William Carey Christian School Stage 2 Development Flood Impact Assessment

Rev 1 Project Number 300203875
Prepared for Liverpool/ Campbelltown Christian School
| 14 October 2024

We design with community in mind

Stantec

Revision Schedule
Project Number: 300203875 PCN1

Rev No	Date	Description	Signature of Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved For Issue by
1A	14 October 2024	WCCS Stage 2 FIA	HR, AC	EL	VJ	EL

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Quality statement

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AUSTRALIA

Contents

List of Appendices

Abbreviations

Enter Abbreviation	Enter Full Name
AEP	Annual Exceedance Probability
ARR	Australian Rainfall and Runoff
DA	Development Application
DCP	Development Control Plan
GIS	Geographic Information Systems
LCC	Liverpool City Council
LGA	Local Government Area
LiDAR	Light detection and Ranging
NSW	New South Wales
PMF	Probable Maximum Flood

1 Introduction

A Flood Impact Assessment has been conducted to evaluate potential flood impacts related to the proposed Stage 2 development of the William Carey Christian School (WCCS). This impact assessment will inform whether the proposed development will have adverse impacts on the surrounding environment.

1.1 Location

The location of the Stage 2 development is within William Carey Christian School, as indicated on Council's Flood Planning Area Map obtained from the ePlanning website in **Figure 1**.

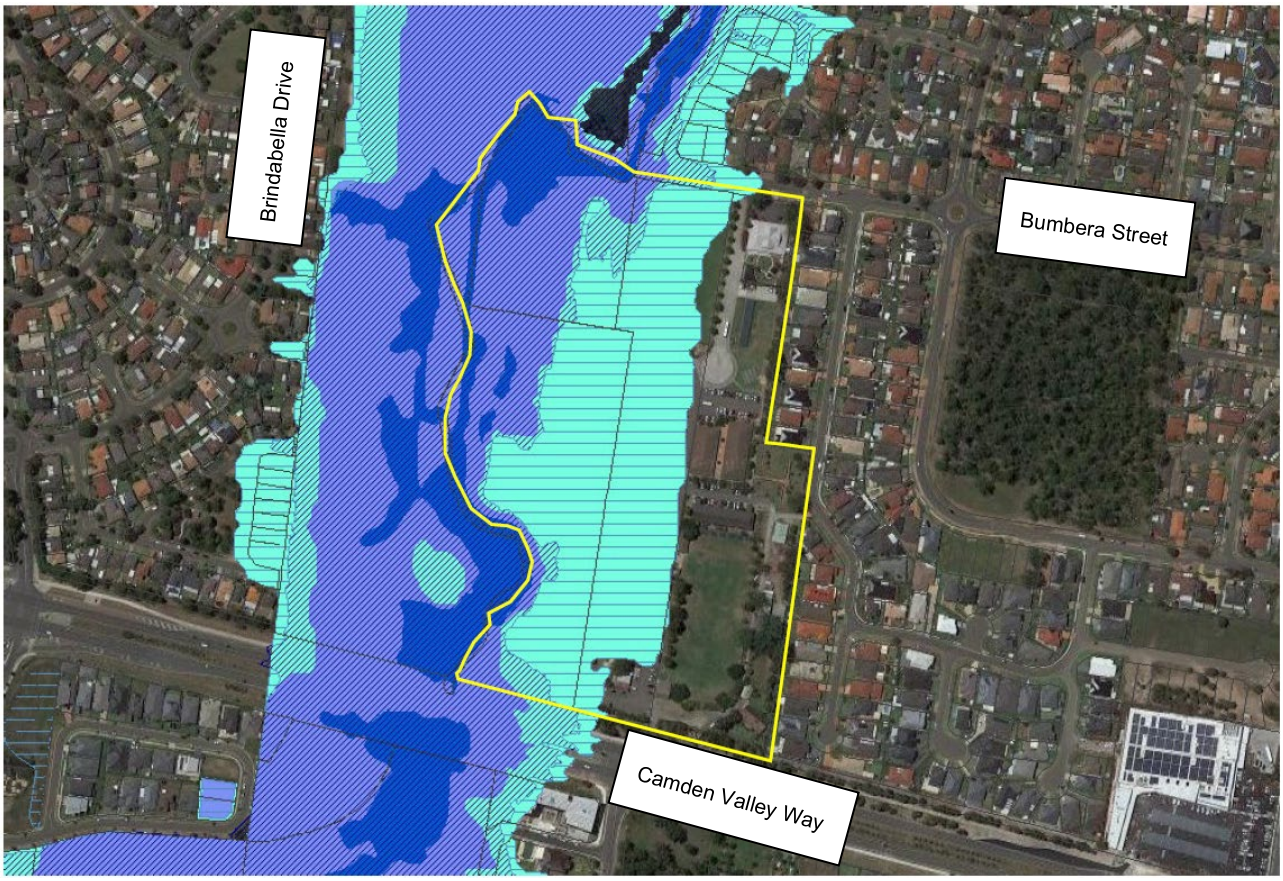

Figure 1 Location of William Carey Christian School (Liverpool City Council ePlanning, Accessed 6 July 2023)

