Department of Education

Construction Stage Flood Emergency Response Plan (FERP): New High School in Jerrabomberra

P2108170JR02V03
August 2022

Limitations Statement

The sole purpose of this report and the associated services performed by Martens & Associates Pty Ltd is to provide a Construction Stage Flood Emergency Response Plan (FERP) at the subject site in accordance with the scope of services set out in the contract / quotation between Martens & Associates Pty Ltd and Department of Education (hereafter known as the Client). That scope of works and services were defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

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

Executive Summary

Martens & Associates Pty Ltd (MA) have prepared this construction stage flood emergency response plan (FERP) for a proposed State Significant Development at Jerrabomberra (the site) for a new high school.

Review of MA flood modelling results found that:

1. In both existing and proposed conditions site flooding is limited to the drainage line on the eastern and southern site boundaries, and the proposed fill pad and buildings are flood free in all events up and including the PMF.

2. The only part of the proposed development that is affected by flooding is the eastern site entry.

3. 1% AEP flood and PMF levels for the sports courts fill pad are 597.4 mAHD and 598.2 mAHD respectively. The fill pad is at least 2.8 m above the PMF level.

4. According to Queanbeyan DCP 2012, the flood planning level (FPL) is the 1% AEP flood level plus 0.5 metre freeboard. All proposed building finished floor levels are above the FPL and PMF levels.

5. Proposed conditions site flood hazards within the drainage line are H1-H5 in the 1% AEP event, and H1-H6 in the PMF event, based on ARR hazard definitions.

This site specific FERP has been prepared to ensure that the site can operate safely in the floodplain environment. Whilst the proposed fill pad and buildings are not directly affected by flooding, part of the site is inundated and likely experiences high flood hazards during the PMF event. In summary:

1. Subscription to a number of warning systems will significantly reduce the likelihood of persons on site during a major flood event.

2. The only high flood risk area on site is located in the depression along the south-eastern site boundary, and affects the proposed eastern entry. Access to these areas should be restricted on wet days with appropriate signage along the footpath to warn of the associated flood risk.

3. In the unlikely scenario that persons are on-site during an unanticipated major flood event, risk to persons is managed through a shelter-in-place strategy. Evacuation can also be carried out if advised by NSW SES.

4. With the implementation of the FERP procedures the risk to life is reduced to acceptable levels.

Contents

1 Introduction

1.1 Overview

Martens & Associates Pty Ltd (MA) have prepared this construction stage flood emergency response plan (FERP) for a proposed State Significant Development at Jerrabomberra (the site) for a new high school. Refer to Attachment A for proposed site layout.

This report should be read in conjunction with the site-specific flood assessment report prepared by MA (September 2021, REF: P2108170JR01V03, hereafter referred to as 'MA flood assessment').

This report has been prepared, supervised and reviewed by suitably qualified flood engineers. Please refer to Attachment E for the company profile and CVs of persons who prepared this report.

1.2 Project Scope and Objectives

Project scope and objectives are:

1. Summarise local flood characteristics from the MA flood assessment report.
2. Prepare a flood emergency response plan (FERP) that assists the construction phase of the proposed new high school at Jerrabomberra.
3. Recommend engineering controls to improve safety in case of the site flooding.

1.3 Relevant Guidelines

This report and the MA flood assessment have 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. State of NSW and Office of Environment and Heritage, *Floodplain Risk Management Guide* (2019).

   Also known as: Floodplain Risk Management Guide EHG (2019)

4. Queanbeyan-Palerang Regional Council (2013), *Queanbeyan Local Environmental Plan (West Jerrabomberra) (LEP)*.

5. Queanbeyan-Palerang Regional Council (*2012*), *Queanbeyan Development Control Plan (DCP)*.

1.4 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 1 in 100 year ARI flood occurs on average once every 100 years.
ARR	Australian Rainfall & Runoff
BOM	Bureau of Meteorology
Council	Queanbeyan-Palerang Regional Council (QPRC)
FERP	Flood emergency response plan
FPL	Flood planning 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.

2 Site Flooding Characteristics

Flood maps have been prepared for the site based on the MA flood assessment for the 1% annual exceedance probability (AEP) with and without climate change and probable maximum flood (PMF) events, and are reproduced in Attachment C.

Site flood conditions and modelling setup are discussed in further detail in the MA flood assessment. We note the following pertinent flood information:

1. In both existing and proposed conditions site flooding is limited to the drainage line on the eastern and southern site boundaries, and the proposed fill pad and buildings are flood free in all events up and including the PMF.

2. The only part of the proposed development that is affected by flooding is the eastern site entry (refer Attachment A).

3. 1% AEP flood and PMF levels for the sports courts fill pad are 597.4 mAHD and 598.2 mAHD respectively. The fill pad is at least 2.8 m above the PMF level.

4. According to Queanbeyan DCP 2012, the flood planning level (FPL) is the 1% AEP flood level plus 0.5 metre freeboard. All proposed building finished floor levels are above the FPL and PMF levels.

5. Proposed conditions site flood hazards within the drainage line are H1-H5 in the 1% AEP event, and H1-H6 in the PMF event, based on ARR hazard definitions (refer Figure 1).

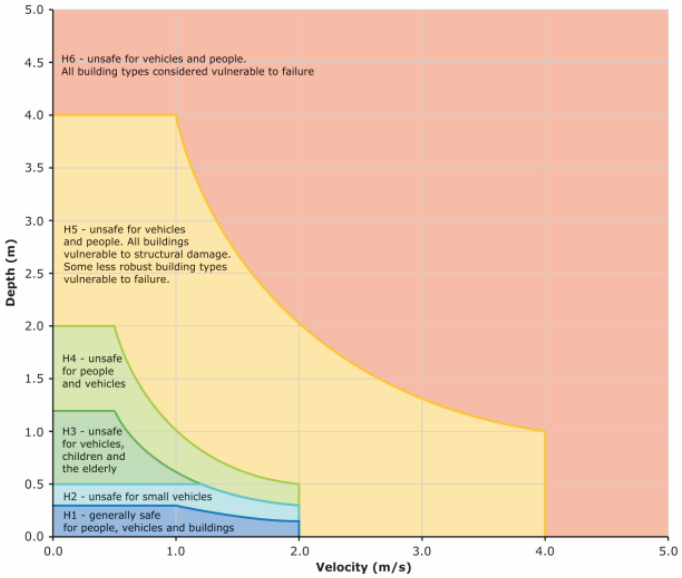


Figure 1: Flood Hazard Curves (Geoscience Australia, 2019).

3 Construction Stage Flood Emergency Response Plan

3.1 Overview

This FERP makes recommendations to ensure that in the event of a flood at the site during the construction stage, risk to personal safety and the environment is appropriately managed. It should be noted that it is highly unlikely that a major flood event will occur while the site is occupied during the construction stage, which we assume will take 2-5 years, in particular because it is typical for construction sites to cease works when heavy rainfall is anticipated.

The proposed development area is flood free in events up to and including the PMF, and therefore the primary response is to shelter-in-place on the fill pad inside any temporary structures, or within the school buildings when constructed. The secondary response would be to evacuate the site if ordered to do so by SES.

The high flood risk area is located in the depression along the south-eastern site boundary and affects the proposed eastern entry. Access to these areas should be restricted on wet days with appropriate signage along the footpath to warn of the associated flood risk.

3.2 Flood Warning Mechanisms

Monitoring weather forecasts and conditions near the site will help to manage the flood risk. A number of methods to monitor the risk of flooding are detailed in the following sections.

3.2.1 Bureau of Meteorology

The Bureau of Meteorology (BoM) generates a number of information sources useful for monitoring the weather forecast and conditions near the site:

1. Rainfall maps (http://www.bom.gov.au/jsp/watl/rainfall/pme.jsp) can be used to estimate the daily rainfall expected to occur over the next 24, 48, 72, and 96 hours as well as the total rainfall for the next 4 and 8 days.

2. Occasionally BoM issues Weather Warnings for NSW and ACT via their website (http://www.bom.gov.au/nsw/warnings/ and http://www.bom.gov.au/act/warnings/). These warnings provide both general warnings across NSW and ACT, and warnings for more specific locations. There are two types of warnings that may indicate that flooding is imminent on the site: Severe

Weather Warnings and Severe Thunderstorm Warnings. Specifically, these warnings should be monitored for references to flash flooding in the Queanbeyan or Canberra areas. Warnings are generally issued with up to 60 minutes notice however for very large events (i.e. east coast lows), warnings may be issued with 24 hours notice or more.

3. The radar service operated by BoM shows current rainfall location and intensity for the Canberra area (http://www.bom.gov.au/products/IDR404.loop.shtml).

3.2.2 Other Warnings

Site management may also be alerted to flood warnings via the following mechanisms:

- The QPRC's 'Disaster Dashboards' warning system includes flood warnings (https://queanbeyanpalerang.disasterdashboards.com/light/dashboard/overview). Storm events that generate flood warnings can potentially cause flooding adjacent to the site.
- SES emergency alert telephone warning system.
- Media warnings (TV, radio, internet etc.).
- Police and / or SES door knocking.
- Weather apps (e.g. 'Early Warning Network').
- Visual observation of flood waters in the depression along the south-eastern site boundary.

If site management or occupants receive a flood warning via any of the mechanisms described above, they should undertake the shelter-in-place procedure immediately as described in Section 3.6, or evacuate the site if instructed to do so, as described in Section 3.5.

3.3 Roles and Responsibilities

3.3.1 Site Management

The managers of the site have the responsibility to implement and maintain the requirements of this FERP. Specifically, they are to ensure that:

- Flood related signage is maintained and legible at all times.

- A suitable number of flood kits are kept on the premises which are to include a first aid kit, portable radio and spare batteries, megaphone, torch and spare batteries, hi-vis vests.
- A Chief Flood Warden is appointed.
- The Chief Flood Warden and all other Flood Wardens are trained in the application of the FERP and the interpretation of rainfall and weather warning information published by BoM and QPRC.
- All staff are to be trained in their respective roles and responsibilities in relation to this FERP.
- The FERP is kept up to date.
- The site is cleaned and checked following a flood event.
- In the event of a flood at the site, all loose materials within the PMF extents are to be moved to higher ground in adequate time to do so safely.
- Sufficient financial resources are provided for the above.

Site management, at its discretion may delegate some of the above tasks to the Chief Flood Warden or others. Site Management will however remain legally responsible to ensure that these tasks are occurring.

3.3.2 Chief Flood Warden

The Chief Flood Warden will report to site management. It is anticipated that the site construction manager or similar will be the Chief Flood Warden. The Chief Flood Warden will:

- Familiarise themselves with the FERP procedures.
- Appoint Flood Wardens such that the Chief Flood Warden or a Flood Warden is always on duty.
- Organise training for themselves and the Flood Wardens in the ongoing maintenance of the flood warning system and implementation of the procedures detailed in this FERP.
- Monitor weather forecasts and flood warnings daily.
- Ensure any alerts received from the flood warning system, Early Warning Network app, BoM, or otherwise are issued directly to the Flood Warden via phone call or text message to all site occupants.

- Ensure the flood response kits are equipped with all required equipment.
- Keep hard copies of the FERP on site and accessible to all staff.
- Implement the procedures in this FERP in the event of a flood, including evacuating and closing the site if instructed to do so.
- Liaise with emergency services in the event of a flood.
- Review the FERP following flood events which trigger an emergency response.

3.3.3 Flood Wardens

The Flood Wardens will:

- Familiarise themselves with this FERP and the procedures within it.
- Follow the procedure within this FERP in the event of a flood.
- Follow the directions of the Chief Flood Warden.
- Fulfil the role of the Chief Flood Warden in their absence.
- Monitor weather forecasts and flood levels on site during operational hours in the absence of the Chief Flood Warden.

3.3.4 Occupants & Visitors

Occupants and visitors of the premises are to follow the directions of site management, the Chief and/or Flood Wardens and signage related to flooding during a flood event on site.

3.4 Flood Response Phases and Triggers

3.4.1 Overview

There are four flood response phases for flooding on the site:

- **Prepared** – will apply at all times when the other phases do not apply.
- **Alert** – this is triggered when heavy rainfall is forecast or a severe weather warning is issued indicating potential flooding at the site.

- **Respond** – this occurs when a flood response is triggered by one of several means indicating a flood is occurring or is likely to occur at the premises.

- **Recover** – this occurs following a flood response operation of any scale and lasts until operations have returned to normal, after which the 'Prepare' phase applies.

Refer to Attachment B for the Flood Actions Checklist which details the four phases, actions and responsibilities.

3.4.2 Prepared

During the prepared phase, weather forecasts and warnings are checked daily and the flood emergency response plan arrangements are maintained.

3.4.3 Alert

The alert phase is triggered by any of the following:

- Heavy rainfall forecast is (≥ 50 mm in the next 24 hours).

- BoM issues a severe weather warning for the Queanbeyan or Canberra area with a chance of flash flooding.

In the alert phase, the rain forecast, warnings and the eastern drainage channel are monitored every 2 hours until BoM advise that heavy rainfall has passed.

3.4.4 Respond

The respond phase is triggered by any of the following:

- SES issues an evacuation order which covers the site.

- The QPRC's 'Disaster Dashboards' warning system issues a flood alert for the area.

- Floodwaters are observed at the depression along the south-eastern boundary or the proposed eastern entry.

In the respond phase, the Chief flood warden or Flood Warden will:

- Keep the site closed if not yet open.

- Relocate all loose materials within the PMF extents to higher ground if safe to do so.

- Ensure that site occupants are notified to shelter-in-place on the fill pad inside any temporary structures, or on the Building A ground floor if constructed.
- Evacuate and lockdown the site if instructed by SES.
- Determine how many occupants are currently on site.
- Notify the SES and site management that there are occupants sheltering-in-place.

If site occupants have sheltered-in-place, once emergency services advise that the flood has receded, occupants will evacuate and the site will be locked down until cleaning and any repairs can be made.

3.4.5 Recover

The recovery phase occurs once the flood situation has ended. If flood waters reached the vicinity of the site, the site should be thoroughly cleaned and repaired if necessary.

In any flood event affecting the site, a debrief should be held with site management and all Flood Wardens, and the FERP should be reviewed.

3.5 Shelter-in-Place Details

The majority of the proposed development area, including the fill pad and ground floor level of the proposed buildings, are located above the PMF level, which enables safe shelter-in-place. Appropriate places to safely shelter-in-place are on the fill pad inside any temporary structures, or on the Building A ground floor if constructed, as shown in and Attachment A.

The shelter-in-place duration would be around 5 hours based on the critical duration PMF (refer to the MA flood assessment report). It is possible that longer duration PMF events will cause a longer isolation time, however we expect this will be less than 8 hours, which is considered an acceptable duration to shelter-in-place.

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

1. PMF refuge is to be available on the ground floor of proposed Building A block or inside any temporary structures.
2. All Flood Wardens on duty will remain with people who shelter-in-place.

3. Emergency kit including torch with spare batteries, portable radio with spare batteries, first aid kit, high visibility vest, drinking water, non-slip foot ware and megaphone in public areas with proper signage.

