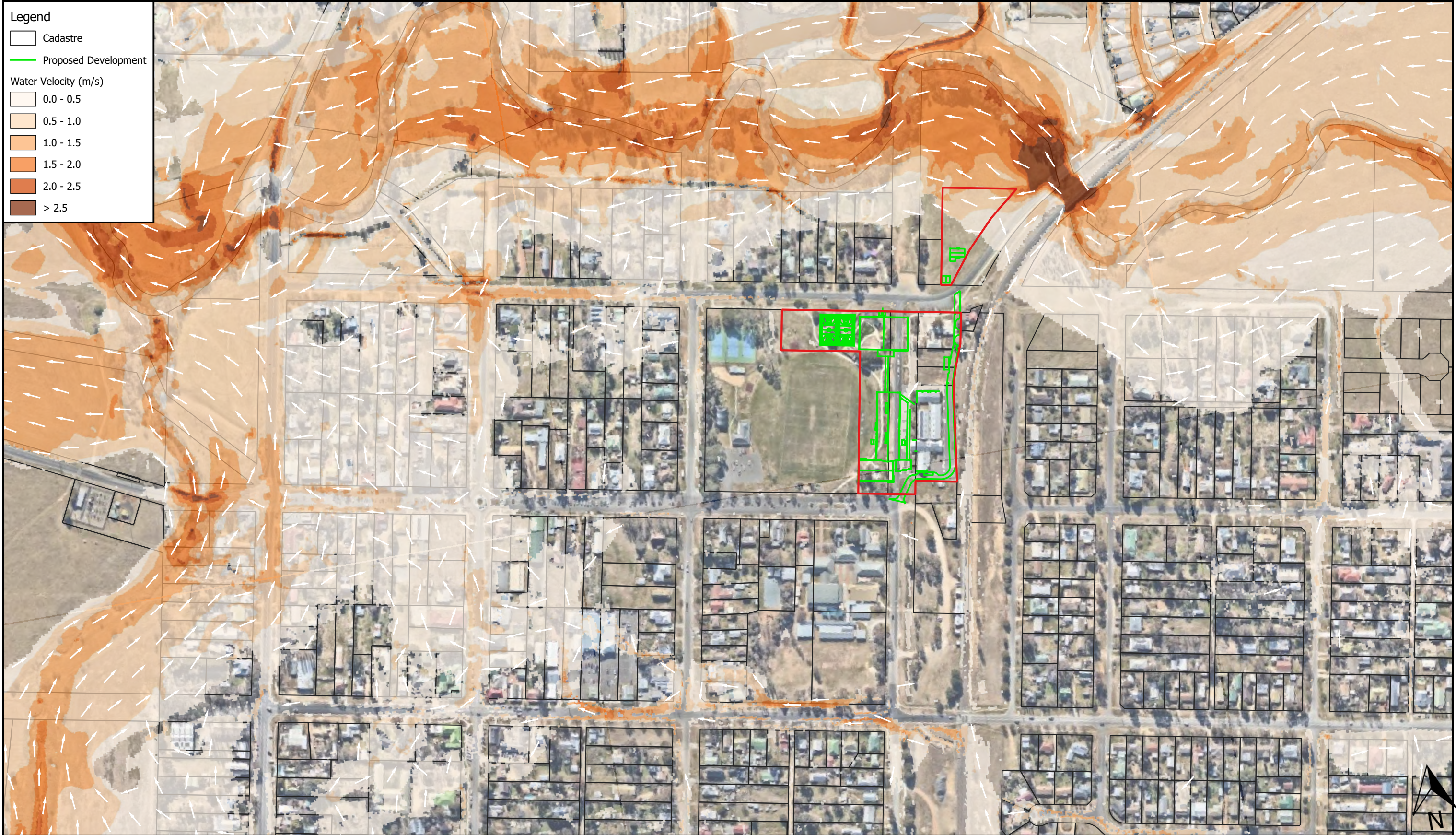
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

1% AEP Critical Duration Storm - Proposed Scenario
Water Level & Water Depth

FL12	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessment	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



