Flood Impact Assessment Report

49 Hockeys Lane, 41 Main Road, and 126 Taylors Lane, Badagarang

Newpro 23 Pty Ltd

Monday 14th October 2024

Prepared by: Leo Zhou

DOCUMENT CONTROL

Issue	Date	Purpose	Author	Approved
A	14/10/2024	Issue for Council Approval	LZ	MV

This report has been prepared by Colliers International Engineering & Design (NSW) Pty Ltd and has undergone a quality assurance review. The signatures above confirm review completion.

Acknowledgement of Country

Colliers Engineering & Design would like to acknowledge the Aboriginal people of Dharawal Country who are the traditional custodians of the land and waters upon which this project is proposed to be built.

We also acknowledge the Wangal people as the traditional owners of the land upon which our Rhodes office is located.

Through them, we pay respects to all Aboriginal and Torres Strait Islander peoples and their elders past, present, and emerging.

Executive Summary

Newpro 23 Pty Ltd have commissioned Colliers Engineering & Design (CED) to undertake a flood impact assessment for the proposed development at 49 Hockeys Lane, 41 Main Road, and 126 Taylors Lane, Badagarang. A flood assessment for this development has previously been undertaken by Maker Eng in 2022, which was subsequently approved by Shoalhaven City Council in 2023 with the release of the Development Application conditions of consent under application number RA21/1003.

The works undertaken in this flood assessment aim to take the approved design for the development and investigate options for improving upon it to maximise the usable public open space area and achieve a more favourable outcome for flood behaviour on the site and flood impacts on the surrounding floodplain. Design options for flooding that have been investigated include:

- Re-designing the northern diversion swale to be able to contain and convey upstream catchment flows towards Good Dog Creek, whilst conforming more closely with the existing topography and catchment behaviour and reducing the swale depth and batter slopes.
- Amending the southwestern treatment swale width and slope to reduce the 1% AEP flood hazard within the swale to H2 which is safe for people and vehicles.
- Converting the swale within the open space area upstream of the site outlet into a culvert system extending to the site boundary to maximise the usable open space area as well as remove the risk of any exposure to high hazard flooding to people on site.
- Lowering the discharge pit levels and invert of the northern wetland (Wetland A) to increase the on-site flood storage, allowing the site to accommodate the 1% AEP with climate change event (the 2100 scenario 1% AEP event) without any flood affectation of the internal roads and lots.

Hydraulic modelling was undertaken for these options and the assessment found that the options investigated were successful in increasing the amount of usable open space and reducing the flood hazard and risk to life on site, as well as generally maintaining or improving upon the off-site flood impacts when compared with the flooding outcomes from the approved Development Application. It is also shown that these improvements can take place whilst complying with the conditions of consent and in accordance with Shoalhaven City Council's guidelines.

Table of Contents

Table of Figures

Table of Tables

Abbreviations

AEP	Annual Exceedance Probability
ARI	Annual Recurrence Interval
AR&R/ARR	Australian Rainfall & Runoff
BCFRMS	Bomaderry Creek Floodplain Risk Management Study
CED	Colliers International Engineering & Design (NSW) Pty Ltd
Council/SCC	Shoalhaven City Council
DCP	Development Control Plan
DEM	Digital Elevation Model
GSDM	Generalised Short Duration Method
LEP	Local Environmental Plan
LiDAR	Light Detection and Ranging
OSD	On-site Stormwater Detention
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
QGIS	Quantum Geographic Information System
TIN	Triangulated Irregular Network

1. Introduction

1.1. Background and Context

Colliers Engineering & Design (NSW) Ltd (CED) was engaged by Newpro 23 Pty Ltd to undertake a Flood Impact Assessment for the development approved under Development Consent RA21/1003 for the subdivision of Lot 7 DP 1256748 on 49 Hockeys Lane, Cambewarra, Lot 4 DP 542936 and Lot 1272 DP 1264383 41 Main Road, Cambewarra, as well as Lot 6 DP 1256748 on 126 Taylors Lane, Cambewarra (the subject site). The current lot and plan numbers for the subject site are Lots 2 and 3 in DP 1281802, Lots 1 and 2 in DP 1256748, and Lot 62 DP 1281131. This assessment has been developed to assess opportunities to improve upon the previously approved development in terms of the flooding outcomes whilst ensuring the development still complies with the conditions of consent and Shoalhaven City Council's guidelines.

Previously a flood impact assessment was prepared by Maker Eng in 2022 to support two Development Applications (DA) for the proposed subdivision on the subject site. This was documented in the "Integrated Water Cycle Management Strategy for Proposed Subdivision of 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra" report (Maker Eng, 2022) and the accompanying memorandum "49 Hockeys Lane, 41 Main Road, and 126 Taylors Lane, Cambewarra Revised On Site Detention Strategy" (Maker Eng, 2022), which were subsequently approved by Shoalhaven City Council in 2023. The DAs were initially separated into one for the combined lots on Main Road and Hockeys Lane, and one for the lot on Taylors Lane. However, a consolidated DA consent with combined conditions of consent was released under RA21/1003, incorporating modifications DS23/3181 and DS24/1082.

The scope of works for this flood impact assessment includes a review the modelling undertaken by Maker Eng and investigating opportunities to improve upon the flooding impacts and outcomes in the approved DA, in particular reducing the flood hazard and off-site flood impacts. It includes an analysis of the existing conditions flow regime and peak flood levels for the 20%, 5%, 1% Annual Exceedance Probability (AEP), 1% AEP with climate change (representing the 2100 1% AEP scenario), and Probable Maximum Flood (PMF) storm events across the subject site, and any potential impacts or changes to the flow regime that may be caused by the proposed development. The analysis is undertaken in accordance with Shoalhaven City Council's ('Council') flood policies and this report provides an overview of the background, methodology, key assumptions and results for the assessment undertaken in accordance with Shoalhaven City Council's Local Environmental Plan (LEP) (2014), Development Control Plan (DCP) (2014), the latest NSW Flood Risk Management Manual (NSW Department of Planning and Environment, 2023) and Australian Rainfall & Runoff (1987).

1.2. Objectives

The objective of this assessment is to investigate options to improve the development's off-site flood effects which Council has already approved, and to see if there are any opportunities to maximise the usable open space for Council.

The scope of work for this analysis includes the following:

- Review available data, guidelines, plans and background for the project;
- Run the hydraulic model for the 20%, 5%, 1% AEP, 1% AEP with climate change and PMF storm events utilising Council's Bomaderry Creek TUFLOW hydraulic model (2016) as the base model, with additional detailed site survey, to gain an understanding of the existing conditions flow regime;
- Build in the proposed development conditions for the approved development and rerun the model for the same storm events;

- Compare existing and developed conditions to formulate an analysis of the impacts to the flood regime due to development;
- Investigate design options to improve upon approved development that results in more public open space for Council and better flooding outcomes for the site and adjoining properties within the floodplain; and
- Prepare a Flood Impact Assessment Report for submission that includes an outline of approach and methodology, key assumptions, results and recommendations.

2. Study Area and Development Description

2.1. Existing Site

The subject site is located north of Nowra and southwest of Wollongong within the Local Government Area (LGA) of Shoalhaven City Council and also falls within the Moss Vale Road South Urban Release Area.

The land currently contains partially constructed Stages of the approved DA RA21/1003 which has been rezoned as a combination of R1 – general residential and RE1 – public recreation under the Shoalhaven LEP 2014 instrument. The first two Stages of the approved development that are under construction includes excavation of the two wetlands which follows the alignment of the existing unnamed waterway on site (prior to any development), as well as associated earthworks, roadworks and stormwater drainage works.

The site is bordered by Good Dog Creek to the southwest, which is a tributary of Bomaderry Creek. The subject site generally falls from the north to south of the property at a grade of approximately 1.5%. There is a ridgeline in the centre of the site going from north to south that splits the site catchment to the west and east. The western portion of the site drains towards Good Dog Creek, whilst the eastern portion of the site drains to the existing unnamed watercourse which eventually converges with Good Dog Creek. Refer to Figure 1 for the site locality.

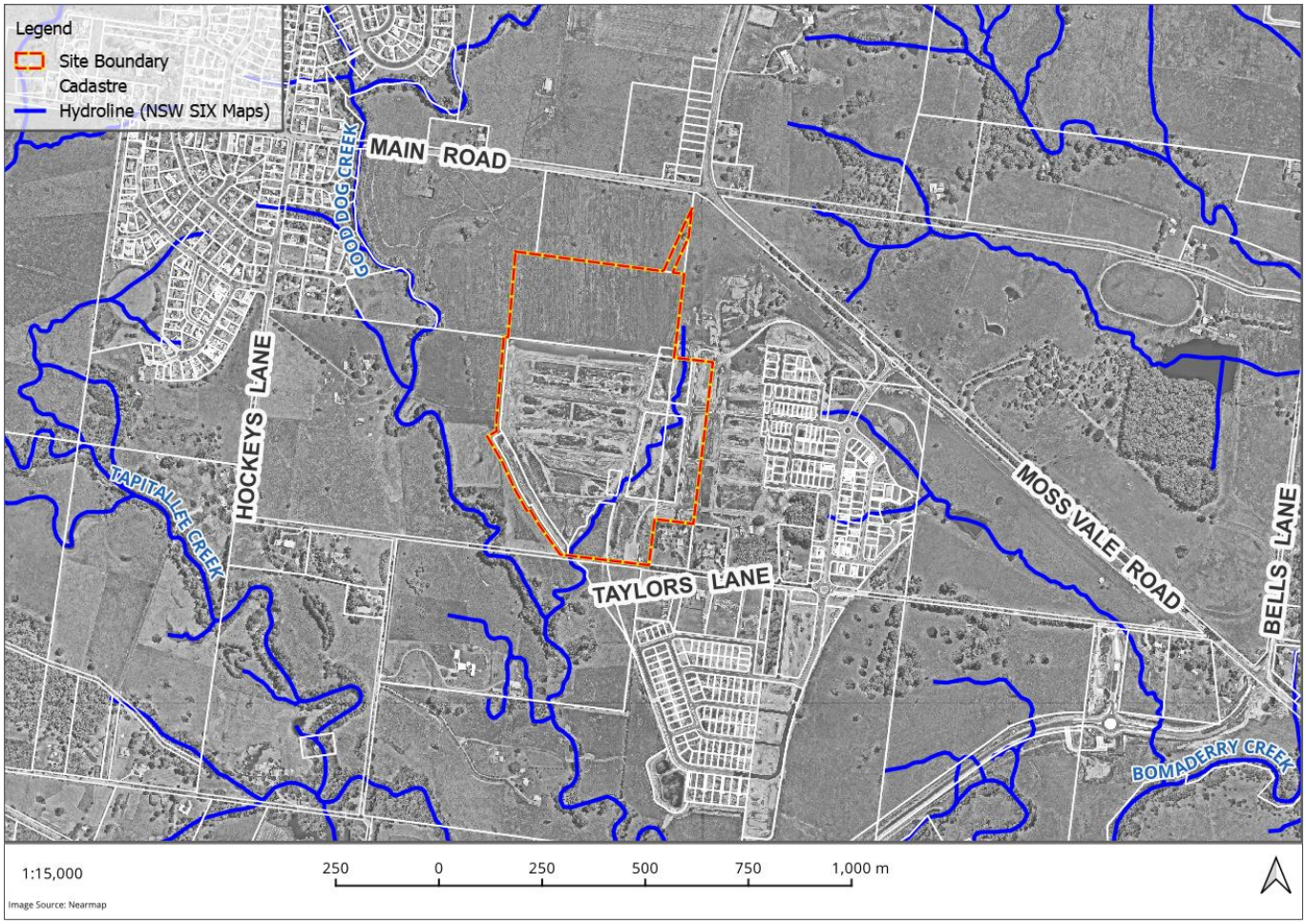


Figure 1 Locality Plan

2.2. Development Description

The proposed development as part of DA RA21/1003 consists of demolition of existing structures and subdivision into 258 residential lots on the Main Road and Hockeys Lane combined lot, and 30 residential lots on the Taylors Lane lot, with associated infrastructure including roads and stormwater drainage and associated cut and fill to create developable residential lots. There is also proposed to be two wetlands, a bioretention basin, and rainwater tanks on each lot on site to manage the development's water quantity and quality objectives. Refer to Figure 2 below for the proposed subdivision layout.

In reviewing the proposed development approved as part of DA RA21/1003, CED have identified several potential areas for improvement in flood behaviour, primarily within the proposed swales and wetlands. The purpose of this site-specific flood assessment is to demonstrate that the improvements to the proposed development can take place in line with the performance requirements of development within the floodplain. The development is largely consistent with the approved DA, however amendments have been made to provide Council with more open space and deliver a better outcome for flood behaviour and off-site impacts whilst complying with the conditions of consent and Council's guidelines. These amendments have been detailed below.

- The northern swale (Swale 1) has been regraded and redesigned to contain and convey the flows from the upstream catchment to Good Dog Creek. A crest was designed in the swale that is consistent with the existing ridgeline of the upstream catchment. This allows the terrain to mimic the pre-development catchments more closely. By doing so, a sag point is introduced in the swale at the north-eastern corner of the site, in line with the ephemeral waterway that existed prior to any development. A pit and pipe system has been proposed at the sag point to take in a portion of the upstream catchment flows through the subject site. The effect of this change is a reduction in the swale depth and batter slopes within the northern swale, and a more accurate representation of the pre-development catchment behaviour.
- The southwestern treatment swale (Swale 2) width and slope has been amended, with vegetation and rock lining being introduced to the outlet of the swale. The outcome of these changes is a reduction in the flood hazard to H2 which is considered to be safe for people and vehicles.
- The open park space immediately upstream of the site outlet has been redesigned to convert the open swale that was previously proposed, into a culvert system which discharges to the existing watercourse via a headwall outlet at the site boundary. This change allows for more usable open space area within the lot as well as removing the risk of exposure to high hazard flooding to any occupants.
- The discharge control pit levels in Wetland A (the northern wetland), and consequently the floor of the wetland, was lowered by 0.65m. This amendment was actioned to provide more on-site detention flood storage to accommodate rarer storm events such as the 1% AEP event with climate change (the 2100 scenario 1% AEP event).
- The bioretention basin footprint and outlet has been adjusted to improve upon the stormwater quality objectives.

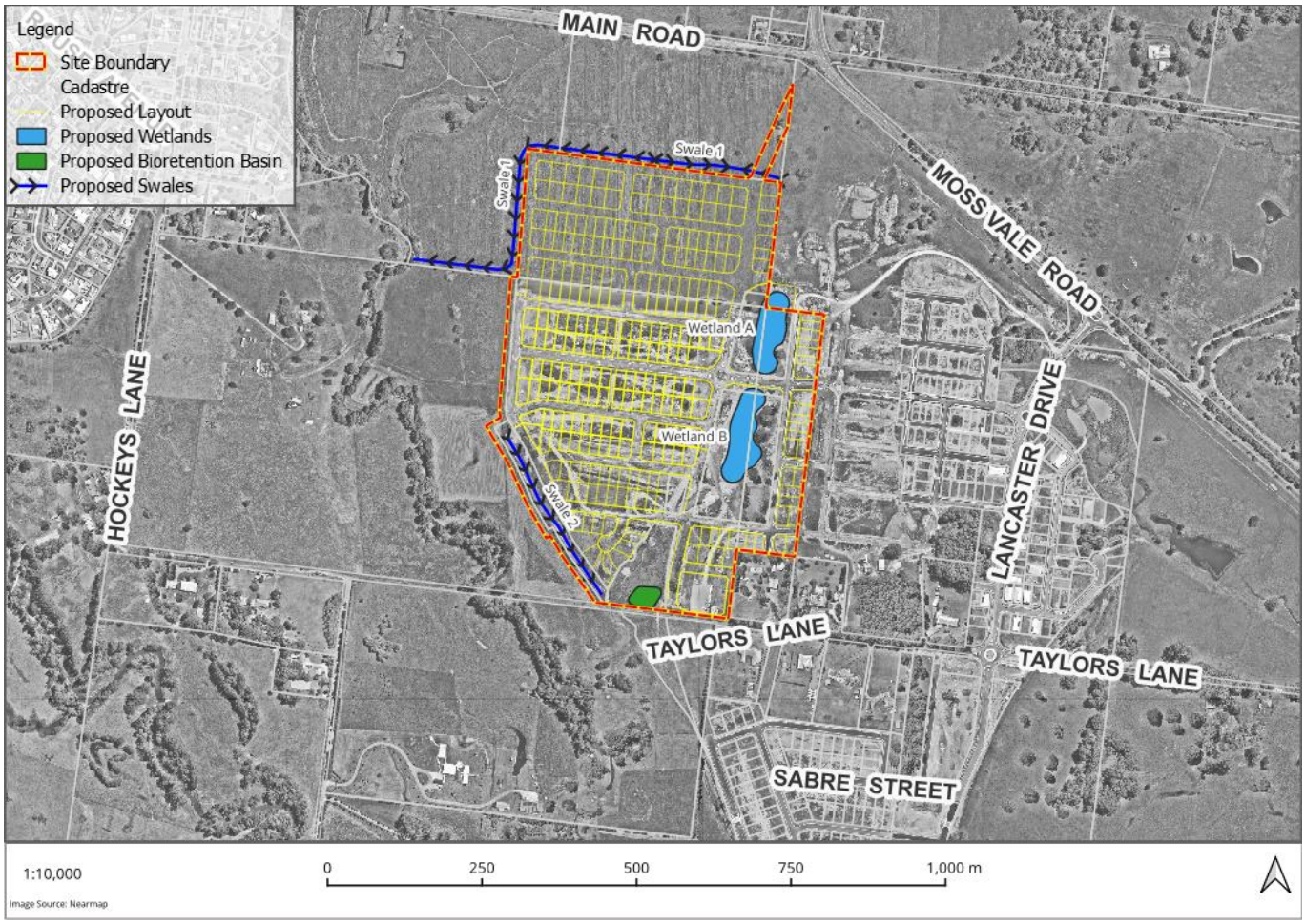


Figure 2 Proposed development layout

3. Data Collation and Review

3.1. Reference Policies and Guidelines

The following documents have been referenced in developing the civil and stormwater documentation for the proposed development:

- 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
- NSW Department of Planning and Environment, 2023, Flood Risk Management Manual
- SEEC, 2018, Integrated Water Cycle Management Assessment For Moss Vale Road South Urban Release Area
- Shoalhaven City Council, 2014, Development Control Plan
- Shoalhaven City Council, 2014, Local Environmental Plan

3.2. Data

The following data has been utilised in the development of the detailed hydrologic and hydraulic modelling for the site:

- Bomaderry Creek Flood Study and the associated TUFLOW hydraulic and XP-RAFTS hydrologic models (BMT WBM, 2010)
- Bomaderry Creek Floodplain Risk Management Study and the associated updated TUFLOW hydraulic and XP-RAFTS hydrologic models (Cardno, 2016)
- Underground stormwater drainage network for proposed development and surrounding area (CED, 2024)
- Civil design earthworks grading (CED, 2024)

4. Flood Modelling

This Flood Impact Assessment has adopted the Bomaderry Creek Floodplain Risk Management Study Model, as provided by Council's flood engineer on 30th April 2024. This flood model was previously prepared by Cardno (now Stantec) in 2016 and built on the original flood study developed by BMT WBM in 2010. The hydrologic model was built in XP-RAFTS, and the hydraulic model was built in the industry standard software, TUFLOW.