4. Any persons sheltering-in-place will not leave the site until SES or the on-site Flood Wardens instructs to do so.

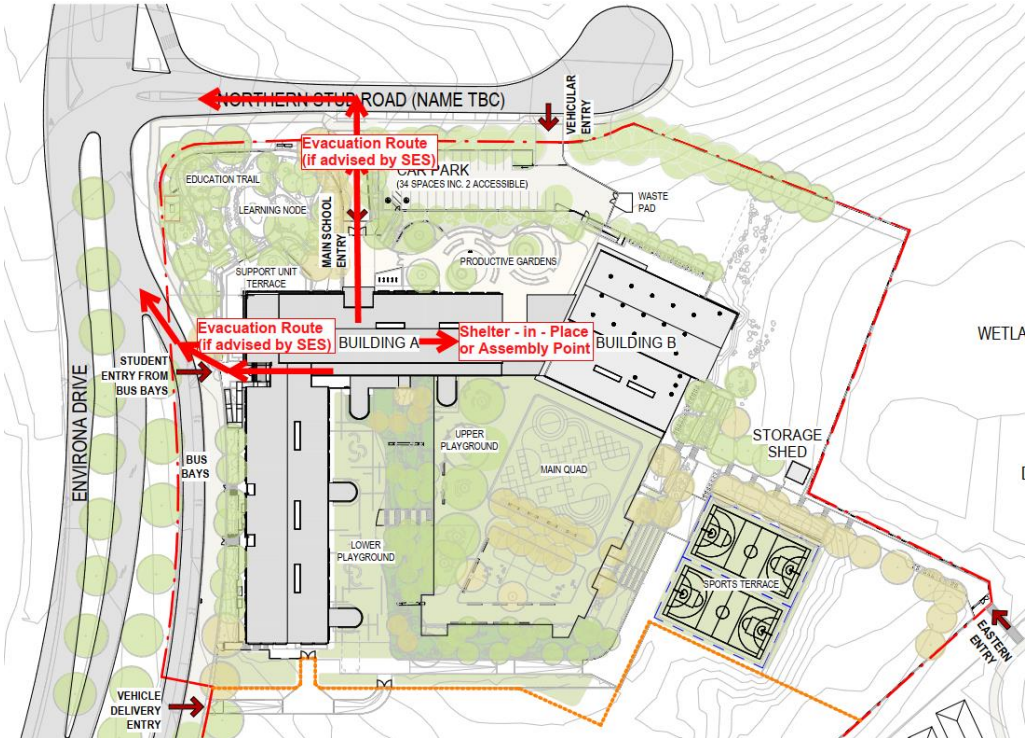


Figure 2: Adopted evacuation route (background architectural from TKD Architects).

3.6 Evacuation Details

The MA flood assessment demonstrates that Environa Drive immediately north of the site and Northern Stub Road is located outside the PMF extents. Therefore, the evacuation route is to travel north from the site via Northern Stub Road and Environa Drive. From there, evacuees can proceed to their own homes if advised by SES to be safe. The evacuation route can be accessed within minutes, and is shown in and Attachment A.

However, as the MA flood assessment does not extend further north, it is uncertain whether Environa Drive or Tompsitt Drive north of the site are affected by hazardous flood waters. Therefore, evacuation during a flood event should only be undertaken if advised by SES.

3.7 Flood Warning Times

Site flood model results indicate that the south eastern portion of the site is affected by high hazard flood waters (> H2) within 25 minutes and 20 minutes after the start of extreme rainfall in the 1% AEP and PMF events respectively. This is the worst-case timing, and smaller flood events would allow for longer lead times before hazardous flood waters affect the site.

The warning mechanisms described in Section 3.2, plus the additional 20-25 minutes between the start of extreme rainfall and site affectation with hazardous flood waters, will allow sufficient time for site occupants to follow this FERP and shelter-in-place or evacuate the site if advised by SES to do so.

3.8 Flood Awareness Training

Flood awareness training should be provided to employees, contractors, site users and visitors to understand site flood behaviour, which will help to prepare site occupants and reduce flooding risks. Training with respect to site flood hazards and emergency procedures should be provided for all staff as part of the site induction process, and yearly flood awareness training is to be provided for all staff.

3.9 Emergency Contact List

NSW SES can be contacted during a flood emergency if required on 132 500. In a life-threating situation it is advised to call triple zero (000) for assistance from police, ambulance or the fire brigade.

The following are the key points that need to be followed after logging a call with NSW SES in case of an emergency:

1. Keeping phones nearby so that it is easy for SES to make contact after assistance request call.

2. Stay away from power lines and fallen tress during the storm period.

3. Follow directions given by SES staff.

4. SES attends to requests for assistance in a priority-based order. Therefore, it is necessary to outline the priority of the call.

5. Cancel the call request if help is not needed anymore stating the reference number given prior.

See Attachment D for full details of emergency contact list for SES and other emergency services during flooding.

4 Summary

This site specific FERP has been prepared to ensure that the site can operate safely in the floodplain environment. Whilst the proposed fill pad and buildings are not directly affected by flooding, part of the site is inundated and likely experiences high flood hazards during the PMF event. In summary:

5. Subscription to a number of warning systems will significantly reduce the likelihood of persons on site during a major flood event.

6. The only high flood risk area on site is located in the depression along the south-eastern site boundary, and affects the proposed eastern entry. Access to these areas should be restricted on wet days with appropriate signage along the footpath to warn of the associated flood risk.

7. In the unlikely scenario that persons are on-site during an unanticipated major flood event, risk to persons is managed through a shelter-in-place strategy. Evacuation can also be carried out if advised by NSW SES.

8. With the implementation of the FERP procedures the risk to life is reduced to acceptable levels.

5 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.

Martens and Associates (September 2021), *Flood Assessment: New High School in Jerrabomberra (P2108170JR01V03)*.

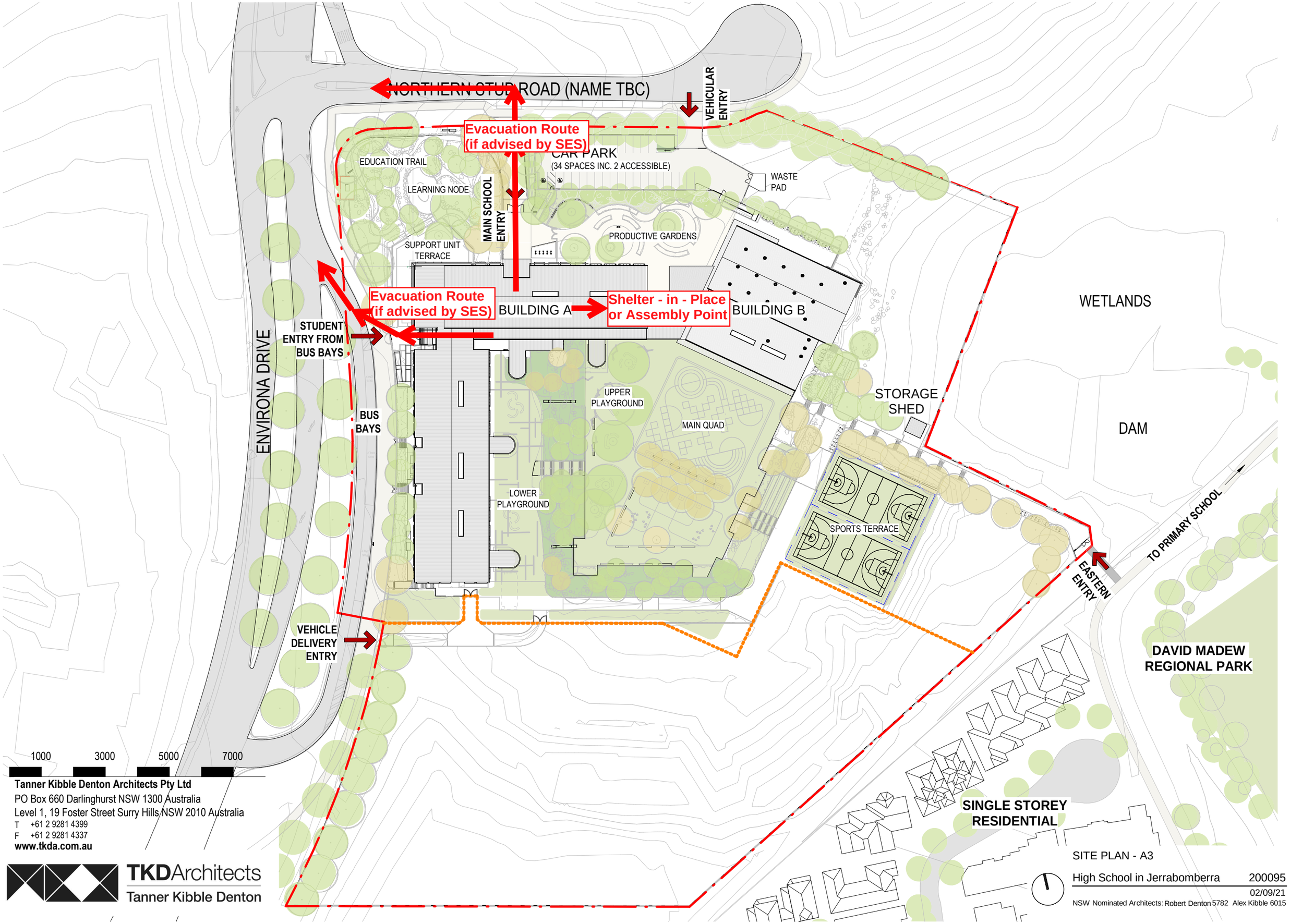
NSW Department of Infrastructure, Planning and Natural Resources (2005), *Floodplain Development Manual*.

Queanbeyan-Palerang Regional Council (2013), *Queanbeyan Local Environmental Plan (West Jerrabomberra) (LEP)*.

Queanbeyan-Palerang Regional Council (2012), *Queanbeyan Development Control Plan (DCP)*.

State of NSW and Office of Environment and Heritage, *Floodplain Risk Management Guide* (2019).

6 Attachment A: Proposed Site Layout



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SITE PLAN - A3

High School in Jerrabomberra 200095

02/09/21

NSW Nominated Architects: Robert Denton 5782 Alex Kibble 6015

7 Attachment B: Flood Actions Checklist

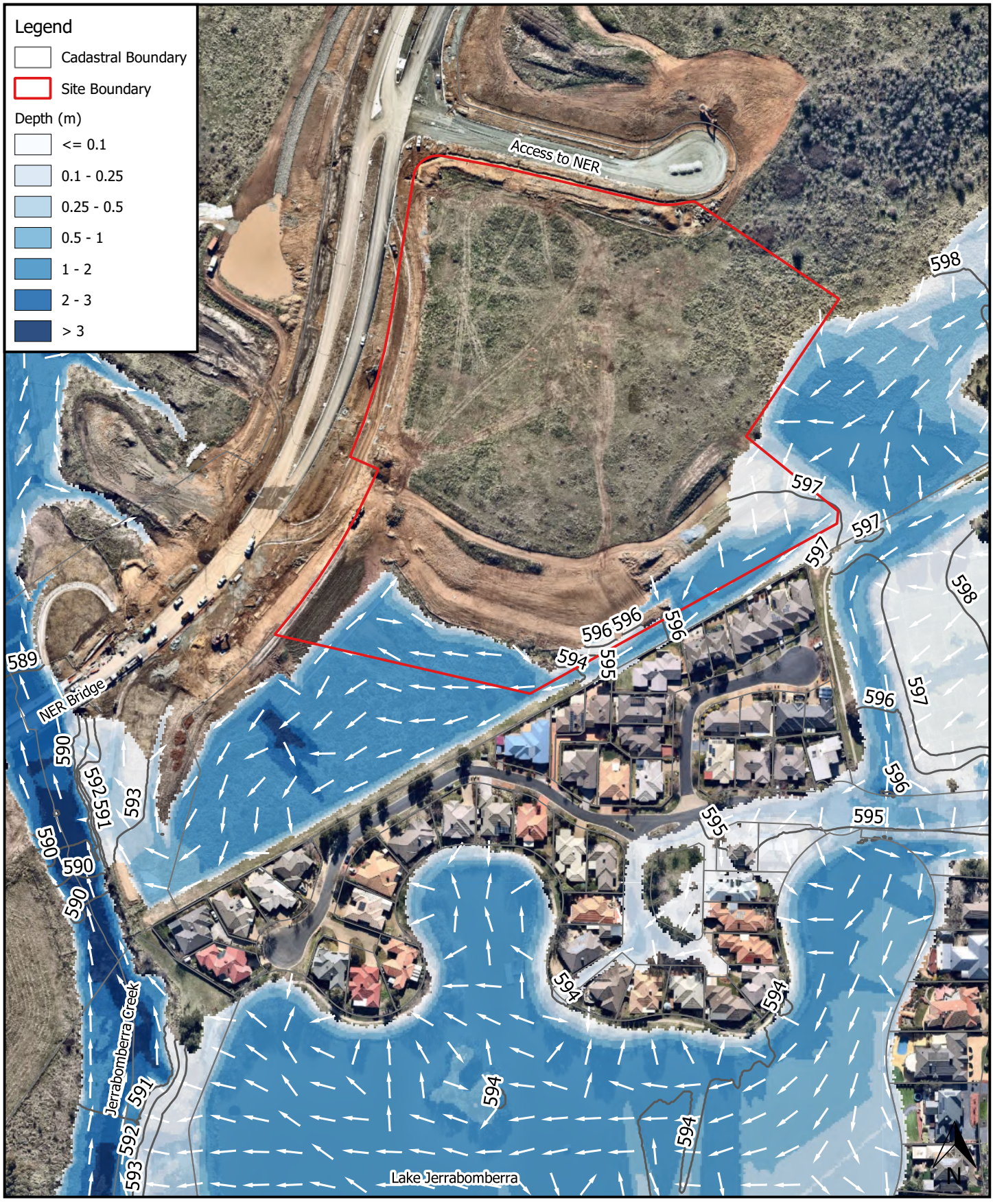
Prepared – Before A Flood			
Trigger	**Action**	**Responsibility**	**Requirements**
Always	Install and maintain legible signs at the eastern entry and adjacent footpath advising not to enter the premises if heavy rainfall is forecast.	Site Management	Informative signs
	Appoint a Chief Flood Warden and ensure that there is always someone in this role.	Site Management	FERP
	Subscribe Chief Flood Warden and the Flood Wardens to a warning alert service so that they receive BOM severe weather warnings direct to their mobile phone.	Site Management	FERP, subscription to service, mobile device, access to BOM website and QPRC Disaster Dashboards website
	Supply and maintain all of the equipment necessary to implement the FERP.	Site Management	Flood response kits including first aid kits, portable radio and megaphone, sufficient torches and hi-vis vests for all Flood Warden, spare batteries for all of the above
	Ensure the Chief Flood Warden and Flood Wardens are trained in the implementation of the FERP and interpretation of the rainfall, flood information and warning information published by BoM.	Site Management	FERP, training resources
	Keep this FERP up to date and review it following a flood emergency.	Site Management	FERP
	Appoint sufficient Flood Wardens such that there will be a Flood Warden on duty (not necessarily on site) at all times, and on site during opening hours.	Chief Flood Warden	FERP
	Appoint sufficient Flood Wardens for the implementation of the FERP in any event.	Chief Flood Warden	FERP
	Monitor BoM weather forecasts and flood warnings daily.	Chief or Flood Warden	Mobile or computer with internet connection
	A database of Site Management, Chief Flood Warden, and Warden mobile phone numbers will be maintained and kept up to date.	Site Management	Phone Numbers
	A list of emergency contacts will be maintained which will include emergency services and utility providers.	Chief Flood Warden	Emergency contact list
	This FERP and the list of contacts will be kept on site in electronic and hard copy.	Chief Flood Warden	Electronic and hard copy of FERP

