Woolacotts.
CONSULTING ENGINEERS

School Infrastructure NSW

Centre of Excellence in Agricultural Education (CoE)

Flood Impact Assessment Report

20-307 | 28th April 2021 | SSDA Submission

Contents

Document control

Rev	Date	Revision details	Approved	Verified	Prepared
A	28.04.21	SSDA Submission			AP

Copyright 2021 © Woolacotts Consulting Engineers | Do not use, copy, or reproduce wholly or in part without written permission

1.0 Introduction

Woolacotts Consulting Engineers have been engaged by the Department of Education (DoE) to prepare an Integrated Water Management Report for the proposed Centre of Excellence in Agricultural Education (CoE).

The new proposed Centre of Excellence in Agricultural Education (CoE) is to be located within the Western Sydney University site off Vines Drive, Richmond ('The Site'). Londonderry Road is located to the west of The Site and Vines Drive is located to the north-east of the site. The total lease area is approximately 11.37ha. Refer to Figure 1 below for the site location and extent.

The proposed high school includes a single-story complex of 6 buildings and ancillary structures located mainly over the eastern side of the site.

The purpose of this report is to detail the following:

- Flood risk on-site taking into account the effects of climate change, sea level rise and an increase in rainfall intensity.
- Assess the impacts of the development, including any changes to flood risk onsite or off-site, and detail design solutions to mitigate flood risk where required.
- Two-dimensional flood modelling

Figure 1 – Site location

2.0 Existing Conditions

The proposed site is adjacent to the Western Sydney University Village at the north-east and Anglicare Carol Allen House at the north-west. The total site area is approximately 11.37ha. The site is generally flat with a gentle slope that falls towards the southern boundary of the site.

The site is largely used for agricultural purposes and there are several swales that run across the site from the north-east boundary to an open channel watercourse along the south-west boundary.

3.0 Proposed Development

The proposed development involves the construction and operation of a new Centre of Excellence (CoE) in Agricultural Education on a leased land parcel within the Western Sydney University (Hawkesbury Campus) site, Richmond NSW.

The CoE will provide new agricultural / STEM teaching facilities with general learning and administration spaces to be utilised by rural, regional, metropolitan and international school students. The CoE will accommodate up to 325 students and up to 32 employees consisting of farm assistants, administration staff and teachers and up to eleven (11) itinerant staff members. The CoE will also include short-term on-site accommodation facilities for up to 62 visiting students and teaching professionals from regional and rural NSW.

The CoE will include five science laboratories, ten general learning spaces, practical activity teaching areas, seminar, botany room, administration block and accommodation facilities. It will also include covered outdoor learning areas, dining / recreation hall, canteen and kitchen, agricultural plots, significant landscaping spaces, car parking and provision of necessary infrastructure.

The proposed development has been designed to be well integrated into the Western Sydney University site, having due regard for scale, bulk and orientation of existing buildings. The educational facilities will display linear open building forms in single story design with open spaces and lightweight construction techniques. The site is benefitted by Blue Mountains views to the west and the building and landscape plans have incorporated viewing opportunities into the design.

Refer to Figure 2 below for the proposed Site Plan.

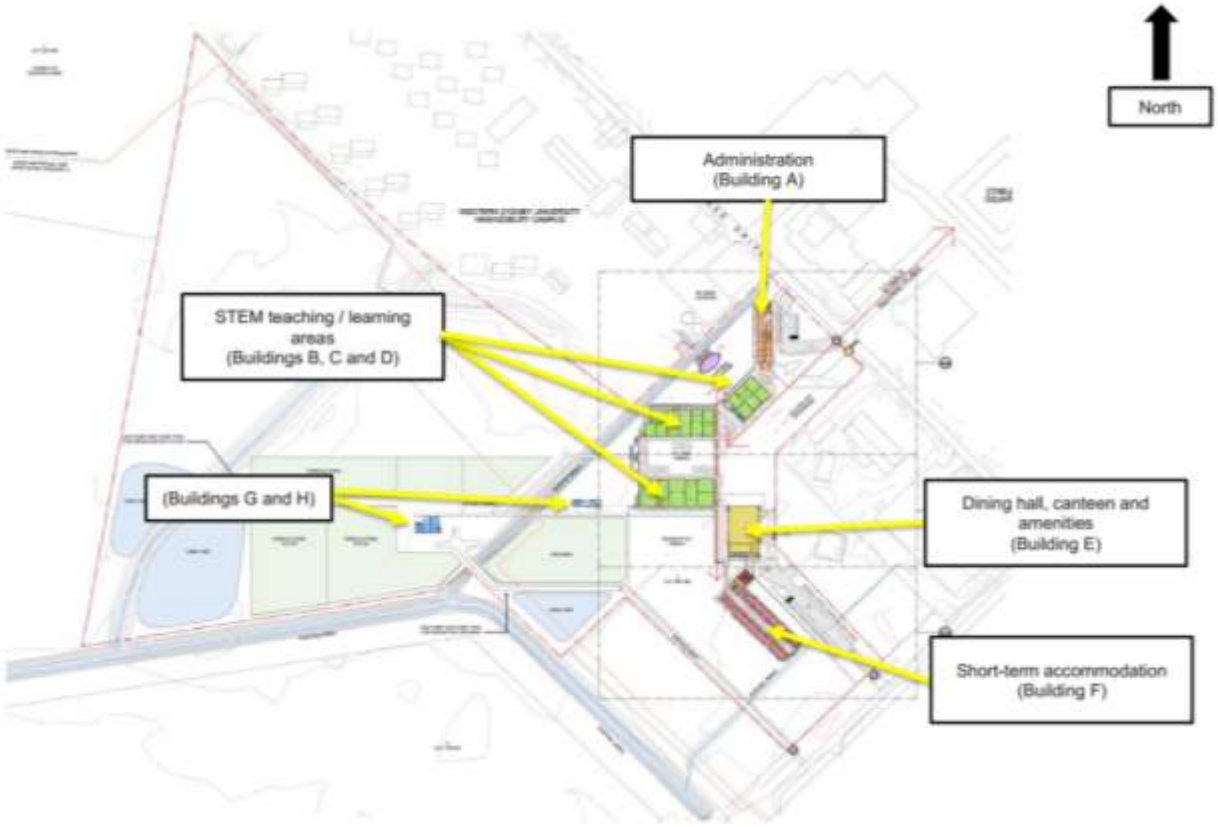


Figure 2 – Proposed Site Plan

4.0 Flood Behaviour

4.1 Flood Investigation

The site is affected by two sources of flooding riverine flooding and local overland flow flooding. Riverine flooding occurs when heavy rainfall causes the water levels in a river to rise and escape the main channel. Local overland flow flooding is run-off that travels over the land during heavy rainfall events, affected by urban features such as stormwater infrastructure, roads, fences, walls and other structures.

Refer Appendix C – Preliminary Flood Investigation Summary, for additional information.

4.2 Riverine Flooding

Flood mapping from the *Hawkesbury Floodplain Risk Management Study & Plan – Volume 3* by Bewsher Consulting Pty Ltd City, December 2012 (Hawkesbury Flood shows that The Site is impacted by riverine flooding from the PMF event *(Note: The PMF is the largest flood that could conceivably occur at a particular location. The PMF defines the extent of the floodplain).* Refer to Figure 4 below for flood extents.

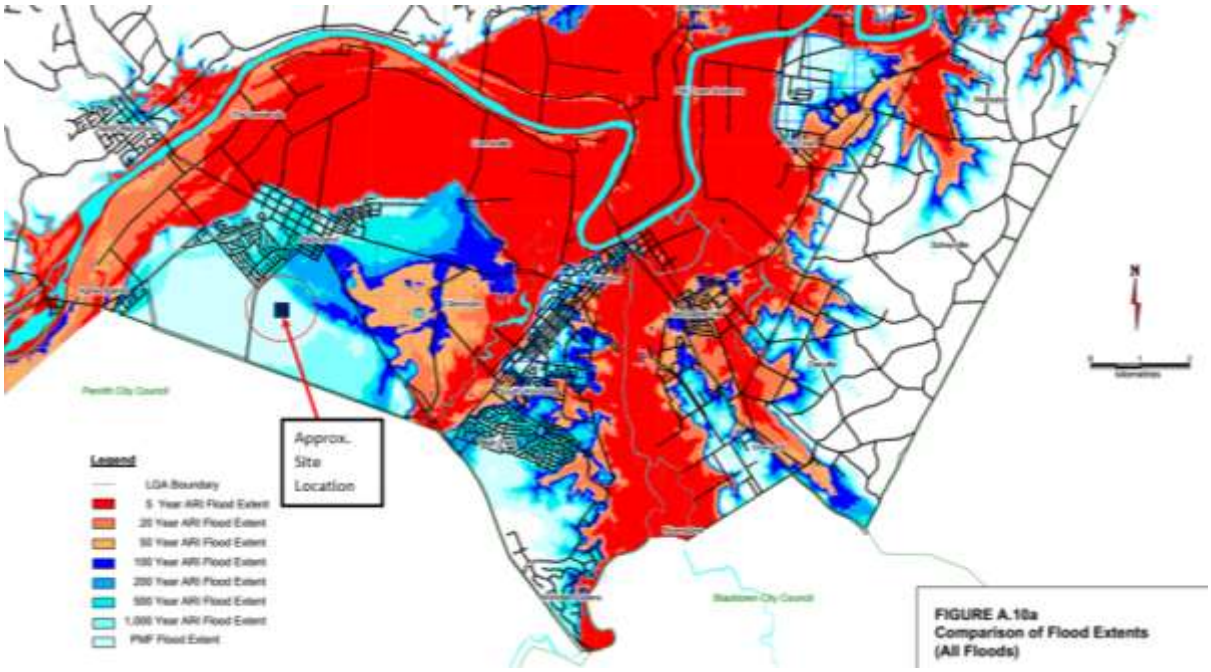


Figure 4 – Flood mapping extract from the Hawkesbury Floodplain Risk Management Study & Plan, December 2012

Figure 1 above shows that The Site is not located within the 1 in 100 year ARI (1% AEP) flood extents and therefore is not subject to the flood development controls specified in Council's *Schedule of Flood Related Development Controls* including but not limited to floor levels, cut & fill, building materials etc.