1.2 Scope of Work

In this study the existing flood model for 1895 Camden Valley Way (Cardno Now Stantec, 2021) was modified by Stantec to accurately reflect the planned development at the site. Following this modification, the proposed flood model was re-run to extract crucial flooding information, including mainstream flood depths, velocities, and hazards for the 5% Annual Exceedance Probability (AEP), 1% AEP, and Probable Maximum Flood (PMF) events. The assessment then analysed the flood impacts specifically for the 5% and 1% AEP events, focusing on how the development altered flood behaviour. Additionally, the study evaluated the development's compliance with Liverpool City Council's (LCC) Development Control Plan (DCP) requirements, ensuring that all necessary regulations were met as outlined in Part 1 Section 9 Flooding Risk including:

- Flood Planning Level to be equal or greater than the 1% AEP flood level plus 500mm freeboard.

1.3 Proposed Development

The proposed Stage 2 development consists of a multi (2) storey classroom building within the existing school extents, surrounded by existing buildings as shown in Figure 2, with an approximate building footprint of approximately 246 m^2. Details of the proposed development are provided in Appendix A.

The proposed development was further updated on 2 September 2024 with additional survey. Details on the surveyed levels is outlined in Section 3 of this report.

Figure 2 Existing and Proposed Building Footprints

2 Previous Studies

2.1 Cabramatta Creek Flood Study and Basin Strategy Review (Bewsher, 2011)

According to Cabramatta Creek Flood Study and Basin Strategy Review prepared by Bewsher (2011):

> *"The study is divided into two parts. Part 1 aims to provide an advanced computer model of flood behaviour in the catchment for existing (2008) flood conditions. The model is also to be used to assess flood behaviour under previous (1989) catchment conditions, and to review the performance of Council's detention basin strategy to mitigate the impact of catchment development on flood behaviour within this time frame. Part 2 investigates the performance of the basin strategy under future (2026) conditions, including full development of the new release areas and construction of the remaining basins from the basin strategy.*
>
> *The adopted modelling approach has been to update an existing RAFTS hydrologic model of catchment runoff, and to input these flows to a new TUFLOW hydraulic model to estimate flood levels, velocities and extents. TUFLOW is a two-dimensional computer model that has been used in over 200 applications in NSW, Queensland, Victoria, South Australia, Tasmania, and in the UK.*
>
> *The models have been calibrated to historic data collected in the August 1986 and April 1988 floods. Both floods were significant, with the 1988 event being estimated to be close to a 100 year event throughout much of the catchment. Calibration data consisted of stage and flow hydrographs at a gauging station at Orange Grove Road, 29 flood height observations for the 1988 flood, and 44 flood height observations for the 1986 flood.*
>
> *Two different flood models have been developed representing existing (2008) and previous (1989) catchment conditions. A third model was developed representing future (2026) catchment conditions during Part 2 of the Study.*
>
> *Culvert Blockage Assumptions*
>
> *The current study makes no allowance for the potential blockage of culverts, bridges, or detention basin outlets. It is recommended that sensitivity testing be undertaken as part of any subsequent investigations to determine how flood behaviour may be affected under various blockage scenarios.*
>
> *Review of Flood Behaviour*
>
> *Design flood behaviour has been analysed for a range of floods for existing (2008) and previous (1989) catchment conditions. A map showing the extent of flood inundation and design flood level contours for the 100 year flood is provided on Figure 6.1 under existing (2008) conditions. Results for other events will be provided digitally for incorporation in Council's GIS. A flood risk management map is also provided on Figure 6.2 for the floodplain.*
>
> *A map showing the difference in the latest estimate of the 100 year flood from the previous estimate from the RMA-2 model is provided on Figure 6.3. The mapping indicates some localised areas where flood level estimates have either increased or reduced, although the majority of the study area has not changed significantly (within 0.2m).*
>
> *A map showing the difference in TUFLOW estimates over the period from 1989 to 2008 is provided on Figure 6.4. With the exception of some localised areas, the majority of the study area shows relatively minor changes (within 0.2m) over this period."*

It is our understanding that the flood extents mapped by Council ePlanning portal in the vicinity of the subject site are based on the results of the 2011 Cabramatta Creek Flood Study.

2.2 Flood Impact Assessment, 1895 Camden Valley Way, Horningsea Park (Cardno now Stantec, 2021)

In August 2021 a Flood Impact Assessment (FIA) was undertaken by Cardno, now Stantec, to assess the impact or otherwise of the proposed development schemes to address the flood risks on 1895 Camden Valley Way, Horningsea Park using a 1D/2D floodplain model supplied by LCC.

2.3 Liverpool Overland Flow Path Study Stage 2 (BMT WBM, 2008)

According to BMT WBM (2008) the aims of the Liverpool Overland Flow Path Part 2 study were to:

- Define overland flow behaviour within the study area including flow rates, velocities, water depths;
- Assess the extents for the 5% AEP, 1% AEP and PMF events; and
- Produce high quality mapping describing the catchment flooding.

The 1895 Camden Valley Way, Horningsea Park FIA primarily focused on the mainstream riverine flood impacts. However, in the Liverpool Overland Flow Path Study Stage 2, overland flow has been considered to better understand the overall flood behaviour, although it is specifically utilized for the flood evacuation of the proposed development. For further details on overland flow considerations, refer to the Stage 2 Flood Evacuation Report and Plan (FERP).