Alert – When a Flood is Possible			
Trigger	**Action**	**Responsibility**	**Requirements**
-BoM forecasts heavy rainfall (50 mm or more in the next 24 hours). - BoM issues a severe weather warning for the Queanbeyan or Canberra area with a chance of flash flooding.	Check BoM severe weather warnings for flash flooding in the Queanbeyan or Canberra area and BoM radar service every 2 hours while the site is open, and 2 hours before opening.	All Flood Wardens	Mobile or computer with internet connection
	Monitor the flood level visually at the eastern entrance and adjacent footpaths during rainfall events.	All Flood Wardens	FERP
Respond – During a Flood Event			
Trigger	**Action**	**Responsibility**	**Requirements**
Any of the following: - The QPRC's 'Disaster Dashboards' warning system issues a flood alert for the area. - Floodwaters are observed at the depression along the south-eastern boundary or the proposed eastern entry.	If the site is closed:		
	Visit the site, if safe to do so, ensure no one is on site, ensure gates are locked and place a sign on the gates advising premises are closed until further notice due to risk of flooding.	Chief Flood Warden or delegate	Informative signs
	Cancel any upcoming deliveries.	Chief Flood Warden or delegate	FERP
	If the site is open:		
	Order all site personnel to move to shelter-in-place on the fill pad inside any temporary structures, or on the Building A ground floor if constructed.	All Flood Wardens	Flood response kits including first aid kits, portable radio and megaphone, sufficient torches and hi-vis vests for all Flood Wardens, spare batteries for all of the above
	Relocate all loose materials within the PMF extents to higher ground if safe to do so.	Site Management	FERP
	Sweep site to ensure everyone is in the nominated assembly area.	Flood Wardens	Torches, megaphone, informative signs
	Explain why sheltering, the sheltering arrangements and the likely duration.	All Flood Wardens	This FERP, megaphone

	Contact site management and advise that there are people sheltering on site.	All Flood Wardens	Telephone and emergency contact list
	Contact the NSW SES (131 500) advise that there are people sheltering on site.	All Flood Wardens	Telephone and emergency contact list
Respond – During a Flood Event			
Trigger	**Action**	**Responsibility**	**Requirements**
Any of the following: - The NSW SES issues an evacuation order which covers the site.	Order an immediate site evacuation.	All Flood Wardens	Flood response kits including first aid kits, portable radio and megaphone, sufficient torches and hi-vis vests for all Flood Wardens, spare batteries for all of the above
	Advise site management that the site is being evacuated.	Chief Flood Warden, or Warden (whoever has called the evacuation)	Telephone, emergency contact list
	Encourage occupants to leave promptly but calmly to Environa Drive either via Main School entrance or entrance from Bus Bays.	Flood Wardens	Megaphone, torches, hi-vis vests
	Sweep the site to ensure everyone has left the site before locking the gates and placing a sign on the gates advising premises are closed until further notice due to risk of flooding.	Chief Flood Warden, or Warden in charge	Torches, megaphone, informative signs
	Cancel any upcoming deliveries, and/or interrupt any ongoing deliveries and instruct vehicles to leave site.	Chief Flood Warden or delegate	FERP
Any of the following: - NSW SES or BoM advises that flood peak has passed. - Flood water recedes or no visible sign of flood water along south eastern boundary	Check the condition of the evacuation route.	Chief Flood Warden	Torches, hi-vis vests
	If safe to do so, direct remaining people on site to evacuate via roads which are clear of flooding.	Chief Flood Warden	Megaphone
	If not safe to do so, contact NSW SES (131 500) and await further instructions.	Chief Flood Warden	Telephone and emergency contact list
	Advise site management of status.	Chief Flood Warden	Telephone and emergency contact list

Recover – After a Flood			
Trigger	**Action**	**Responsibility**	**Requirements**
All clear given by NSW SES, BoM, QPRC 'Disaster Dashboard' or Chief Flood Warden	No one will be allowed to return to the site while flooding is still occurring or has recently occurred.	Site Management and Chief Flood Warden	Informative signs
	Site access roads will need to be cleared of debris before the site is accessed. This should only be undertaken under the direction of the NSW SES or Queanbeyan-Palerang Regional Council, due to risks from electricity, gas, debris and venomous animals.	Site Management and Chief Flood Warden	Telephone and emergency contact list
	Normal site usage should be able to resume once the site has been checked to ensure that utilities are restored and no structural damage has occurred. These checks need to be undertaken by professionals qualified to do so. Although landscaping areas would need cleaning that would not prevent use of the premises if the building is in working order.	Site Management and Chief Flood Warden	Contact details for structural engineer, electricians and plumbers
	Before any cleaning or repair work is undertaken on site, a hazard assessment will be undertaken, safe work methods statements (SWMS) prepared and personal protective equipment supplied consistent with the known hazards which can be associated with floods: - Slips, trips and falls - Sharp debris - Venomous animals - Contaminated water and sediments	Site Management and Chief Flood Warden	Correct SWMS and PPE
	A debrief will be held and may involve emergency services. The flood event and response, including the use of this FERP and any emergency procedures will be reviewed.	Site Management, Chief Warden and other wardens who were involved in response	FERP, a log of actions taken during the event. This check list can be used for that purpose with times and notes recorded against each action.
	Changes may be made to the FERP and the requirements for future emergency response should the review identify any improvements which may be made.	Site Management and Chief Flood Warden	FERP

8 Attachment C: Flood Assessment Mapset



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP - Existing Conditions Water Level (mAHD) & Water Depth (m)

FL04	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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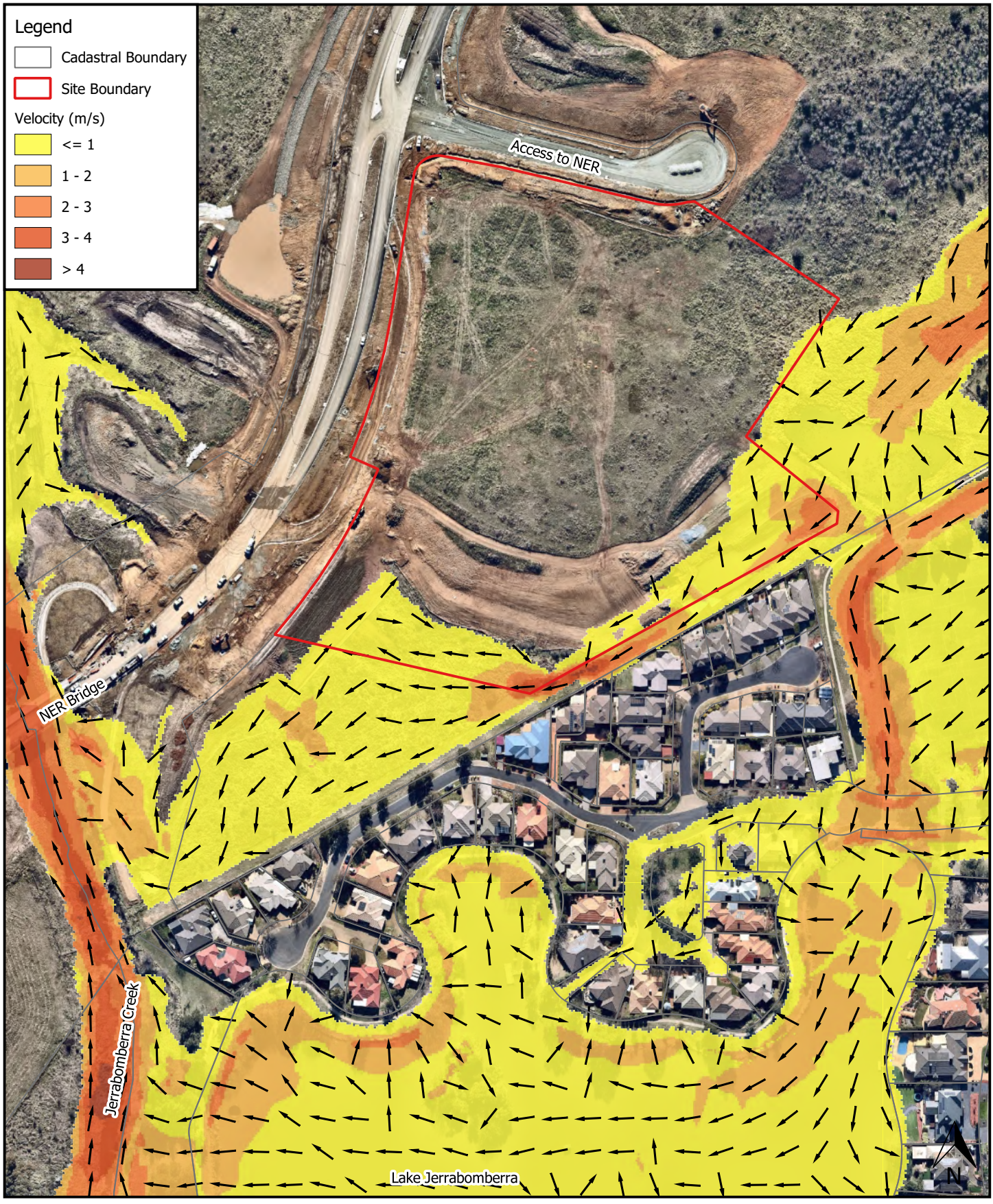
Environment | Water | Geotechnics | Civil | Projects

Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



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Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP - Existing Conditions Water Velocity (m/s)

FL05	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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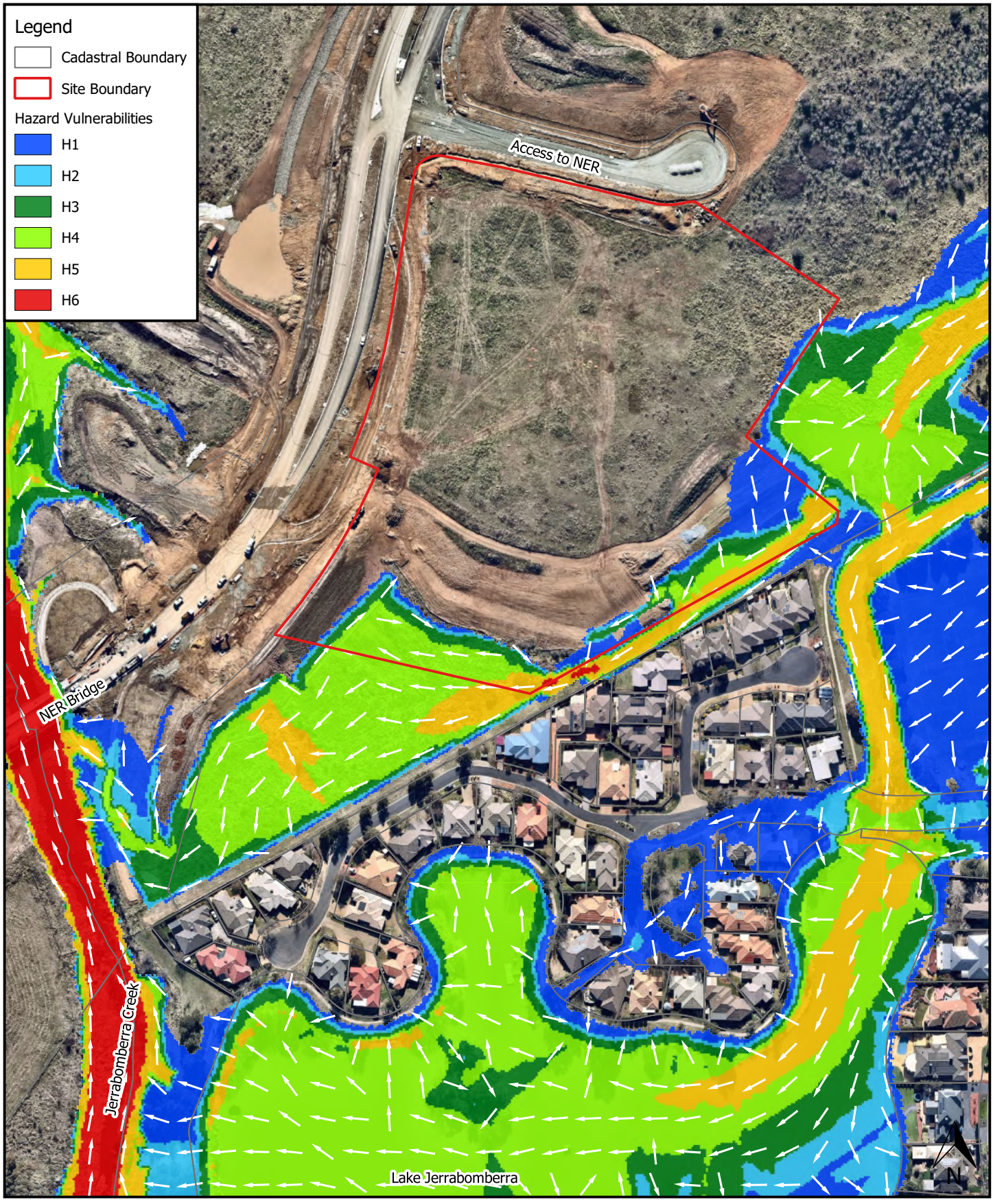
Environment | Water | Geotechnics | Civil | Projects

Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).
Flood Hazard Vulnerabilities based on ARR 2019 Combined flood hazard curves.

Map Title / Figure:

1% AEP - Existing Conditions Flood Hazard Vulnerabilities

FL06	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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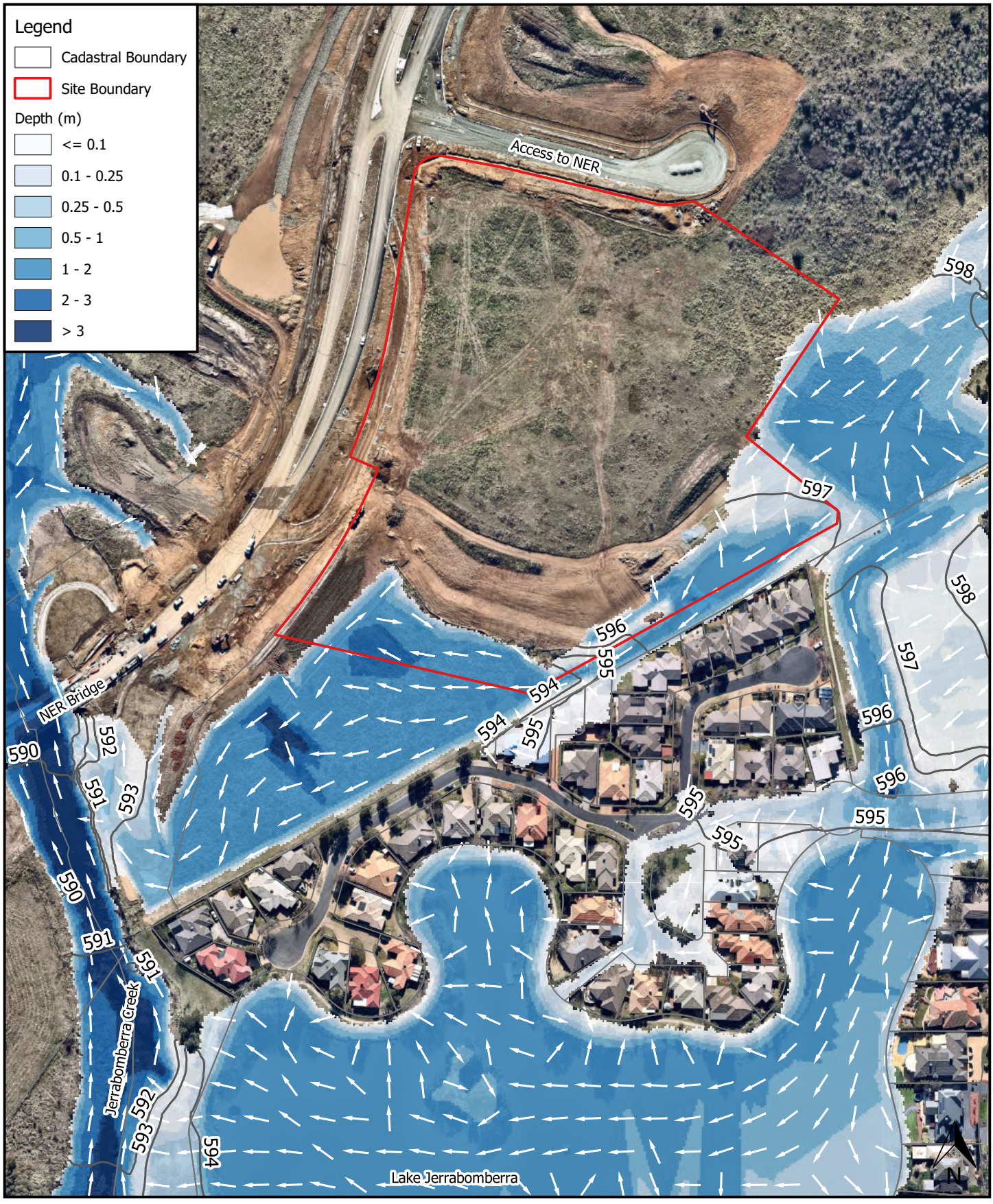
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP with Climate Change - Existing Conditions Water Level (mAHD) & Water Depth (m)