The peak flood levels from riverine flooding for The Site are 17.5m AHD for the 1% AEP flood event and 26.4m AHD for the PMF event. The site is located in a very low flood risk precinct (Figure A.15)

4.3 Overland Flow Flooding

An assessment of overland flow flooding was undertaken as part of the previous SSDA submission. This is detailed in the *Civil Engineering Report and Stormwater Management Plan* by TTW dated 11 May 2018. This assessment showed that the site is impacted by overland flow flooding from the 1 in 100 year flood event.

Woolacotts engaged GRC Hydro to undertake two-dimensional overland flow flood modelling of the proposed development as specified in Section 3.0 above. A summary of the results of this modelling is provided below:

- The Tuflow modelling has shown that the site has very minimal overland flow flood affectation with a series of shallow overland flow paths and some areas of shallow ponding. Refer to Figure 5 below for the 1% AEP pre-developed flood extents and depths
- The 1% AEP rainfall intensity was increased by 10% to account for potential increases in rainfall. This in an in peak water levels by 0.01-0.02 m (except for the drainage channel where up to 0.06 m increase occurs). Based on this assessment it is concluded that the small size of the site's catchment means the climate change scenario does not have any significant effect on flood risk at the site.
- The proposed development is located in the eastern portion of the site where shallow overland flow flooding occurs in flood events up to and including the PMF
- The 1% AEP flood level impact that compared the changes in flood levels between existing and proposed conditions is shown in Figure 6 below. The 1% AEP flood levels range from 230m to 22.9m AHD within the vicinity of the buildings.
- As seen in Figure 6 below, the shallow flooding at the subject site is largely unaffected by the proposed development. The impact map shows the localised drainage on the east side of the site is partially blocked by the proposed raised area where a car park will be located. A new 0.375 m diameter culvert is proposed to drain the flow at this location. Impacts are minimal and do not affect any existing buildings or any areas outside of the campus.
- For the 1% AEP, the majority of the shallow flooding on the site results in a H1 hazard category. A H1 hazard classification is the lowest level of hazard and is generally safe for people, vehicles, and buildings. However, the western drainage path has H2 and H3 hazard classifications and there are very localised areas of H2 hazard classifications in the eastern portion of the site.
- Based on a flood planning level of 23.5m AHD, the proposed buildings are therefore sufficiently protected against overland flow flooding.

Refer to Appendix A for *the Overland Flow Flood Study* by GRC Hydro dated 23rd April 2021 for further information on overland flow flooding.

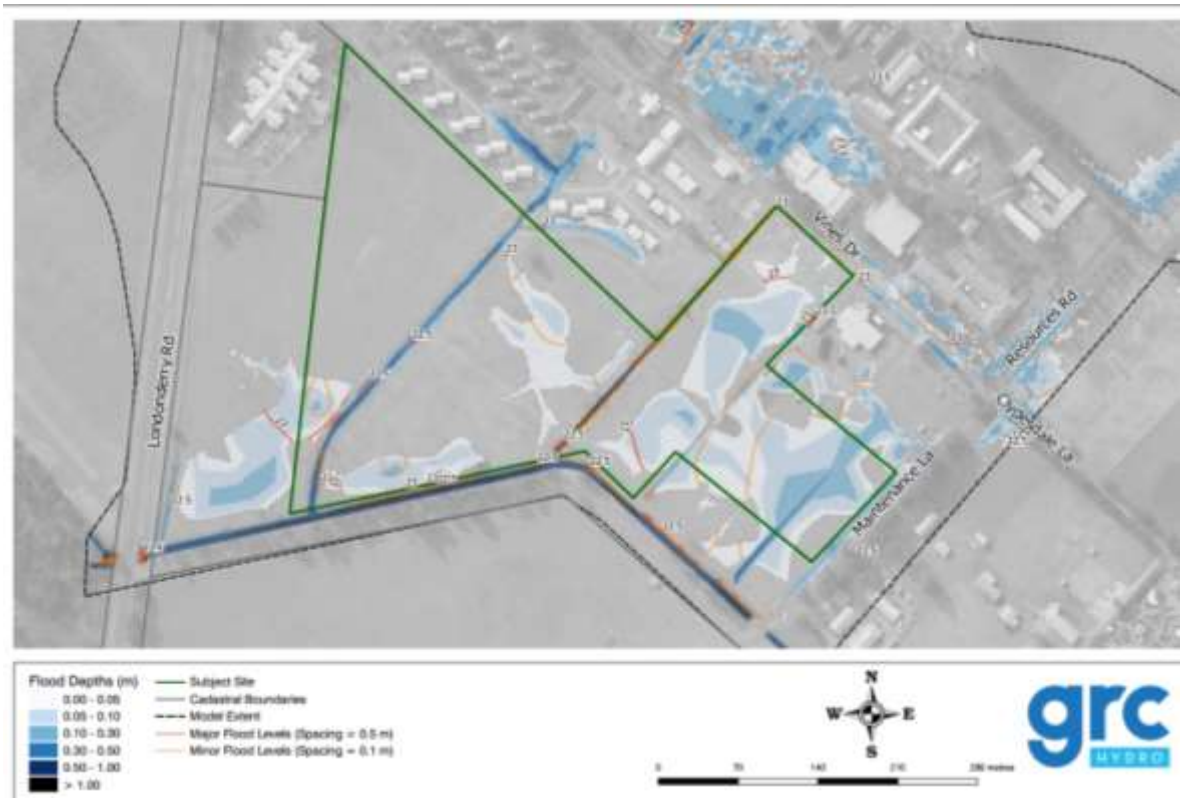


Figure 5 – 1% Pre-developed flood mapping (extract from *Overland Flow Flood Study)*

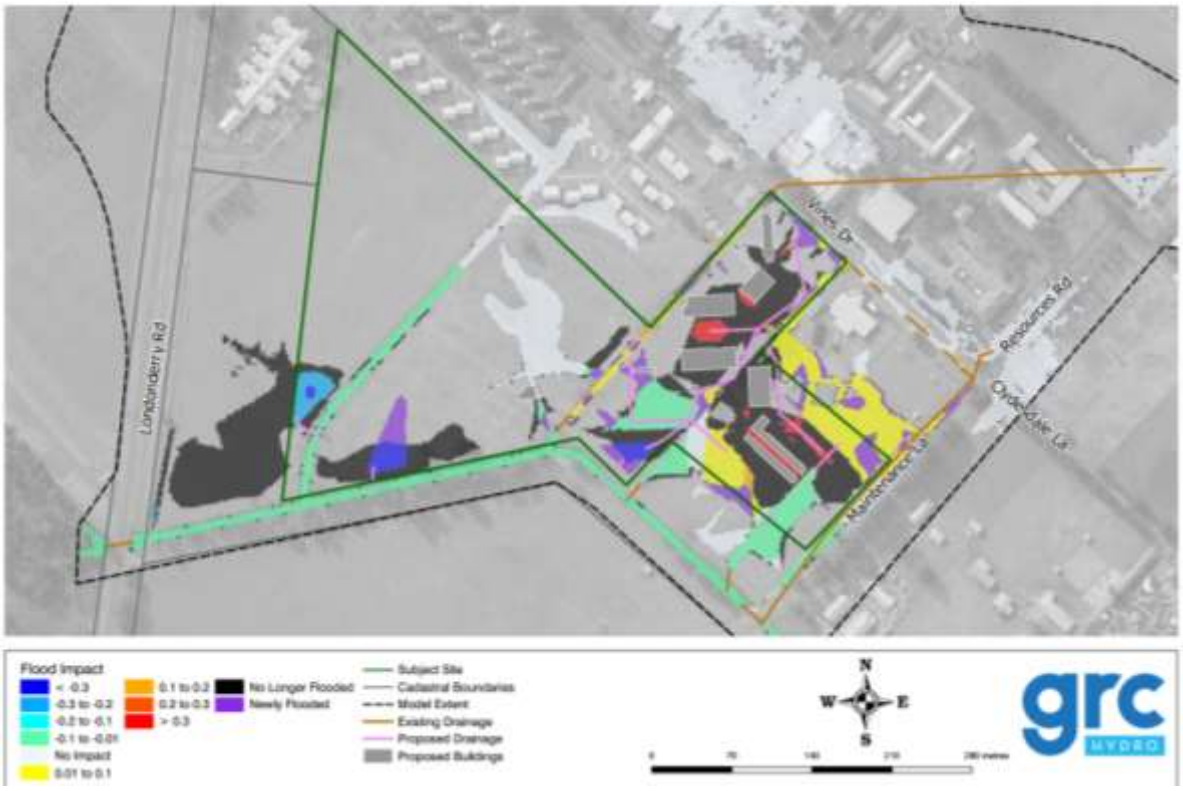


Figure 6 – 1% Post-developed flood mapping (extract from *Overland Flow Flood Study)*

5.0 Flood management and impacts

5.1 Minimum Floor Levels

According to Council requirements, the Finished Floor Levels must be located 500mm above the 1% AEP flood level. Overland flow flooding governs the minimum floor level requirements as it is higher than the riverine flooding for the 1% AEP (23.0m AHD versus 17.5m AHD). As a result, the minimum level is 23.5m AHD. Refer summary in Table 1 below.