3 Available Data

The following information were available for the purpose of the current assessment:

- A copy of the hydrological and floodplain model assembled for 1895 Camden Valley Way (Cardno, now Stantec, 2021) which includes information on the benchmark flood behaviour in the vicinity of the school;
- Detailed survey and/or ALS data covering the proposed Stage 2 proposed development;
- A digital copy of the Stage 2 – Modular building development 3D DWG (GDA94 MGA56), including details on the proposed building and access locations, and proposed floor levels;
- Survey information provided by Beyond Survey (dated 17 August 2024, and then further updated 2 September 2024). The proposed building's ground level is at +40.900 and the first floor is at +44.580. For further details, refer to Appendix B.

4 Flood Modelling Summary

4.1 Hydrology

Hydrological modelling is undertaken to establish inflow boundaries to the TUFLOW hydraulic model (flow hydrographs from external catchments and local rainfall directly on to the flood-prone area). A conventional RAFTS model was developed to inform hydrology of 1895 Camden Valley Way LCC.

A summary of 1895 Camden Valley Way LCC hydrology model assumptions is provided here:

- Council adopted one Intensity- Frequency-Duration (IFD) table (ARR1987) for the entire Local Government area (LGA);
- No areal reduction factor was considered appropriate for the study;
- In the absence of historical flow records, the values below were adopted as representative of the catchment for design purposes:
  - Pervious surfaces: Initial Loss: 20 mm and Continuing Loss: 2.5 mm/hr; and
  - Impervious surfaces: Initial Loss: 5 mm and Continuing Loss: 0 mm/hr.
- For the PMF event an initial loss of 0 mm and continuing loss of 0 mm/hr were adopted. For the PMF event it was assumed that fully saturated catchment conditions would be present.

Stantec adopted the same hydrology model as the input for the hydraulic modelling.

4.2 Hydraulics

4.2.1 Hydraulic Model for 1895 Camden Valley Way LCC FIA

The TUFLOW 1D/2D (Tuflow_2016_03_AA) software was adopted for hydraulic modelling of 1895 Camden Valley Way LCC. A summary of the TUFLOW model assumptions is provided here:

4.2.1.1 Drainage network

Considering the design event magnitudes being investigated, i.e. 5%, 1% and PMF, Council resolved to include only the pipe network with diameter larger than or equal to 600 mm. Council provided information where available on the existing drainage system.

4.2.1.2 Hydraulic Roughness

The adopted hydraulic roughness coefficients are shown in **Table 4-1**.

Table 4-1 Adopted Hydraulic Roughness Coefficients Based on Land Use Manning's 'n'

Land Use/Surface Type	Manning's 'n'
Roads - all road reserve	0.025
Short Grass / Bare Earth	0.035
Vegetated Area	0.05
Forest	0.1
Vegetated Floodplain	0.07
Unmaintained Floodplain	0.06
Buildings	1.0
Channel	0.035
Channel overbank	0.1
Dense veg	0.09
Heavy veg	0.075
Water Body	0.02

High Manning's value of 1.0 for residential/industrial buildings was adopted to account for inundation within buildings (accounting for storage), but not simulating significant flow through the building.

4.2.1.3 Critical Duration

The flood mapping series included each of the design event magnitudes simulated in the study, the 5% AEP, 1% AEP and PMF flood events. A range of design event storm durations including 15 minutes, 30 minutes, 60 minutes, 90 minutes, 120 minutes, 180 minutes and 360 minutes were simulated for each of the study areas.

The critical duration for the majority of the study areas for overland flooding (not mainstream flooding) was of the order of 60 mins to 90 mins.

4.2.2 Existing Conditions

Stantec updated the 1895 Camden Valley Way LC TUFLOW model based on the available data to better present the existing flooding conditions at the site and surrounds. The following update was made to the model:

- The recent ground survey was included in the model to form a new benchmark model.

Australian Rainfall and Runoff (ARR) 1987 guidelines was adopted in the current study, consistent with the 1895 Camden Valley Way LCC.

The Existing Conditions model was run for the 5% AEP 1% AEP and PMF flood events.

4.2.3 Proposed Conditions

The Existing Conditions model was updated through inclusion of the below key development item to represent the Proposed Conditions flooding at the site and surround:

- The proposed building was incorporated into the model. The building was modelled by adopting the same approach as previously modelled, using a high roughness value of n=1.

The Proposed Conditions model was run for the 5% AEP 1% AEP and PMF flood events.

4.3 Flood Modelling Results

Existing conditions maps are presented in the Figure 1 to Figure 12 of Appendix D, which show that:

- The WCCS site is not affected by 20% AEP and 1% AEP flooding events.

- Within the study area in the existing PMF event:
    - The flood depth is between 0.03m to 0.3m, and
    - The majority of flood velocity is <0.5 m/s, up to 1m/s limited to small, localised areas.
    - Flood hazards of H1 and H2 category are observed.