FL07	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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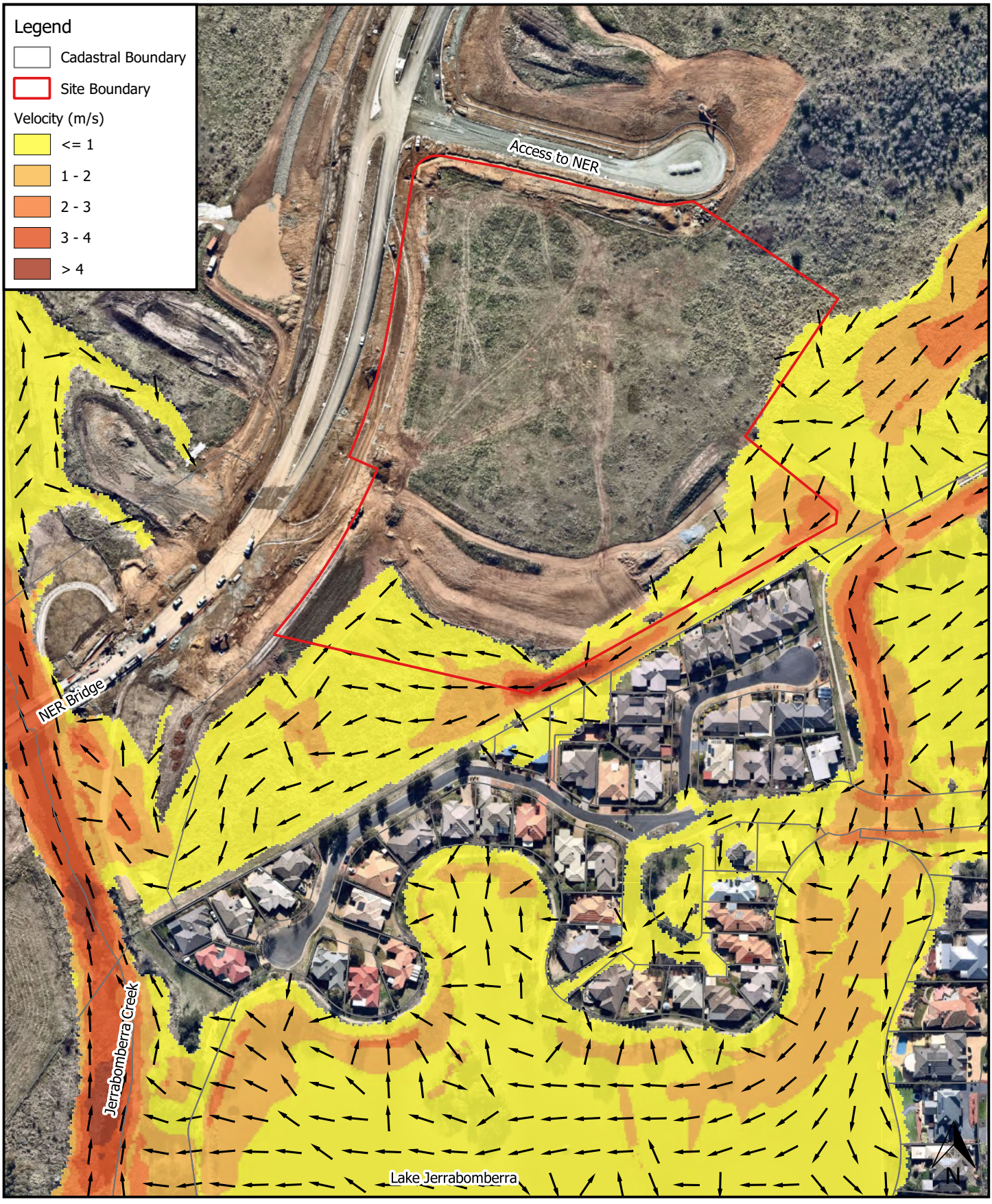
Environment | Water | Geotechnics | Civil | Projects

Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

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Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP with Climate Change - Existing Conditions Water Velocity (m/s)

FL08	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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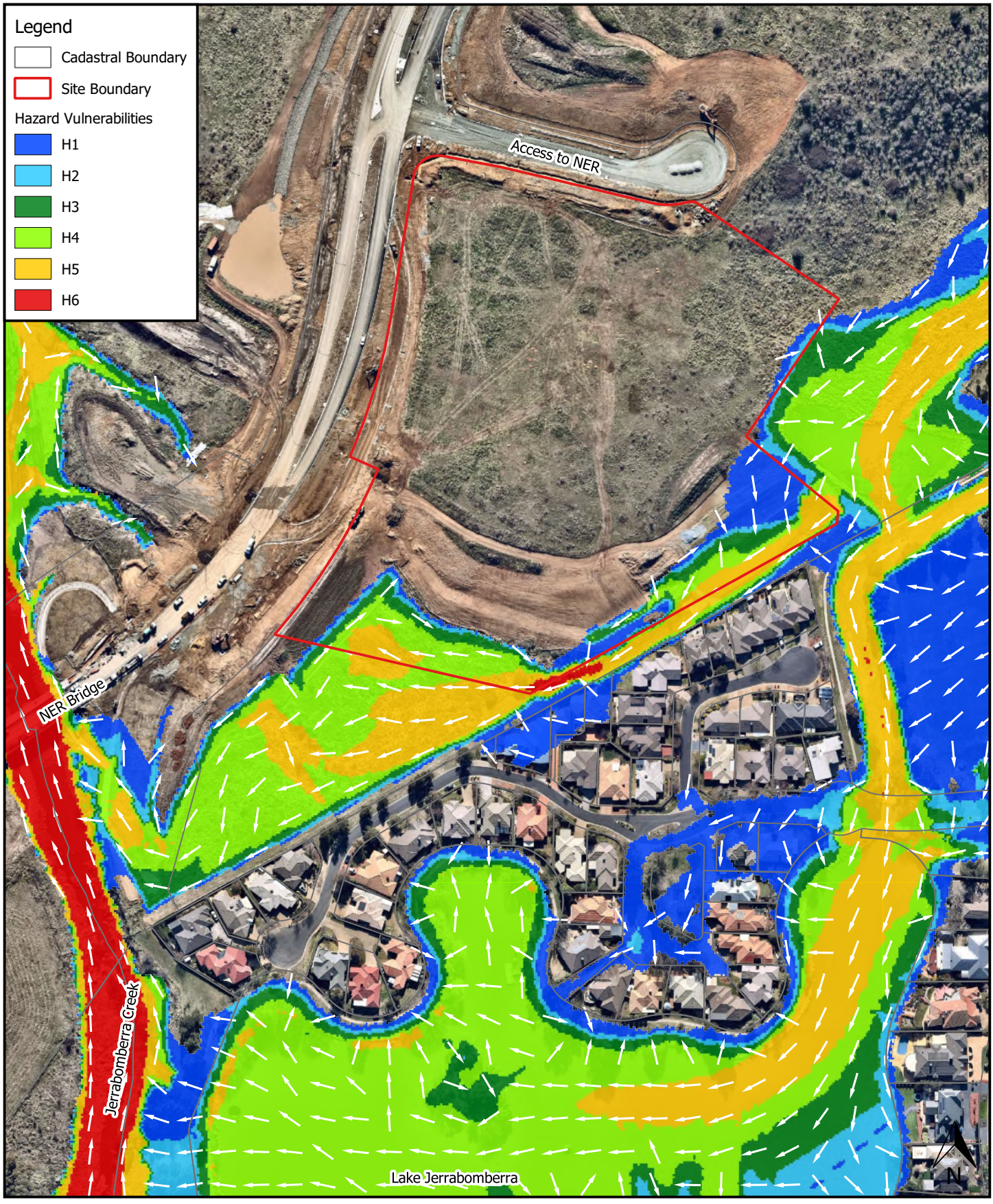
Environment | Water | Geotechnics | Civil | Projects

Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



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1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).
Flood Hazard Vulnerabilities based on ARR 2019 Combined flood hazard curves.

Map Title / Figure:

1% AEP with Climate Change - Existing Conditions Flood Hazard Vulnerabilities

FL09	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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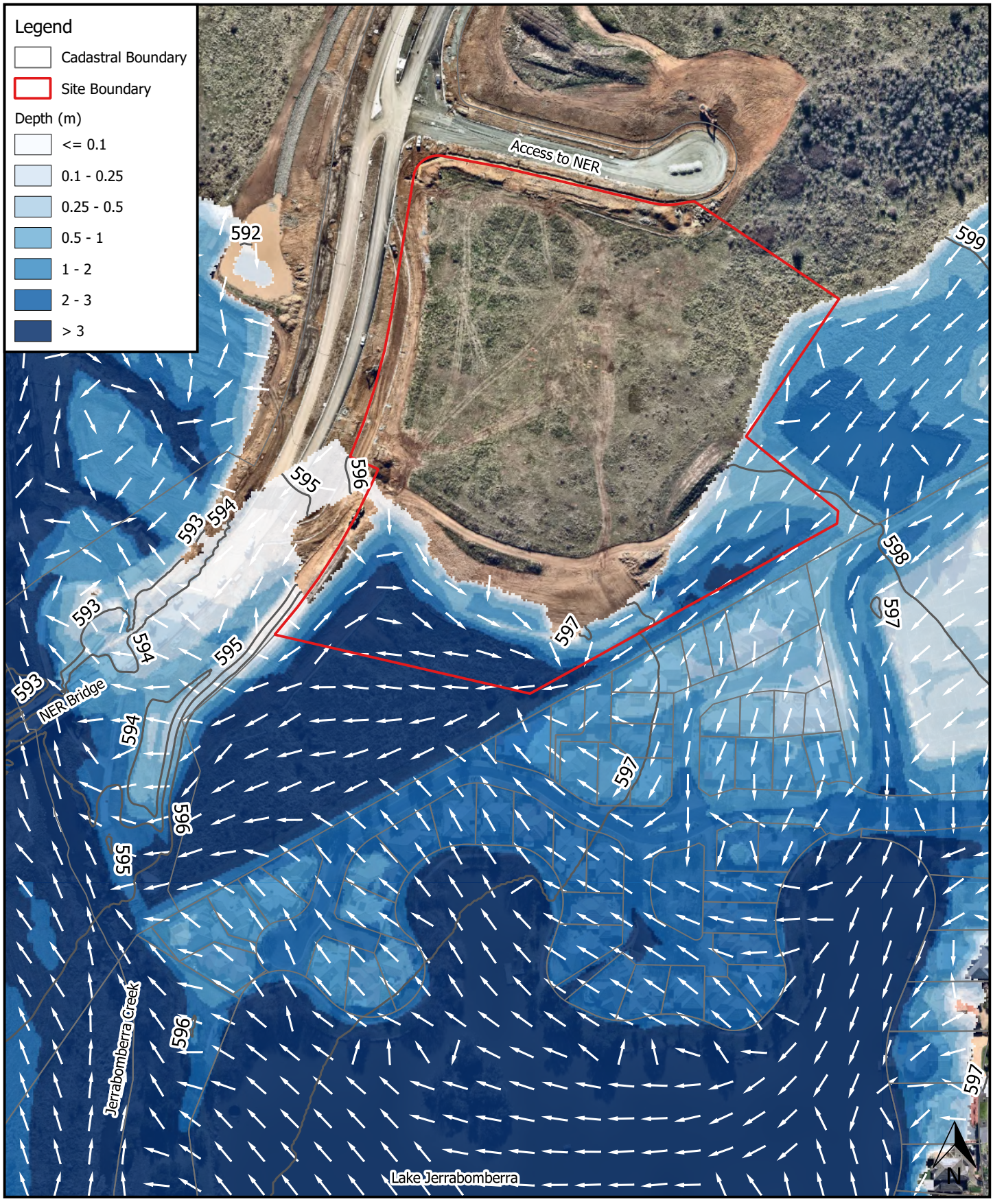
Environment | Water | Geotechnics | Civil | Projects

Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

PMF - Existing Conditions Water Level (mAHD) & Water Depth (m)

FL10	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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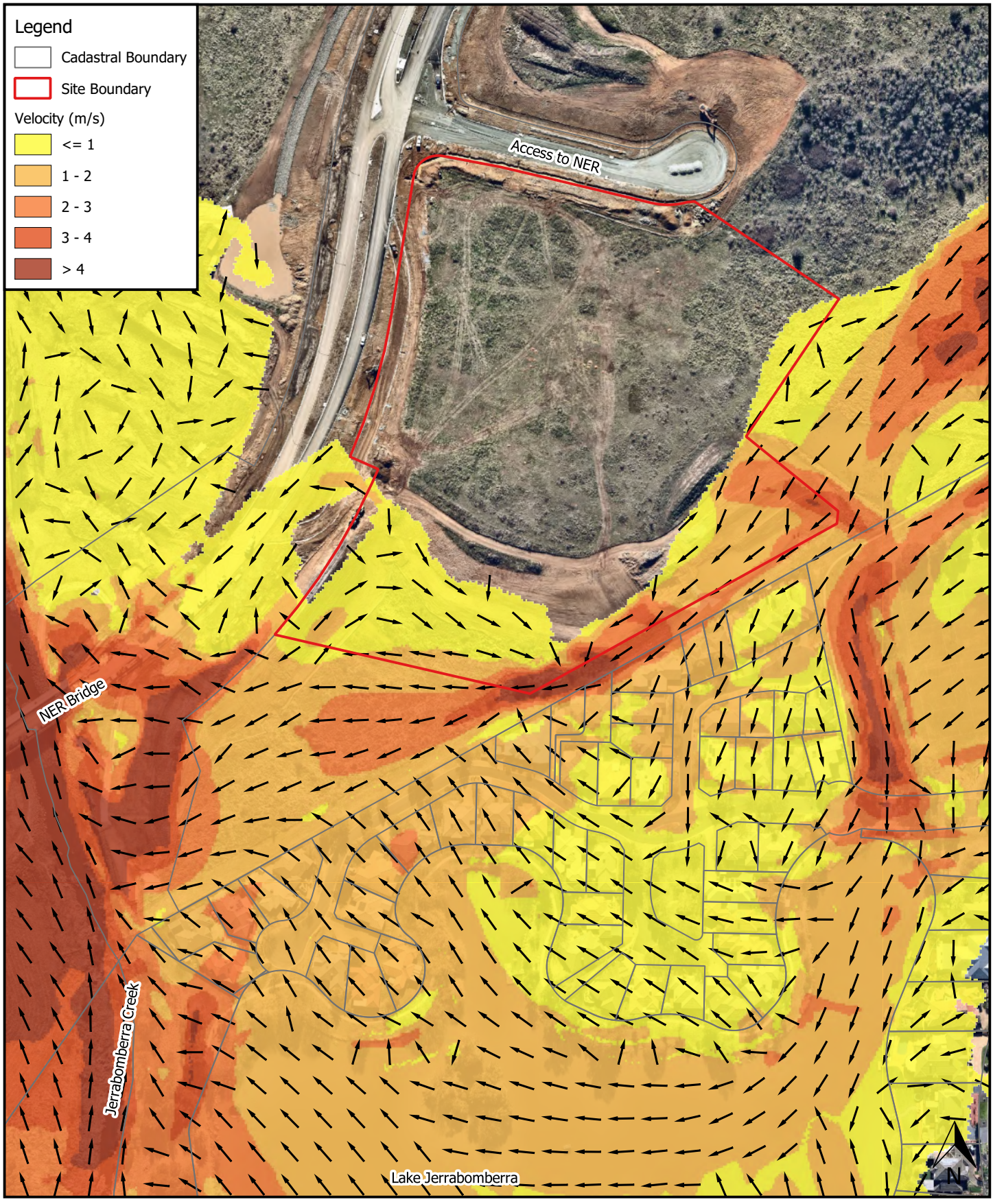
Environment | Water | Geotechnics | Civil | Projects

Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

PMF - Existing Conditions Water Velocity (m/s)

FL11	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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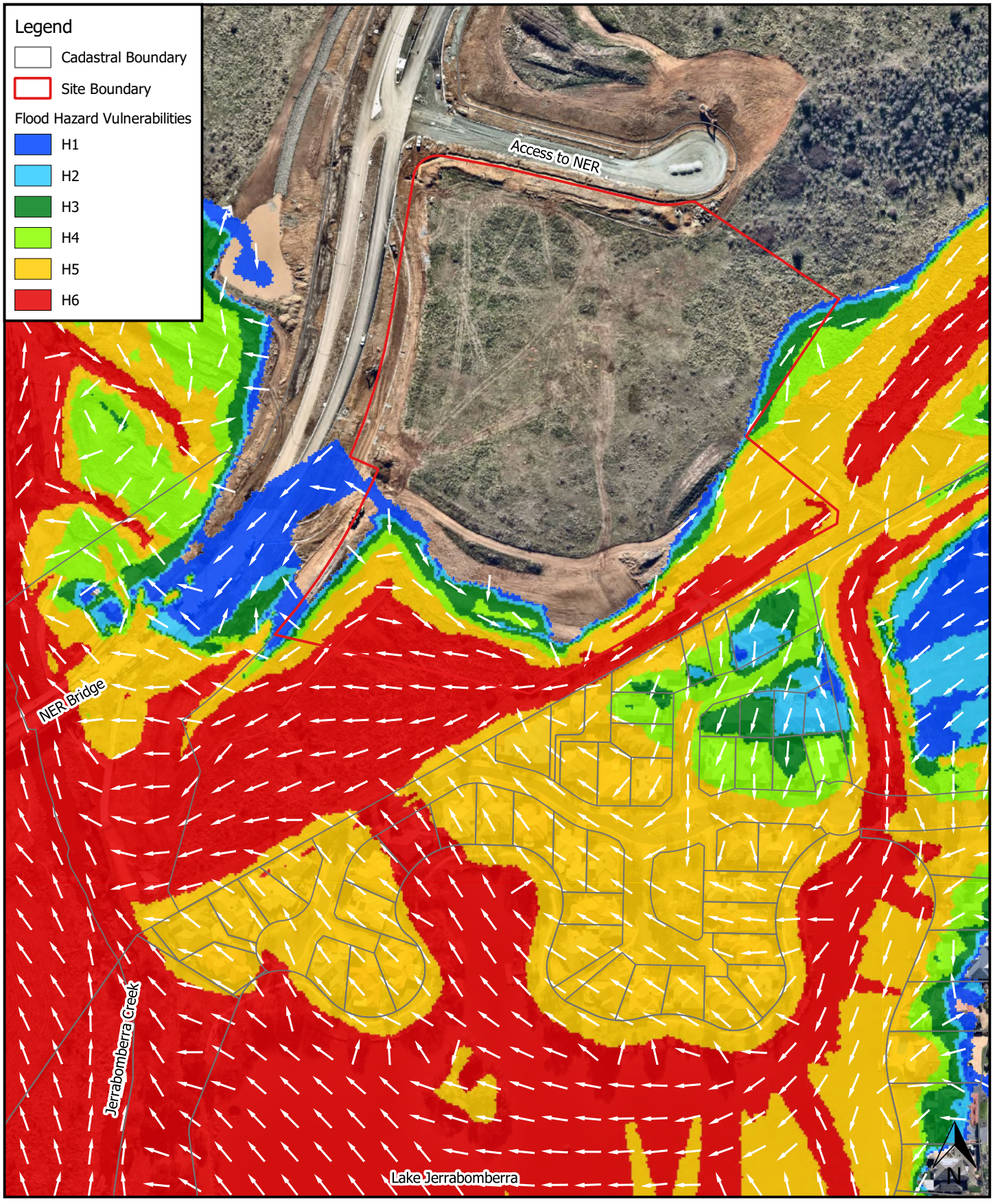
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).
Flood Hazard Vulnerabilities based on ARR 2019 Combined flood hazard curves.

Map Title / Figure:

PMF - Existing Conditions Flood Hazard Vulnerabilities

FL12	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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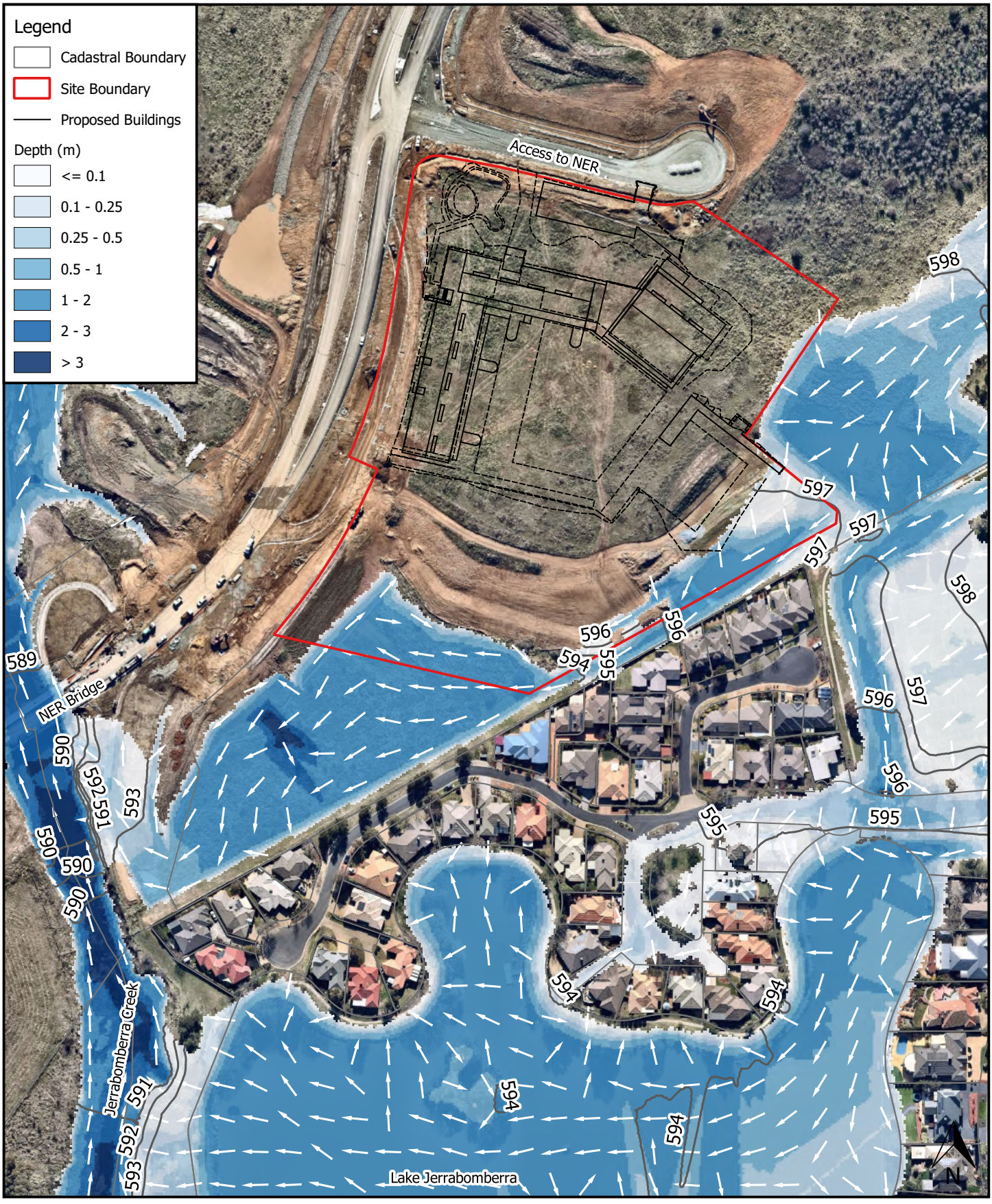
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP - Developed Conditions Water Level (mAHD) & Water Depth (m)

FL13	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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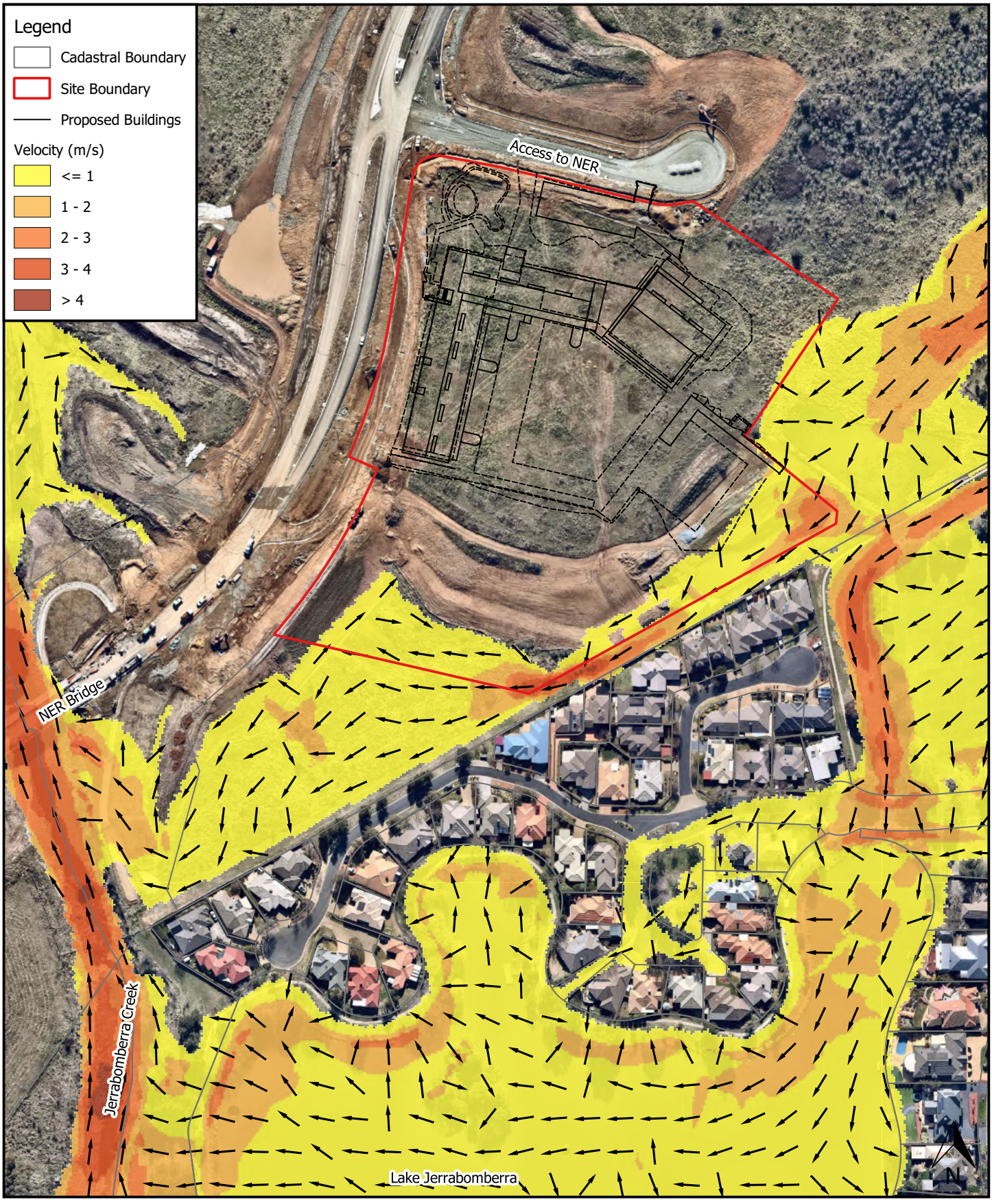
Environment | Water | Geotechnics | Civil | Projects

Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP - Developed Conditions Water Velocity (m/s)

FL14	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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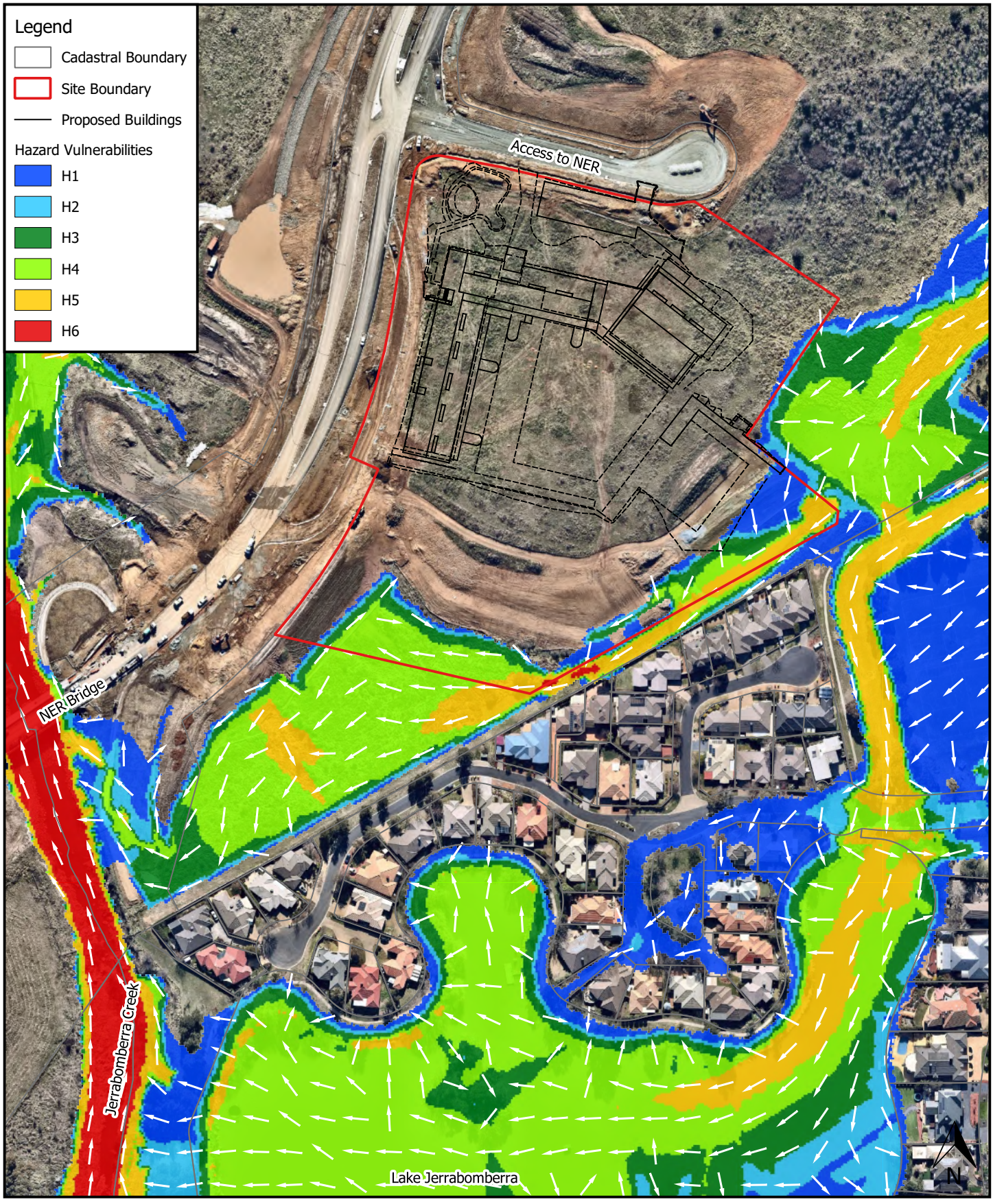
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).
Flood Hazard Vulnerabilities based on ARR 2019 Combined flood hazard curves.