Table 1 - Minimum Floor Level Information

Flood Type	**Riverine Flooding**	**Overland Flow Flooding**
Design flood level (1% AEP)	17.5m AHD	23.0m to 22.9m AHD
Freeboard	0.5m	0.5m
Flood Planning Level (FPL)	18.00m AHD (1% AEP + 0.5m Freeboard)	23.5m AHD (1% AEP + 0.5m Freeboard)
Probable Maximum Flood (PMF)	26.4m AHD	23.2 to 23.0m AHD

5.2 Flood Response

The two main responses to a flood emergency include evacuation or Shelter in Place. Evacuation involves moving to an area that is outside the reach of floodwaters, while Shelter in Place refers to staying within the building until floodwaters have receded and it is safe to leave.

Shelter in place is only possible if the proposed “shelter” is located above the PMF level. Given that the PMF level from riverine flooding is 26.4m AHD and the proposed development is single storey with a proposed FFL 23.5m AHD, shelter in place is not considered a feasible option. Therefore, a flood emergency management plan was required.

Refer to the *Flood Emergency Management Plan* (dated 28th April 2021, Revision A) for details of the flood response.

Appendix A
Overland Flow Flood Study

Woolacotts.
CONSULTING ENGINEERS

HAWKESBURY AGRICULTURAL CENTRE OF EXCELLENCE (CoE) OVERLAND FLOW FLOOD STUDY

APRIL 2021

grc HYDRO

Hawkesbury Agricultural Centre of Excellence (CoE) Overland Flow Flood Study

Project Number:	210010
Client:	Woolacotts Consulting Engineers
Client Contact:	Justin Chirillo
Report Author:	Christine Chang and Felix Taaffe
Date:	23 April 2021
Verified By:	

Date	Version	Description
23 April 2010	1	Hawkesbury Agricultural CoE Flood Study - DRAFT

Filepath: j:\210010\Admin\210010_Hawkesbury_Agricultural_Centre_of_Excellence_Study_DRAFT_v02.docx

GRC Hydro
Level 9, 233 Castlereagh Street
Sydney, NSW 2000
Tel: +61 432 477 036
Email: info@grchydro.com.au

This document is produced by GRC Hydro solely for the benefit and use by the client in accordance with the terms of the engagement. GRC Hydro does not and shall not assume any responsibility or liability whatsoever to any third party arising out of any use or reliance by any third party on the content of this document.

Contents

Figures

EXECUTIVE SUMMARY

A flood study has been undertaken for proposed development within the University of Western Sydney campus. The development consists of a series of buildings and a car park in what is currently a grassed area on the campus.

The assessment was carried out to determine overland flow flood behaviour at the site and assess the proposed development. A hydrologic and hydraulic model (DRAINS and TUFLOW) was used to establish that the site has very minimal overland flow flood affectation, with a series of shallow overland flowpaths and some areas of shallow ponding. Peak flood depths, levels and velocities and hazard has been mapped for the site.

The proposed development is located in the eastern portion of the site where shallow overland flow flooding occurs in flood events up to and including the PMF. It will involve raising and re-grading land, with new buildings' floor levels at or above the 1% AEP + 0.5 m level for overland flow flooding. The site will not significantly impact on existing flooding, with only a localised increase in one portion of the site. Based on this assessment the development is considered suitable for the site and in accordance with the SEARs requirements.

DRAFT

1. INTRODUCTION

This report has been prepared by GRC Hydro Pty Ltd on behalf of Woolacotts Consulting Engineers. Development of a grassed area of the Western Sydney University Hawkesbury Campus is proposed. The development will include a complex of single-story buildings and ancillary structures located between Vines Drive and Maintenance Lane. This report assesses flooding at the site in accordance with the Secretary's Environmental Assessment Requirements (SEARs). The subject site can be affected by both riverine flooding from the Hawkesbury River and local overland flow flooding. The current assessment only addresses overland flow flooding.

2. PROPOSED DEVELOPMENT

2.1 Site Description

The proposed Hawkesbury Agricultural Centre of Excellence (CoE) is to be located within the Western Sydney University Hawkesbury campus, in Richmond. The subject site is located in a portion of the campus bounded by Londonderry Road, Vines Drive and Maintenance Lane. The subject site area is approximately 11.6 ha. Existing school buildings within the campus are located on the northern side of the subject site. The north-west and southern side of the site are adjoining to private properties (Lot 133 under Anglicare Carol Allen House, and the lot at southern side of site under Greening Australia).

The terrain of the site is generally flat and slopes down slightly from north-west to south-east, with an elevation range of around 22 mAHD at the north-west corner of site and 24 mAHD at south-east end of site. A study area and digital elevation model (DEM) map is presented in Figure A-1.

2.2 Proposed Development

The proposed development consists of six single-story buildings and ancillary structures. The development is located in the eastern half of the subject site, generally between Vines Drive and Maintenance Lane. As part of the development, the subject site will be raised and re-graded around the proposed buildings. The development also includes a car park and access road.

2.3 SEARs SSDA Requirements

This flood study addresses the relevant Standard Secretary's Environmental Assessment Requirements (SEARs) for the proposed development, which include the assessment of hydrologic flows, potential flooding impacts and flood hazard considerations. Peak flood level, depth, extent and flood hazard have been produced for the 1% AEP and PMF events. The current study is for the purpose of addressing SEARs requirements pertaining to overland flow only.

2.4 Previous Studies

Flooding at the site was previously assessed by TTW (Civil Engineering Report and Stormwater Management Plan, Hurlstone Agricultural High School (Hawkesbury), May 2018). This included review of mainstream and overland flooding affectation at the site. Mainstream flooding was taken from

the Hawkesbury Floodplain Risk Management Study & Plan (December 2012, Bewsher). Overland flooding was assessed via a hydrologic model (DRAINS) and a hydraulic model (TUFLOW). The assessment identified localised overland flowpaths that pass across the site via existing drainage channels. The hydrologic and hydraulic models have then been utilised by GRC Hydro in the current study.

3. FLOODING ASSESSMENT

3.1 Model Setup

Existing flood behaviour at the subject was established for the 1% AEP and PMF events. The existing hydrologic and hydraulic models (DRAINS and TUFLOW) were reviewed and updated as part of the current assessment. Following review of the hydrologic and hydraulic models, minor updates were made include:

- Establishing a new DRAINS model based on slightly revised subcatchment layout, including splitting subcatchment 5 into four subcatchments as modelling indicated runoff did not concentrate to a single location in the existing subcatchment. The imperviousness percentage was also estimated for each subcatchment
- Adoption of rainfall-on-grid (also termed direct rainfall) for subcatchments 12 to 18. These subcatchments were in the subject site and so the redistribution of any flowpaths was better assessed via distribution of rainfall across the subcatchment.
- Revised Manning's n value in TUFLOW to represent the vegetation in the open paddocks and channels
- Adjusting the TUFLOW model's 1D drainage elements including the location and invert levels based on survey
- Adding additional downstream boundaries in the TUFLOW model to avoid artificial pooling of runoff against the model extent.
- Adjustments to the locations of the hydrologic model inflows in the TUFLOW model.

The revised subcatchment layout is shown in Image 1 and Image 2 below. Figure A-2 shows the model input layers.

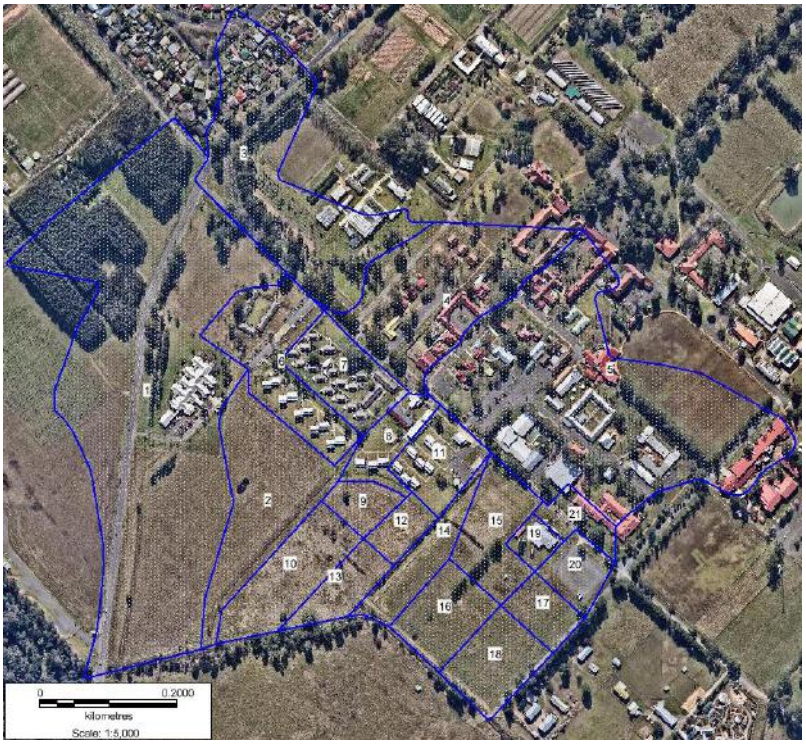


Image 1: Sub-Catchment Boundaries in TUFLOW Model (Civil Engineering Report and Stormwater Management Plan, by TTW, 2019)