0 40 80 120 160 200 m

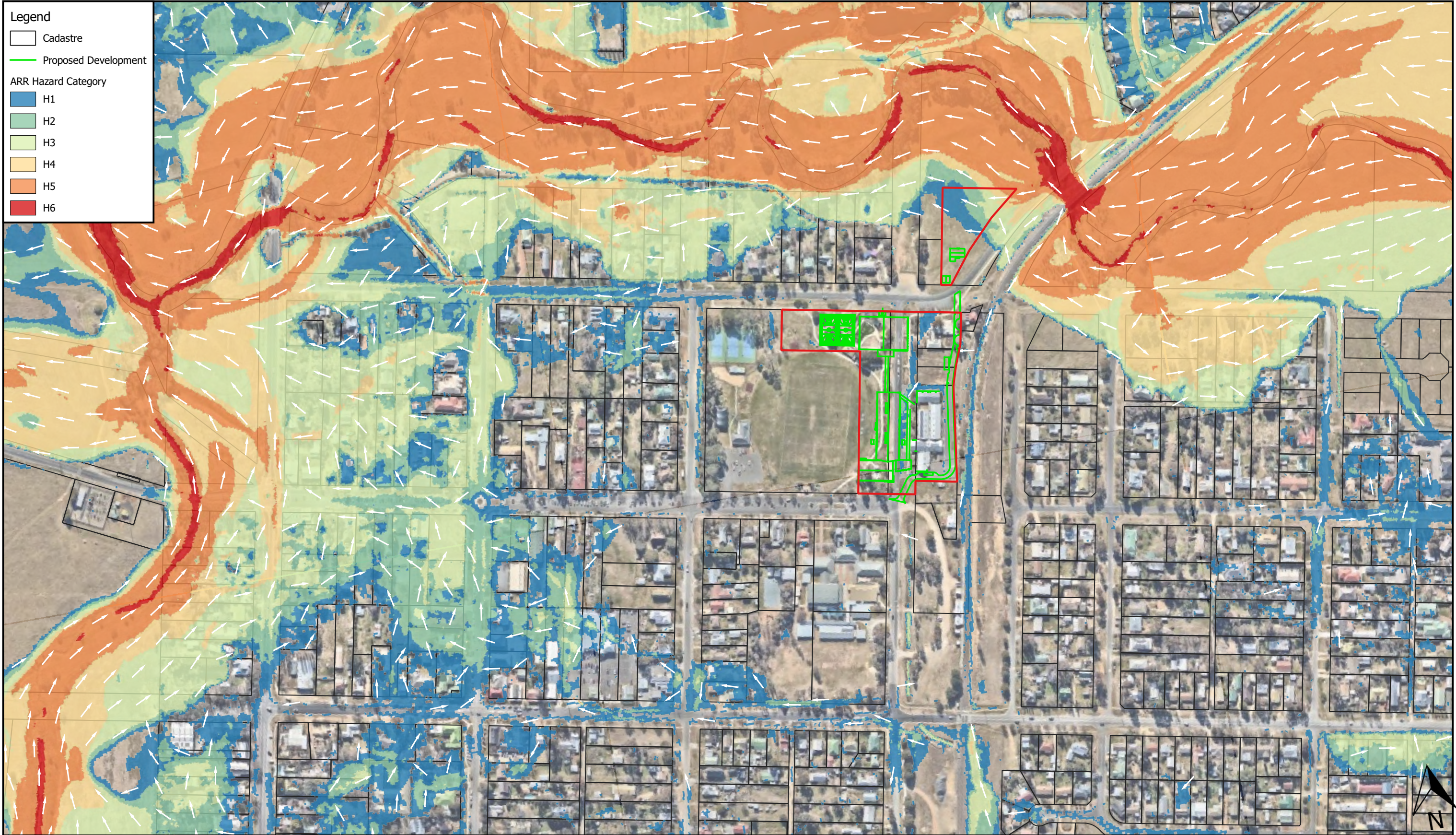
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Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

Map Title / Figure:
**1% AEP Critical Duration Storm - Proposed Scenario
Water Velocity**

FL13	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmentnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