Map Title / Figure:

1% AEP - Developed Conditions Flood Hazard Vulnerabilities

FL15	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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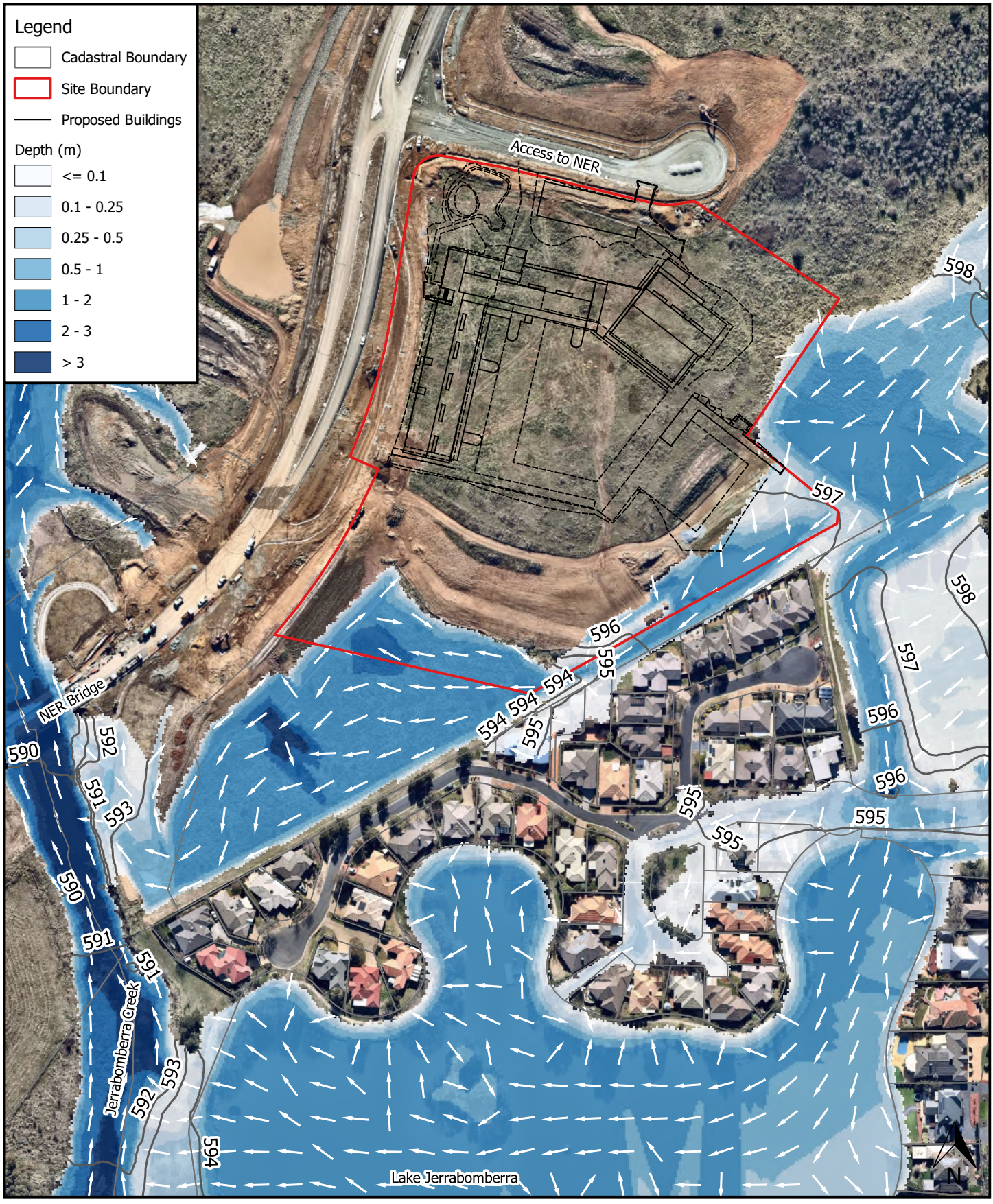
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP with Climate Change - Developed Conditions Water Level (mAHD) & Water Depth (m)

FL16	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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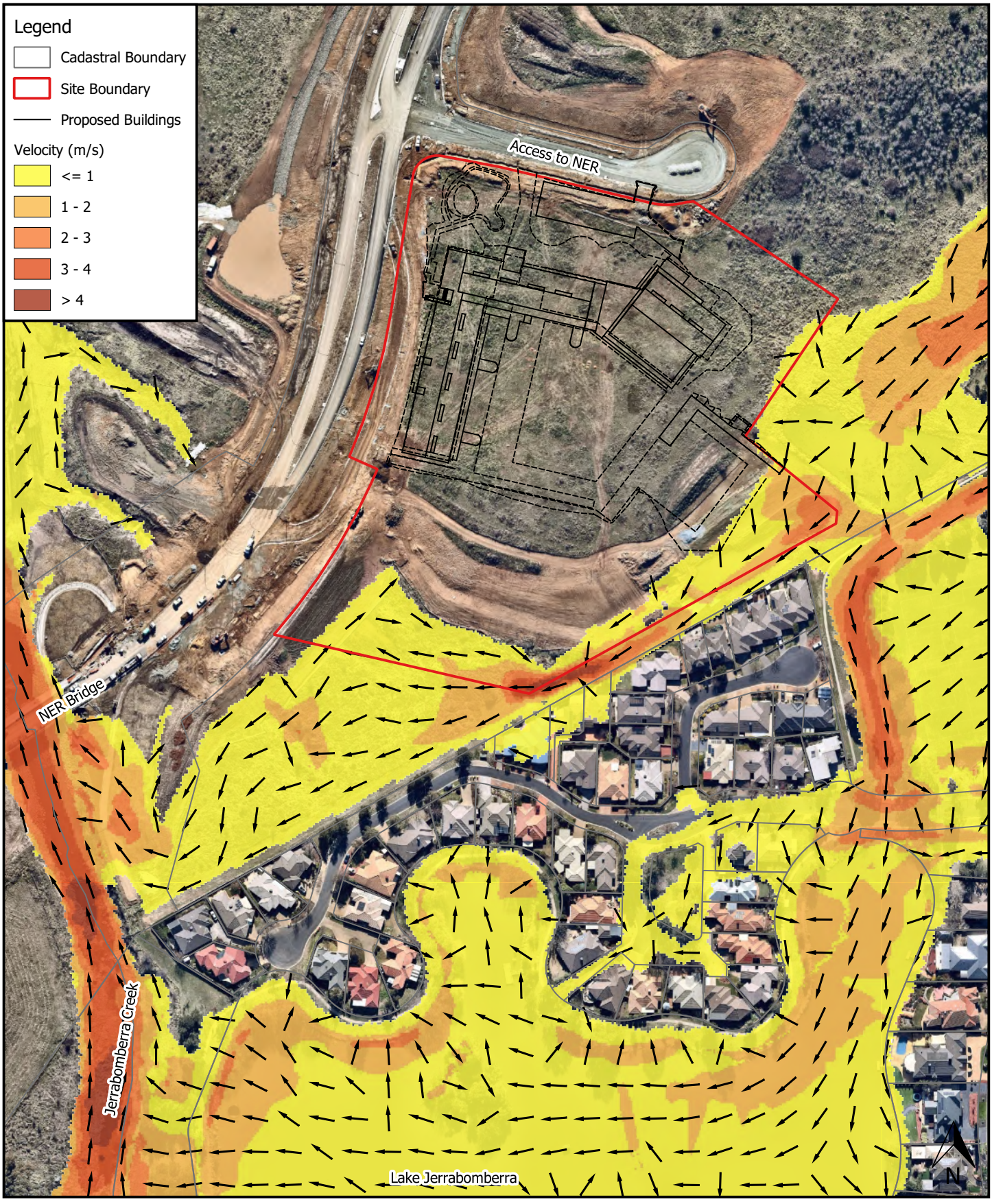
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

1% AEP with Climate Change - Developed Conditions Water Velocity (m/s)

FL17	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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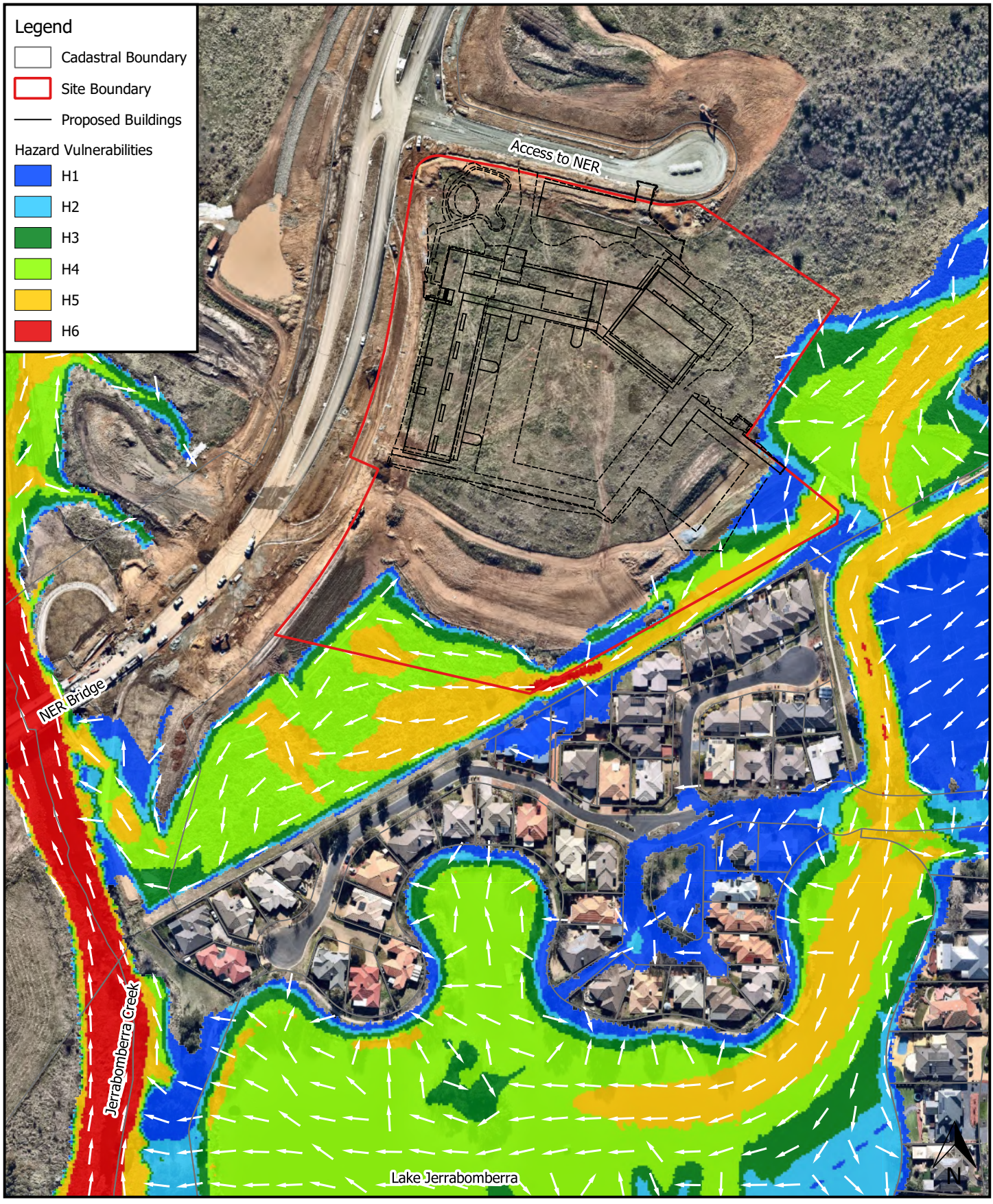
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).
Flood Hazard Vulnerabilities based on ARR 2019 Combined flood hazard curves.

Map Title / Figure:

1% AEP with Climate Change - Developed Conditions Flood Hazard Vulnerabilities

FL18	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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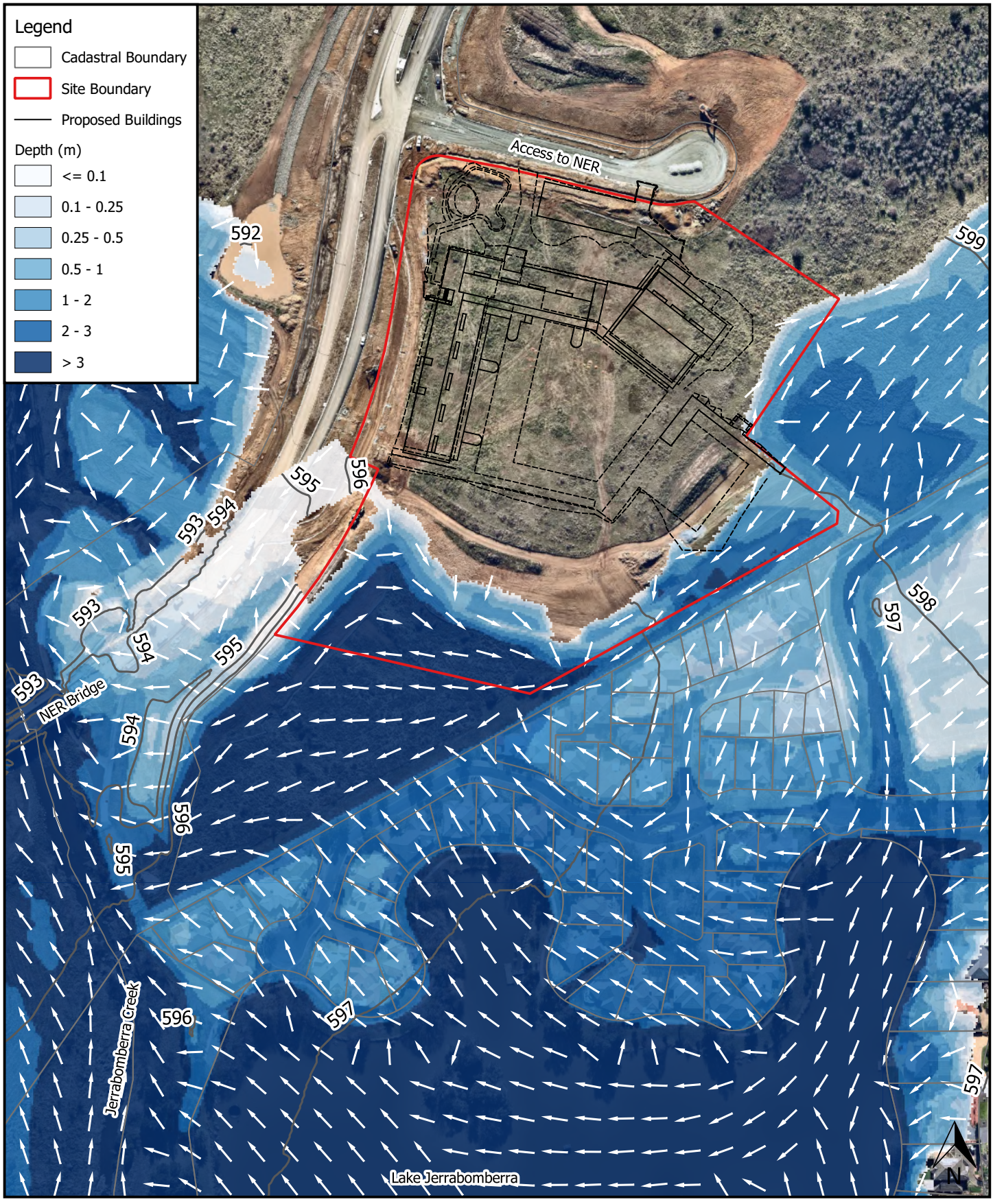
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