Proposed conditions flood maps are presented in the Figure 13 to Figure 24 of Appendix D, which show that within the study area:

- The proposed stage 2 site is not affected by 20% AEP and 1% AEP mainstream flooding.
- The PMF event flood depths range from 0.03m to 0.3m, with differences not exceeding 0.01m across the site.
- In the PMF event, flood hazards of H1 category and H2 category were observed.

4.4 Flood Impact Assessment

The water level difference plots presented in the Figure 25 to Figure 27 (Appendix D). A summary of flood impacts is provided below:

- In the 20% AEP flood and 1% AEP flood event, the proposed stage 2 site remains flood free.
- In the PMF flood event, localised flood level difference within the study site show negligible flood impact (less than 0.01m).

As the site is not affected by the 1% AEP event, it falls under LCC DCP's low flood risk category. The flood level difference plots disclose that negligible adverse impacts

4.5 Flood Planning Requirements

The proposed site building's ground level is set above the 1% AEP plus flood freeboard and exceeds the reported PMF water level of 40.56m AHD. The proposed building's surveyed ground level is at +40.90m AHD and the first floor is at +44.58m AHD. No additional flood control measures, other than evacuation, are to be considered.

4.6 Flood Emergency Response Plan

Details on flood evacuation and response actions will be provided in the Flood Emergency Response Plan (FERP) to be prepared by Stantec, considering the site contains overland flow.

5 Conclusion

Flood impact assessment for WCCS Stage 2 development was conducted using the flood model adopted by Council for the purpose 1895 Camden Valley Way LLC Flood Impact Assessment. The model was updated by including:

- The WCSS study survey to better reflect the Existing conditions of the site;
- The proposed new building footprints using high roughness values (n=1) to simulate the structures and to better reflect the Proposed conditions of the site.

The Existing and Proposed Conditions models were run for the 5% AEP, 1% AEP, and PMF events to assess flood depths, velocities, and hazards.

The results indicate that:

- The WCCS site remains flood-free during the 20% AEP and 1% AEP events;
- In the PMF event, the flood level difference plots disclose that negligible adverse impacts ;
- PMF flood hazards under the proposed Conditions remain unchanged (compared to Existing Conditions).

The study confirms that the proposed development will not exacerbate existing flood conditions the proposed

The proposed site building's ground level is set above the 1% AEP plus flood freeboard and exceeds the reported PMF water level. No additional flood control measures, other than evacuation, are to be considered.

Details on flood evacuation and response actions will be provided in the Flood Emergency Response Plan (FERP) to be prepared by Stantec, considering the site contains overland flow.

Appendix

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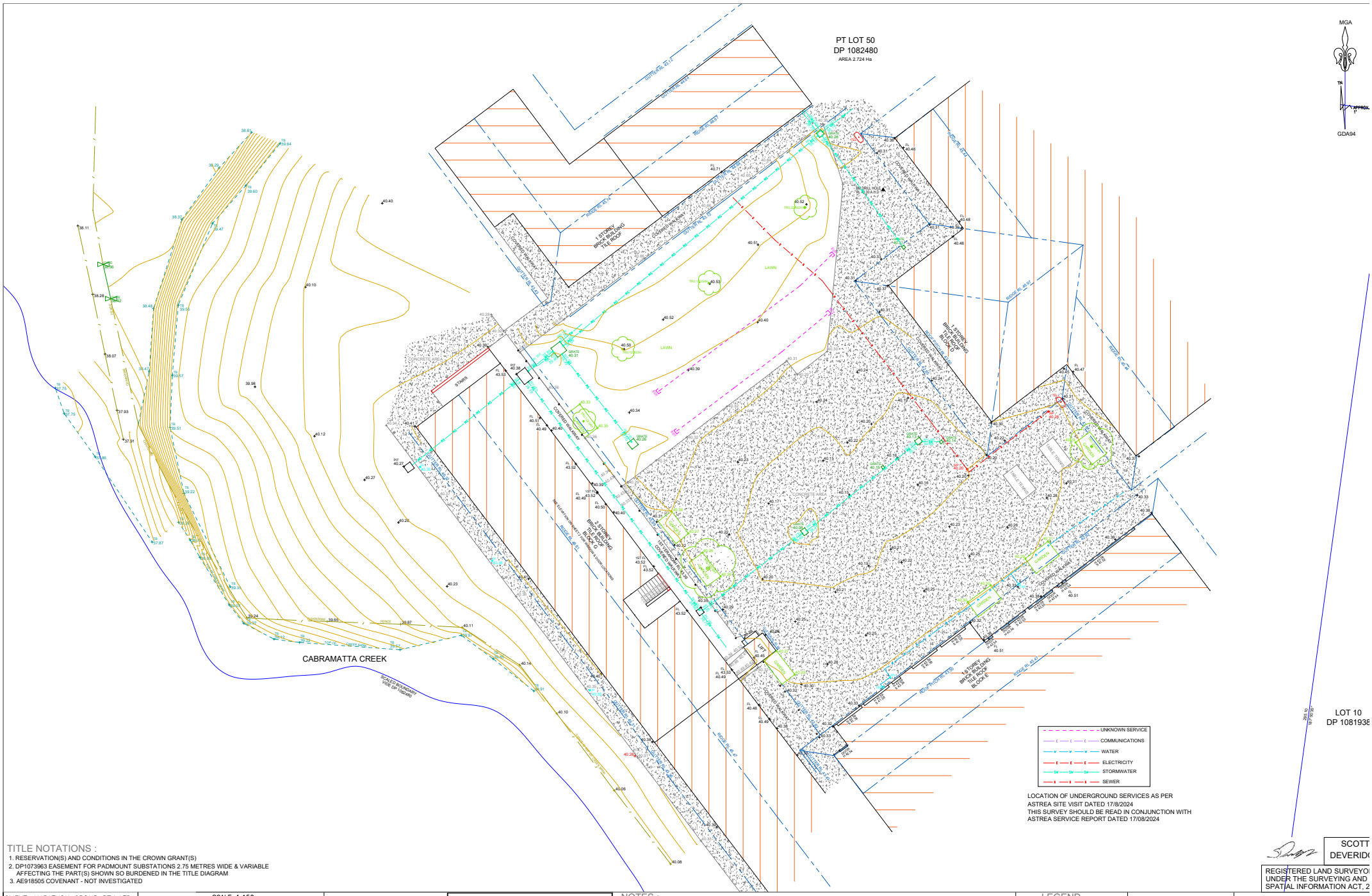
Appendix A Proposed Site Plan