1% AEP Critical Duration Storm - Proposed Scenario
ARR Flood Hazard Categories

FL14

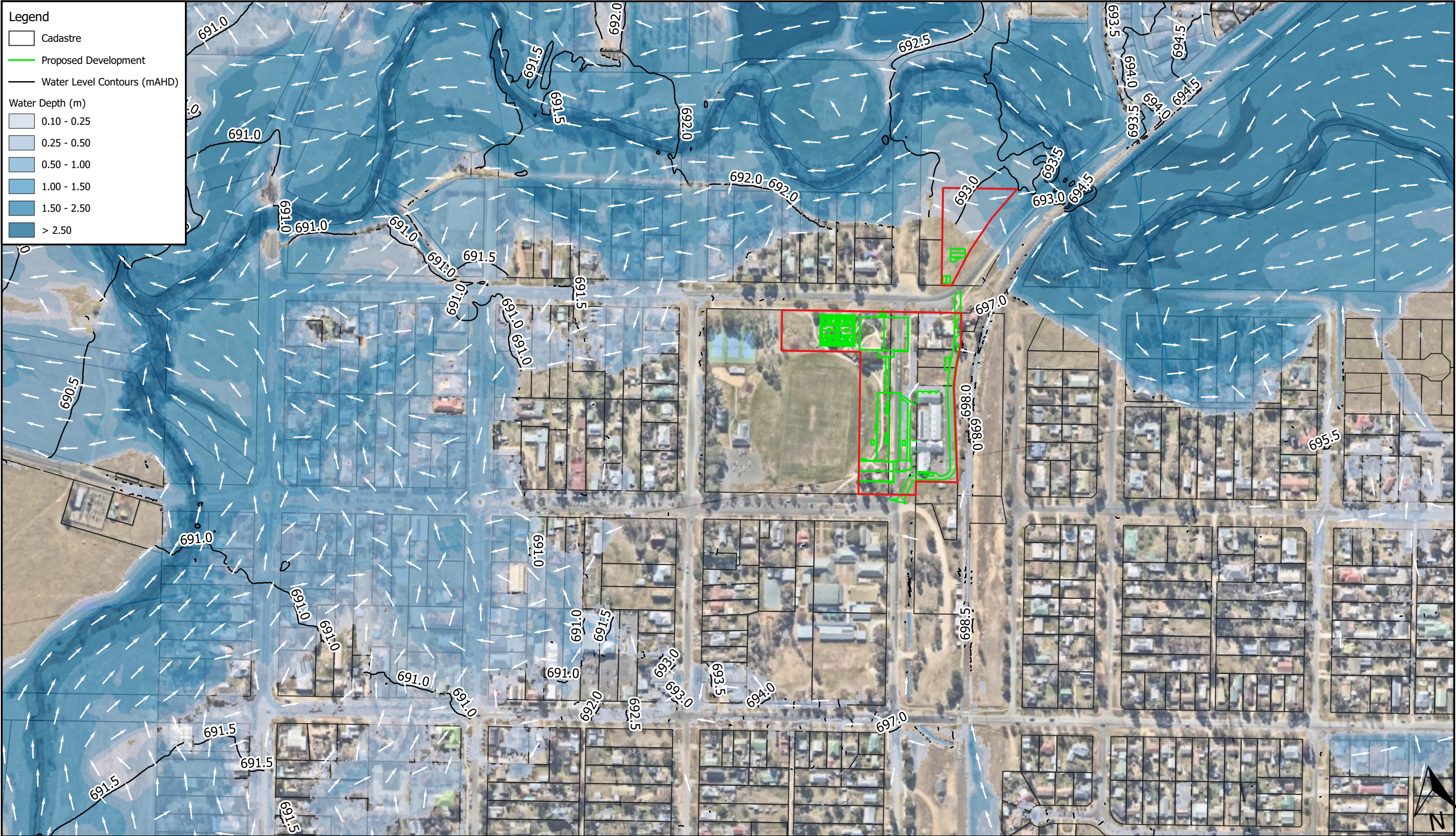
Majara St & Gibraltar St, Bungendore NSW