The model has been approved by Council and is appropriate to adopt for this assessment, therefore, within this report we highlight only the changes that were incorporated into the model to facilitate site-specific modelling and the accompanying report for the Bomaderry Creek Flood Study (BMT WBM, 2010) and the Bomaderry Creek Floodplain Risk Management Study (Cardno, 2016), hereafter referred to as the **BCFRMS**, should be referred to for other modelling parameters.

4.1. Hydrology Approach

The hydrologic modelling approach adopted within the TUFLOW model utilised inflow hydrographs developed in a separate XP-RAFTS hydrologic model following the ARR87 methodology. These were input into the TUFLOW model as point inflow boundaries located towards the outlet of each sub-catchment.

The XP-RAFTS model and sub-catchment delineations provided in the BCFRMS were used as the foundation for updated hydrologic modelling for the proposed development.

4.1.1. Pre-Development Scenario Hydrology

The pre-development hydrological scenario was modelled with the following catchment conditions:

1. The subject site is considered to be in its fully undeveloped state.
2. The neighbouring subdivision east of the subject site (which is currently under construction) is considered to be fully developed.

In the pre-development scenario, the sub-catchment boundaries around the proposed site were adjusted to suit the site boundaries and the proposed subdivision to the east of the site, as well as the updated terrain from the detailed survey. Based on these updated sub-catchments, an amended pre-development hydrologic model was produced. The sub-catchment delineation for the pre-development and post-development scenarios is shown in Figure 3 below.

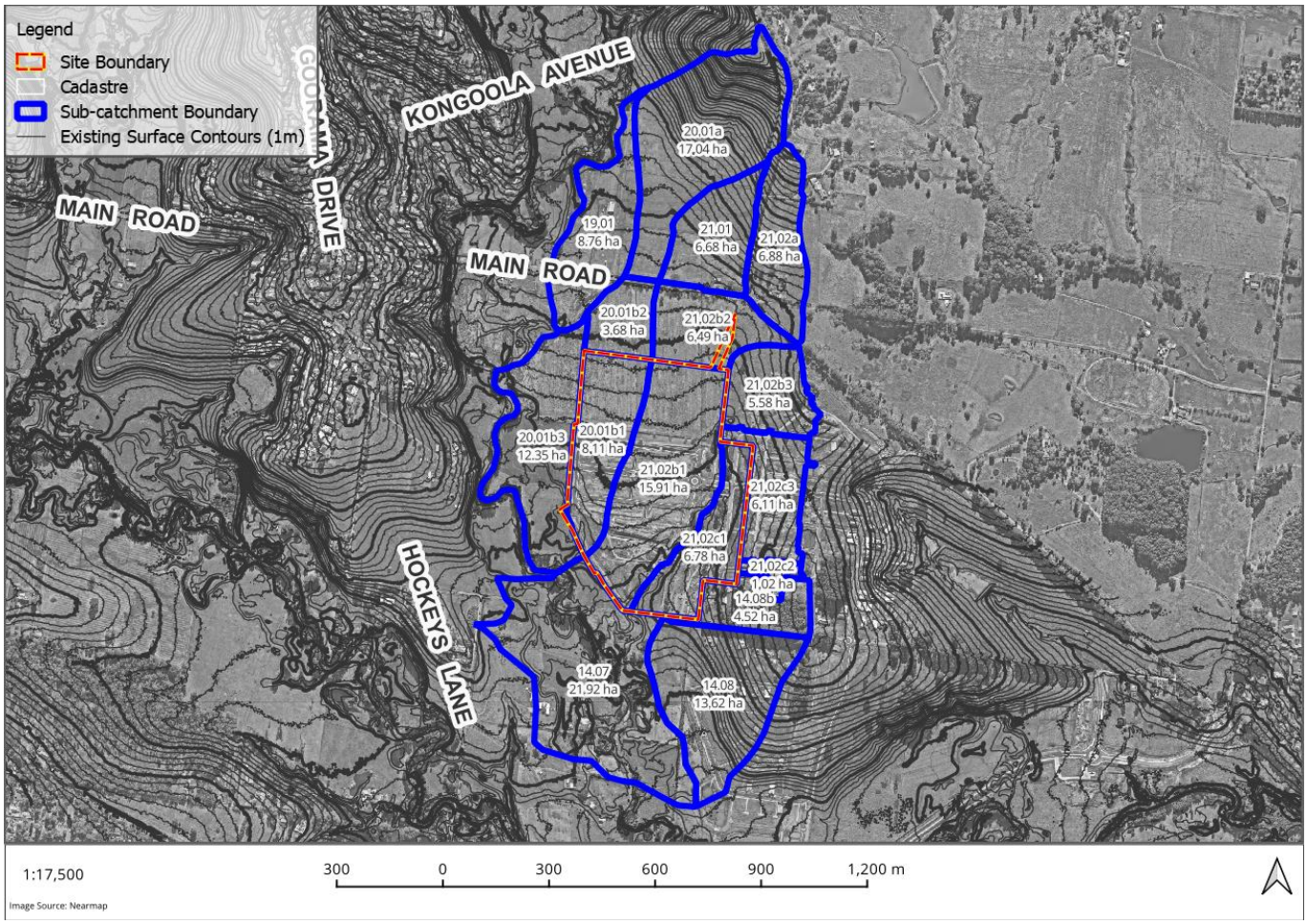


Figure 3 Pre-development sub-catchment boundaries

4.1.2. Post-Development Scenario Hydrology

In the post-development scenario, the sub-catchment boundaries were delineated to match the catchments to the proposed internal stormwater catchment plan from the civil design. This plan details the sub-catchments draining to the two proposed wetlands and the bio-retention basin, as well as any bypass catchments. Based on these updated sub-catchments, an amended post-development hydrologic model was developed.

The catchment parameters such as impervious percentage and vectored slope were also adjusted to represent the developed subdivision. The impervious percentages adopted for the development were based on the land use and the values are consistent with the values within Shoalhaven DCP 2014 Chapter NB3.2 for Moss Vale Road South Urban Release Area, with the exception of road reserves, for which a 90% imperviousness based on typical cross sections of the proposed roads as opposed to the conservative 100% imperviousness. The impervious area values for each land use are reported in Table 1 below.

The rainwater tanks proposed for on-site stormwater detention (OSD) and stormwater retention purposes has also been modelled in the post-development hydrologic model. A 10kL rainwater tank was designed for each residential lot within the site catchment with 6kL dedicated to OSD and 4kL dedicated to rainwater re-use. As per Shoalhaven DCP Chapter G2 A5.9 ,50% of any retention volume can contribute towards on-site stormwater detention volume required for development, hence the rainwater tanks have been modelled with

8 kL of OSD each. It has also been assumed that 80% of the roof area within each residential lot drains into rainwater tank.

The sub-catchment delineation for the post-development scenario is shown in Figure 4, and the parameters adopted in XP-RAFTS for the post-development catchments is shown in Table 2.

The amended XP-RAFTS models for pre-development and post-development scenarios were then simulated to produce the updated inflow hydrographs for inputting to TUFLOW.

Table 1 Imperviousness values adopted for each land use

Land Use	Impervious %
Low Density / General Residential	60
Open Space	25
Road Reserve	90

Table 2 Post-development sub-catchments XP-RAFTS parameters

Catchment	Area (ha)	Impervious %	Vectored Slope (%)
Cat A	6.33	63.3	1.76
Cat A	7.97	56.2	1.76
Cat C	6.27	69.9	1.33
Cat D1	8.36	63.4	1.67
Cat E	1.87	35.9	2.49

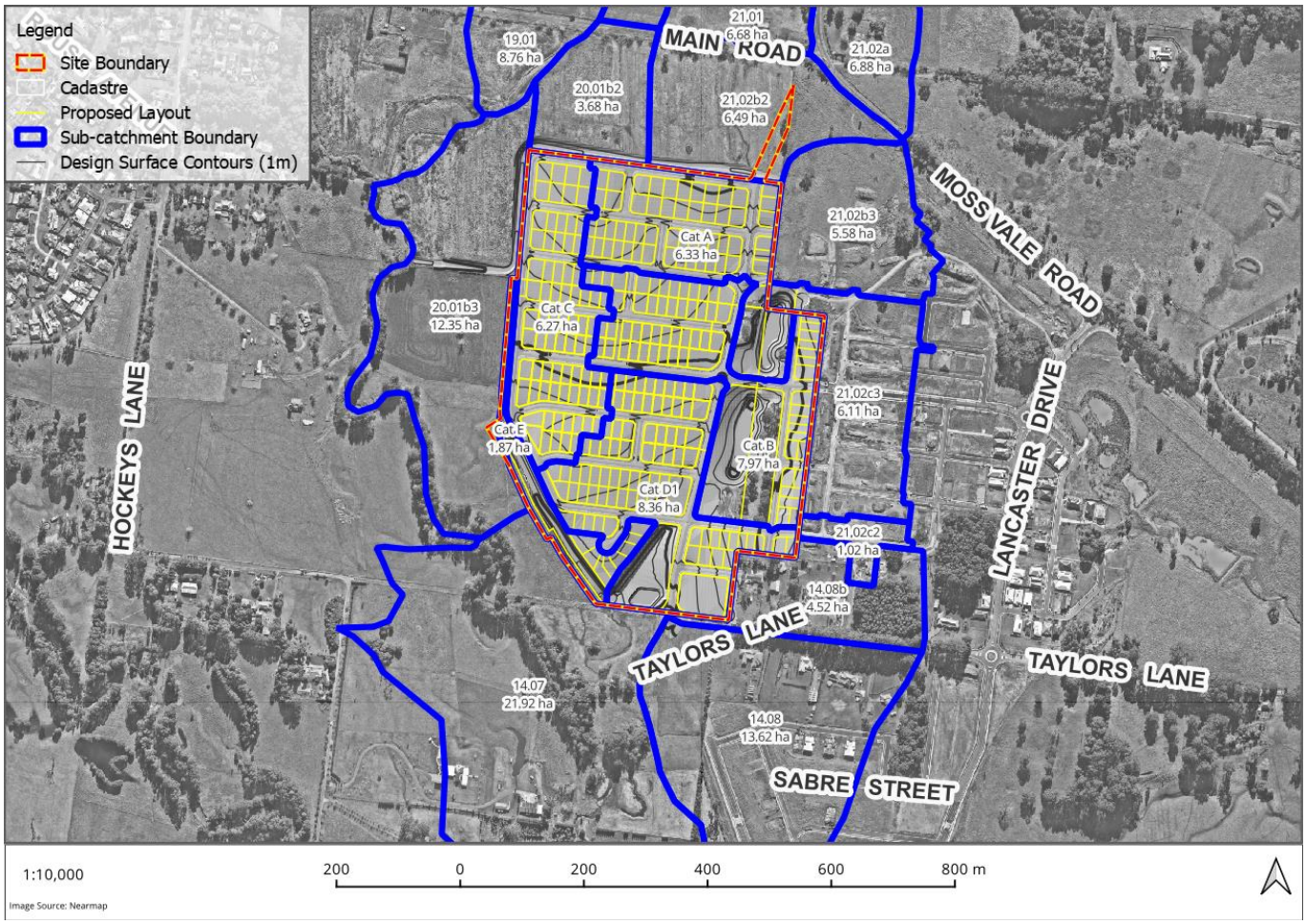


Figure 4 Post-development sub-catchment boundaries

4.1.3. Simulated Storm Events

The storm events simulated for the 20% AEP, 1% AEP, and PMF were adopted based on the ARR 87 IFDs as per the BCFRMS, with the same durations adopted in the BCFRMS for design runs. These are reported in Table 3 below. As per the BCFRMS that generally the 2-hour event is critical in the upper catchment, whilst the 6-hour event is critical around the Bomaderry Creek gorge near the Bomaderry township. It was determined through running both durations that the 2-hour storm event is critical at and immediately downstream of the subject site for the 1% AEP event. For the 5% and 20% AEP storm events, the 2 hour storm event was critical at the site, whilst the 6 hour storm event was critical downstream of the site. For the PMF event, the 45 minute storm event was critical in the upper portion of the site, whilst the 1 hour storm event was critical in the lower portion and downstream of the site. These storm events have been simulated in the TUFLOW model to produce peak flood levels, depths, velocities, and flood hazard.

The 1% AEP climate change with 30% increased rainfall intensity event to represent the 2100 scenario 1% AEP event was also simulated in accordance with the conditions of consent.

Table 3 Simulated storm events

AEP	Storm Duration (mins)
20%	120 360
5%	120 360
1%	120
PMF	45 60

4.2. Hydraulic Modelling

As discussed earlier, the flood modelling for this Flood Impact Assessment adopted the BCFRMS model. Outlined below in Sections 4.2.1 to 4.4 are the changes made to the model to facilitate the assessment of the proposed development on the subject site.

4.2.1. Pre-Development Model Changes

The following changes have been made to the base model to model site-specific details and more accurately reflect the current existing conditions in the area. Similar to the hydrology, the existing scenario was modelled with the following conditions:

1. The subject site is considered to be in its fully undeveloped state.
2. The neighbouring subdivision east of the subject site is considered to be fully developed.

The following changes were made to the hydraulic model as part of this assessment:

- The TUFLOW run version was updated to version 2023-03-AE and the TUFLOW HPC solver was used to improve simulation run times and the accuracy and stability of the model.
- The TUFLOW model boundary extents were reduced to improve simulation run times. The downstream boundary was redefined at the convergence of Good Dog Creek, Tapitallee Creek and Bomadery Creek at a point approximately 1km downstream of the site. A HT boundary was defined at the downstream boundary, with the level set to the approximate peak water level at the location in each storm event where this information was available. This change has no effect on the flood behaviour at the site.
- The existing conditions scenario in the hydraulic model was updated with detailed survey in the locality of the site to ensure the site topography (prior to any development) is accurately reflected in the model. The survey includes surface levels as well as surveyed drainage culverts on site and in the vicinity.
- The point inflow boundaries have been adjusted at the site to match the updated pre-development sub-catchment boundaries and to better reflect the current topography and overland flow path locations.
- The Manning's 'n' roughness values for the locality have been updated based on recent aerial imagery. The most appropriate roughness values have been adopted from the default materials file in Council's base model.

- The farm dams on site (pre-development) were modelled as being full. The farm dams in the neighbouring subdivision at the northeast corner of the site were also filled in.
- The neighbouring subdivision was raised in elevation above the floodplain where necessary to represent the design surface and prevent floodwaters from encroaching the neighbouring site.
- All other elements of the model remain unchanged from the base Council model.

4.2.2. Post-Development Scenario

The existing scenario hydraulic model was revised to account for the proposed changes in land use, road alignments, and wetland and basin locations under post-development conditions. The post-development hydraulic model scenario was adopted as follows:

- A "developed conditions" scenario was prepared which represents the existing conditions scenario with the proposed development in place on the subject site, including all associated earthworks, roadworks, swales, trunk drainage works, and stormwater works associated with the two proposed wetlands and the bio-retention basin. The proposed works that have been modelled are detailed in Figure 5 below.
- The Manning's 'n' roughness values for the proposed development have been updated accordingly. The most appropriate roughness values have been adopted from the materials file in Council's base model.
- The point inflow boundaries have been adjusted at the site to match the updated post-development sub-catchment boundaries and the inflow hydrographs have been updated from the post-development XP-RAFTS model to reflect the proposed civil design. The site runoff is discharged directly into the proposed wetlands, basin and swales.
- The initial water level in the wetlands and basin was set to the lowest discharge pit level.
- All other elements remain unchanged from the existing conditions model.

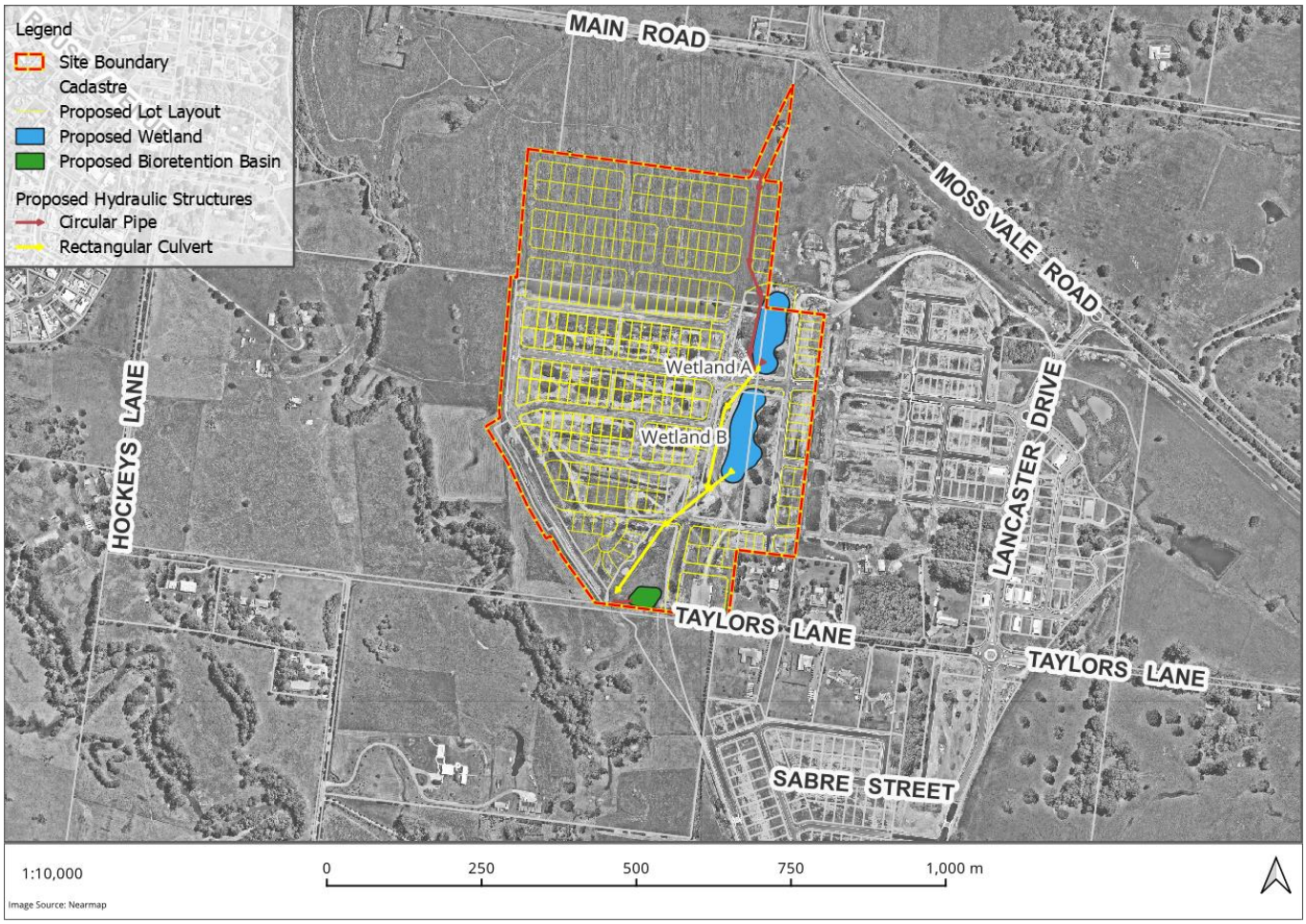


Figure 5 Proposed trunk drainage works

4.3. Mannings Roughness

The Mannings 'n' roughness values that were adopted in the original BCFRMS are outlined in Table 4 and illustrated in Figure 6 and Figure 7 below for the pre-development and post-development cases respectively below. No modifications were made to the supplied TUFLOW Mannings 'n' roughness values or layout outside of the proposed civil works.