PMF - Developed Conditions Water Level (mAHD) & Water Depth (m)

FL19	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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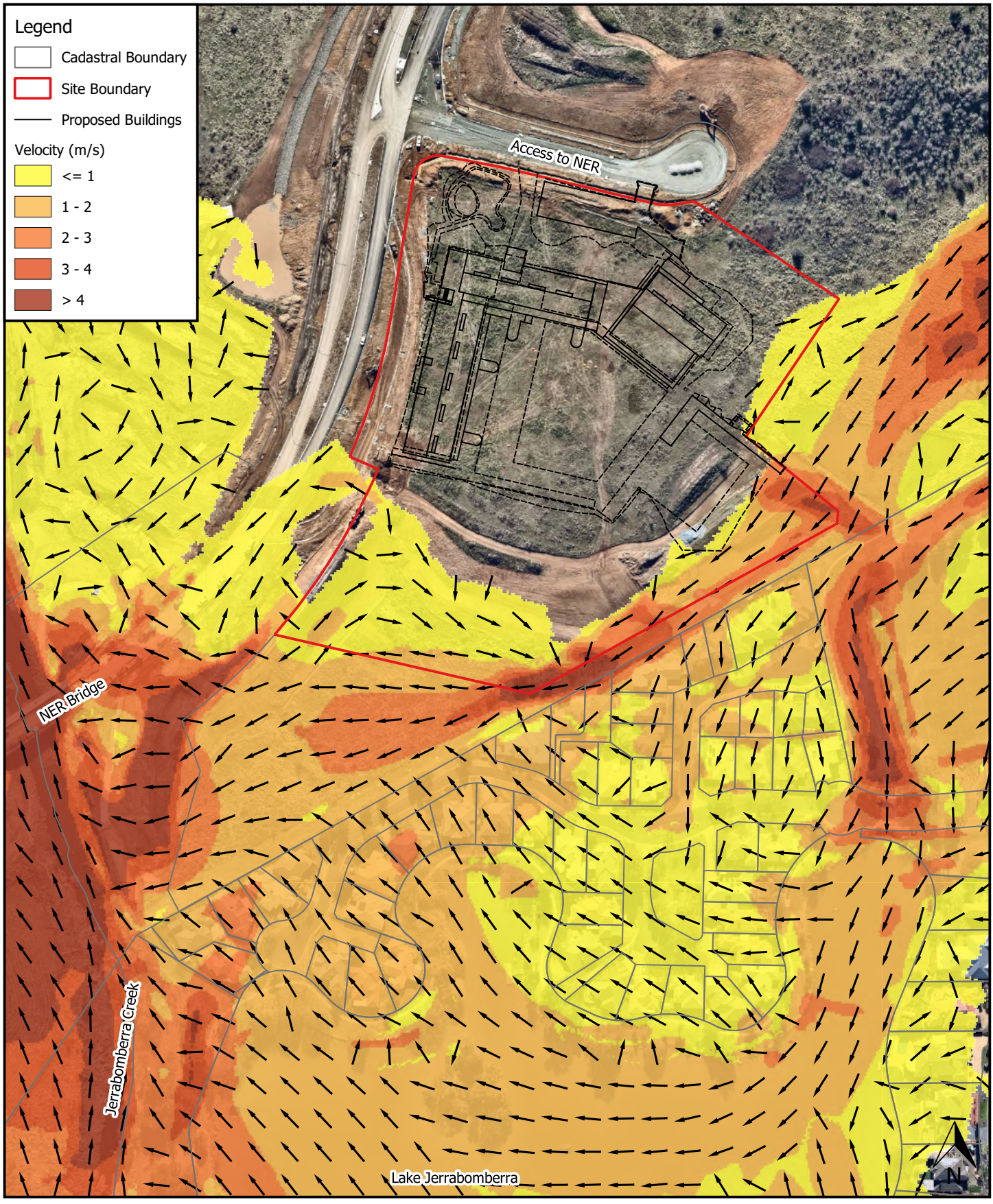
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).

Map Title / Figure:

PMF - Developed Conditions Water Velocity (m/s)

FL20	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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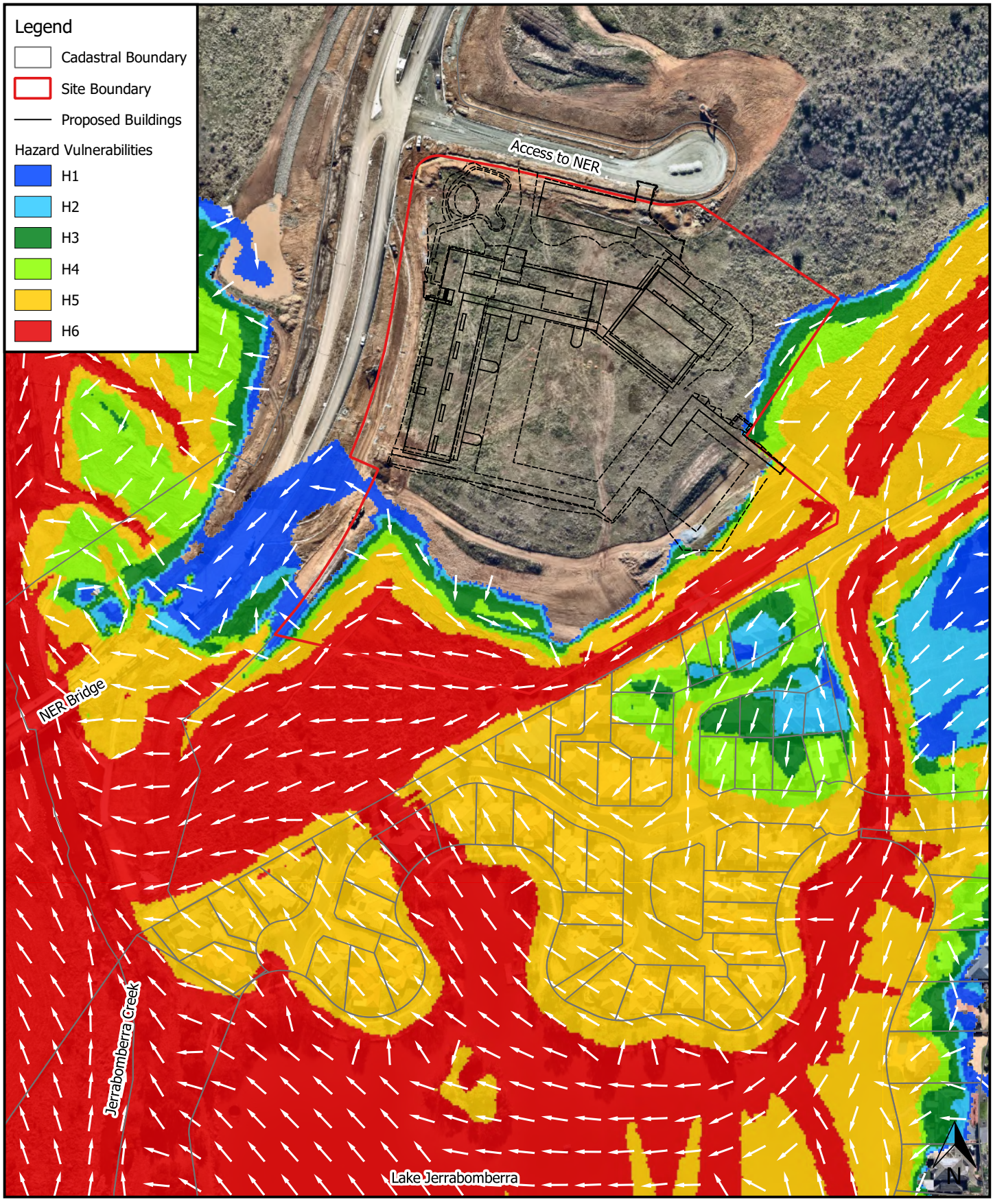
Project No: P2108170 Map Set: MS01-R03 EPSG: 28355



Project No: P2108170 Map Set: MS01-R03 EPSG: 28355

0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Map Title / Figure:

PMF - Developed Conditions Flood Hazard Vulnerabilities

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).
Flood Hazard Vulnerabilities based on ARR 2019 Combined flood hazard curves.

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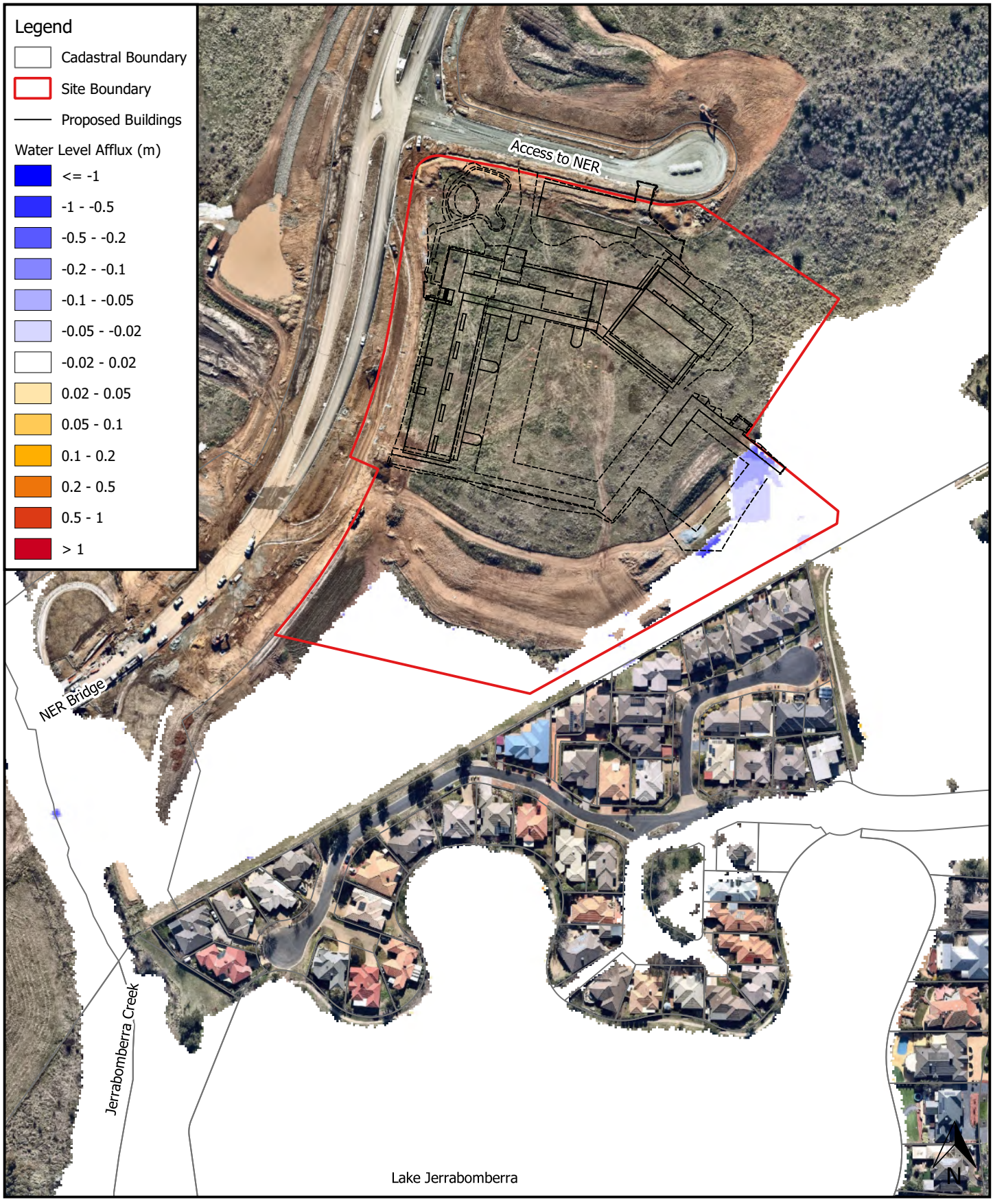
FL21	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date



0 20 40 60 80 100 m

1:2500 @ A4

Viewport Results

Aerial Image from Nearmap (2021).
Cadastre sourced from SIX Maps Clip & Ship (2021).
Areas coloured white represent negligible change.
Areas coloured blue represent water level reduction.
Areas coloured yellow / red represent water level increase.

Map Title / Figure:

1% AEP - Developed Conditions Water Level Afflux (m)

FL22	Map
Lot 1, DP1263364	Site
New High School in Jerrabomberra	Project
Flooding Assessment	Sub-Project
Department of Education	Client
22/09/2021	Date

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Project No: P2108170 Map Set: MS01-R03 EPSG: 28355

9 Attachment D: Emergency Contact List

When to call the NSW SES

NSW STATE EMERGENCY SERVICE

132 500

For emergency help in flood, storm and tsunami

000 EMERGENCY

IN LIFE-THREATENING EMERGENCIES
CALL TRIPLE ZERO (000)

Due to flood or storm is anyone trapped or injured?

YES → Call **Triple Zero (000)**.

NO

Has a fallen tree blocked access? (i.e. front door/driveway/road)

OR

Is a tree threatening to fall on your property or driveway?

OR

Is your property flooded or in danger of flooding?

OR

Is your roof damaged or leaking?

OR

Is there damage to your property that you cannot fix yourself?

NO

Contact your insurance company or a private contractor to assess and complete the job, or repair it yourself if safe to do so.

YES

Call the NSW SES on 132 500

Your request for assistance will be logged by our operations centre who will give you a reference number. Your request will then be forwarded onto the nearest SES unit for action.

NSW SES Volunteers undertake temporary emergency measures to make your home and the situation safe. It is important that you contact either your insurance company or a private contractor to make permanent repairs to damage resulting from a flood or storm or to remove any remaining debris.

When to call the NSW SES

NSW STATE EMERGENCY SERVICE

132 500

For emergency help in flood, storm and tsunami

000 EMERGENCY

IN LIFE-THREATENING EMERGENCIES
CALL TRIPLE ZERO (000)

The ***NSW SES*** experiences many calls during floods and storms.

Assisting people in our communities who are overwhelmed by damage and impacts of natural disasters as quickly as possible is important to all ***NSW SES*** volunteers.

What to do after logging a call with us:

- Make sure you keep your phone close by so we can easily contact you about your request for assistance.
- Stay away from any fallen trees and/or power lines that may have been brought down in the storm.
- Follow any safety recommendations you are given by the ***NSW SES***.
- ***NSW SES*** attends to request for assistance in a priority based order. A life threatening emergency will always be given immediate priority.
- If you no longer require emergency assistance, call us on **132 500** quoting your reference number to cancel the request. This helps free up our emergency crews if you no longer need us.