New High School in Bungendore

Flood Assessmentnet

School Infrastructure NSW

06/09/2021



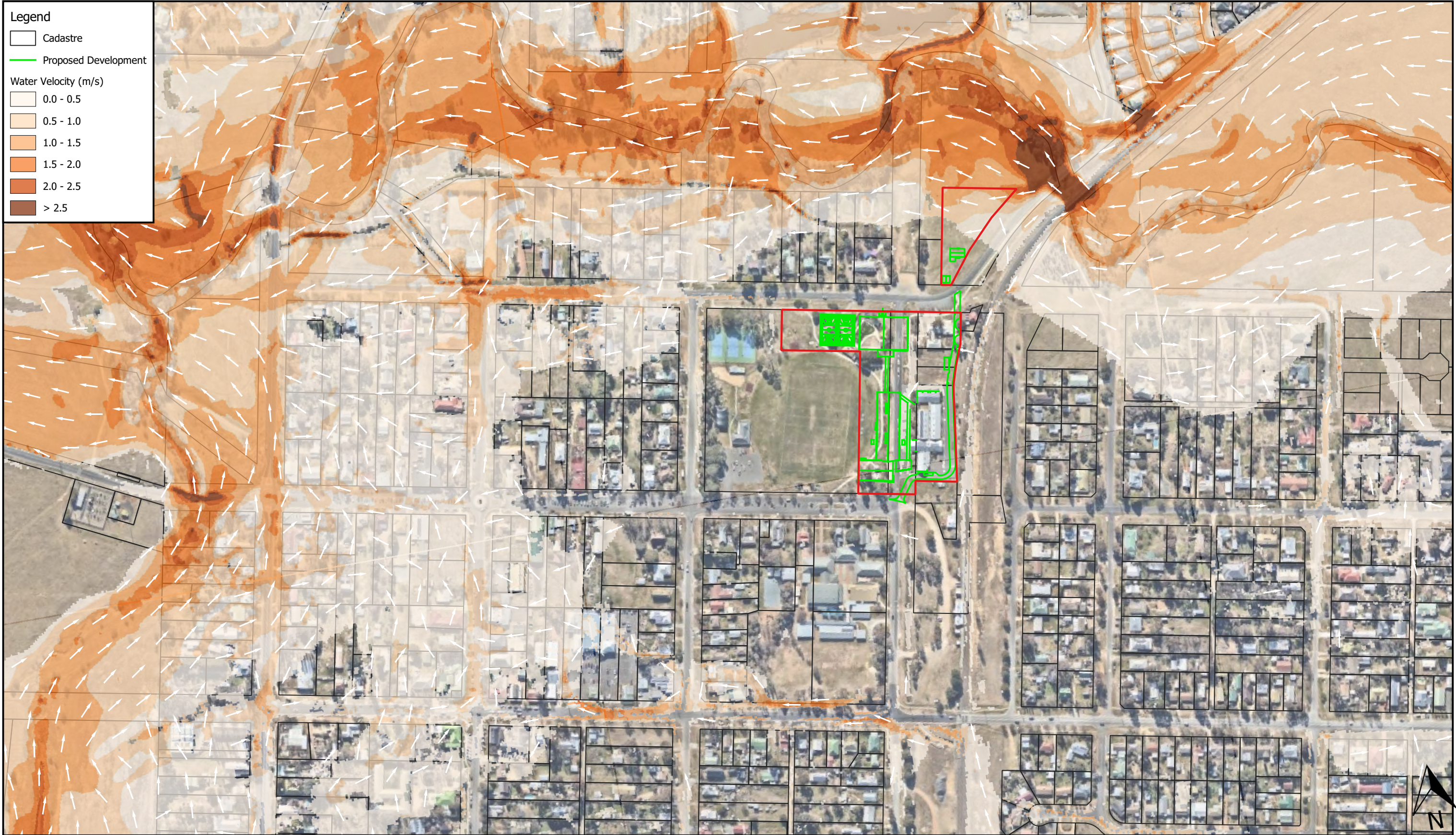
0 40 80 120 160 200 m

1:4000 @ A3

Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

1% AEP Climate Change Critical Duration Storm - Proposed Scenario
Water Level & Water Depth