Table 4 Mannings 'n' roughness values

Description	Material ID	Manning's 'n' Value
Channel Roughness Type 1	1	0.035
Channel Roughness Type 2	2	0.040
Channel Roughness Type 3	3	0.050
Channel Roughness Type 4	4	0.060
Floodplain Pasture	5	0.050
Floodplain Light Vegetation	6	0.070
Floodplain Dense Vegetation	7	0.100
Floodplain Very Dense Vegetation	8	0.150
Roads	9	0.030
Rural Lot	10	0.050
Urban Lot	11	0.050
Industrial	12	0.030
Grassed channel with rip rap and macrophytes	101	0.080

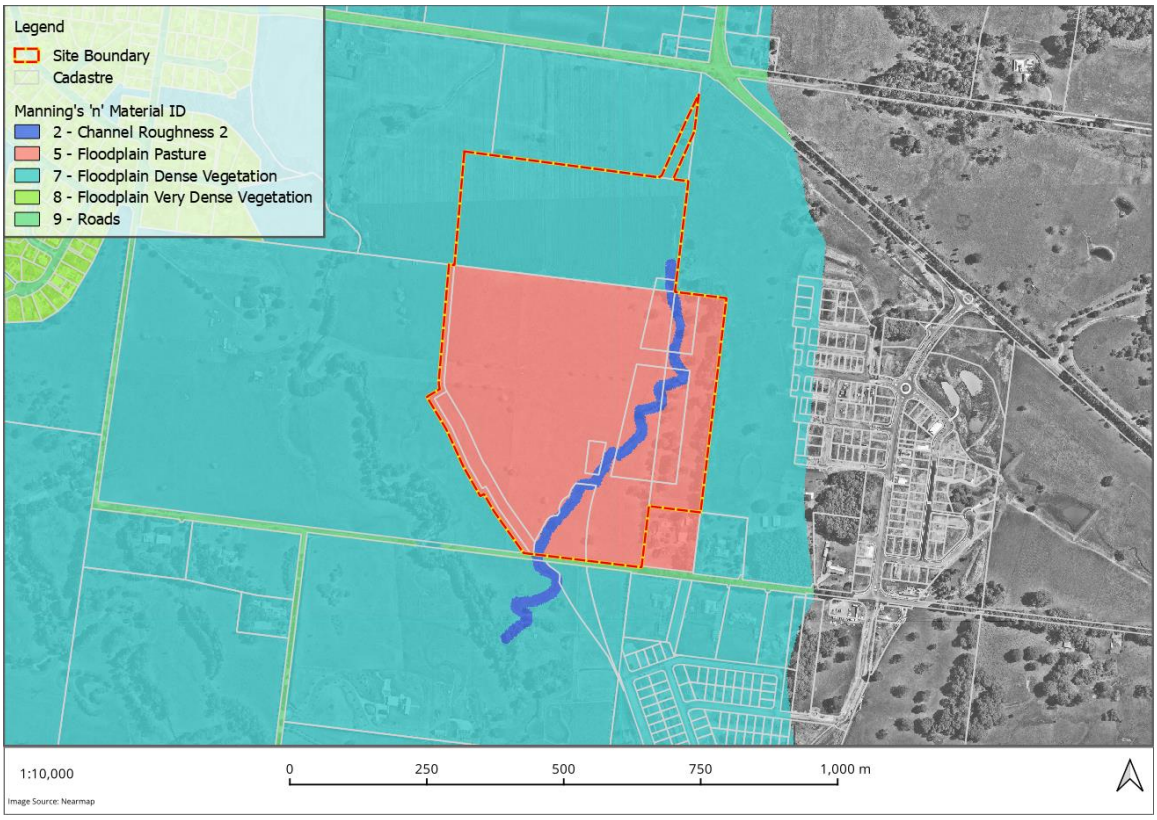


Figure 6 Pre-development Mannings 'n' roughness values

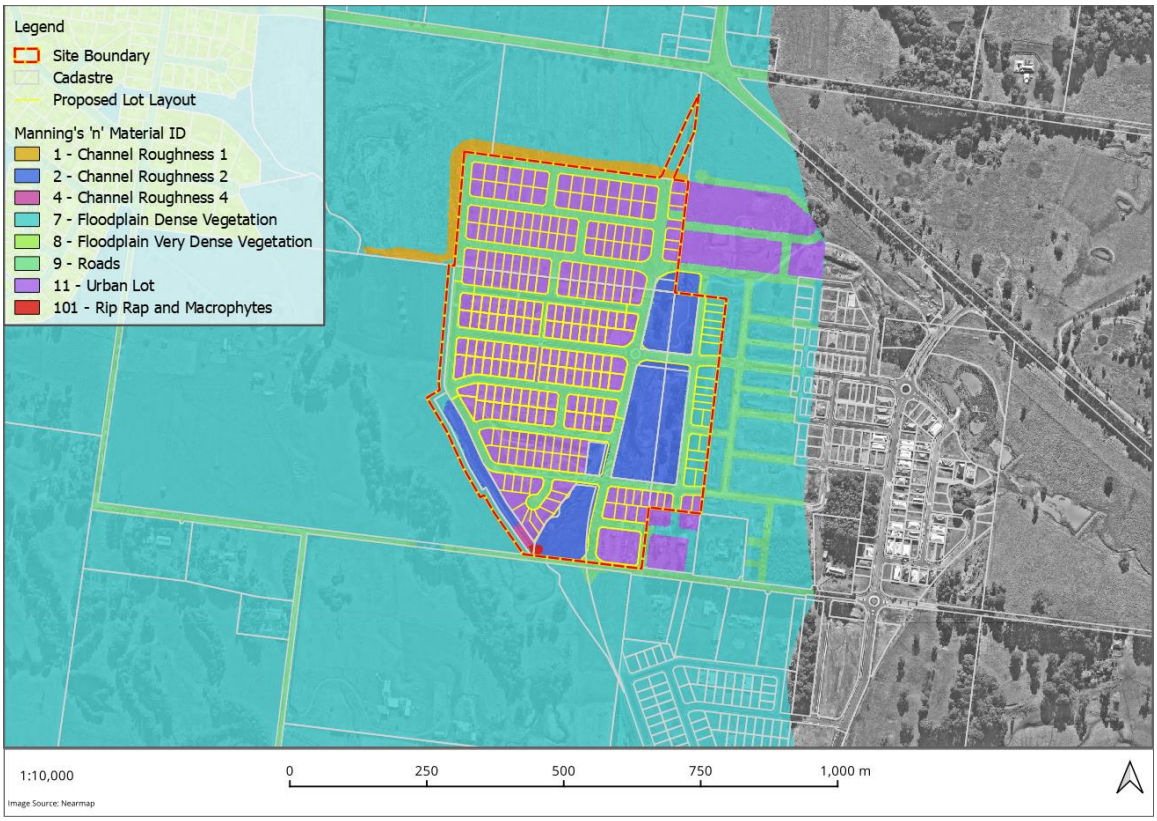


Figure 7 Post-development Mannings 'n' roughness values

4.4. Terrain

The existing conditions terrain for the subject site incorporates the surveys for the site as well as its surroundings. The only change in the developed conditions terrain is the inclusion of the earthworks and lot grading surface for the proposed development, including the wetlands, bioretention basin, and swales.

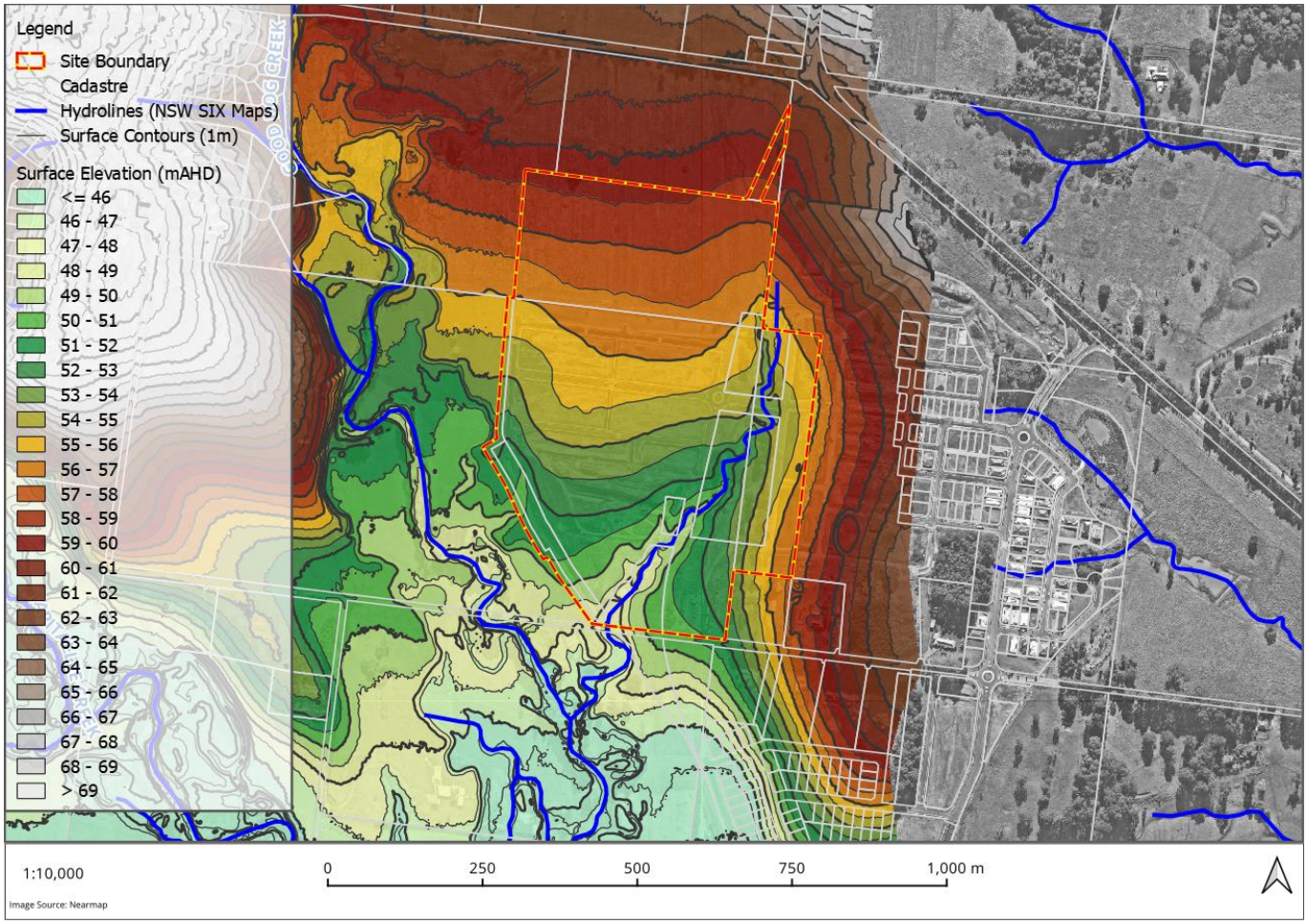


Figure 8 Pre-development digital elevation model

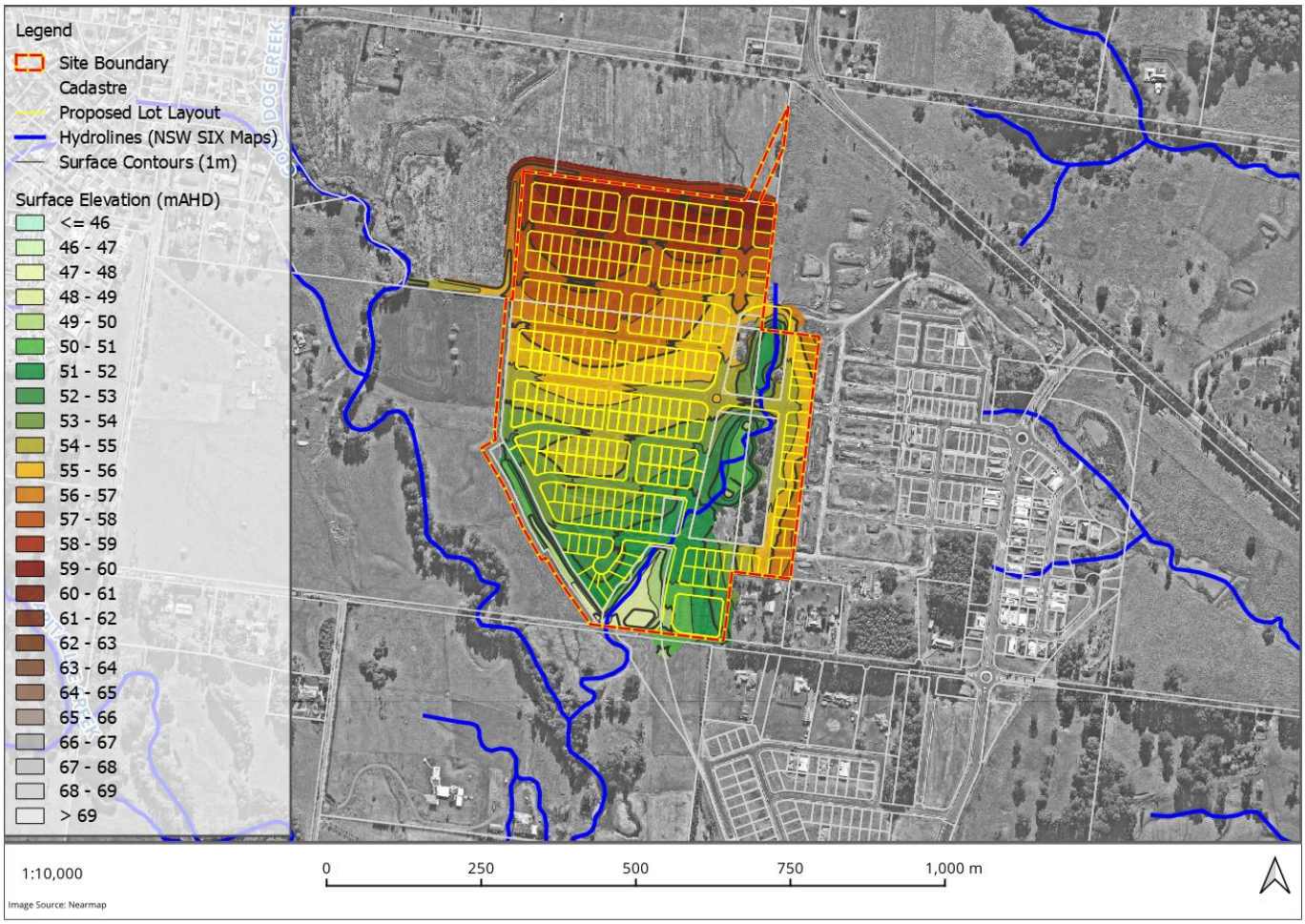


Figure 9 Post development digital elevation model

4.5. On-Site Stormwater Detention

On-site stormwater detention has been provided for the site in the form of a 10kL rainwater tank on each lot as well as using storage volume above the wetlands. This remains unchanged from the OSD strategy proposed in the memorandum "49 Hockeys Lane, 41 Main Road, and 126 Taylors Lane, Cambewarra Revised On Site Detention Strategy" (Maker Eng, 2022) which was approved by Shoalhaven City Council. However, by lowering the staged outlet control pits as well as the base of the Wetland A by an equal amount, the wetland has been lowered in elevation to allow for even more OSD storage above it for larger storm events such as the 2100 1% AEP scenario. There have been no other changes made to the proposed OSD strategy for the site.

5. Results and Discussion

The results of the existing conditions and developed conditions flood modelling are detailed in Sections 5.1 and 5.2 below. The impact of the proposed development on flooding is discussed in Section 5.3. The flood hazard mapping is based on the general flood hazard curves mentioned in ARR 2019 as per Figure 10.