N=6241097.7427
E=301492.6931

Appendix B Revised Survey



LOCATION OF UNDERGROUND SERVICES AS PER
ASTREA SITE VISIT DATED 17/8/2024
THIS SURVEY SHOULD BE READ IN CONJUNCTION WITH
ASTREA SERVICE REPORT DATED 17/08/2024

TITLE NOTATIONS :

1. RESERVATION(S) AND CONDITIONS IN THE CROWN GRANT(S)
2. DP1073963 EASEMENT FOR PADMOUNT SUBSTATIONS 2.75 METRES WIDE & VARIABLE AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM
3. AE918505 COVENANT - NOT INVESTIGATED

SCOTT DEVERID

REGISTERED LAND SURVEYO
UNDER THE SURVEYING AND
SPATIAL INFORMATION ACT, 2

CLIENT: MARATHON GROUP PTY LTD

PLAN OF: 38–44 BUMBERA ST PRESTONS

BEING: PART LOT 50 DP 1082480

SHOWING: GENERAL DETAIL & UNDERGROUND SERVICES

PURPOSE: ARCHITECTURAL DESIGN COUNCIL SUBMISSION

SHEET 1 0F 2

SCALE 1:150
0 1 2 3 4 5 10 15

SURVEYOR :	AB
DATUM :	AUSTRALIAN HEIGHT DATUM
JOB REF. :	BM1444
DRAWING No.	BM1444–DETAIL–MAIN BLD
CHECKED :	AB
DATE OF SURVEY:	17TH AUGUST 2024
REDUCTION RATIO :	1:150

BEYOND MEASURE
SURVEYS

44 STURT STREET
SWANSEA NSW 2281

PHONE : 0413 472 138

aaron@beyondmeasuresurveys.com.au

ABN 30 733 082 068

..\bmlogo.jpg

NOTES :

* BOUNDARIES HAVE BEEN IDENTIFIED AND ARE ACCURATE FOR PLANNING PURPOSES
*BOUNDARIES MUST BE SURVEYED AND MARKED PRIOR TO ANY CONSTRUCTION.
* THIS SURVEY HAS BEEN PREPARED UNDER DIRECT SUPERVISION BY REGISTERED SURVEYOR SCOTT DEVERIDGE
* LAND DIMENSIONS AND AREAS HAVE BEEN COMPILED FROM PLANS OBTAINED FROM LPMA.
* BEARINGS RELATE TO MGA NORTH ORIGINATING FROM DP 1066463 COORDINATES ARE GDA 94, ORIGIN SSM118901
* LEVEL DATUM IS AUSTRALIAN HEIGHT DATUM ORIGIN SSM 95011 RL 40.515 (SCIMS)
* VISIBLE, ACCESSIBLE SERVICES ONLY HAVE BEEN LOCATED. THIS PLAN DOES NOT PURPORT TO SHOW UNDERGROUND SERVICES.
* THE EXISTENCE OF UNDERGROUND SERVICES HAS NOT BEEN ESTABLISHED.
* EXISTENCE OF SERVICES MUST BE VERIFIED BY CONTACTING DIAL BEFORE YOU DIG (DBYD) 1100.COM.AU
CRITICAL SERVICES MUST BE EXPOSED AND LOCATED
* NEIGHBOURING HOUSES , WINDOWS AND ROOF POSITIONS ARE APPROXIMATE ONLY.
* FLOOR LEVELS GENERALLY SURVEYED AT DOOR THRESHOLDS. INTERNAL ROOMS NOT SURVEYED.
* CONTOURS INTERVALS SHOWN ARE 100mm, INDICATIVE OF LAND FORM. SPOT LEVELS SHOULD TAKE PRECEDENCE.
* THIS TITLEBLOCK IS AN INTEGRAL PART OF THIS DRAWING AND SHOULD NOT BE REMOVED.