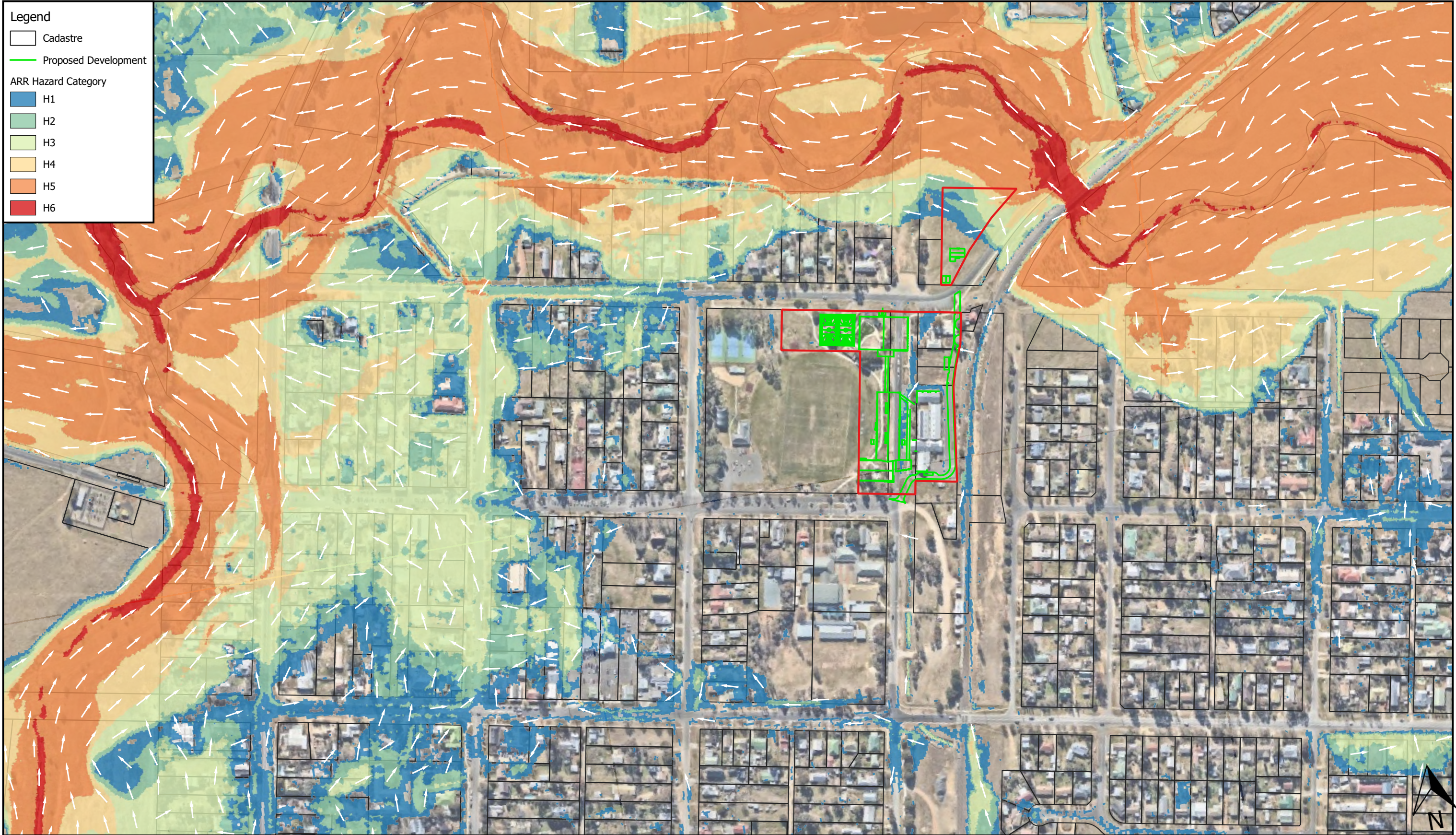
0 40 80 120 160 200 m

1:4000 @ A3

Viewport B

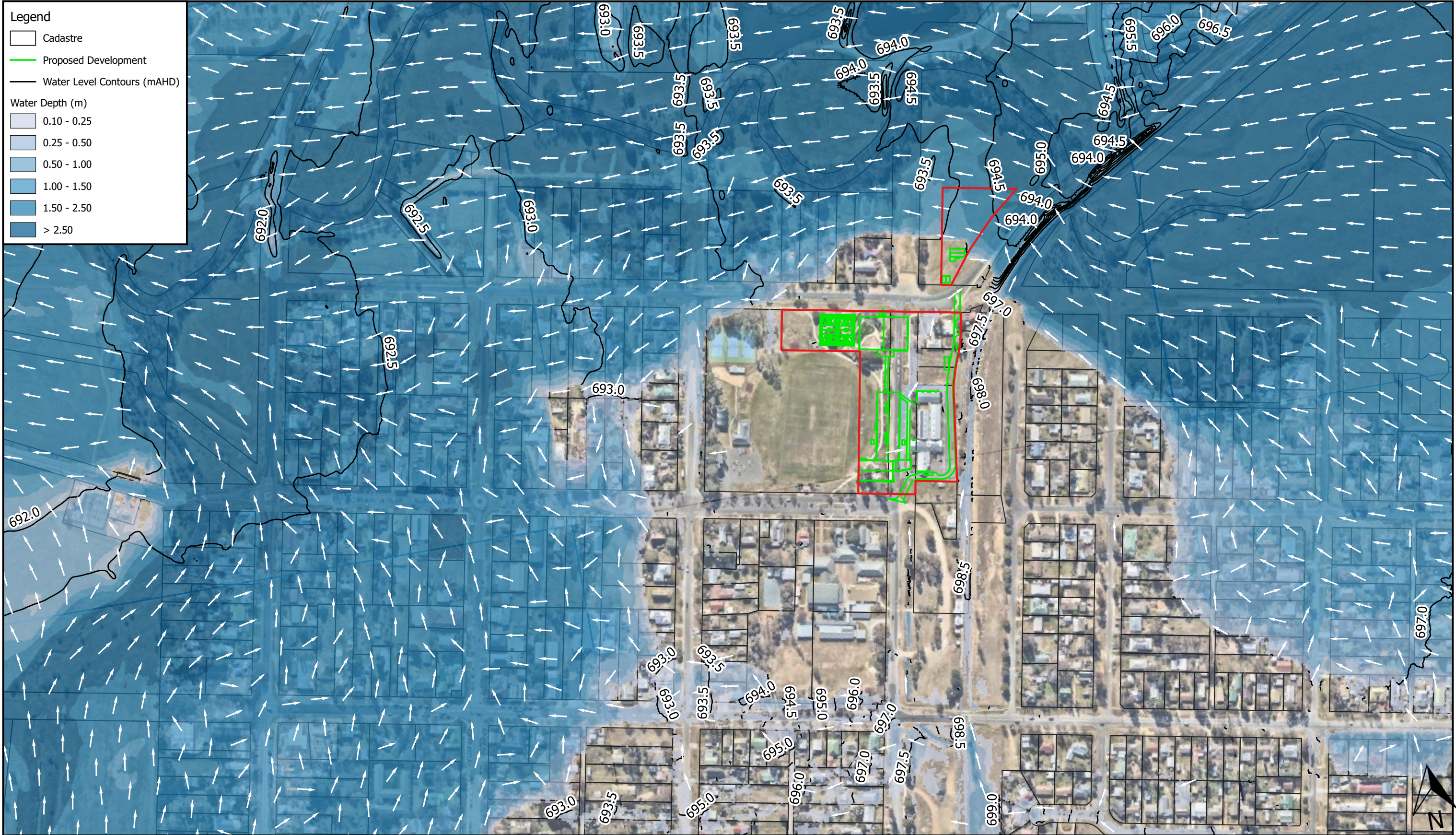
Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.