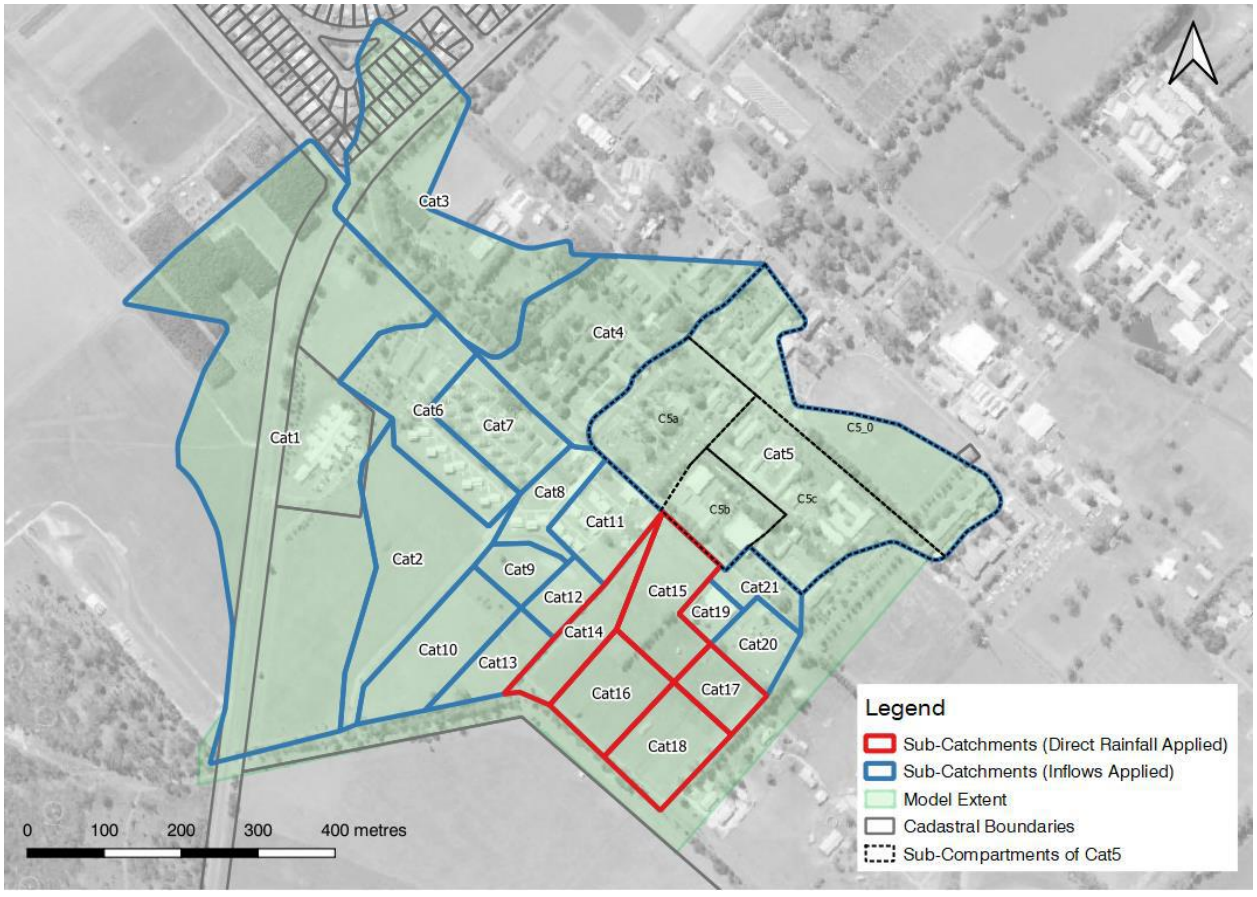


Image 2: Revised Sub-Catchment Boundaries

In the absence of calibration data for the site's catchment, the hydraulic model results were validated based on a review of the unit flow rate for the 1% AEP event. The unit flow rate is calculated as the 1% AEP peak flow, divided by the catchment size, to give a flow rate per hectare. GRC Hydro have estimated unit flow rates for many catchments across Sydney and find that values are consistently in the 0.1-0.4 m^3/s per hectare range, for overland flow catchments.

Two subcatchments were chosen for review of the unit flow rate, as shown on Image 3. The model results gave a 1% AEP flow on the west location of 1.3 m^3/s from a 4.5 ha catchment, or a unit flow rate of 0.3 m^3/s per hectare. The 1% AEP peak flow at the east location of 0.2 m^3/s from a 1.1 ha catchment, or a unit flow rate of 0.2 m^3/s per hectare. These values fall within the expected range and give a strong indication that the hydrologic and hydraulic model results are accurate and reliable.

The TUFLOW results for the 1% AEP were also compared to the previous TTW model. Revised results did not show major differences but in some areas flood depths were marginally different.

Image 3: Flow locations and Sub-Catchment Area of Unit Flow Rates Check

3.2 Existing Flood Behaviour

Hydraulic model results are presented in the following section, which include the assessment of hydrologic flows, potential flooding impacts and flood hazard considerations. Peak flood level, depth, extent and flood hazard have been produced for the 1% AEP and PMF events.

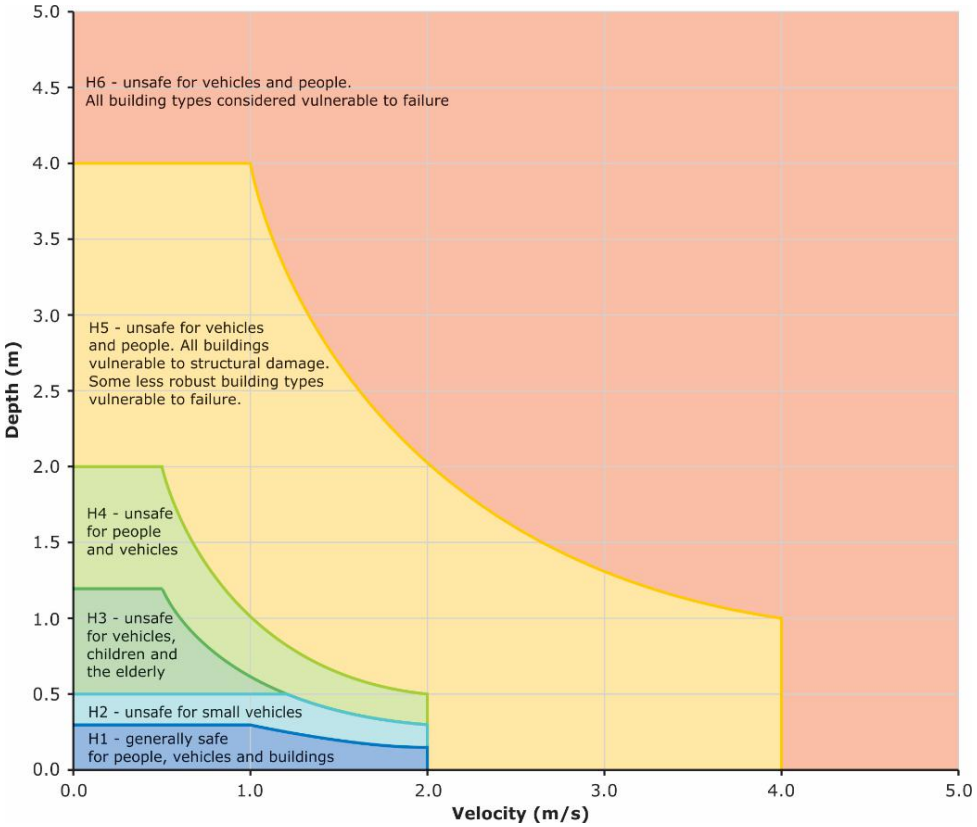
These are presented in Figure A-3 to Figure A-8, as follows:

- Figure A-3: Existing Flood Depths and Levels- 1% AEP;

- Figure A-4: Existing Flood Velocity- 1% AEP;
- Figure A-5: Existing Flood Hazard- 1% AEP;
- Figure A-6: Existing Flood Depths and Levels- PMF;
- Figure A-7: Existing Flood Velocity- PMF;
- Figure A-8: Existing Flood Hazard- PMF;

Flood hazard mapping has been developed through application of ARR2019 and Australian Emergency Management Institute (AEMI) flood hazard guidelines. The guidelines consider the threat to people, vehicles and buildings based on flood depth and velocity at a specific location. The AEMI flood hazard mapping can be used to assess the flood hazard for site occupants and proposed site usage, as well as for the community surrounding the site. The hazard categories are shown in Chart 1 below.

Chart 1: Flood Hazard Curves (Australian Emergency Management Handbook 7)



The results show there are several shallow overland flowpaths that pass through the subject site, generally from the north-east to the south-west. In the 1% AEP, flood depths at the site from west to east are:

- The western portion of the site is largely unaffected. There are depths of around 0.3-0.5 m in the drainage channel that traverses the site and drains to the south-west corner. There are some areas of localised ponding of around 0.1 m depth.
- There is a second drainage path near the centre of the site with depths of around 0.5 m.

- The east portion of the site has shallow ponding over a large area of around 0.1-0.3 m depth, draining via a third drainage path flowing south.

Of particular importance is the minimal upstream catchment of the subject site. Overall the site is largely draining runoff from rainfall that falls on the site itself, in addition to some small areas to the north. This means flooding at the site is minimal and in many locations would be considered local drainage overland flow, meaning specific flood planning controls are not warranted.

This type of shallow flooding is also shown on the hazard map, which for the 1% AEP shows virtually all flood-affected areas have the lowest level of hazard (H1), which is generally safe for people, vehicles and buildings. The exception is western drainage path has H2 and H3 hazard and there are very localised areas of H2 in the eastern portion.

In the PMF, flood depths are around 0.1-0.2 m higher than the 1% AEP across most of the site. The only larger difference is in the western drainage path which is 0.6 m higher. For the eastern portion of the site where development is proposed, the PMF is only slightly higher than the 1% AEP. Aside from the western drainage path, hazard is still predominantly H1 with some localised areas of H2.

Climate Change Assessment

The 1% AEP rainfall intensity was increased by 10% to account for potential increases in rainfall intensity associated with climate change. The procedures outlined in Book 1, Chapter 6 of ARR2019 were applied with the following parameters/assumptions; East Coast South Cluster, medium consequence risk rating, RCP4.5, 2090 planning horizon.