LEGEND

RDG - RIDGE HEIGHT
SIP - SERVICE INSPECTION POINT
GASM - GAS METER
TW - TOP OF WALL
DP - DOWN PIPE
TG - TOP OF GUTTER
SMH - SEWER MANHOLE
S - SILL OF WINDOW
H - OF WINDOW
TEL - TELSTRA PIT
VEHICLE CROSSING
WM - WATER METER

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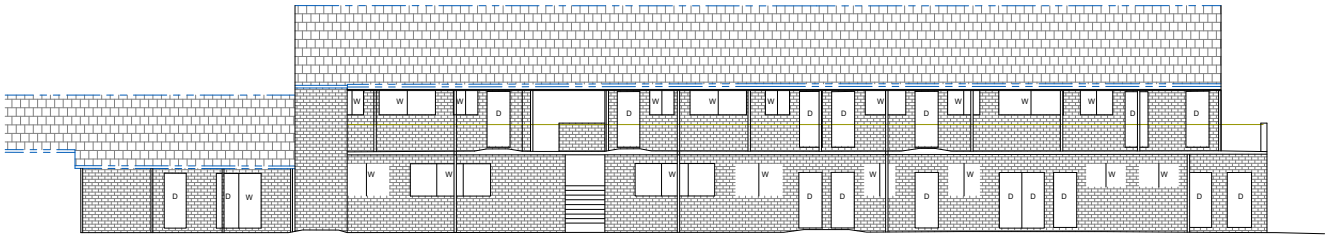
REV	AMENDMENTS



NORTH EASTERN ELEVATION BLOCK G DATUM RL 40.00

SCOTT
DEVERID

REGISTERED LAND SURVEYO
UNDER THE SURVEYING AND
SPATIAL INFORMATION ACT, 2

CLIENT: MARATHON GROUP PTY LTD

PLAN OF: 38–44 BUMBERA ST
PRESTONS

BEING: PART LOT 50 DP 1082480

SHOWING: ELEVATIONS

PURPOSE: ARCHITECTURAL DESIGN
COUNCIL SUBMISSION

SHEET 2 0F 2

SCALE 1:100

0 1 2 3 4 5 6 7 8 9 10

SURVEYOR :	AB
DATUM :	AUSTRALIAN HEIGHT DATUM
JOB REF. :	BM1444
DRAWING No.	BM1444–DETAIL–MAIN BLD
CHECKED :	AB
DATE OF SURVEY:	17TH AUGUST 2024
REDUCTION RATIO :	1:100

BEYOND MEASURE
SURVEYS

44 STURT STREET
SWANSEA NSW 2281

PHONE : 0413 472 138

aaron@beyondmeasuresurveys.com.au

ABN 30 733 082 068

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VEHICLE CROSSING
WM - WATER METER

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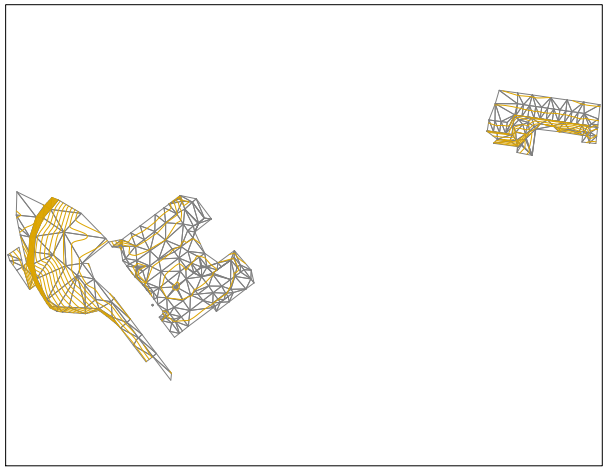
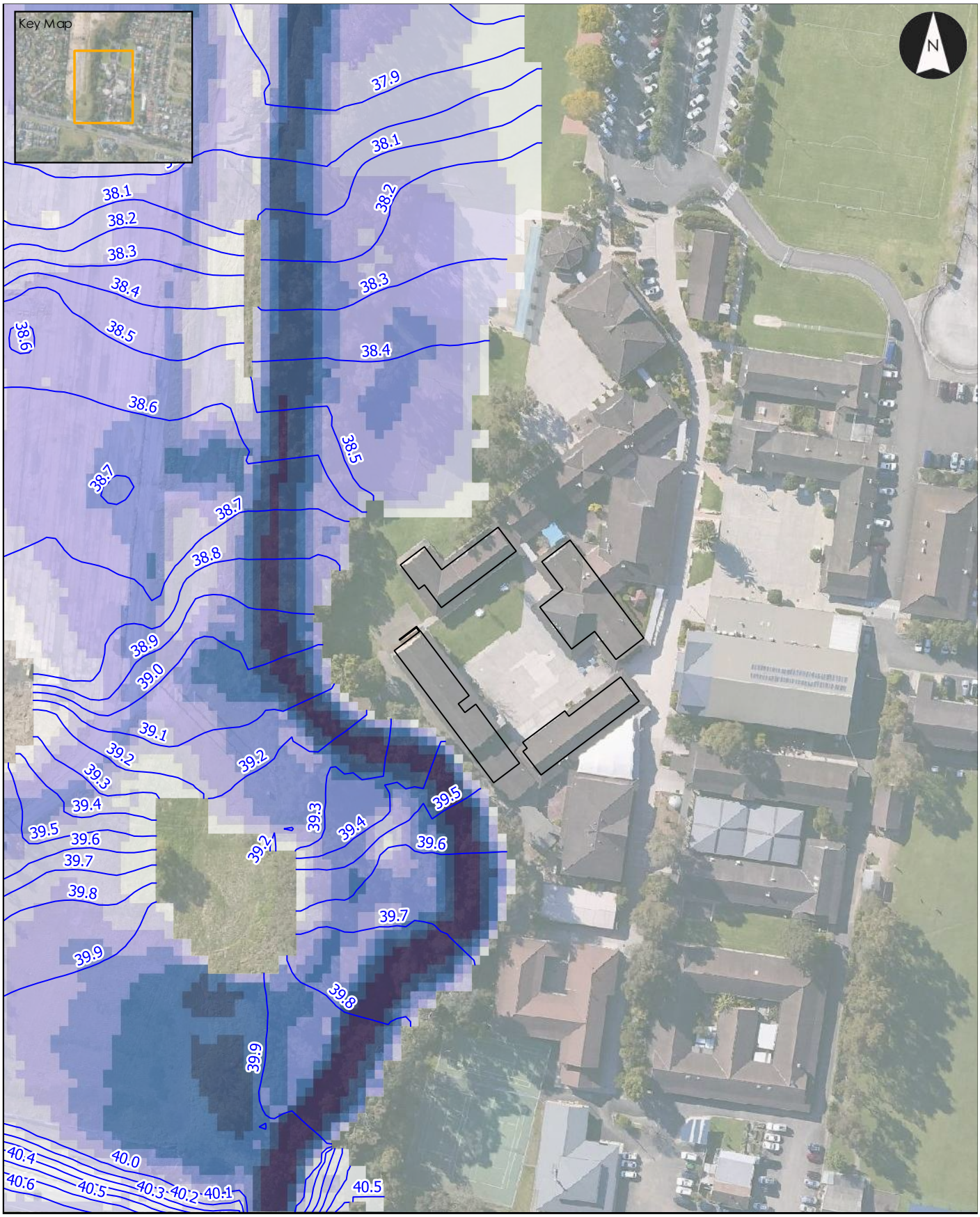