For great tips on how you can Get Ready this Storm Season, or to find out more information about the *NSW SES*, head to our website at www.ses.nsw.gov.au

NSW Emergency Contact Numbers

NORTHERN SETTLEMENT SERVICES LIMITED

Services	Disaster	Service Name	Telephone Number	Details	Social Media	App	Website
000 EMERGENCY	All Emergencies	Emergency	TRIPLE ZERO (000)	All life threatening emergencies			www.triplezero.gov.au
	All Emergencies	NSW Police Force	TRIPLE ZERO (000)	Police Assistance Line - 131 444, Crime Stoppers - 1800 333 000 **Report crimes that are not in progress**		–	www.police.nsw.gov.au
		NSW Fire & Rescue	TRIPLE ZERO (000)	Helps the community during building fires, car accidents, rescues & accidents involving hazardous material			www.fire.nsw.gov.au
		NSW Rural Fire Service - RFS	TRIPLE ZERO (000)	Info Line - 1800 679 737 Help the community during bush, grass & building fires, as well as car accidents		NSW RFS	www.rfs.nsw.gov.au
SES NSW STATE EMERGENCY SERVICE		NSW Emergency Service - SES	132 500	For general help in a flood or storm			www.ses.nsw.gov.au
TIS TRANSLATING AND INTERPRETING SERVICE	–	Translating Interpreting Service - TIS	13 14 50	If you do not speak English well, you can call TIS (not an emergency service)	–	–	www.tisnational.gov.au

Updates During and After an Emergency

	All Emergencies	Emergency NSW	–	Alerts and Updates	–	–	www.emergency.nsw.gov.au
ABC Local Radio Your Emergency Broadcaster Be prepared. Stay informed.	All Emergencies	ABC Local Radio ABC Emergency	–	Emergency Broadcasts Updates			www.abc.net.au/news/emergency/
NSW Emergency New South Wales	All Disasters	State Disaster Welfare Services	1800 018 444	Disaster Relief Grants	–	–	www.emergency.nsw.gov.au

Developed by Northern Settlement Services Ltd. Natural Disaster Awareness Program in partnership with NSW State Emergency Service and NSW Rural Fire Service. Project funded by the Commonwealth and NSW Governments under the Community Resilience Innovation Program. Resource funded by Westpac Natural Disaster Recovery Fund. **www.nsservices.com.au**

10 Attachment E: Company Profile and Engineer CVs

martens
consulting engineers

capability statement

world class sustainable engineering solutions

Environment | Water | Wastewater | Geotechnics | Civil

martens consulting engineers

contents

About us

ENGINEERING SOLUTIONS

Martens & Associates are an Australian engineering consultancy wholly owned by employees specialising in the fields of environment, water, wastewater, geotechnical and civil engineering.

With 25+ years of national and international industry experience, we bring cutting edge knowledge, technology and innovative design to meet your engineering needs. Martens have undertaken more than 6000 projects involving environmental engineering design, documentation, construction, management, auditing and reporting throughout the Australia, New Zealand and South Pacific region. You can rely on our advice being:

- Practical
- Cost and budget effective
- Informed and experienced
- Industry best practice
- Committed to excellence

OUR HISTORY

The company was founded by Dr Daniel Martens and has grown rapidly into a multi-disciplinary team of highly skilled engineers, designers, scientists, hydrogeologists, technicians and support staff.

PROJECT LIFE CYCLE MANAGEMENT

Martens & Associates Pty Ltd provide comprehensive expertise for all stages of your engineering project lifecycle from concept development through to planning, detailed design, construction and operation.

WORKING WITH YOUR DEADLINES

Your design and / or construct project is just as important to us as it is to you. When you enlist our services, you are ensuring that your project is going to be well managed. We provide:

- On-time project delivery
- Strict project time lines
- Experienced staff

Sustainable Engineering Solutions

OUR GOAL

To deliver water and energy efficient engineering solutions that can be readily and cost effectively integrated into your project.

BEST PRACTICE ENVIRONMENTAL STANDARDS

Our firm specializes in delivering sustainable engineering solutions which meet and exceed best practice environmental standards. You can rely on our advice achieving:

- Re-use of resources
- Minimising of waste products
- Energy efficient designs
- Water conservation
- Recycling of waste products
- Minimising of environmental impact

CORE ENGINEERING BUSINESS AREAS

Our core business areas are:

- Environmental Engineering
- Water Engineering
- Wastewater Engineering
- Geotechnical Engineering
- Civil Engineering

SPECIALIST SERVICES

Specialist areas where sustainable solutions are offered include:

- Stormwater collection, treatment and re-use systems
- Effluent re-use and irrigation systems
- Water sensitive urban design
- Groundwater recharge applications
- Beneficial biosolids re-use and soil conditioning
- Waste minimisation programs
- Water reclamation

martens
consulting engineers

Environmental Engineering

KEY AREAS

For 15 years we have provided environmental management services to private, corporate and government needs in locations throughout Australia, New Zealand and the South Pacific. Our expertise in environmental management and engineering has been widely used to assist with developments, provide site remediation and develop suitable environmental controls. These services are applied on projects as diverse as:

- Urban, commercial and industrial development
- Residential sub-divisions
- River and water-course management and engineering
- Mining and extraction industries

STAYING IN FRONT OF THE OTHERS

Our engineers and scientists place emphasis on maintaining up-to-date knowledge about current best practice, legislation, regulations and emerging issues. We add value by helping ensure that our clients meet current and emerging best practice performance criteria in the most cost-ffective manner.

CORE CAPABILITIES

Our services cover a range of environmental management and engineering disciplines, including:

- Environmental Impact Statements (EIS)
- Review of environmental factors (REF)
- Geomorphological survey
- Floodplain management plans
- River management and engineering
- Investigation of groundwater resources
- Legislation and environmental compliance
- Environmental auditing
- Water quality
- Environmental monitoring programs
- Air and noise impact assessment

"serving the environmental management needs of industry"

Water Engineering

MULTI-DISCIPLINARY SERVICES

For 15 years now, Martens & Associates Pty Ltd have provided industry with benchmarking expertise in water engineering. We offer comprehensive services for all aspects of the water cycle and scales of projects ranging from feasibility studies, through to the design and construction. Our key water engineering disciplines are:

- Water supply
- Stormwater
- Treatment
- Environment

RISK AND COST MANAGEMENT

Our experienced engineers will add value to your project by helping to manage and reduce your risk exposure whilst dealing with challenging water management issues in a cost-effective and innovative manner.

CORE CAPABILITIES

Our services cover a range of technical disciplines, including:

- Water supply, storage and resource allocation
- Stormwater engineering and urban drainage
- Flood hydrology and hydraulics
- Water quality control
- Sediment and erosion control
- Water balance
- Irrigation systems
- Coastal Processes
- Environmental monitoring
- Management

"comprehensive services for all aspects of the water cycle"

Wastewater Engineering

KEY CAPABILITIES

Martens & Associates maintain expertise in a wide array of wastewater engineering disciplines ranging from collection and treatment through to land application and beneficial re-use of treated effluent. We have undertaken more than 500 wastewater engineering projects including process design and / or construction sewage treatment plants and effluent re-use schemes. We maintain extensive in-house expertise in a wide range of traditional and innovative wastewater management practices which we readily apply to your unique project. Our wastewater engineering services cover:

- Feasibility assessment and option evaluation
- Concept designs
- Detailed designs
- Approvals
- Project management
- Construction and monitoring

TYPICAL APPLICATIONS

Martens & Associates involvement in the planning, investigation, design and construction of sewage management infrastructure has extended to many types of developments. Our services are by no means restricted to only these items, with our design engineers ready to solve new wastewater collection, transport, treatment and management problems in an innovative manner using conventional, new or hybrid technologies.

- Individual on-site systems
- Resort complexes
- Shopping centres
- Restaurants
- Hotels / motels
- Schools
- Trade waste applications
- Piggery wastes
- Landfill leachate
- Food processing
- Villages
- Contaminated stormwater

"traditional & innovative designs to achieve sustainable solutions"

Geotechincal Engineering

KEY AREAS

For over 10 years our engineers have been working with clients to help them develop creative designs and solutions to their geotechnical problems. Our geotechnical expertise is used in a wide range of markets to investigate sub-surface conditions and develop designs for site development, structures and excavations. These services are applied on projects as diverse as:

- Single story buildings to multi-story developments
- Urban developments
- Water supply and earth dams
- Excavations for buildings, pipelines and utilities
- Road, rail and urban transit systems
- Tunnels and underground storage facilities

ADDING VALUE

Our engineers and scientists provide specialist technical services directly to clients which permit efficiencies in our work and in our clients' management requirements. We add value by helping our clients manage their risk exposure, and deal with challenging issues in a cost effective and innovative manner.

CORE CAPABILITIES

Our services cover a range of technical disciplines:

- Foundation engineering
- Soil and rock mechanics
- Engineering geology
- Terrain and natural hazard evaluations
- Hydrogeology
- Contamination assessment and remediation
- Risk management
- Pavement and materials engineering
- Mining
- Geophysics
- Soft-ground engineering

"developing creative designs & solutions to geotechnical problems"

Civil Engineering

OUR EXPERIENCE

Martens & Associates have for 10 years provided successful civil engineering solutions to the full range of development types including:

- Residential housing developments
- Rural and rural-residential sub-divisions
- Agricultural infrastructure
- Commercial developments
- Industrial developments and estates

Our specific areas of expertise include:

- Road design
- Earthworks and excavations
- Pavement design
- Sub-divisions
- Carparking design and solutions
- Marinas and seawalls

PROJECT MANAGEMENT

Depending on your requirements, Martens & Associates can provide a range of project management services. Our services cover the full development cycle

- Project feasibility and options investigations
- Planning advice
- Development Application (DA) management
- Construction certificate (CC)
- Tender documentation and expressions of interest (EOI)
- Contractor engagement
- Construction management
- Auditing and compliance

"building for a better future"

Contact

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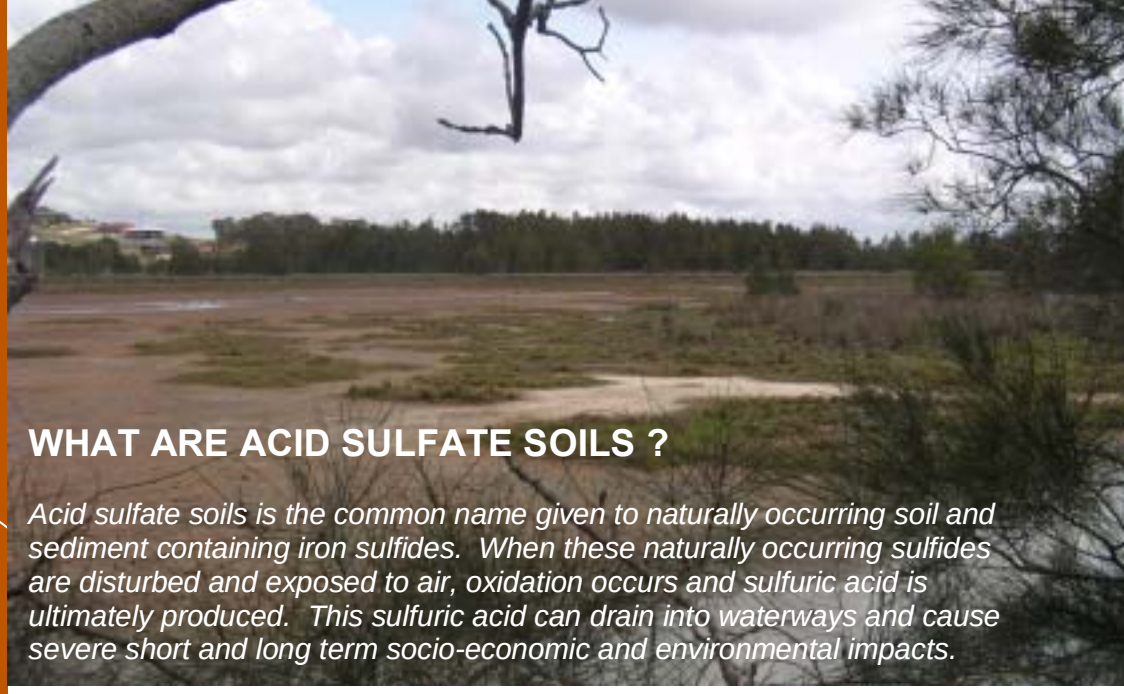
Acid Sulfate Soils

Capability Sheet CS1



WHAT ARE ACID SULFATE SOILS ?

Acid sulfate soils is the common name given to naturally occurring soil and sediment containing iron sulfides. When these naturally occurring sulfides are disturbed and exposed to air, oxidation occurs and sulfuric acid is ultimately produced. This sulfuric acid can drain into waterways and cause severe short and long term socio-economic and environmental impacts.

WHAT CAUSES ACID SULFATE SOILS ?

Many activities and industries can lead to acid drainage such as grazing, cropping, development and aquaculture. The most common activities that disturb acid sulfate soils are:

- Agricultural activities that involve land drainage
- Agricultural activities that lower groundwater (eg. cropping)
- Extractive industries and channel / floodplain mining
- Groundwater abstraction or flow modification
- Infrastructure works such as flood management
- Urban and tourism development
- Works that prevent tidal and flood inundation

The impacts of acid sulfate disturbance constitute the most acute water based environmental problem in coastal areas of Australia. The problem is comparable to the environmental impacts of salinity in inland waters. Acid drainage can cause fish kills, fish disease, oyster damage and mortality, adverse effects on aquatic ecosystems, release heavy metals from contaminated sediments, human and animal health impacts from polluted water, adverse impacts on soil structure and arability and damage to built structures such as bridges and buildings.

TECHNICAL SERVICES

Martens and Associates Pty Ltd provide comprehensive environmental and geotechnical services for investigating, controlling and managing acid sulfate soils.

- Stage 1 preliminary investigation (geomorphogical)
- Stage 2 comprehensive acid sulphate soil survey
- Acid sulphate soil management plans
- Construction management protocols
- Groundwater well (Piezometer) installation and monitoring
- Impact assessment where leaching has occurred
- Soil remediation strategies and site supervision

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Biosolids Management

Capability Sheet CS2

BIOSOLIDS RE-USE TECHNICAL SERVICES

Dewatered and stabilised sludges and other organic waste bi-products represent valuable biosolids products available to a range of re-use applications. Martens & Associates Pty Ltd have expertise in a range of biosoilds activities. We have delivered state-of-the-art solutions to biosolids management and re-use projects throughout Australia and New Zealand.

Our services include:

- Sludge processing and dewatering
- Sludge management
- Organic waste recycling
- Development applications
- Site assessment for Biosolids application
- Design of Biosolids application schemes
- Composting programs

APPLICATIONS

Biosolids are today regarded as a valuable agricultural resource. Sludge products typically contain very high organic matter levels and can be suitable, depending on stabilization grade, for a range of applications:

- Soil conditioning
- Agricultural fertilizer
- Sub-soil drainage
- Crop management

ON-GOING MONITORING OF RE-USE PROGRAMS

Biosolids re-use programs frequently involve considerable monitoring in order that any risks to public health and the environment are suitably managed and maintained within acceptable limits. The level of monitoring will depend on the type and strength of sludge applied to the soil profile.

Our monitoring services include:

- Sludge quality and compliance
- Soil condition and chemistry
- Surface water quality
- Microbiological activity
- Groundwater quality
- Air quality

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Coastal Engineering

Capability Sheet CS4

OUR EXPERIENCE

Martens & Associates have experience in a wide range of projects in coastal engineering involving open ocean, estuarine, lagoon and coastal river system environments.

We undertake investigations and provide engineering design solutions for coastal developments at varying scales ranging from 'home-owner' level including pontoons, slipways, boat sheds, jetties, retaining walls, through to larger scale investigations such as estuary management, coastal flooding and inlet management schemes.

KEY PROJECT AREAS

Key project areas include:

- Coastal erosion and hazard definition
- Environmental risk and impact assessment
- Coastal flooding and inundation modelling
- Coastal sedimentation and process investigations
- Coastal management
- Coastal geotechnical investigations
- Field investigations of tides and sediment transport
- Computer modelling

INVESTIGATION & DESIGN OF COASTAL WORKS

Martens & Associates scientists and engineers provide a range of investigation and engineering design services for the coastal environment including:

- Seawalls
- Marinas
- Revetments
- Groynes
- Breakwaters
- Training walls
- Beach nourishment
- Dune reconstruction
- Configuration dredging

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