In the hydrological model, application of the 10% increased rainfall results in an average peak flow increase across the sub-catchments of around 13%. The augmented inflows to the hydraulic model (TUFLOW) translate to a general increase of peak water levels by 0.01-0.02 m or less, except for the drainage channel where up to 0.06 m increase occurs. Based on this assessment it is concluded that the small size of the site's catchment means the climate change scenario does not have any significant effect on flood risk at the site.

3.3 Assessment of Proposed Development

The proposed development is located in an area of shallow overland flooding. To assess the suitability of the development with regard to overland flow, the proposed design was schematised in the hydraulic model as a 'proposed' case. This was then used to assess flood risk to the site itself, and secondly, impact on the existing flood behaviour established in the previous section.

The model 'proposed' case was based on the design drawings and 3D TIN provided by Woolacotts and shown in Image 4. The proposed case in the hydraulic model consisted of:

- Incorporation of the proposed landform into the TUFLOW model grid;
- Integration of the new proposed stormwater network into TUFLOW model as 1D elements;

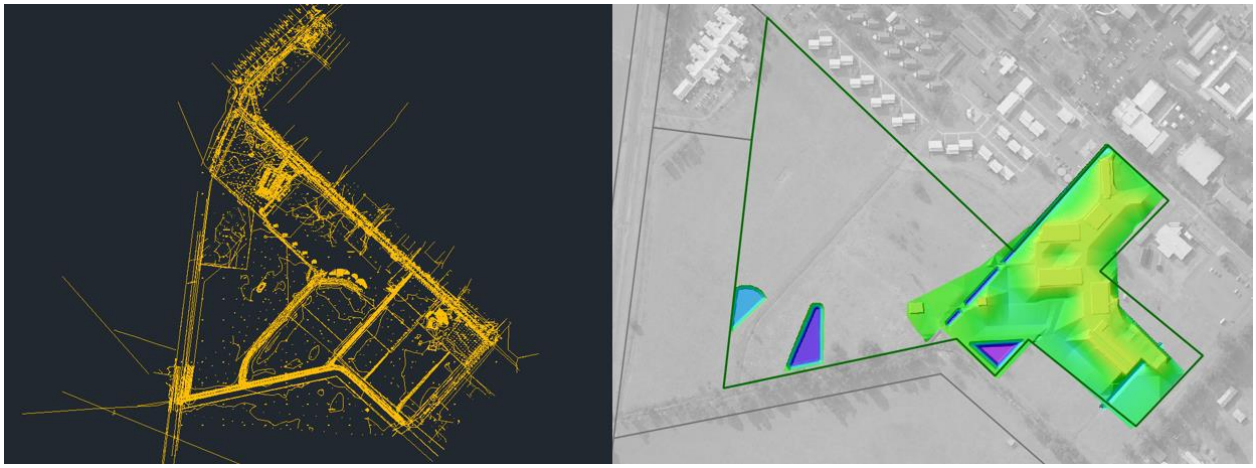


Image 4: Design Drawing and Converted 3D TIN of Site

The 1% AEP flood level impact that compared the changes in flood levels between existing and proposed conditions is presented in Figure A-9. As can be seen on the impact figure, the shallow flooding at the subject site is largely unaffected by the proposed development. The impact map shows the localised drainage on the east side of the site is partially blocked by the proposed raised area where a car park will be located. A new 0.375 m diameter culvert is proposed to drain the flow at this location. Impacts are minimal and do not affect any existing buildings or any areas outside of the campus. The impact map also shows areas of impact within the development area, for example some areas of red or increased flooding level, that are model artifacts of the rainfall-on-grid model approach, and not an actual adverse impact.

The floor levels for the proposed development are all set at 23.50 mAHD. The highest corresponding 1% AEP flood level is 23.0 mAHD near Block A, with Blocks B-F having flood levels of around 22.9. Review of Hawkesbury DCP indicates their Flood Policy 2020 does not apply to areas of overland flow, so a conventional flood planning level of 1% AEP + 0.5 m has been applied. Based on this flood planning level (23.5 mAHD), the proposed buildings are therefore sufficiently protected against overland flow flooding.

4. CONCLUSIONS

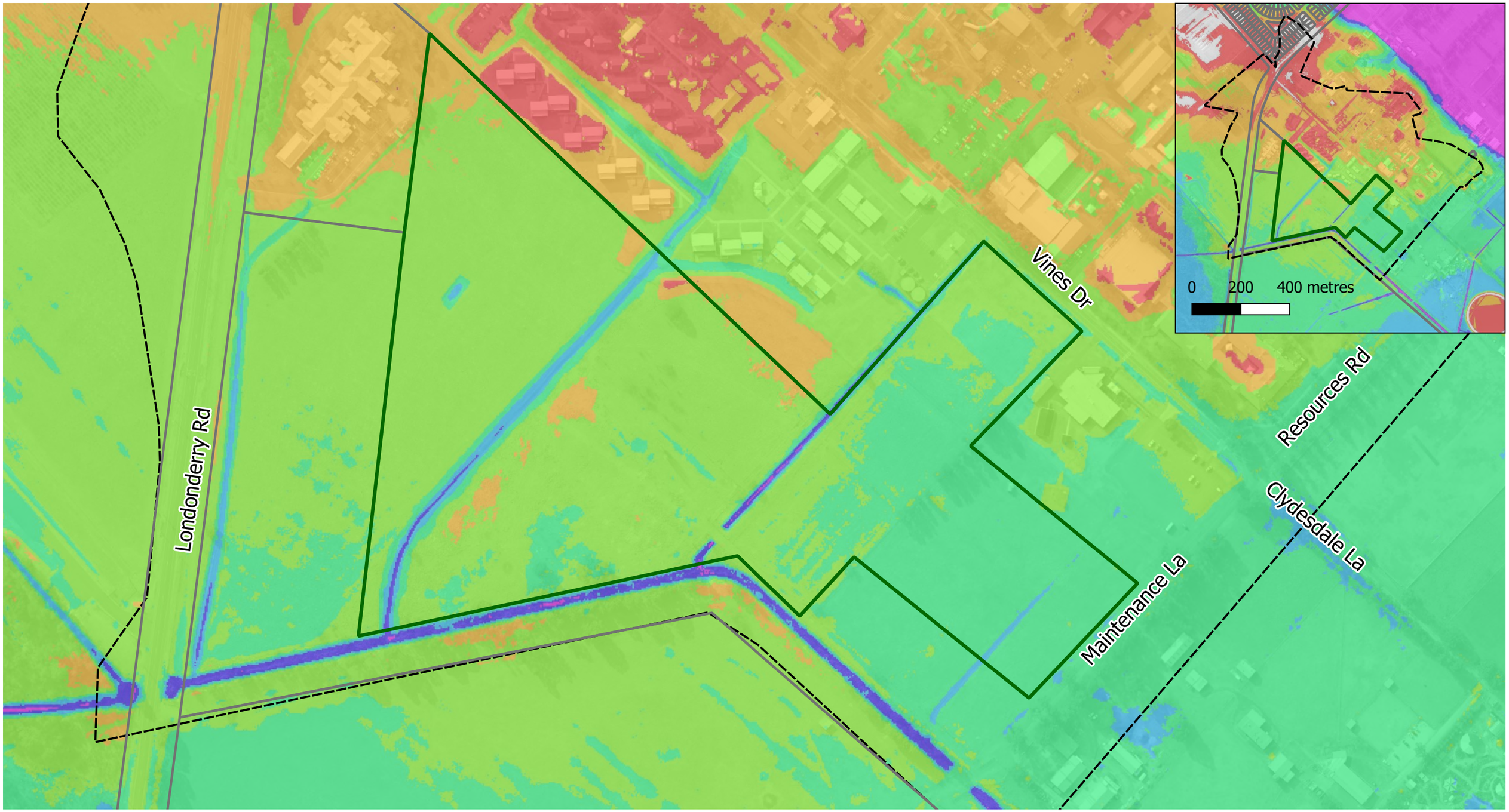
A flood study has been undertaken for proposed development within the University of Western Sydney campus. The development consists of a series of buildings and a car park in what is currently a grassed area on the campus.

The assessment was carried out to determine overland flow flood behaviour at the site and assess the proposed development. A hydrologic and hydraulic model (DRAINS and TUFLOW) was used to establish that the site has very minimal overland flow flood affectation, with a series of shallow overland flowpaths and some areas of shallow ponding. Peak flood depths, levels and velocities and hazard has been mapped for the site.

The proposed development is located in the eastern portion of the site where shallow overland flow flooding occurs in flood events up to and including the PMF. It will involve raising and re-grading land, with new buildings' floor levels at or above the 1% AEP + 0.5 m level for overland flow flooding.

The development will not significantly impact on existing flooding, with only a localised increase in one portion of the site. Based on this assessment the development is considered suitable for the site and in accordance with the SEARs requirements.