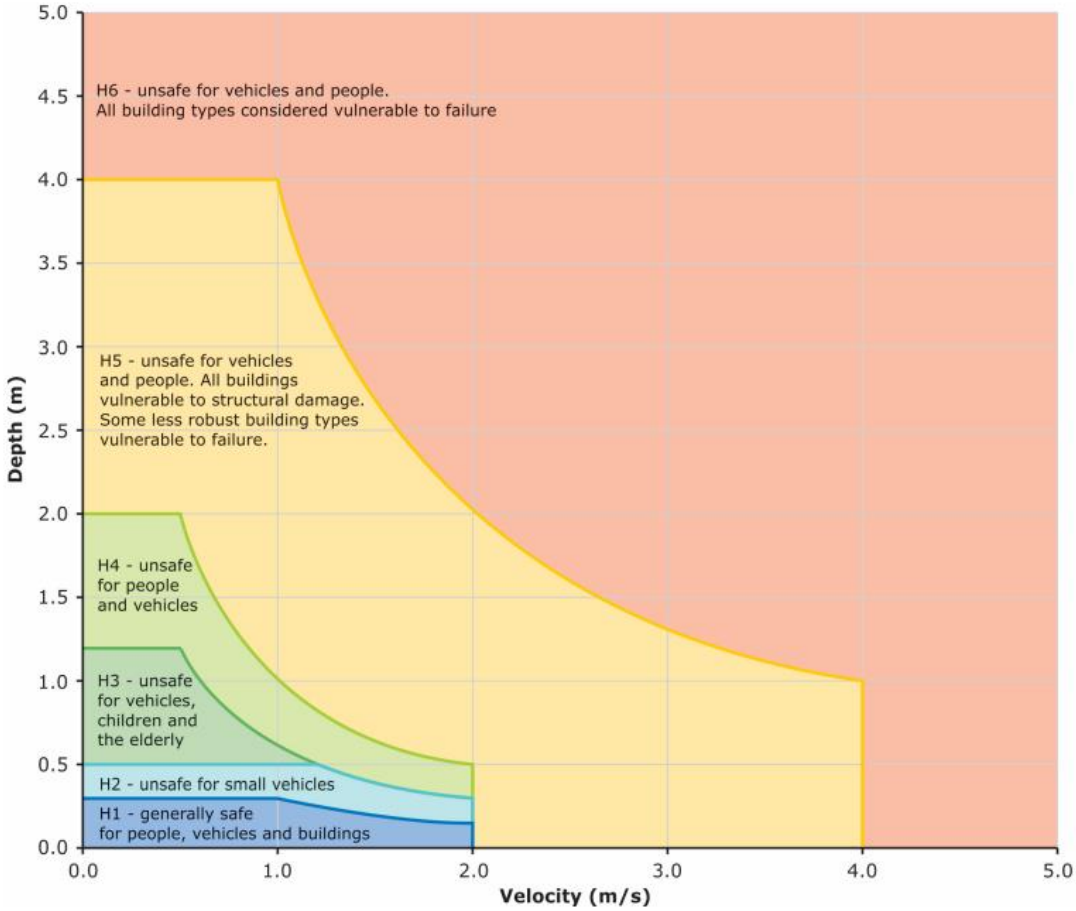


Figure 10 Combined Flood Hazard Curves (Smith, 2019)

5.1. Existing Conditions

The site is situated within the floodplain of Good Dog Creek, with the primary flooding mechanism being overland flooding due to runoff from the site and the upstream catchment to the north. The southwest corner of the site is affected by overbank flows from Good Dog Creek in rarer storm events, but largely isn't affected by the creek in storm events up to and including the 2100 1% AEP event (1% AEP with climate change).

With the exception of the existing waterway in the centre of the site, the overland flow on site is largely sheet flow with flood depths less than 150mm in the 2100 1% AEP scenario. The overland flow arrives from the upstream catchment through several culvert crossings underneath Main Road and Moss Vale Road.

The flood depths within the existing waterway on site reach up to approximately 1.4m in the 2100 1% AEP event. This corresponds to a flood hazard of up to H5 in the waterway which is considered unsafe for people and vehicles. The flood hazard across the majority of the site is H1 which is considered generally safe for everyone.

The existing conditions 2100 1% AEP flood depth results are illustrated in Figure 11, with the flood hazard results shown in Figure 12. The 1% AEP flood depth and hazard results are also presented in Figure 13 and Figure 14, and appear to be consistent with the existing 1% AEP results presented in the Integrated Water Cycle Management Strategy (Maker Eng, 2022) for the approved DA of the proposed development.

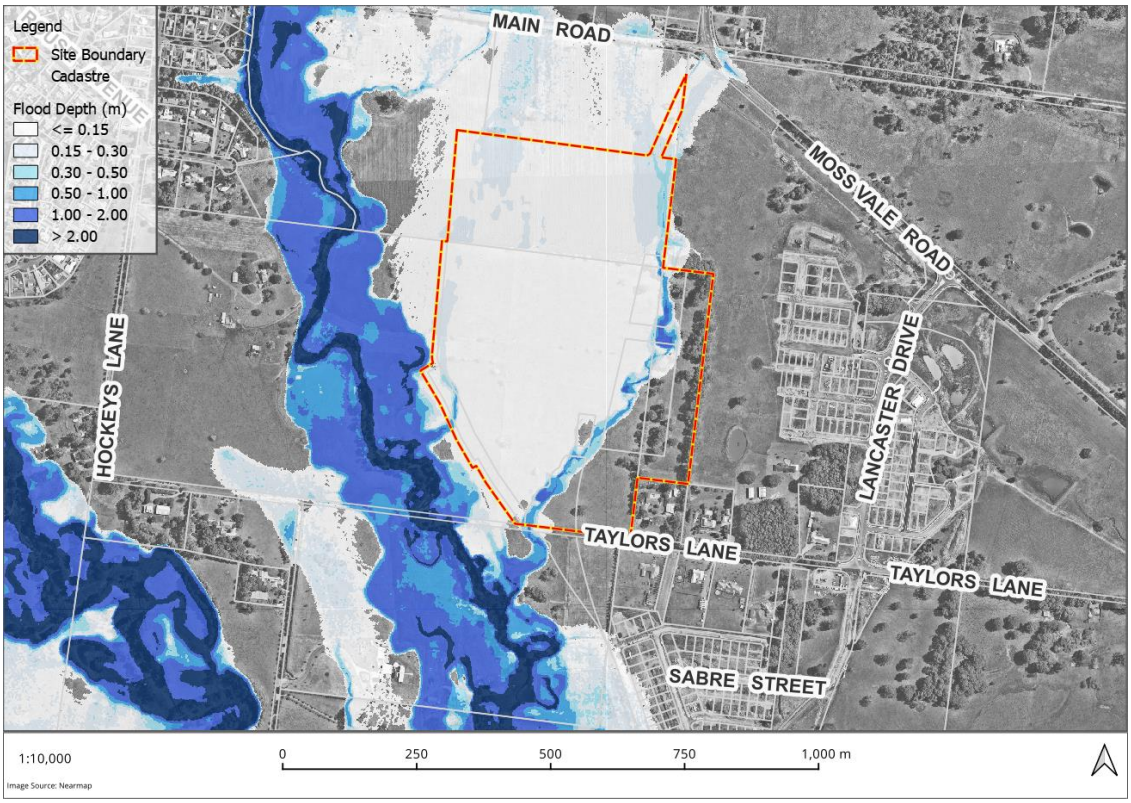


Figure 11 Existing conditions 2100 1% AEP flood depth

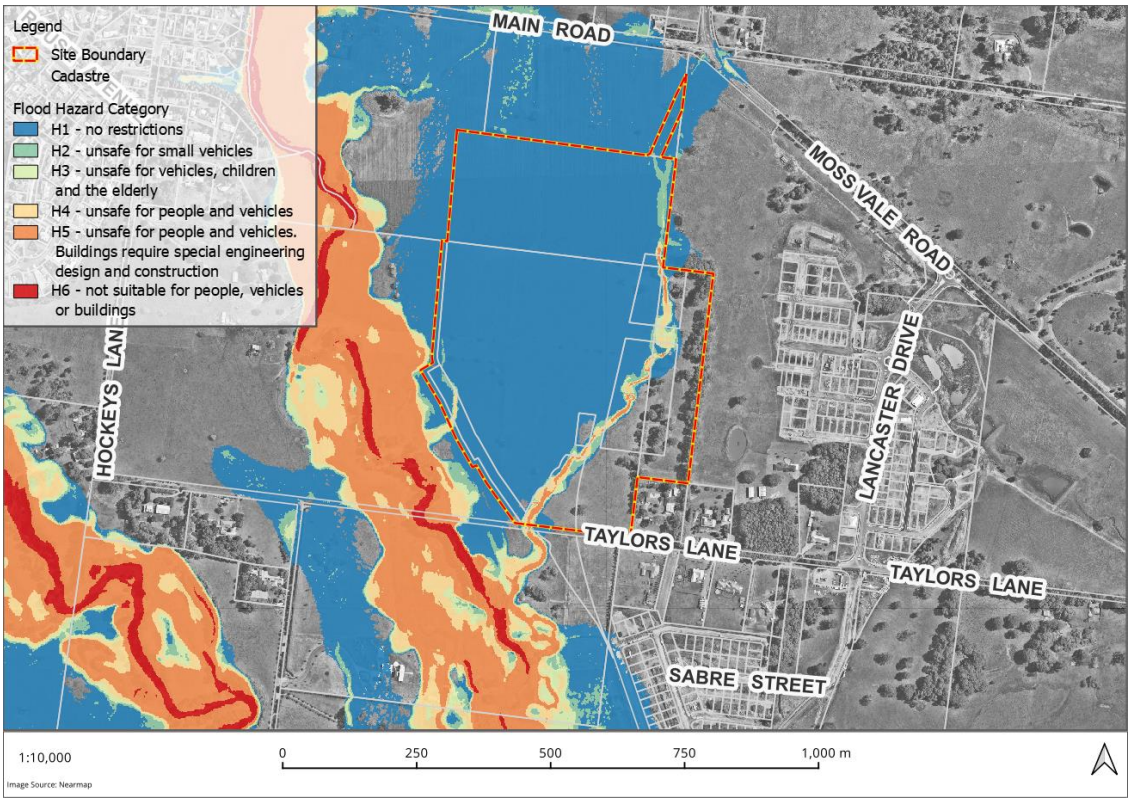


Figure 12 Existing conditions 2100 1% AEP flood hazard

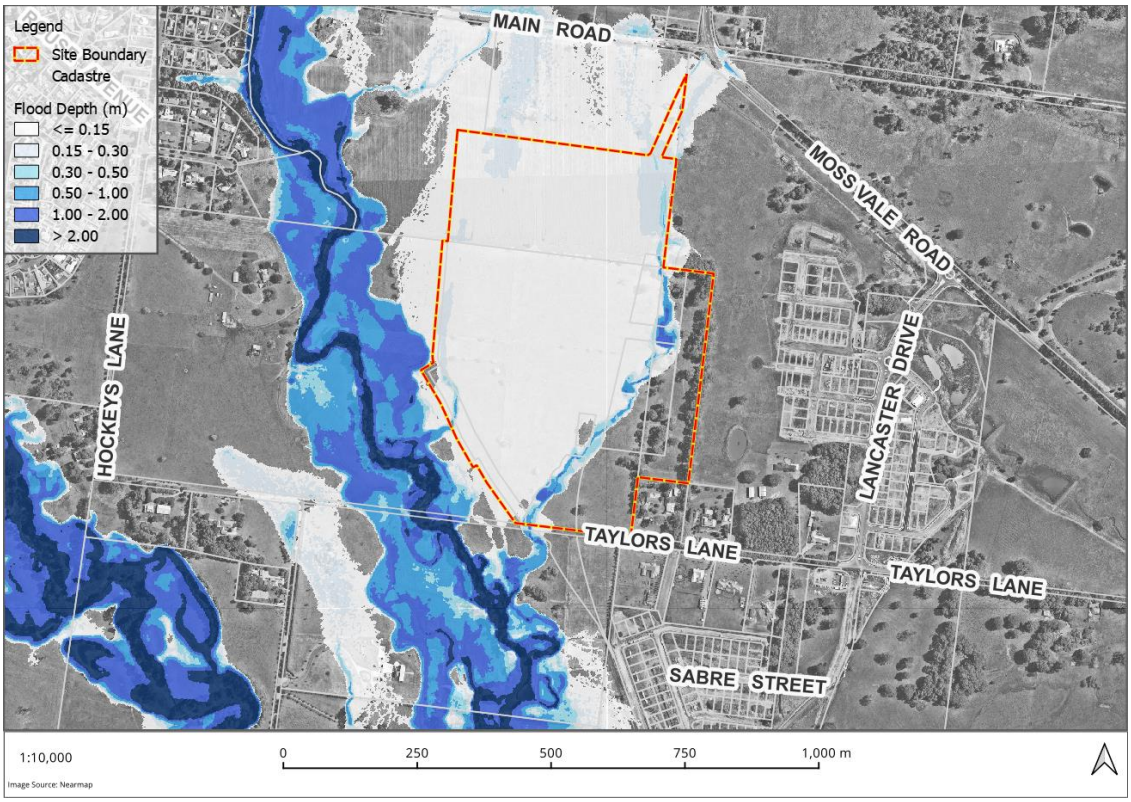


Figure 13 Existing conditions 1% AEP flood depth

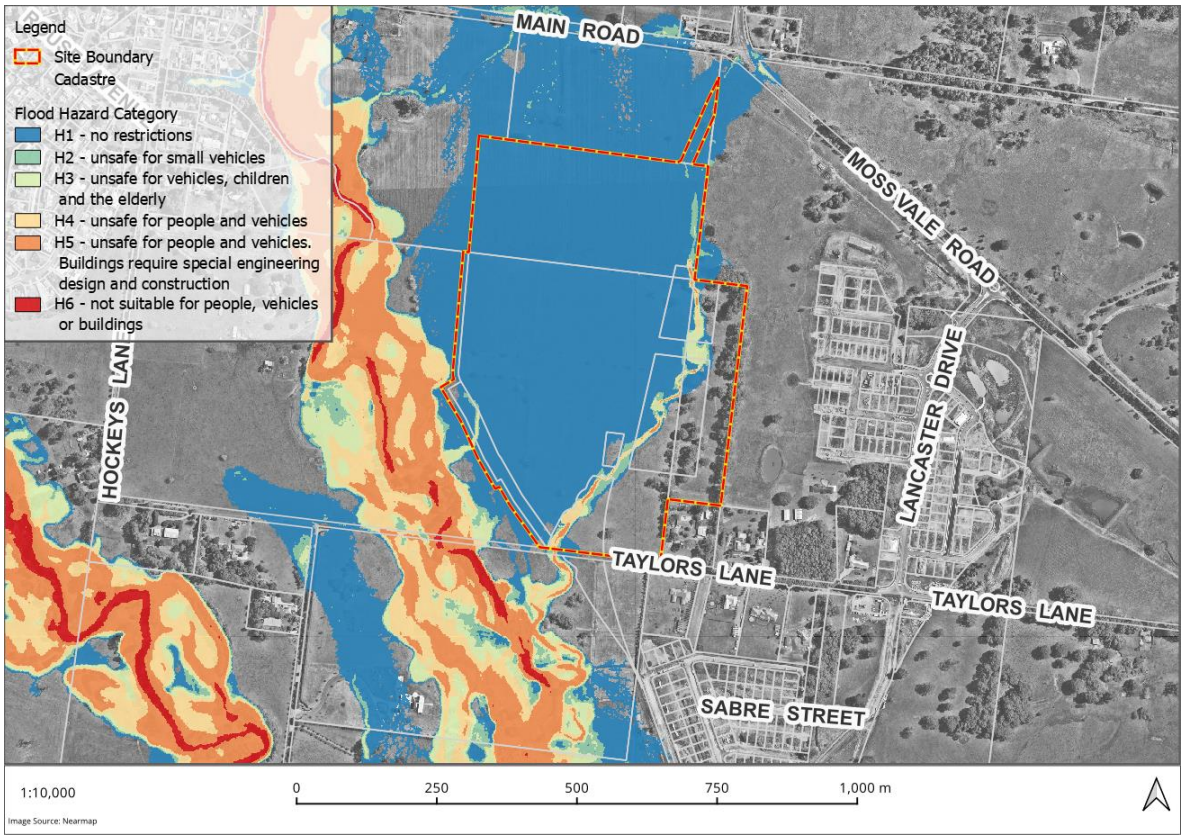


Figure 14 Existing conditions 1% AEP flood hazard

5.2. Developed Conditions

The developed conditions 2100 1% AEP flood depth mapping is illustrated in Figure 15 below, with the flood hazard mapping shown in Figure 16. The developed conditions flood depth and hazard are also provided in Figure 17 and below. The full suite of flood maps for the 1% AEP, 2100 1% AEP, and PMF events are presented in Appendix A.

The proposed development is filled such that the roads and lots are above the 2100 scenario 1% AEP event, thus overall significantly reducing the flood extents over the site. The overland flow from the upstream catchment is partially diverted around the proposed development via the proposed swale along the northern boundary, with a portion being taken into the proposed trunk drainage system through the centre of the site. The runoff from the site internal catchments is discharged directly into the wetlands, the bioretention basin, and the proposed swale running along the southwestern boundary of the site. The flood waters are conveyed from the wetlands through a culvert system which discharge the water into the unnamed watercourse at the site outlet along the southern boundary. This culvert system renders the adjacent open space area near the site outlet to be flood free.

As the flood waters are contained within the proposed stormwater drainage elements, the residential lots and roads are not flood affected in the 2100 1% AEP event developed conditions and flood extents over the site have largely been reduced from existing conditions to create developable lots.

The flood depths in the 2100 1% AEP event reach up to 1.6m within the northern swale, and up to 0.5m within the southwestern swale. In the wetlands flood depths reach up to 2.7m This corresponds to flood

hazards of H5 in the northern swale (Swale 1), H4 in the southwestern swale (Swale 2), and H5 in the wetlands.

In the 1% AEP event, the flood hazard within the northern swale also reaches up to H5, whilst the hazard within the southwestern swale reaches up to a maximum of H2 only, which is generally considered safe for people and vehicles, except for small vehicles. The flood hazard within the wetlands reaches up to H5.

In the PMF event, the flood waters in the northern swale and the wetlands overtops into the site, which inundates the internal roads with low hazard flood waters, reaching up to a maximum of H2 at most road sag points, and up to H3 downstream of Wetland B. This still allows access for vehicles to pass through the majority of the site in the event of flood evacuation.

The maximum flood depth and hazard results within the swales and wetlands are largely consistent with the 1% AEP and PMF results in the Integrated Water Cycle Management Strategy (Maker Eng, 2022). There are also improvements made to the maximum flood hazard within the southwestern swale (Swale 2) in the 1% AEP event, which reached up to H3 hazard in the approved DA. The civil design and post-development flood depth and hazard levels have already been assessed and accepted by Council through a site-specific merit-based approach that considers the proposed design to have achieved a desirable balance between available public open space and stormwater quality infrastructure on Council land whilst also preserving environmental values on site, for example through the establishment of wetlands to offset the loss of the existing waterway. The existing waterway has been realigned to be conveyed through the northern swale (Swale 1), which results in a flood hazard within the swale that is consistent with the existing waterway, hence the development is compatible with the flood hazard of the land.