Appendix C Flood Model Results



20 year ARI Existing Conditions Flood Depth and Extent

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 1

Legend

- Existing Buildings
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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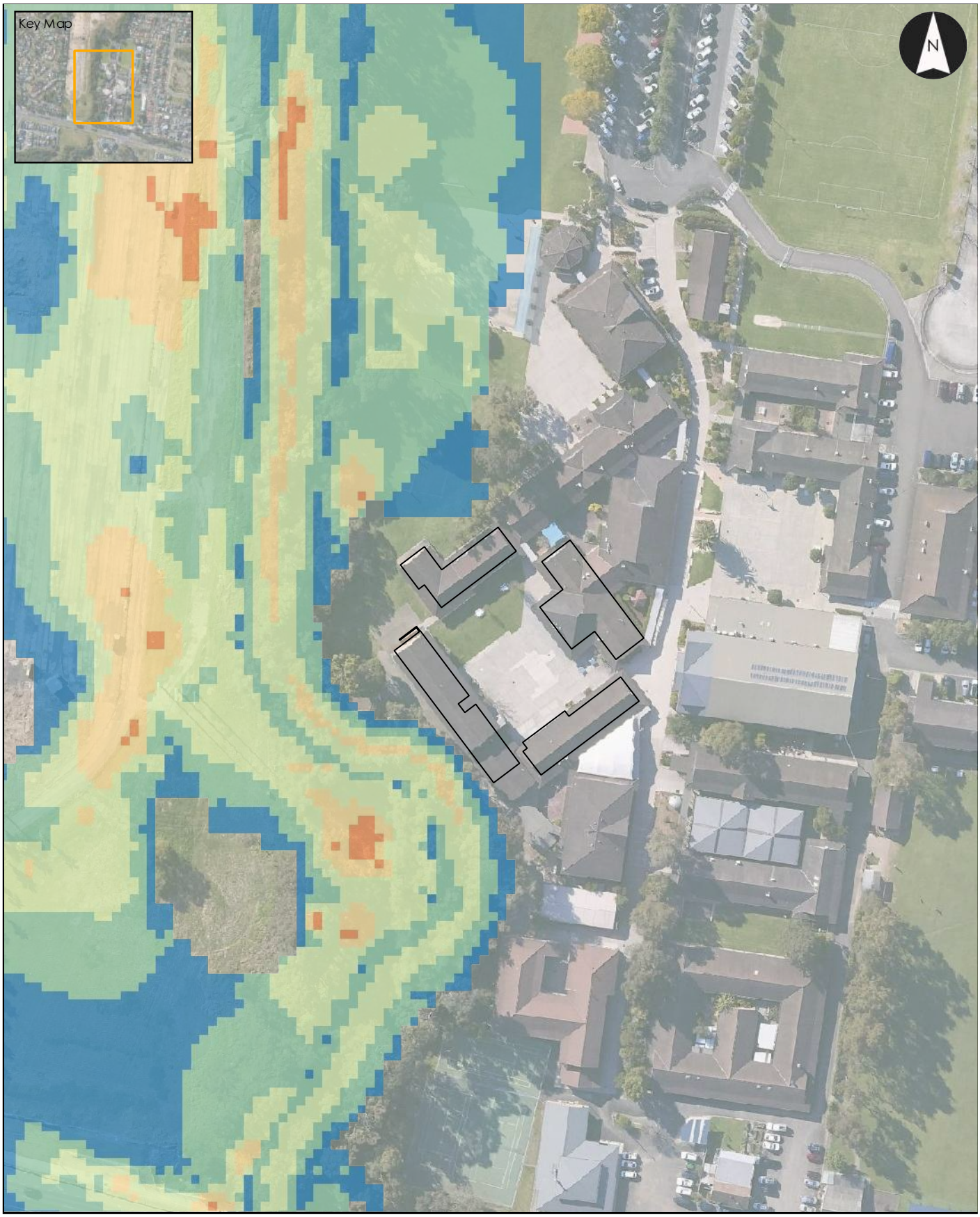