DRAFT



Ground Level (m AHD)

- <= 21.5
- 21.5 - 22.0
- 22.0 - 22.5
- 22.5 - 23.0
- 23.0 - 23.5
- 23.5 - 24.0
- 24.0 - 24.5
- > 24.5

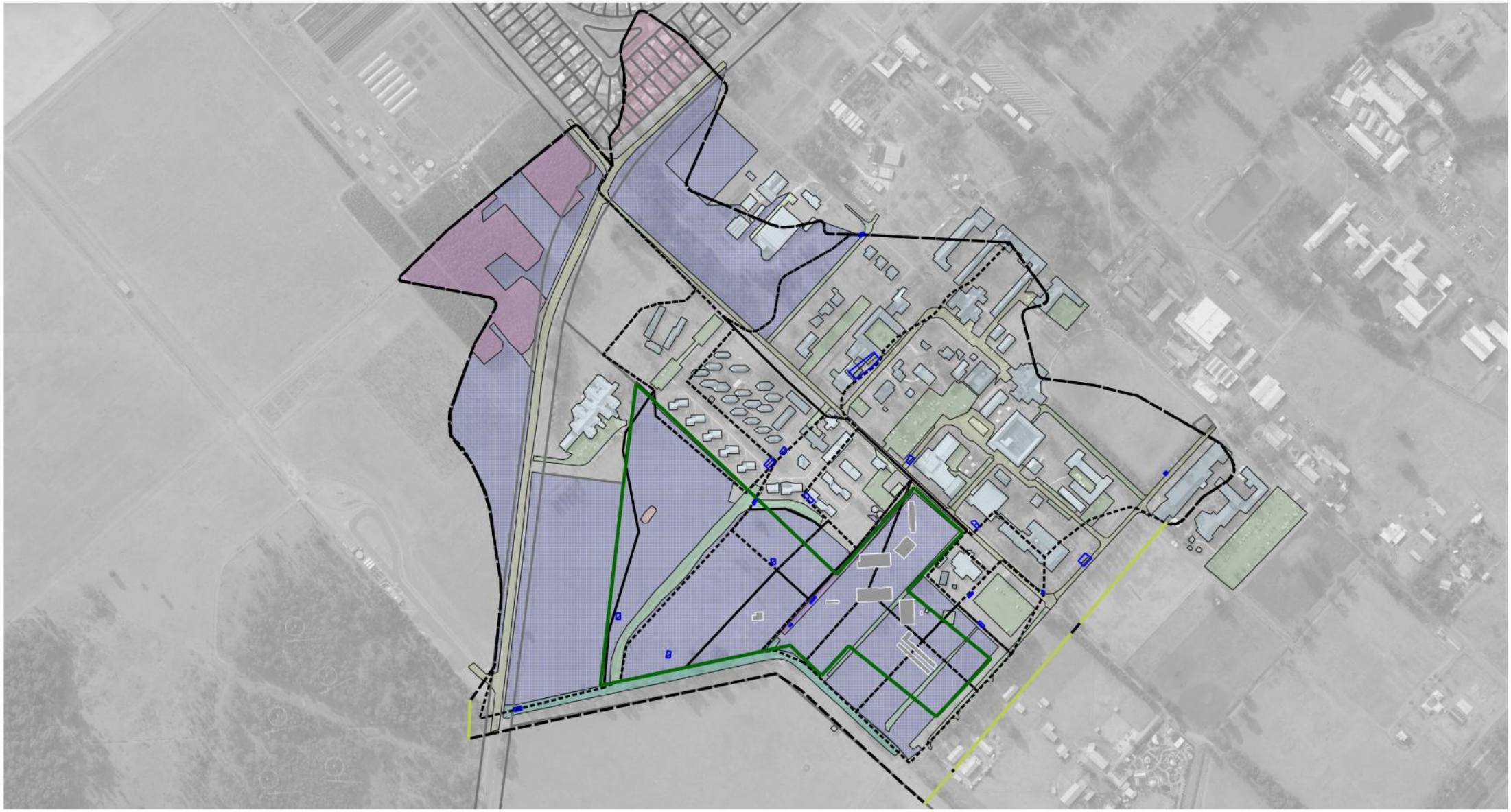
- Subject Site
- Cadastral Boundaries
- Model Extent

N W E S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Study Area and DEM**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **01**



Legend

- Carparks/ Impervious (n = 0.022)
- Buildings (n = 3.000)
- Ponds and other water bodies (n = 0.030)
- Bewly built/ Resurfaced road (n = 0.018)
- New residential block (n = 0.100)
- Trees (n = 0.200)
- Grass paddock (n = 0.065)
- Grass paddock (n = 0.025)
- Channel/ Swale (n = 0.035)
- Main channel/ Reeds (n = 0.025)

* n here represents Mannings Value

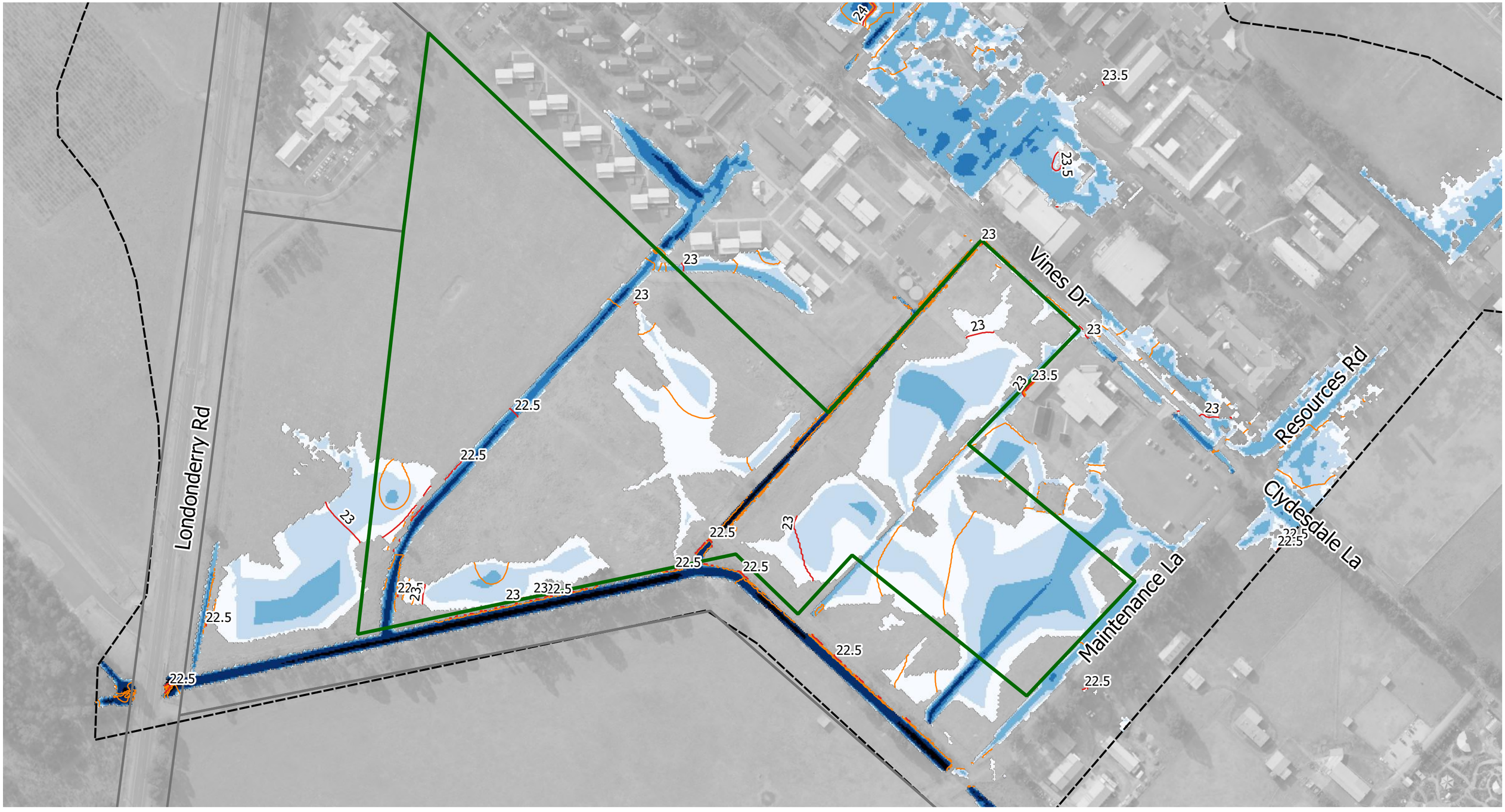
- Downstream Boundary
- Subject Site
- Cadastral Boundaries
- Model Extent
- Proposed Buildings

N W E S

0 100 200 300 400 metres

grc HYDRO

TITLE: **Hydraulic Model Inputs- Existing Conditions**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:5000**	FIGURE No. **02**



Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

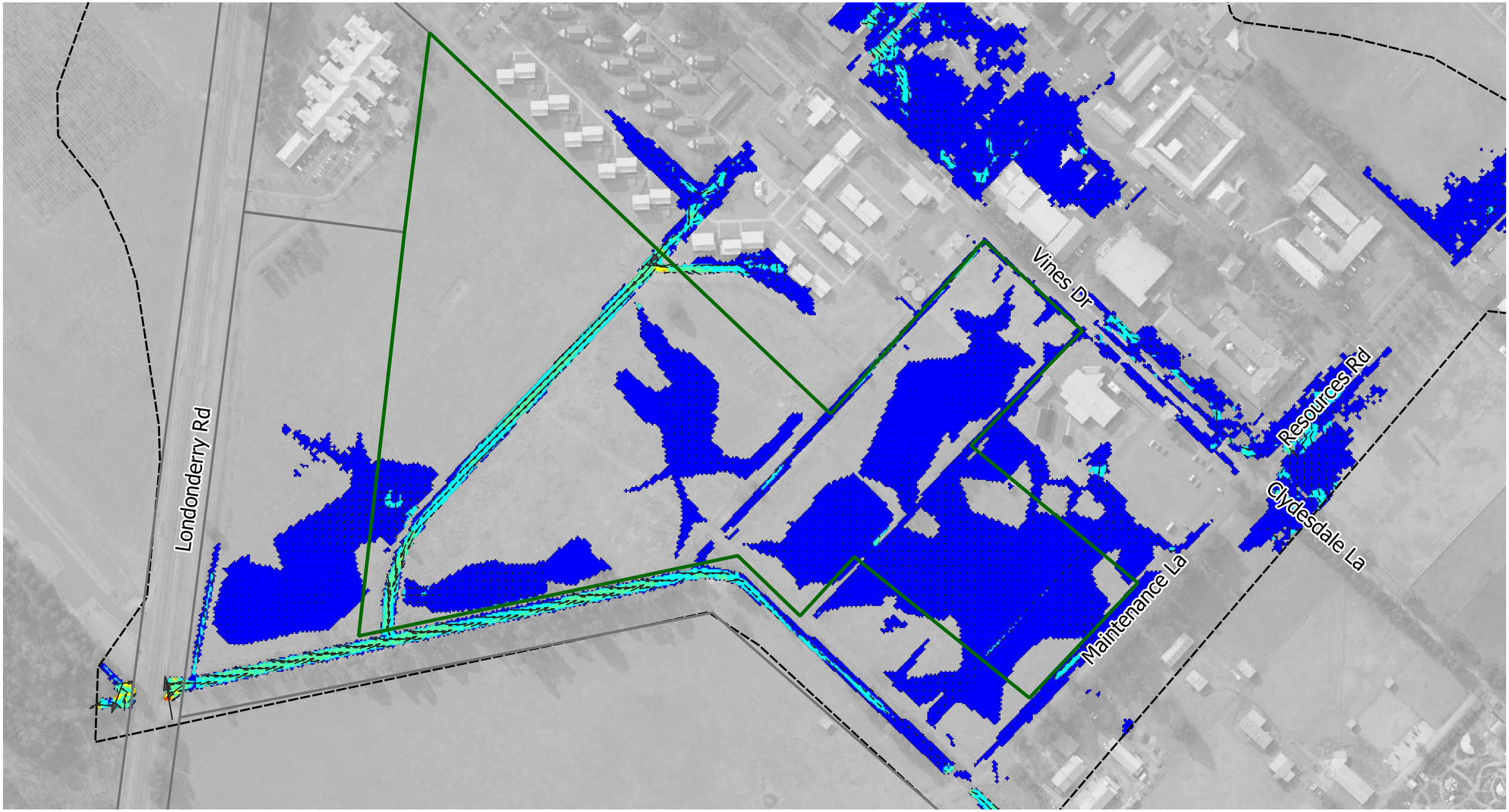
- Subject Site
- Cadastral Boundaries
- Model Extent
- Major Flood Levels (Spacing = 0.5 m)
- Minor Flood Levels (Spacing = 0.1 m)