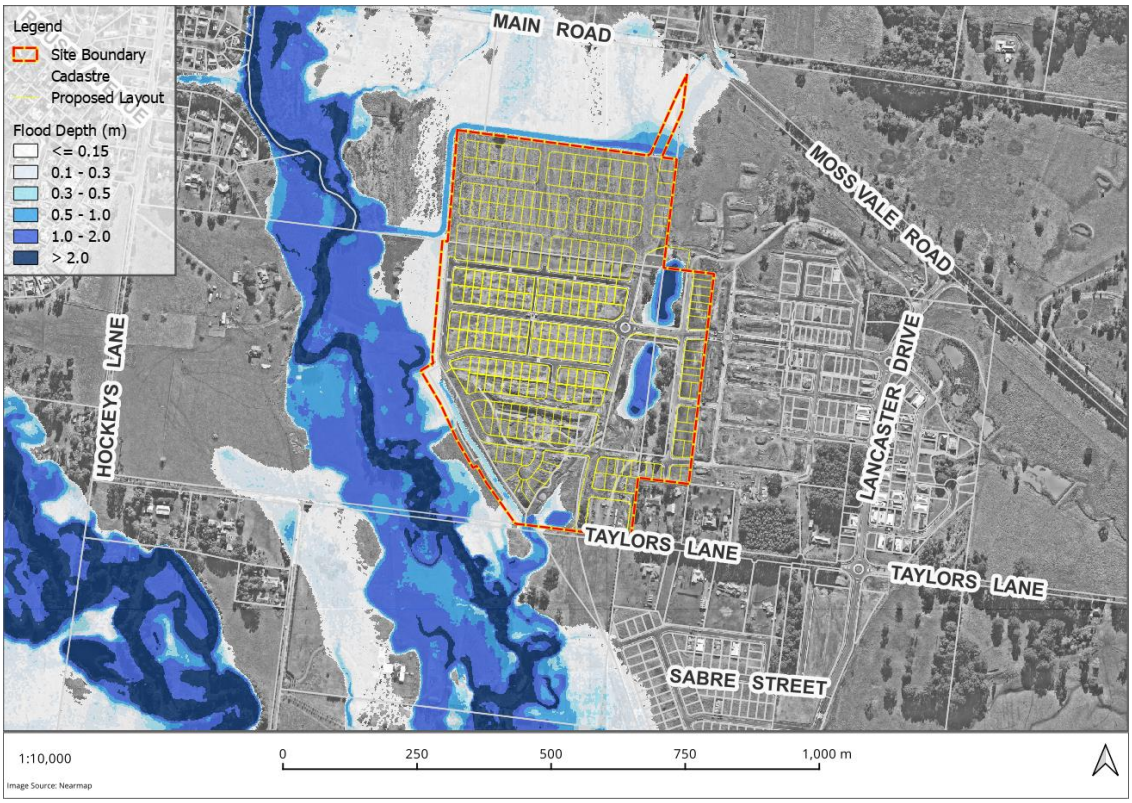


Figure 15 Developed conditions 2100 1% AEP flood depths

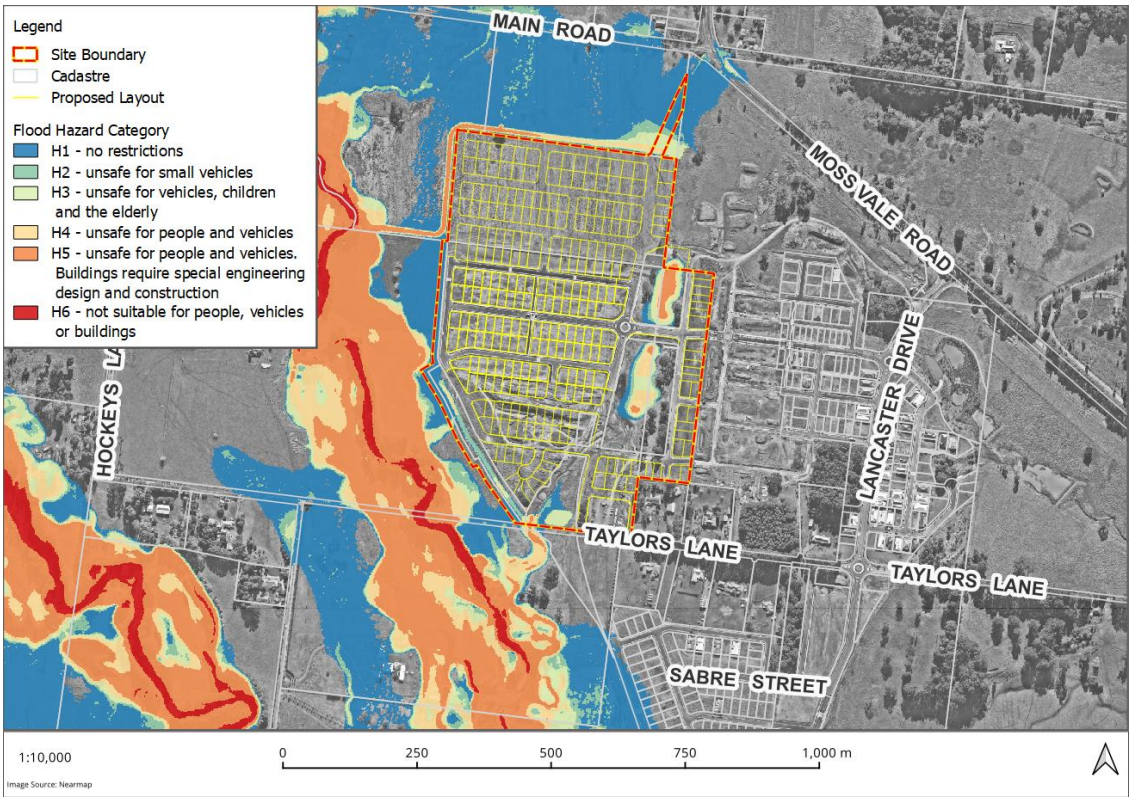


Figure 16 Developed conditions 2100 1% AEP flood hazard

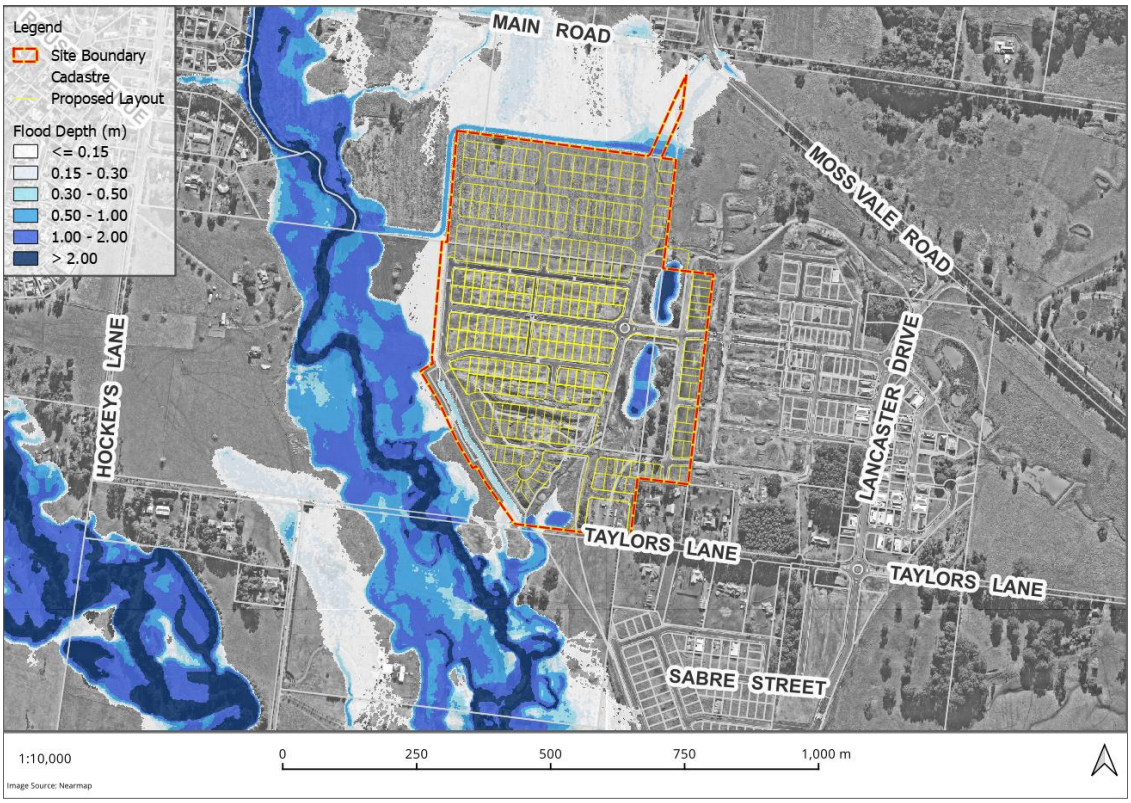


Figure 17 Developed conditions 1% AEP flood depths

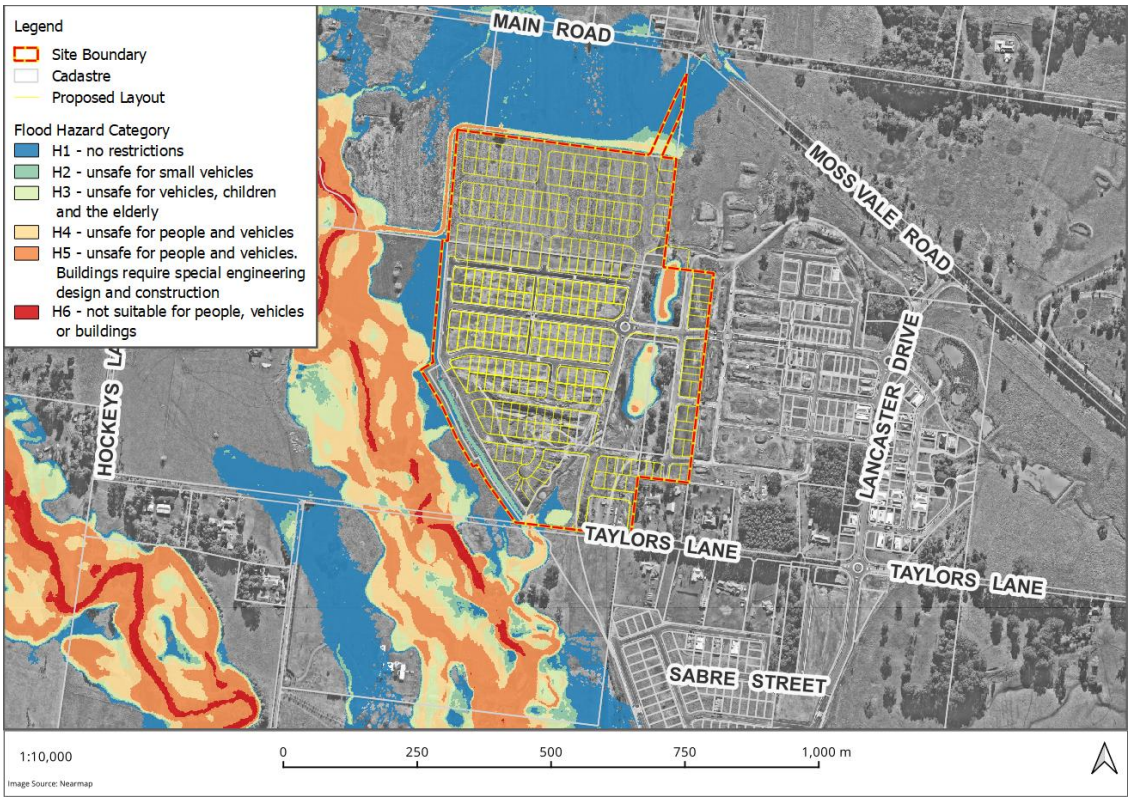


Figure 18 Developed conditions 1% AEP flood hazard

5.3. Off-site Impacts

Afflux is the change in peak flood levels between the developed conditions and existing conditions flooding. It is noted beforehand that the off-site flood impacts in the 1% AEP event presented in this assessment are compared to the 1% AEP flood impacts shown in the Integrated Water Cycle Management Strategy (Maker Eng, 2022) for the approved DA (see Figure 20), and that the current proposed design in this assessment generally shows improvements to flood impacts across all locations. The flood afflux identified due to the proposed development on the subject site are as follows:

- The three locations identified with flood impacts appear to be fairly consistent with Maker Eng's results.
- There is an increase in flood levels to the north of the site. The extent of increase appears to be similar to the impacts in the approved DA.
- There is also an increase in flood levels in Good Dog Creek to the west of the site due to the proposed northern swale diverting flood waters to this area. When compared to the approved DA results, the impacts have been shifted from the site boundary at the edge of the floodplain to a localised area within the Good Dog Creek corridor. These flood impacts have also been reduced from over 100 mm (as per the approved DA outcome) to under 50 mm, and the area along the western boundary is no longer impacted. It is noted that in correspondence with the previous DA assessing officer from Shoalhaven City Council, it was stated that afflux up to 50mm was acceptable in rural areas.
- The impacts to the south of the site at the outlet point is also a localised increase immediately downstream of the site boundary. The extent of these impacts are also reduced when compared to the outcome from the approved DA as there are no widespread impacts further downstream in Good Dog Creek.

- There is no impact on or further inundation of lots in areas which were previously dry and outside of the flow path (i.e. there is no increase in off-site flood extents).
- As the off-site impacts due to the proposed development are localised and consistent with the approved DA outcomes, but also generally improve upon them, the resulting impacts are considered to be acceptable. The off-site impacts also do not affect any existing structures and does not newly inundate any dry areas.

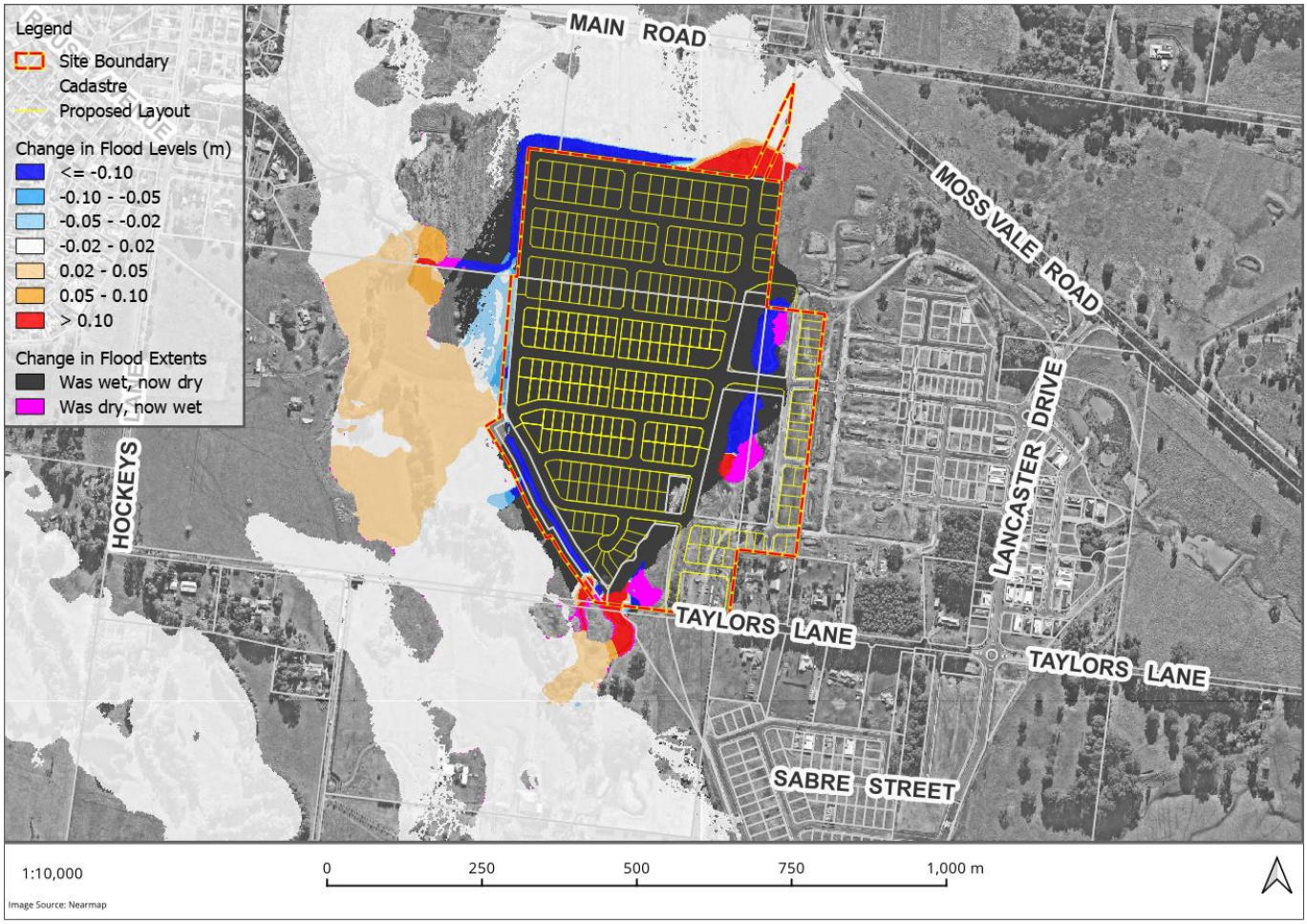


Figure 19 Flood afflux map (1% AEP)