1% AEP Climate Change Critical Duration Storm - Proposed Scenario Water Velocity



1% AEP Climate Change Critical Duration Storm - Proposed Scenario
ARR Flood Hazard Categories

FL17	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmentnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



Legend

- Cadastre
- Proposed Development
- Water Level Contours (mAHD)

Water Depth (m)

- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.50
- > 2.50

0 40 80 120 160 200 m

1:4000 @ A3

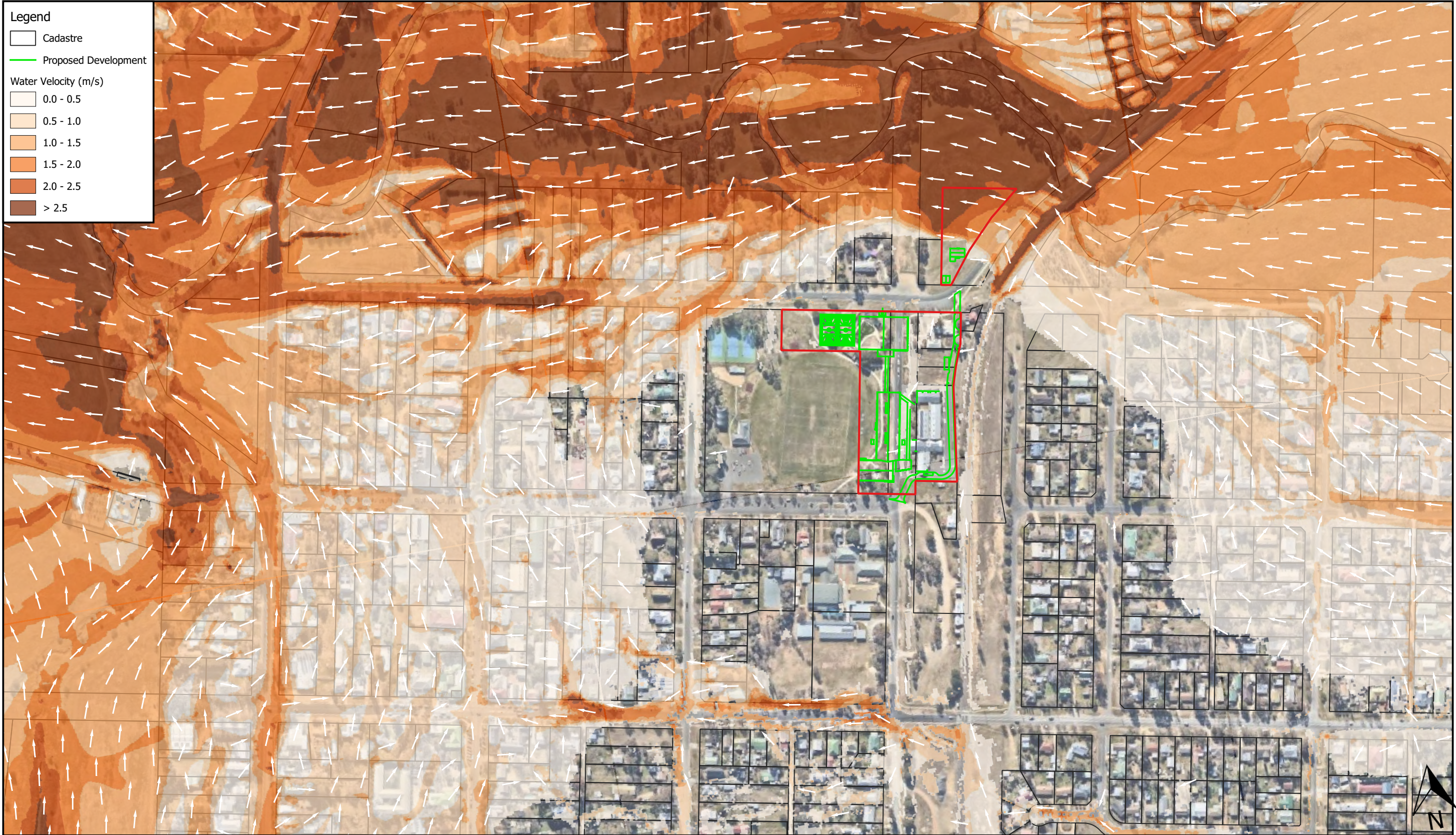
Viewport B

Notes:

- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

**PMF Critical Duration Storm - Proposed Scenario
Water Level & Water Depth**

FL18	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmentnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date



0 40 80 120 160 200 m

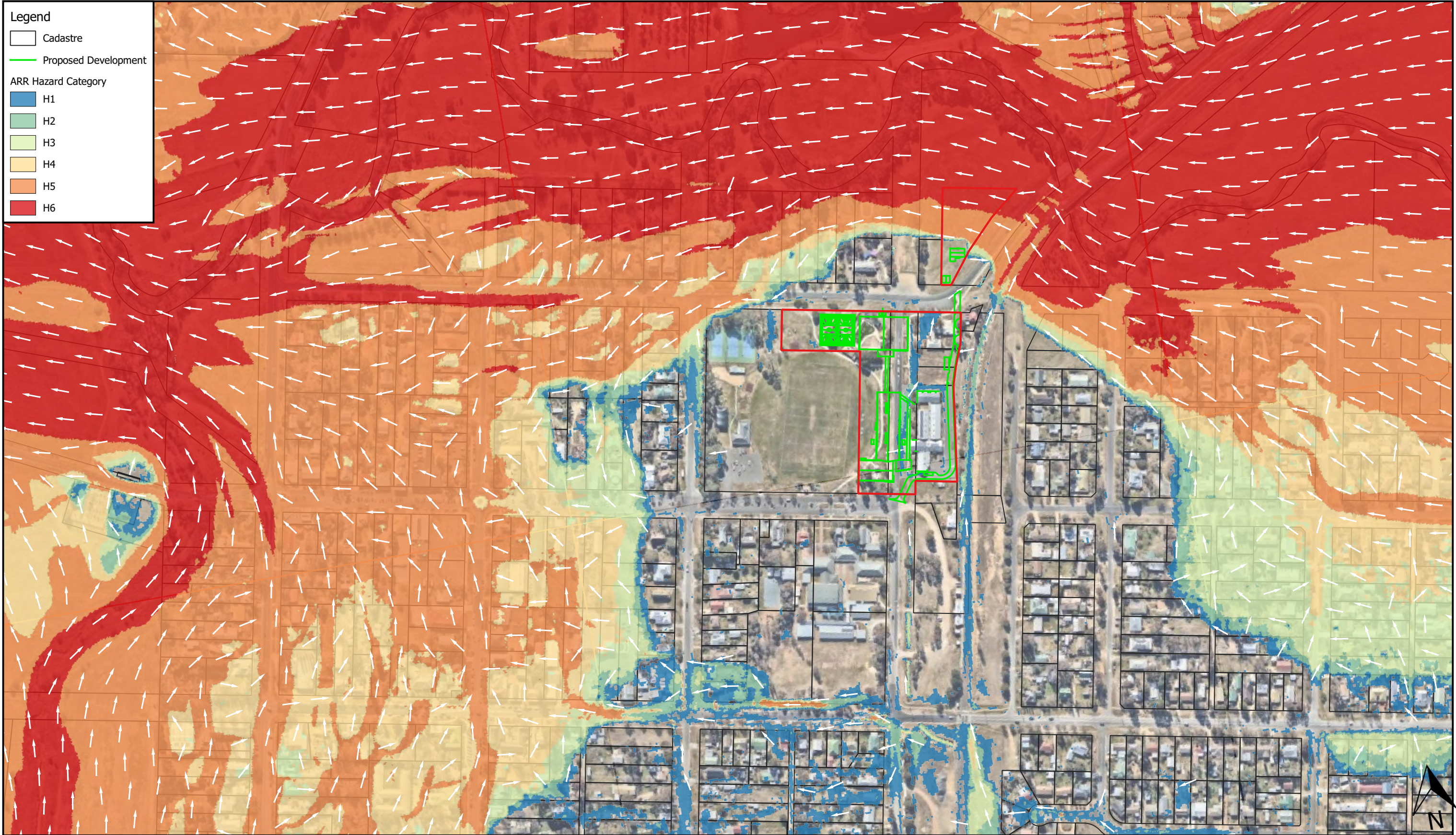
1:4000 @ A3

Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

PMF Critical Duration Storm - Proposed Scenario
Water Velocity

FL19	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessmentnet	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date