N W E S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Existing Flood Depths and Levels- 1% AEP**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **03**



Flood Velocity (m/s)

- < -0.25
- 0.25 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- > 2.00

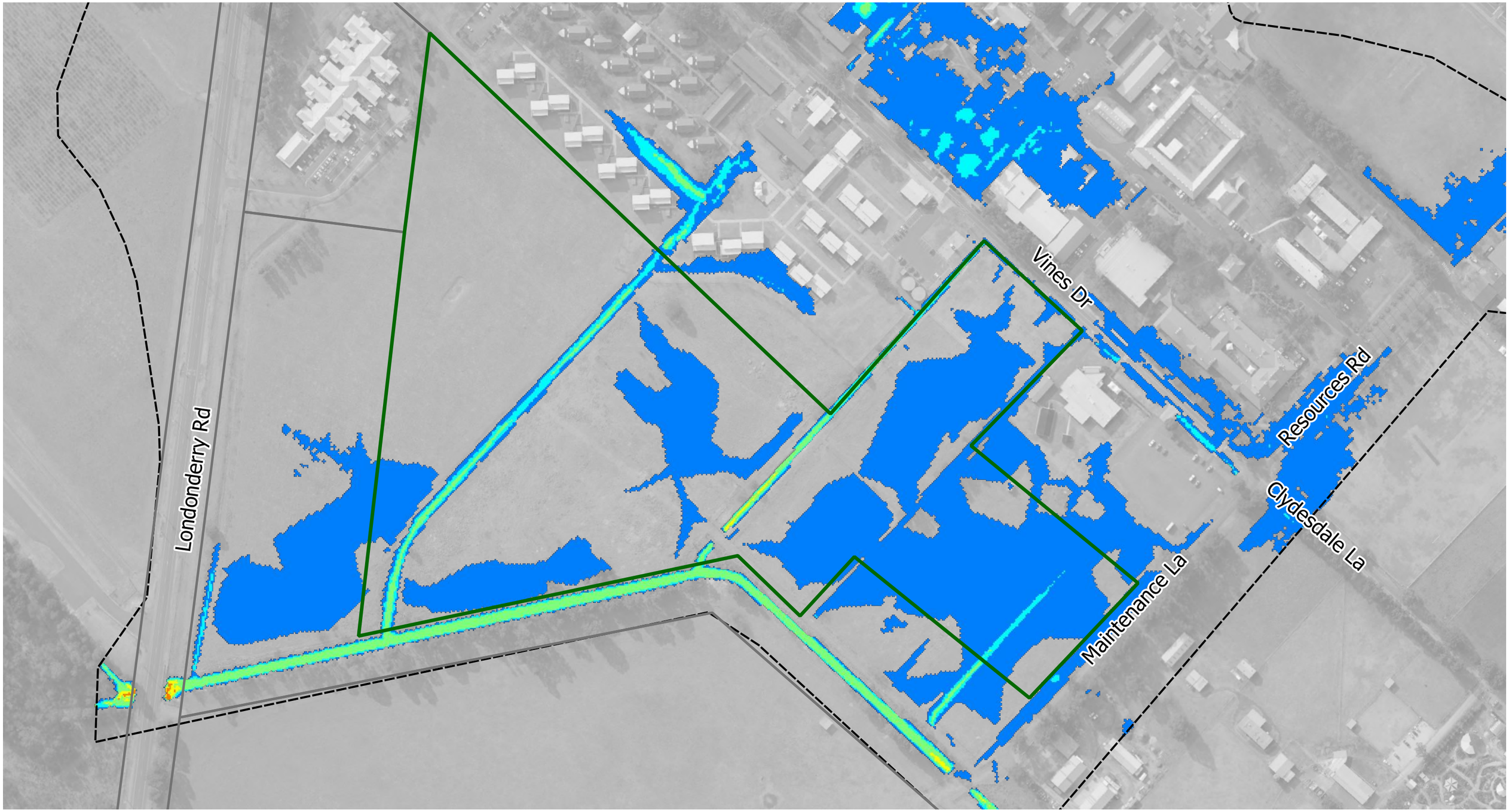
- Subject Site
- Cadastral Boundaries
- Model Extent
- Velocity Arrows

N W E S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Existing Flood Velocity- 1% AEP**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **04**



Flood Hazard (ZAEM1)
- H1
- H2
- H3
- H4
- H5
- H6

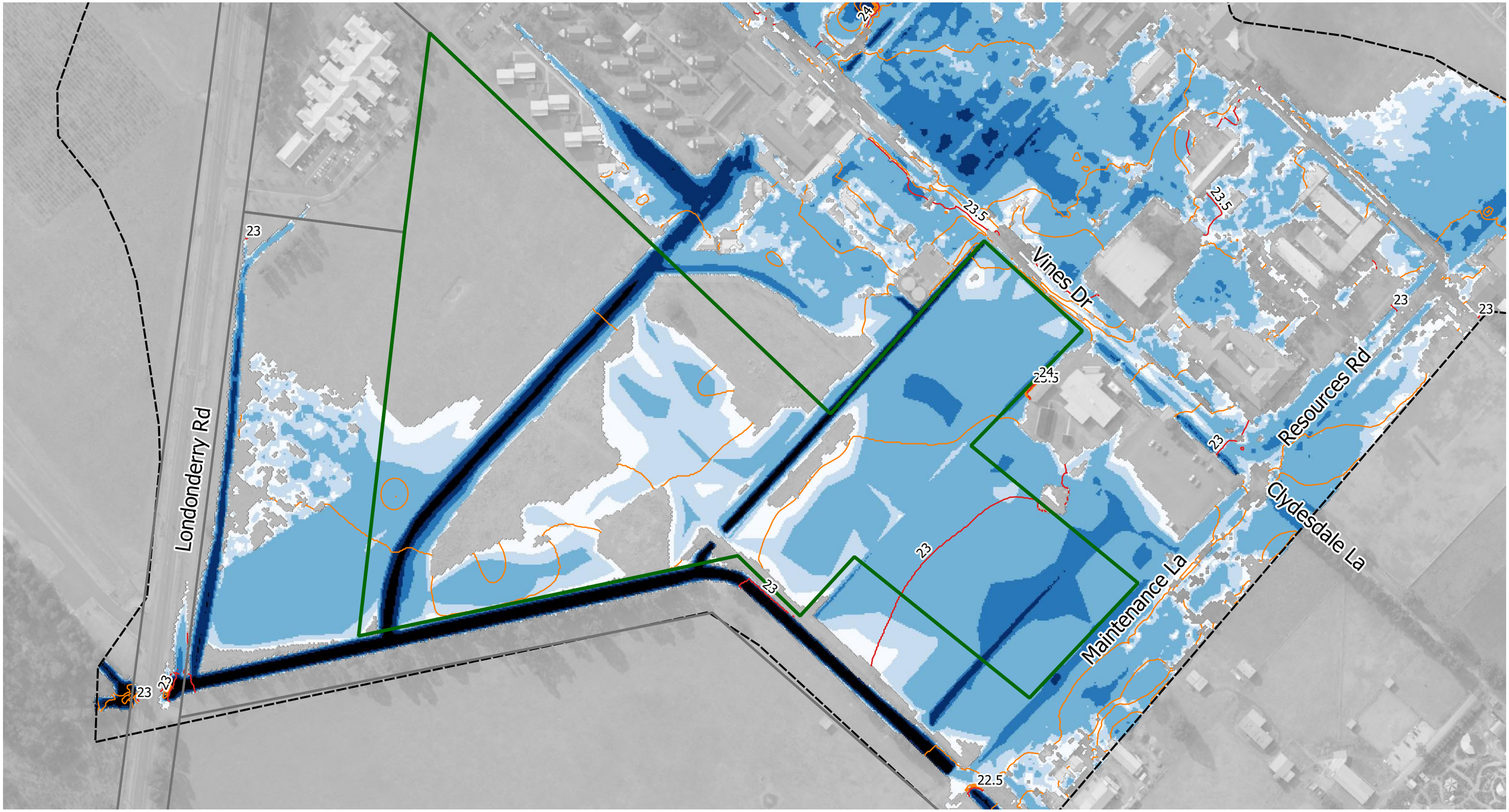
Subject Site
Cadastral Boundaries
Model Extent