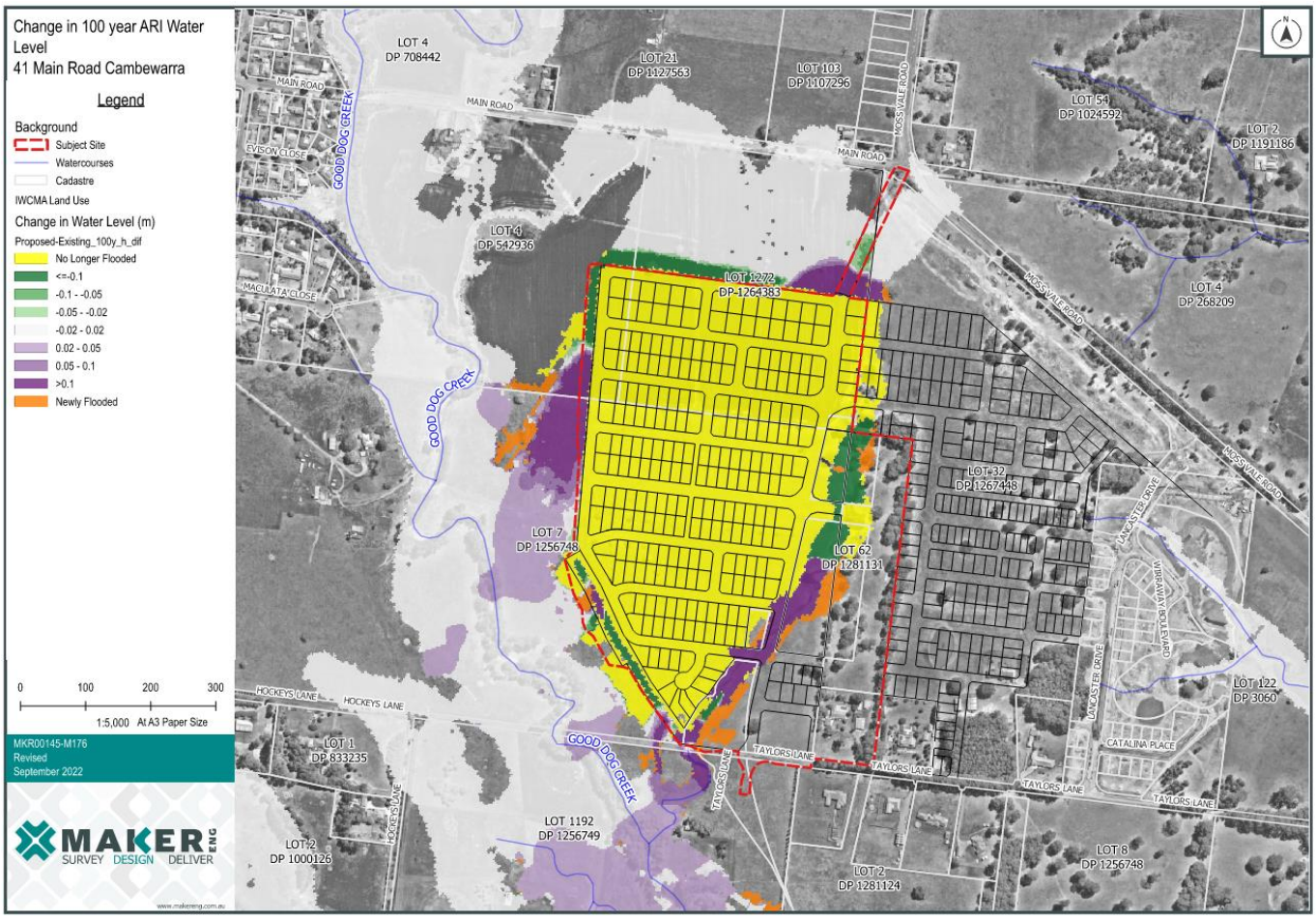


Figure 20 Flood afflux map (1% AEP) from Integrated Water Cycle Management Strategy (Maker Eng, 2022) for Approved DA

5.4. Compliance with Conditions of Consent

Shoalhaven City Council submitted a list of conditions of consent for the submitted DAs under RA21/1003. The flooding related conditions are listed and commented on in Table 5 below.

Table 5 Shoalhaven City Council Conditions of Consent RA21/1003

Conditions of Consent	CED Comment
42. Flooding – Subdivision Works Certificate Requirements Prior to the issue of a Subdivision Works Certificate, a professional engineer, (as defined in the National Construction Code) must submit to the satisfaction of the Certifier, certification that the following items have been detailed on the construction drawings:	-

Conditions of Consent	CED Comment
a) All roads will be constructed at or above the 2100 scenario 1% Annual Exceedance Probability (AEP) event flood level as documented on a Flood Certificate obtained from Council that is based on the latest flooding information held.	1. All proposed roads are flood free in the 2100 scenario 1% AEP event.
b) All new lots are constructed at or above the 2100 scenario 1% AEP event flood level as documented on a Flood Certificate obtained from Council that is based on the latest flooding information held.	2. All new lots are flood free in the 2100 scenario 1% AEP event.
c) Flood-free emergency vehicle access is provided to the subdivision for ambulance, SES, fire brigade, police and other emergency services during a 2100 scenario 1% AEP flood event.	3. As all proposed roads are flood free in the 2100 scenario 1% AEP event, there is flood-free emergency vehicle access across the whole site.
d) Flood-free pedestrian access is provided during a 2100 scenario 1% AEP flood event.	4. As all proposed lots and roads are flood free in the 2100 scenario 1% AEP event, there is flood-free pedestrian access across the whole site.
e) All electrical installations must be constructed above the Flood Planning Level (FPL) or be able to be isolated prior to a flood event.	5. The flood planning level (FPL) is defined as the 1% AEP + 0.5m freeboard as per Shoalhaven City Council's LEP. As the site is flood free in storm events up to and including the 2100 1% AEP event, and the lots have over 0.5m freeboard from the nearest 1% AEP flood level, all electrical installations can be constructed above the FPL.
f) The location of all hazardous substances are located at or above the 2100 scenario 1% AEP Flood Level.	6. As the site is flood free in the 2100 1% AEP event, all hazardous substances are located above the 2100 1% AEP flood level.
g) The realigned unnamed waterway and proposed cut-off drains must have a 2100 scenario 1% AEP capacity and a velocity-depth product that does not exceed 0.3m2/s.	7. The realignment of the unnamed waterway on the site through the proposed northern swale (Swale 1) conveys the 2100 1% AEP flows. Although the velocity-depth (VD) product exceeds 0.3 m^2/s, it is considered unrealistic for a flood conveyance swale (which replaces a waterway) to have a VD product of less than 0.3 m^2/s. The flood hazard within the northern swale is also consistent with the hazard in the existing waterway on site that is being realigned through the swale, hence the outcome is compatible with the flood hazard of the existing land.

Conditions of Consent	CED Comment
	8. The flood hazard in the proposed swales throughout the remainder of the site has been reduced compared to the results of the approved DA. They are now considered to be safe for both people and vehicles in the 1% AEP event. The swale at the previous outlet of the proposed trunk drainage culvert system on site has been removed by extending the culvert system to the site outlet, and the proposed treatment swale in the southwest corner of the site has a maximum flood hazard category of H2 in the 1% AEP event as per Condition 46A WSUD Measures – Treatment Swale. This is considered to be an acceptable level of flood hazard reduction for proposed swales across the site.
h) All fences must be designed with openings below the Flood Planning Level to allow free flow of floodwater.	9. The site is largely raised above the FPL; however all affected fences are to be designed with openings below the FPL to allow free flow of water.

6. Conclusion and Recommendations

This report has been prepared to assess the design improvements that have been undertaken for the development approved under Development Consent RA21/1003 at 49 Hockeys Lane, 41 Main Road, and 126 Taylors Lane, Badagarang, NSW. The flood impact assessment is consistent with inputs for the Bomaderry Creek Flood Study (BMT WBM, 2010) and subsequent Bomaderry Creek Floodplain Risk Management Study (Cardno, 2016) prepared on behalf of Shoalhaven City Council, with additional survey undertaken to inform the topography of the site as well as local drainage features. This site-specific flood study was used to assess the impact of the proposed development on surrounding flood behaviour. The results have been compared to the results of the Integrated Water Cycle Management Strategy (Maker Eng, 2022) submitted for the two DAs on the subject site and found to be largely consistent both in terms of flood behaviour and locations of off-site flood impacts.

The results of the hydraulic modelling of pre- and post-development scenarios demonstrates that the site is above the 2100 scenario 1% AEP flood level in accordance with the conditions of consent. There is also a definitive improvement in the flood impacts of the proposed development on adjacent properties when compared with the approved DA outcomes. The off-site impacts to the north and south are consistent with the results from the approved DA, whilst the off-site impacts to the west have been reduced in magnitude and shifted towards Good Dog Creek as opposed to causing impacts along the western boundary of the site. Overall, there is no impact on existing structures nor any increase in flood extents into previously dry areas, and there are no irreconcilable differences with the approved DA outcomes.

Flood extents over the site have been reduced and are largely contained within the proposed northern diversion swale, southwestern treatment swale, the on-site wetlands and basin. This renders the proposed residential area flood free in the 2100 scenario 1% AEP event, with sufficient freeboard above the 1% AEP event. The hazard within the swales and the overall risk to people and exposure to flood conditions has been reduced near the outlet of the site and within the adjacent open space area, the extents of which have also been maximised with the conversion of the open swale into an culvert system.

It is therefore concluded that the proposed development improves upon the approved DA outcomes and is compliant with the conditions of consent for RA21/1103, as well as the Shoalhaven LEP (2014) and DCP (2014) with regards to the flood conditions and impacts on flood behaviour.

7. References

Ball, J., Babister, M., Nathan, R., Weeks, W., Weinmann, E., Retallick, M., & Testoni, I. (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Commonwealth of Australia. Retrieved August Tuesday 30th, 2023

BMT WBM. (2010). *Bomaderry Creek Flood Study.* Surry Hills: BMT WBM.

BMT WBM. (2018). TUFLOW Classic/HPC User Manual Release Build 2018-03-AD. Retrieved August 2023, from https://downloads.tuflow.com/TUFLOW/Releases/Latest/TUFLOW%20Manual.pdf

Cardno. (2016). *Bomaderry Creek Floodplain Risk Management Study.* St Leonards: Cardno.

Commonwealth of Australia Australian Institute for Disaster Resilience. (2017). *Flood Hazard Supporting document for the implementation of Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia.* Australian Institute for Disaster Resilience Australian Government Attorney-General's Department. Retrieved August 25, 2023, from https://knowledge.aidr.org.au/media/3518/adr-guideline-7-3.pdf

Maker Eng. (2022). *Integrated Water Cycle Management Strategy For Proposed Subdivision of 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra.* Wollongong: Maker Eng.

Maker Eng. (2022). *Revised On Site Detention Strategy.* Wollongong: Maker Eng.

NSW Department of Planning and Environment. (2023). Flood Risk Management Manual. NSW, Australia. Retrieved November 17th, 2023, from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Water/Floodplains/flood-risk-management-manual-2023-230220.pdf

Shoalhaven City Council. (2014). *Shoalhaven City Council Development Control Plan.* Nowra: Shoalhaven City Council.

Shoalhaven City Council. (2014). *Shoalhaven City Council Local Environmental Plan.* Nowra: Shoalhaven City Council.

Strategic Environmental & Engineering Consulting. (2018). *Integrated Water Cycle Assessment For Moss Vale Road South Urban Release Area.* Bowral: SEEC.

A. Flood Mapping

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend

- Site Boundary
- Cadastre
- 0.2m Water Level Contour (mAHD)

Flood Level (mAHD)

- <= 46
- 46 - 47
- 47 - 48
- 48 - 49
- 49 - 50
- 50 - 51
- 51 - 52
- 52 - 53
- 53 - 54
- 54 - 55
- 55 - 56
- 56 - 57
- 57 - 58
- 58 - 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- 63 - 64
- 64 - 65
- 65 - 66
- 66 - 67
- 67 - 68
- 68 - 69
- > 69

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE

1:5,000

50 0 50 100 150 200 m

Colliers

Colliers Engineering & Design (NSW) Pty Ltd endeavours to ensure that the information provided in this map is correct at the time of publication. Colliers Engineering & Design (NSW) Pty Ltd does not warrant, guarantee or make representations regarding the currency and accuracy of information contained within this map.

Map 01: 1% AEP Existing Water Level
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend
- Site Boundary
- Cadastre

Flood Depth (m)
- <= 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE
VIEW

1:5,000
50 0 50 100 150 200 m

Colliers

Map 02: 1% AEP Existing Depth
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend

Site Boundary

Cadastre

Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- > 2.50

MAIN ROAD

MOSS VALE ROAD

HARKNESS PARADE

DROVERS ROAD

MYRTLE DRIVE

GIPSY MOTH STREET

SPITFIRE STREET

LANCASTER DRIVE

WIRRAWAY BOULEVARD

CATALINA PLACE

HOCKEYS LANE

TAYLORS LANE

LANCASTER DRIVE

RUNWAY STREET

DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Colliers

Map 03: 1% AEP Existing Velocity

Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra

Project Number: 479-23

Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend

- Site Boundary
- Cadastre

Flood Hazard Category

- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people and vehicles. Buildings require special engineering design and construction
- H6 - not suitable for people, vehicles or buildings

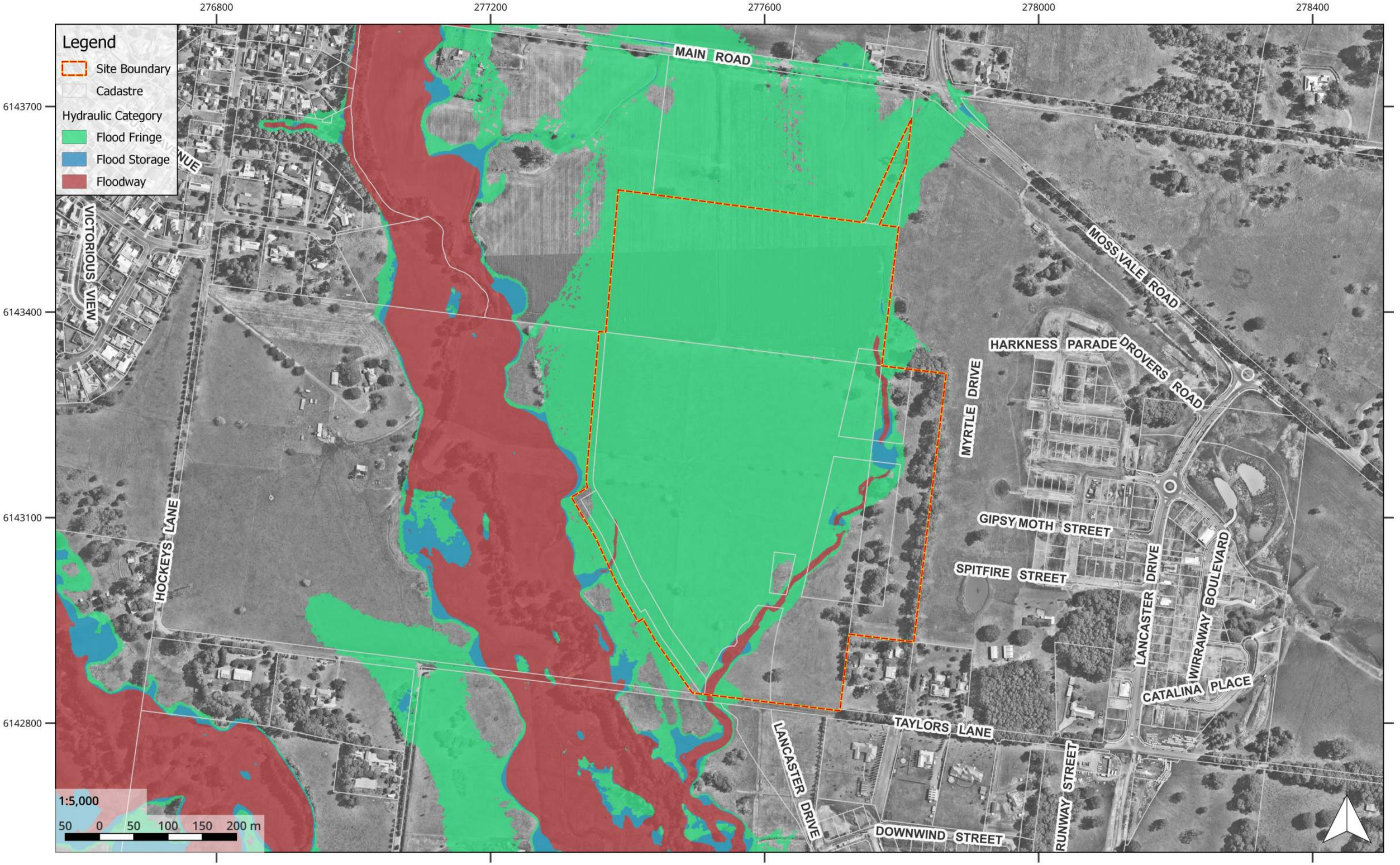
MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
HOCKEYS LANE
TAYLORS LANE
LANCASTER DRIVE
RUNWAY STREET
DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Colliers

Map 04: 1% AEP Existing Hazard
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 05: 1% AEP Existing Hydraulic Category
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend

- Site Boundary
- Cadastre
- 0.2m Water Level Contour (mAHD)

Flood Level (mAHD)

- <= 46
- 46 - 47
- 47 - 48
- 48 - 49
- 49 - 50
- 50 - 51
- 51 - 52
- 52 - 53
- 53 - 54
- 54 - 55
- 55 - 56
- 56 - 57
- 57 - 58
- 58 - 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- 63 - 64
- 64 - 65
- 65 - 66
- 66 - 67
- 67 - 68
- 68 - 69
- > 69

1:5,000

50 0 50 100 150 200 m

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE

Colliers

Map 06: 2100 1% AEP Existing Water Level
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend
- Site Boundary
- Cadastre