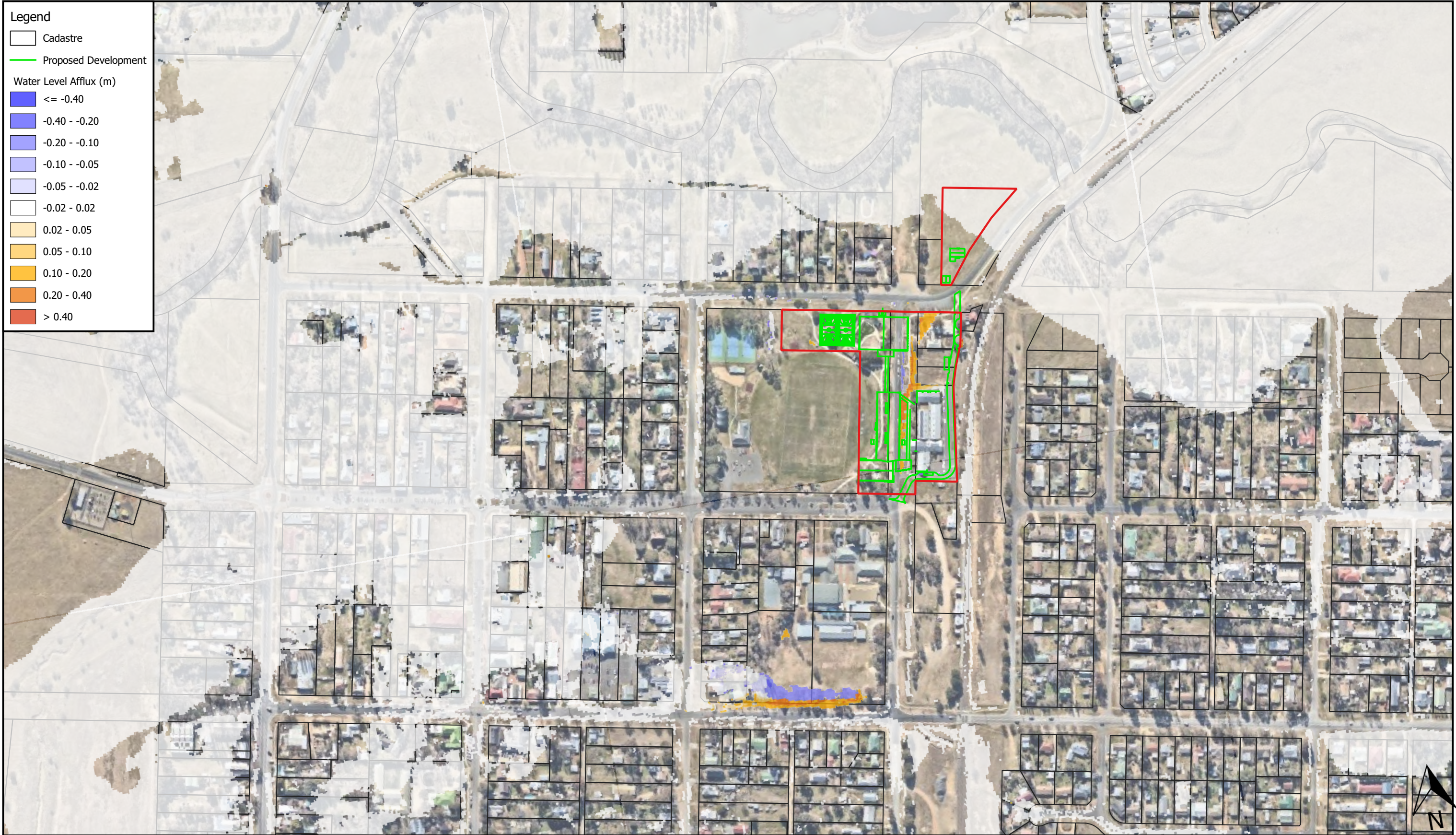


1:4000 @ A3

Viewport B

Notes:

- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Flood hazard categories based on Australian Rainfall and Runoff (2019) "A Guide to Flood Estimation" combined flood hazard categories.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.



0 40 80 120 160 200 m

1:4000 @ A3

Viewport B

Notes:
- Aerial from Nearmaps (2017).
- Cadastre from NSW Spatial Services (2021) 'Clip & Ship' SIX Maps website.
- Areas coloured white represent negligible change. Areas coloured blue represent water level reduction. Areas coloured yellow / red represent water level increase.
- Flood results are considered valid for the subject site only and any offsite flooding may not be accurate.

1% AEP Critical Duration Storm - Proposed Scenario
Water Level Afflux

FL21	Map
Majara St & Gibraltar St, Bungendore NSW	Site
New High School in Bungendore	Project
Flood Assessment	Sub-Project
School Infrastructure NSW	Client
06/09/2021	Date