N
W
E
S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Existing Flood Hzard- 1% AEP**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **05**



Flood Depths (m)

- 0.00 - 0.05
- 0.05 - 0.10
- 0.10 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- > 1.00

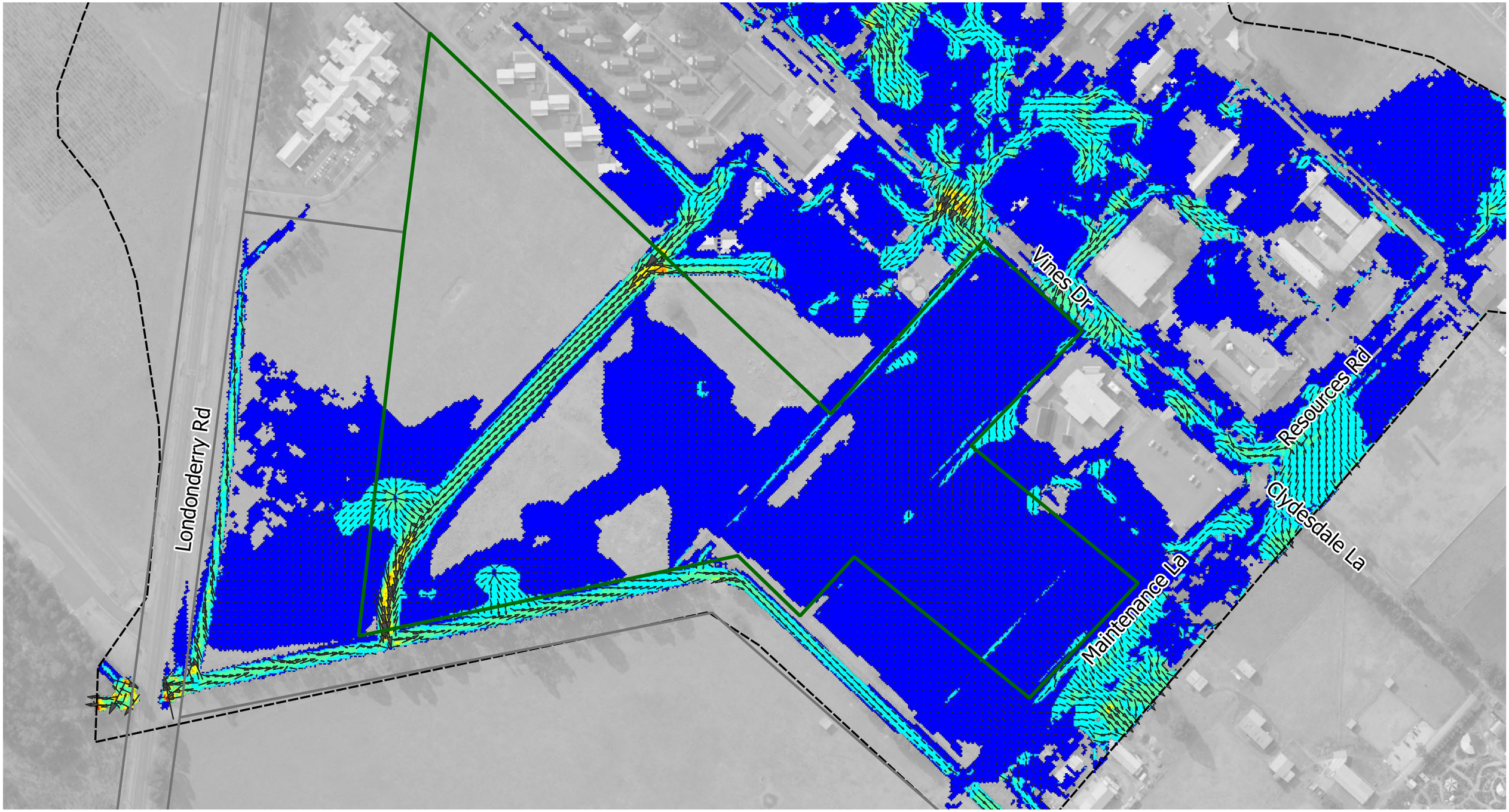
- Subject Site
- Cadastral Boundaries
- Model Extent
- Major Flood Levels (Spacing = 0.5 m)
- Minor Flood Levels (Spacing = 0.1 m)

N W E S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Existing Flood Depths and Levels- PMF**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **06**



Flood Velocity (m/s)
- < -0.25
- 0.25 to 0.50
- 0.50 to 1.00
- 1.00 to 1.50
- 1.50 to 2.00
- > 2.00

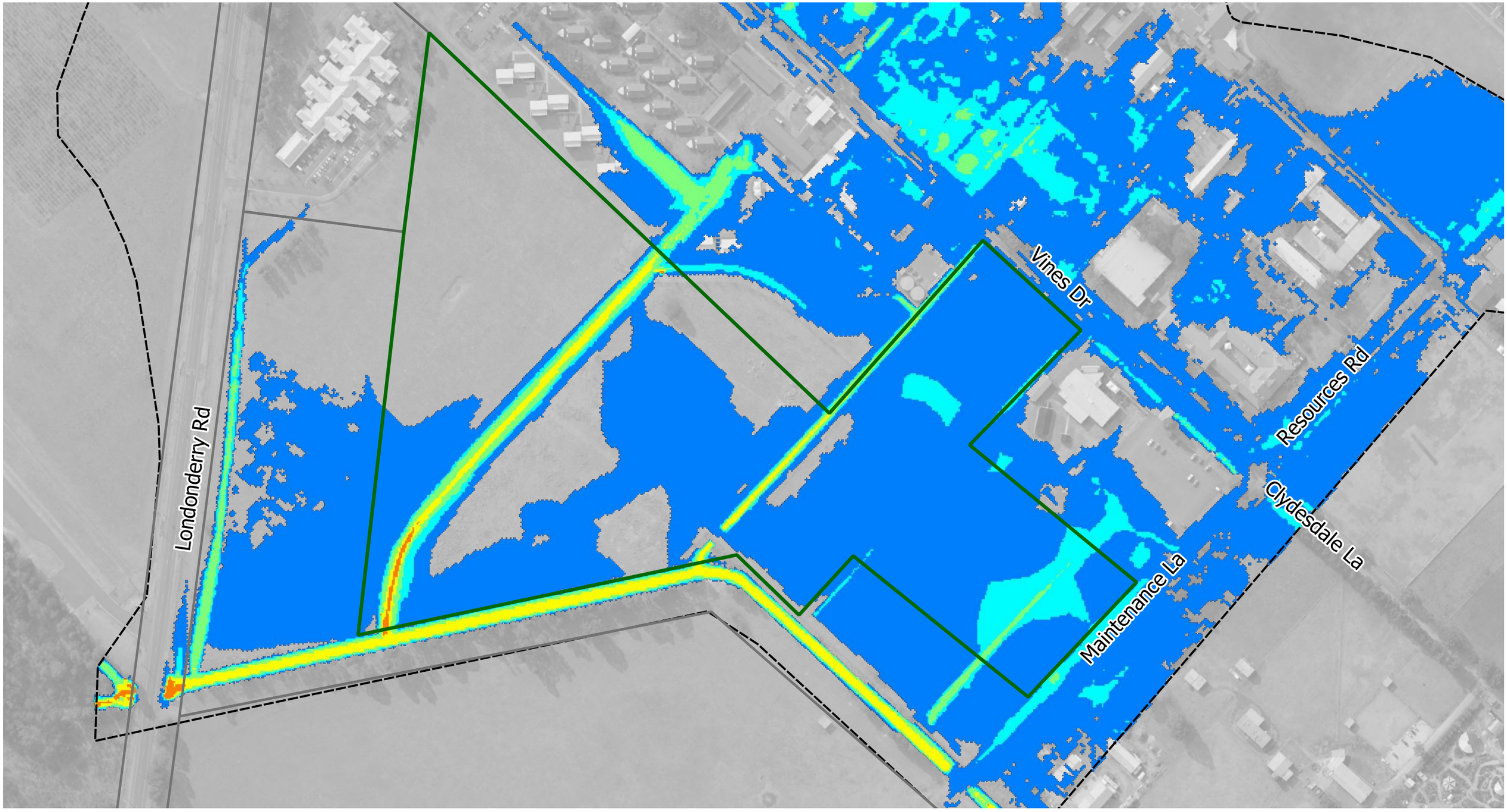
- Subject Site
- Cadastral Boundaries
- Model Extent
- Velocity Arrows

N W E S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Existing Flood Depths and Levels- PMF**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **07**



Flood Hazard (ZAEM1)
- H1
- H2
- H3
- H4
- H5
- H6

- Subject Site
- Cadastral Boundaries
- Model Extent

N
W E
S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Existing Flood Hzard- PMF**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **08**

Flood Impact

- < -0.3
- -0.3 to -0.2
- -0.2 to -0.1
- -0.1 to -0.01
- No Impact
- 0.01 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- > 0.3
- No Longer Flooded
- Newly Flooded

- Subject Site
- Cadastral Boundaries
- Model Extent
- Existing Drainage
- Proposed Drainage
- Proposed Buildings

N W E S

0 70 140 210 280 metres

grc HYDRO

TITLE: **Flood Impact- 1% AEP**	PROJECT: **Hawkesbury Agricultural CoE Flood Study**	PROJECT No. **210010**	DATE: **04-2021**	SCALE: **1:2500**	FIGURE No. **09**