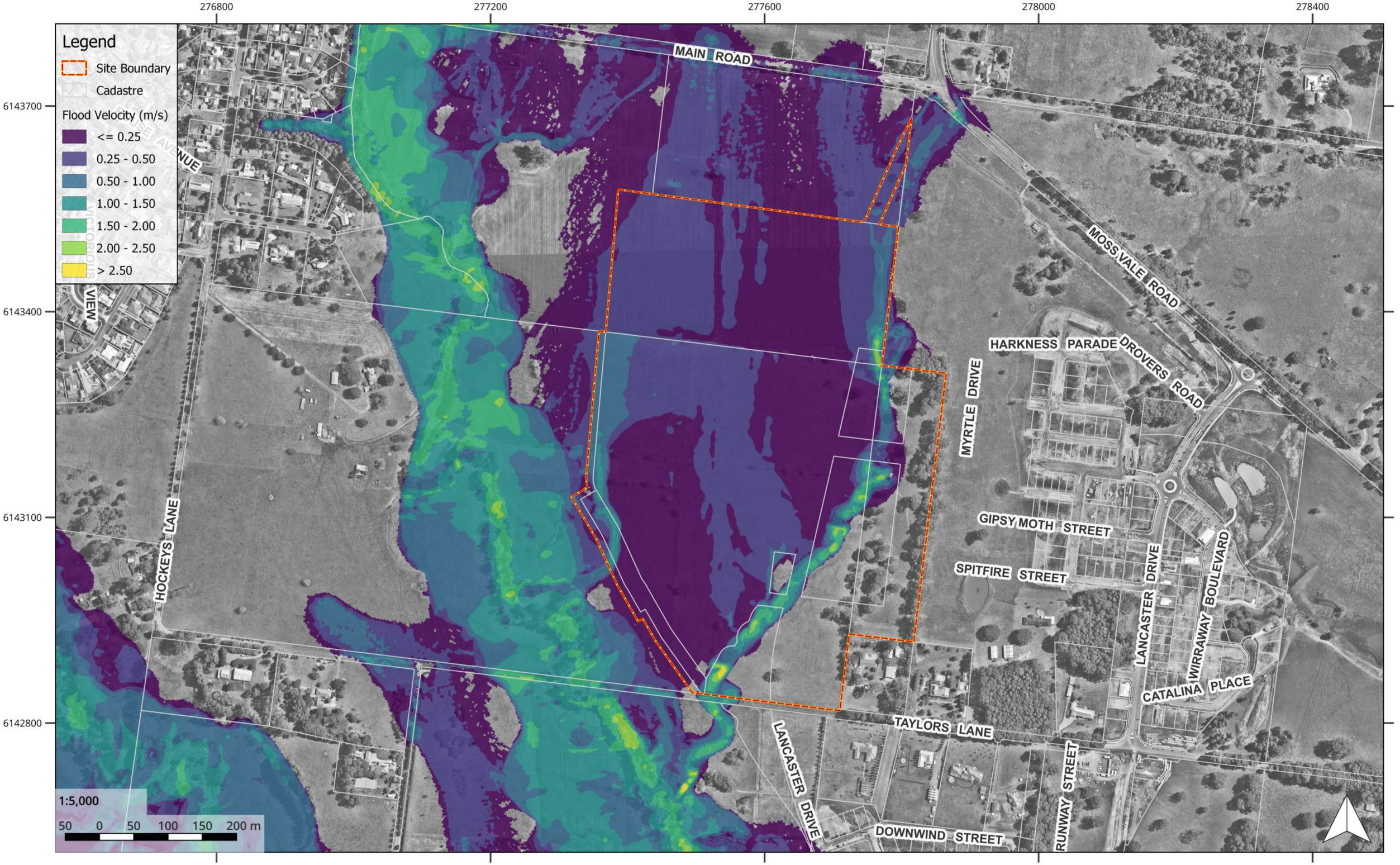
Flood Depth (m)
- <= 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE
LANCASTER DRIVE

1:5,000
50 0 50 100 150 200 m

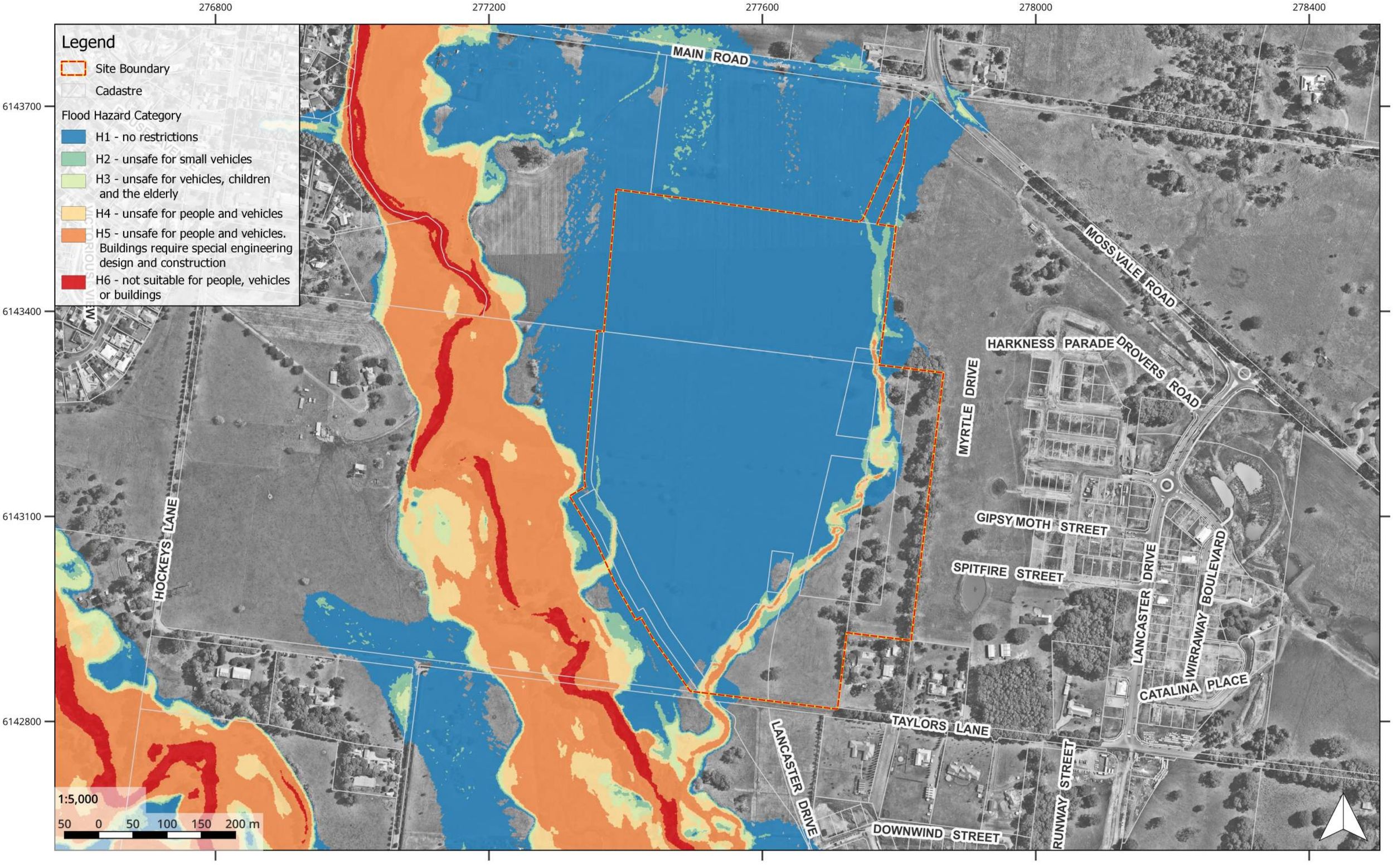
Colliers

Map 07: 2100 1% AEP Existing Depth
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 08: 2100 1% AEP Existing Velocity
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 09: 2100 1% AEP Existing Hazard
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800
277200
277600
278000
278400

6143700
6143400
6143100
6142800

Legend
Site Boundary
Cadastre
Hydraulic Category
Flood Fringe
Flood Storage
Floodway

MAIN ROAD
VICTORIOUS VIEW
HOCKEYS LANE
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET

1:5,000
50 0 50 100 150 200 m

Colliers

Colliers Engineering & Design (NSW) Pty Ltd endeavours to ensure that the information provided in this map is correct at the time of publication. Colliers Engineering & Design (NSW) Pty Ltd does not warrant, guarantee or make representations regarding the currency and accuracy of information contained within this map.

Map 010: 2100 1% AEP Existing Hydraulic Category
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend

- Site Boundary
- Cadastre
- 0.2m Water Level Contour (mAHD)

Flood Level (mAHD)

- <= 46
- 46 - 47
- 47 - 48
- 48 - 49
- 49 - 50
- 50 - 51
- 51 - 52
- 52 - 53
- 53 - 54
- 54 - 55
- 55 - 56
- 56 - 57
- 57 - 58
- 58 - 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- 63 - 64
- 64 - 65
- 65 - 66
- 66 - 67
- 67 - 68
- 68 - 69
- > 69

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE

1:5,000

50 0 50 100 150 200 m

Colliers

Map 011: PMF Existing Water Level
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend
- Site Boundary
- Cadastre

Flood Depth (m)
- <= 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE
LANCASTER DRIVE

1:5,000
50 0 50 100 150 200 m

Colliers

Map 012: PMF Existing Depth
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend

Site Boundary

Cadastre

Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- > 2.50

MAIN ROAD

MOSS VALE ROAD

HARKNESS PARADE

DROVERS ROAD

MYRTLE DRIVE

GIPSY MOTH STREET

SPITFIRE STREET

LANCASTER DRIVE

WIRRAWAY BOULEVARD

CATALINA PLACE

HOCKEYS LANE

TAYLORS LANE

LANCASTER DRIVE

RUNWAY STREET

DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Colliers

Map 013: PMF Existing Velocity

Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra

Project Number: 479-23

Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre

Flood Hazard Category

- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people and vehicles. Buildings require special engineering design and construction
- H6 - not suitable for people, vehicles or buildings

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
HOCKEYS LANE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Colliers

Map 014: PMF Existing Hazard
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700 6143400 6143100 6142800

Legend
- Site Boundary
- Cadastre

Hydraulic Category
- Flood Fringe
- Flood Storage
- Floodway

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
VICTORIOUS VIEW
HOCKEYS LANE
TAYLORS LANE
LANCASTER DRIVE
RUNWAY STREET
DOWNWIND STREET

1:5,000
50 0 50 100 150 200 m

Colliers

Map 015: PMF Existing Hydraulic Category
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout
- 0.2m Water Level Contour (mAHD)

Flood Level (mAHD)

- <= 46
- 46 - 47
- 47 - 48
- 48 - 49
- 49 - 50
- 50 - 51
- 51 - 52
- 52 - 53
- 53 - 54
- 54 - 55
- 55 - 56
- 56 - 57
- 57 - 58
- 58 - 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- 63 - 64
- 64 - 65
- 65 - 66
- 66 - 67
- 67 - 68
- 68 - 69
- > 69

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE

1:5,000

50 0 50 100 150 200 m

Colliers

Map 016: 1% AEP Developed Water Level
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout

Flood Depth (m)

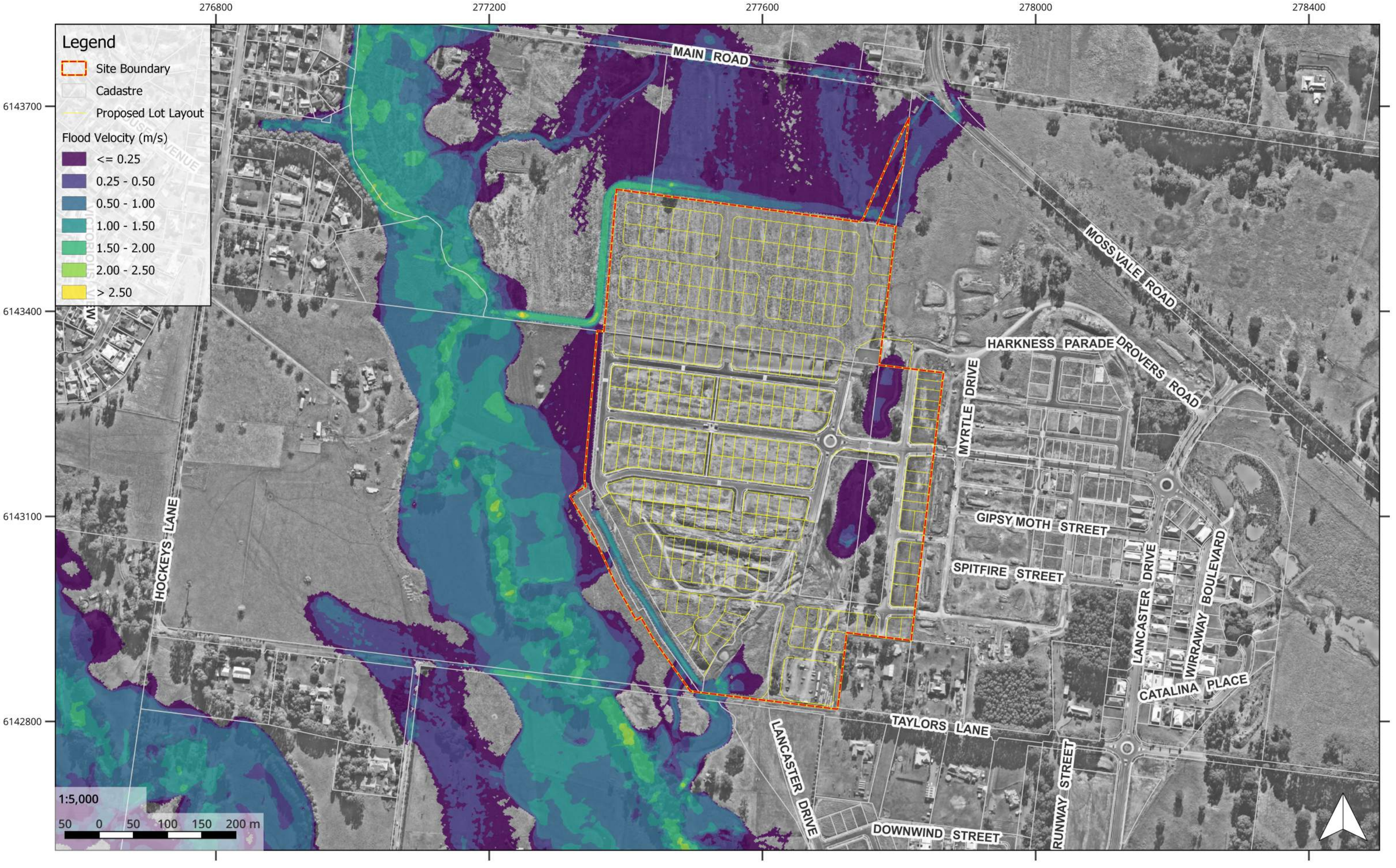
- <= 0.15
- 0.15 - 0.30
- 0.30 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
HOCKEYS LANE
TAYLORS LANE
LANCASTER DRIVE
RUNWAY STREET
DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Map 017: 1% AEP Developed Depth
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 018: 1% AEP Developed Velocity
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout

Flood Hazard Category

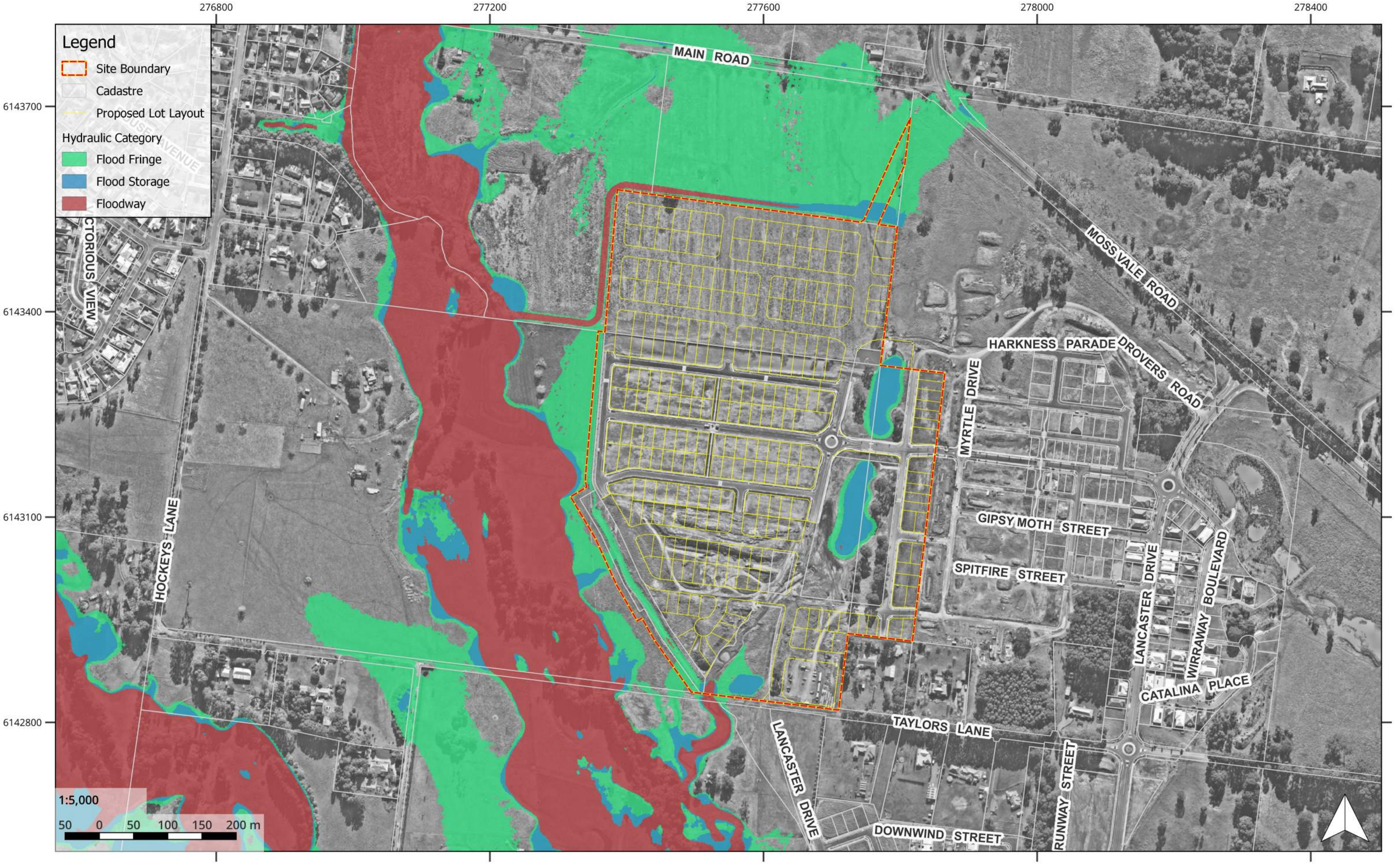
- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people and vehicles. Buildings require special engineering design and construction
- H6 - not suitable for people, vehicles or buildings

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
HOCKEYS LANE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
LANCASTER DRIVE
RUNWAY STREET
DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Map 019: 1% AEP Developed Hazard
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 020: 1% AEP Developed Hydraulic Category
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout
- 0.2m Water Level Contour (mAHD)

Flood Level (mAHD)

- <= 46
- 46 - 47
- 47 - 48
- 48 - 49
- 49 - 50
- 50 - 51
- 51 - 52
- 52 - 53
- 53 - 54
- 54 - 55
- 55 - 56
- 56 - 57
- 57 - 58
- 58 - 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- 63 - 64
- 64 - 65
- 65 - 66
- 66 - 67
- 67 - 68
- 68 - 69
- > 69

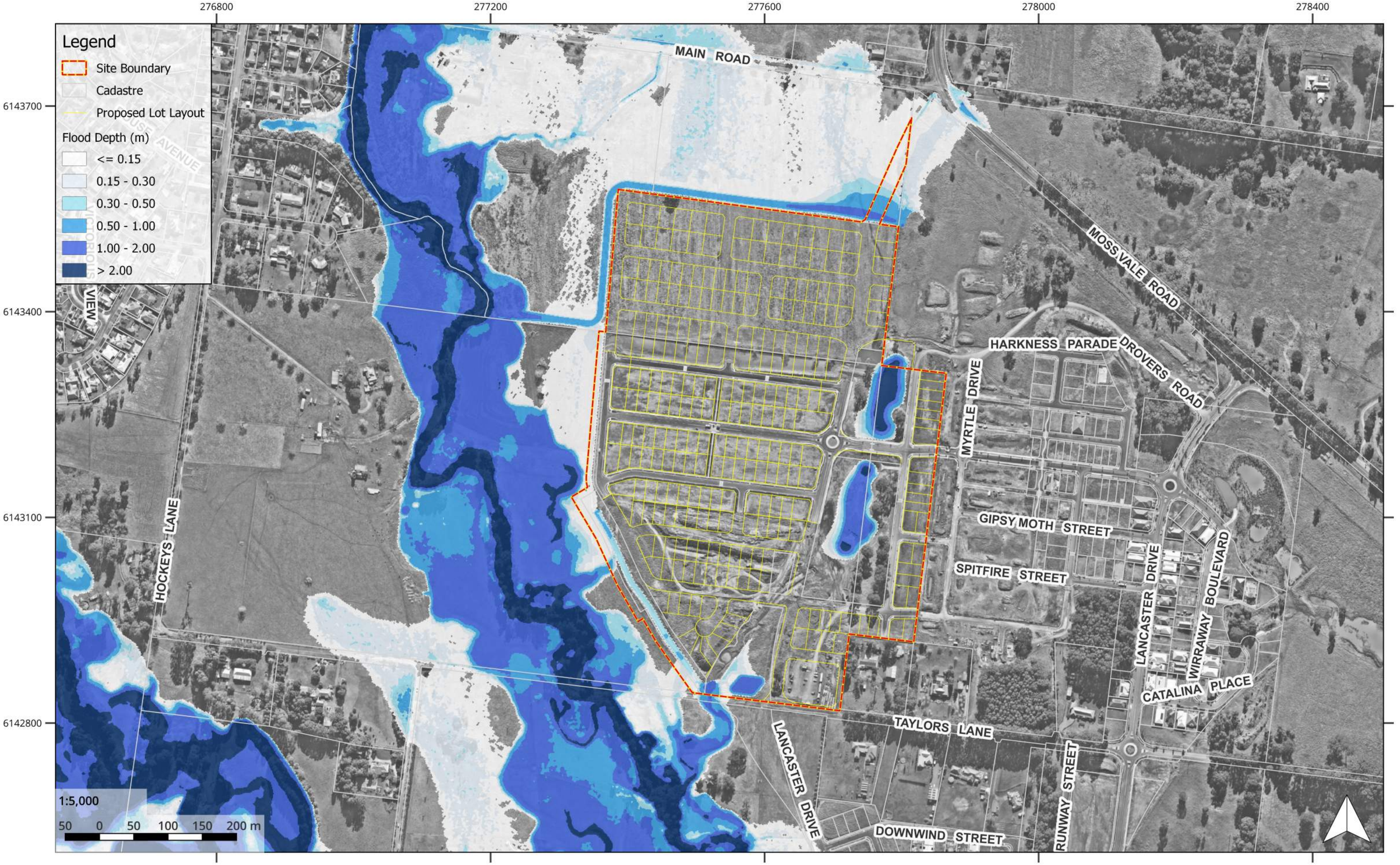
MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
TAYLORS LANE
RUNWAY STREET
DOWNWIND STREET
HOCKEYS LANE

1:5,000

50 0 50 100 150 200 m

Colliers

Map 021: 2100 1% AEP Developed Water Level
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 022: 2100 1% AEP Developed Depth
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

Colliers

Map 023: 2100 1% AEP Developed Velocity
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout

Flood Hazard Category

- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people and vehicles. Buildings require special engineering design and construction
- H6 - not suitable for people, vehicles or buildings

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
HOCKEYS LANE
TAYLORS LANE
LANCASTER DRIVE
RUNWAY STREET
DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Colliers

Map 024: 2100 1% AEP Developed Hazard
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

Map 025: 2100 1% AEP Developed Hydraulic Category
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout
- 0.2m Water Level Contour (mAHD)

Flood Level (mAHD)

- <= 46
- 46 - 47
- 47 - 48
- 48 - 49
- 49 - 50
- 50 - 51
- 51 - 52
- 52 - 53
- 53 - 54
- 54 - 55
- 55 - 56
- 56 - 57
- 57 - 58
- 58 - 59
- 59 - 60
- 60 - 61
- 61 - 62
- 62 - 63
- 63 - 64
- 64 - 65
- 65 - 66
- 66 - 67
- 67 - 68
- 68 - 69
- > 69

MAIN ROAD

MOSS VALE ROAD

HARKNESS PARADE

DROVERS ROAD

MYRTLE DRIVE

GIPSY MOTH STREET

SPITFIRE STREET

LANCASTER DRIVE

WIRRAWAY BOULEVARD

CATALINA PLACE

TAYLORS LANE

RUNWAY STREET

DOWNWIND STREET

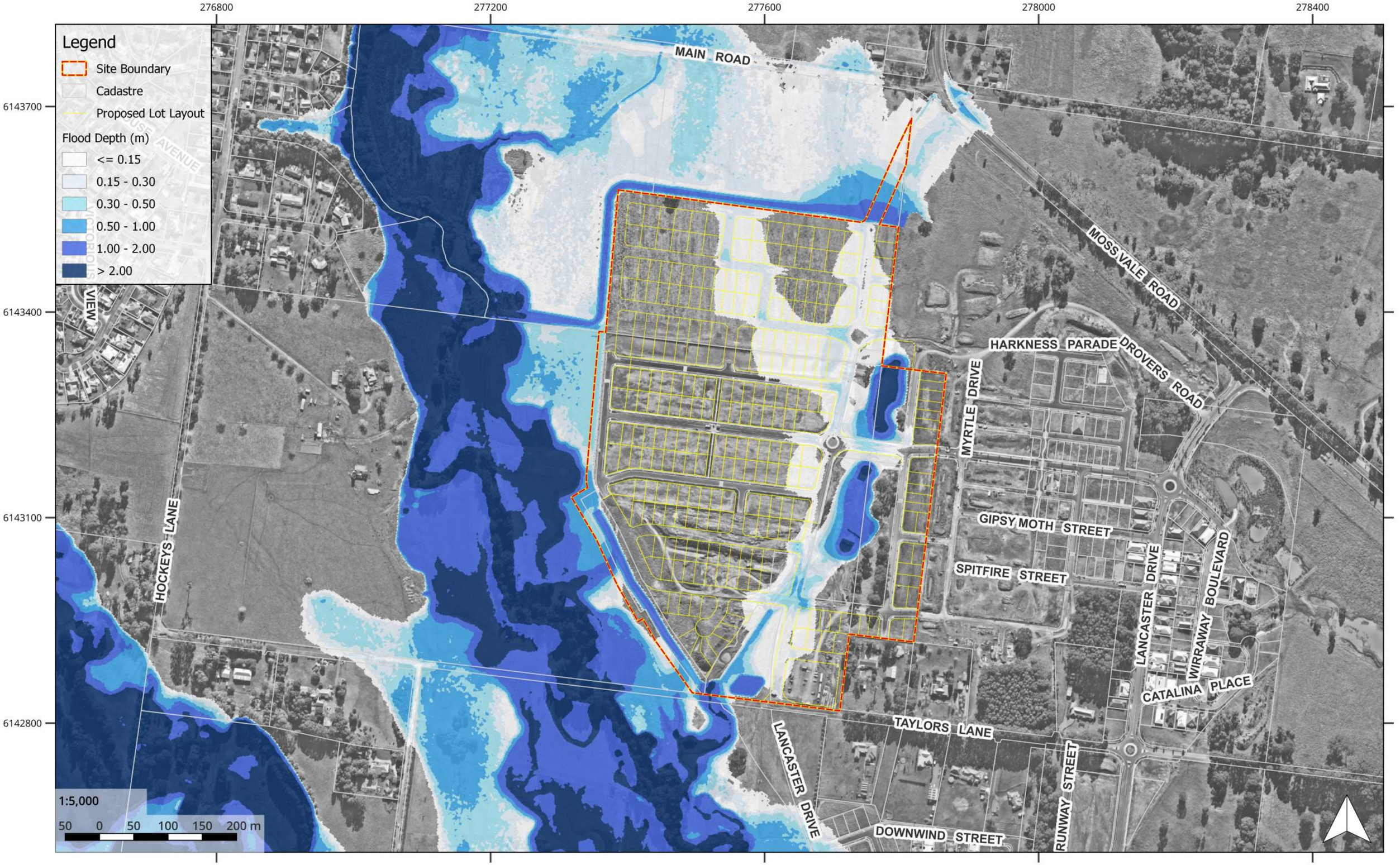
HOCKEYS LANE

1:5,000

50 0 50 100 150 200 m

Colliers

Map 026: PMF Developed Water Level
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 027: PMF Developed Depth
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout

Flood Velocity (m/s)

- <= 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 1.50
- 1.50 - 2.00
- 2.00 - 2.50
- > 2.50

MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
HOCKEYS LANE
TAYLORS LANE
LANCASTER DRIVE
RUNWAY STREET
DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

Colliers

Map 028: PMF Developed Velocity
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd

276800 277200 277600 278000 278400

6143700

6143400

6143100

6142800

Legend

- Site Boundary
- Cadastre
- Proposed Lot Layout

Flood Hazard Category

- H1 - no restrictions
- H2 - unsafe for small vehicles
- H3 - unsafe for vehicles, children and the elderly
- H4 - unsafe for people and vehicles
- H5 - unsafe for people and vehicles. Buildings require special engineering design and construction
- H6 - not suitable for people, vehicles or buildings

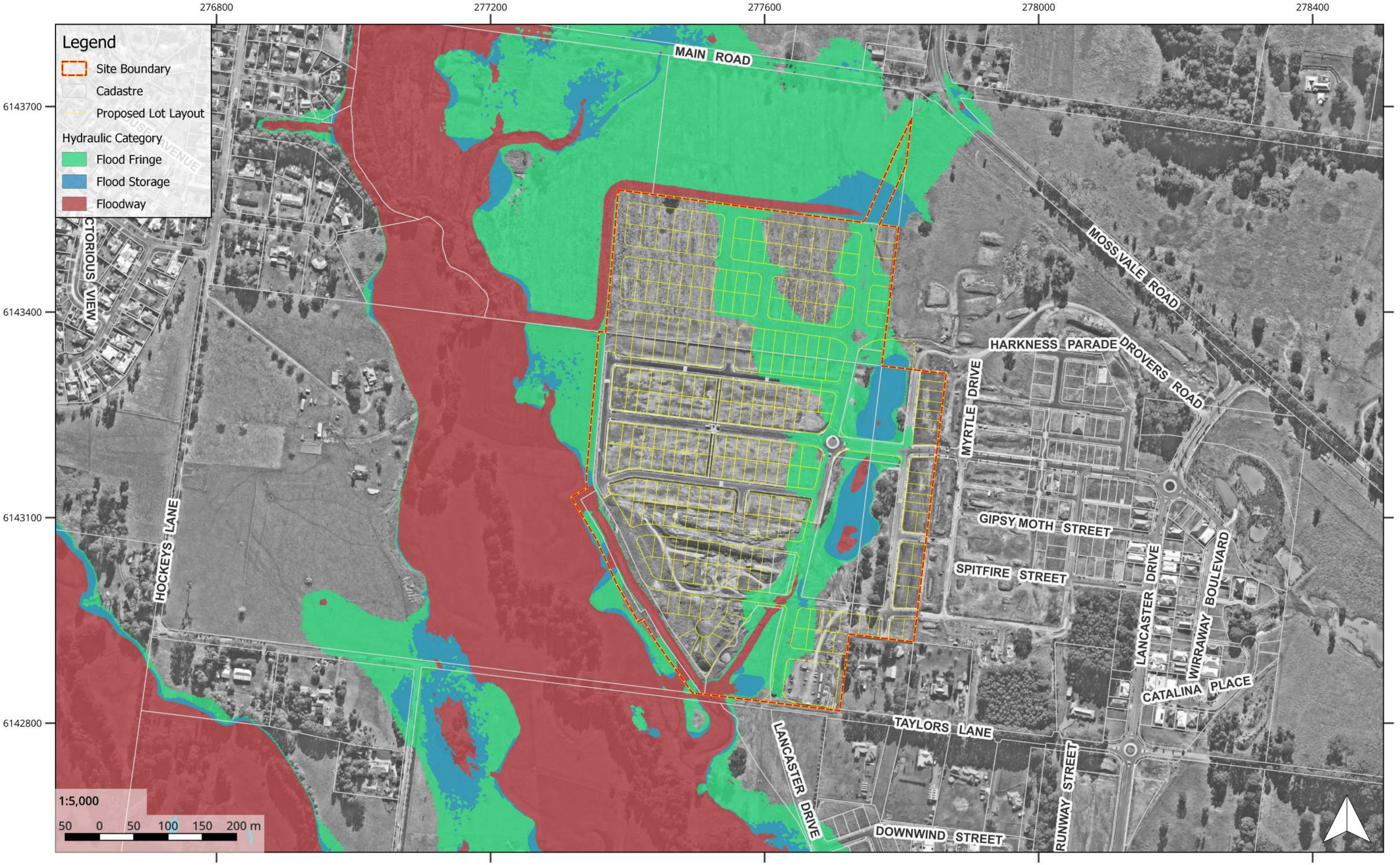
MAIN ROAD
MOSS VALE ROAD
HARKNESS PARADE
DROVERS ROAD
MYRTLE DRIVE
GIPSY MOTH STREET
SPITFIRE STREET
LANCASTER DRIVE
WIRRAWAY BOULEVARD
CATALINA PLACE
HOCKEYS LANE
TAYLORS LANE
LANCASTER DRIVE
RUNWAY STREET
DOWNWIND STREET

1:5,000

50 0 50 100 150 200 m

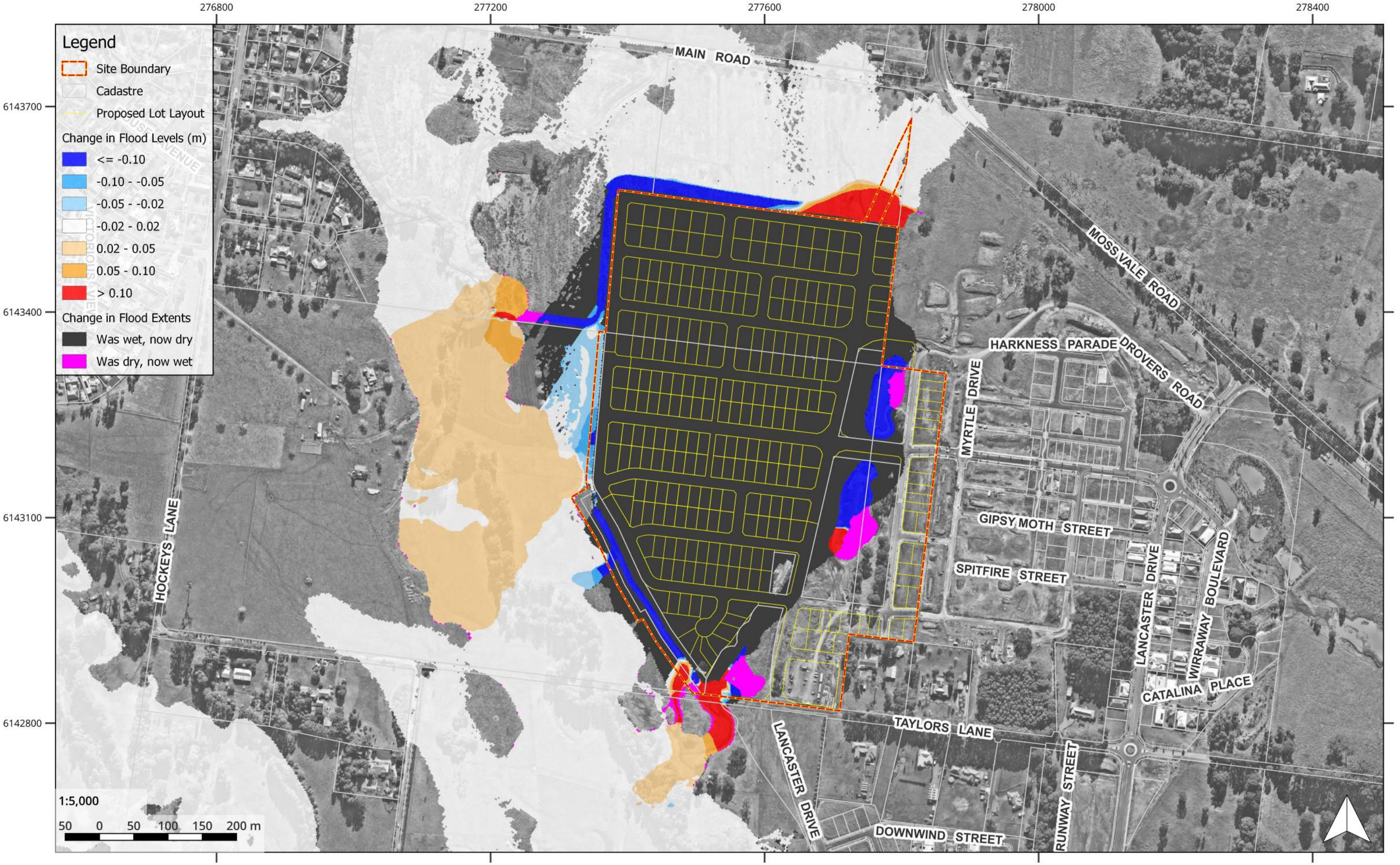
Colliers

Map 029: PMF Developed Hazard
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 030: PMF Developed Hydraulic Category
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd



Colliers

Map 031: 1% AEP Flood Afflux
Project: 49 Hockeys Lane, 41 Main Road and 126 Taylors Lane, Cambewarra
Project Number: 479-23
Client: Newpro 23 Pty Ltd