20 year ARI Existing Conditions Flood Velocity

Legend

Existing Buildings

Flood Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- > 3.0

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

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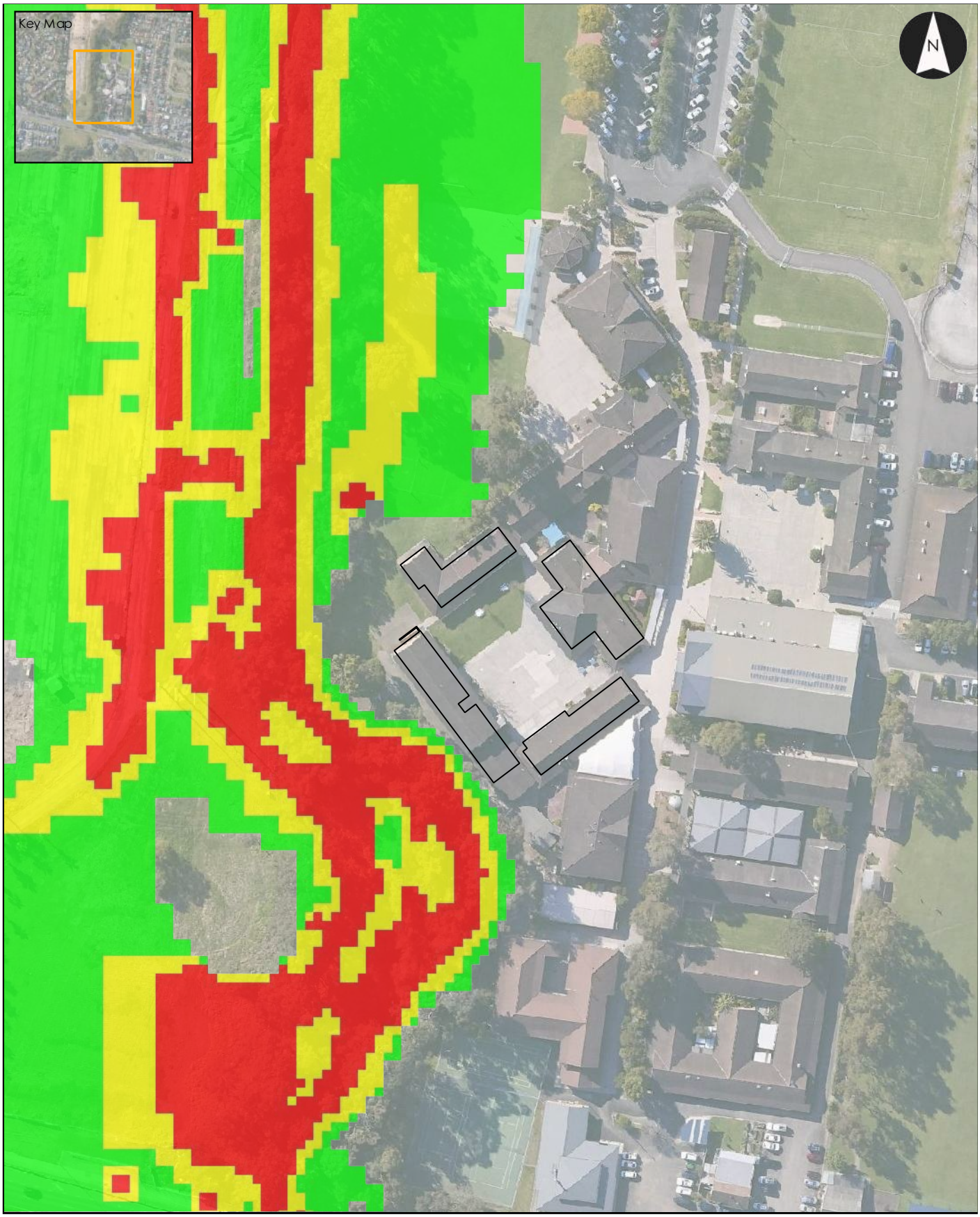

20 year ARI Existing Conditions Provisional Flood Hazard

Legend

Existing Buildings

Provisional Hazard

- Low
- Transitional
- High

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

Figure No: 3

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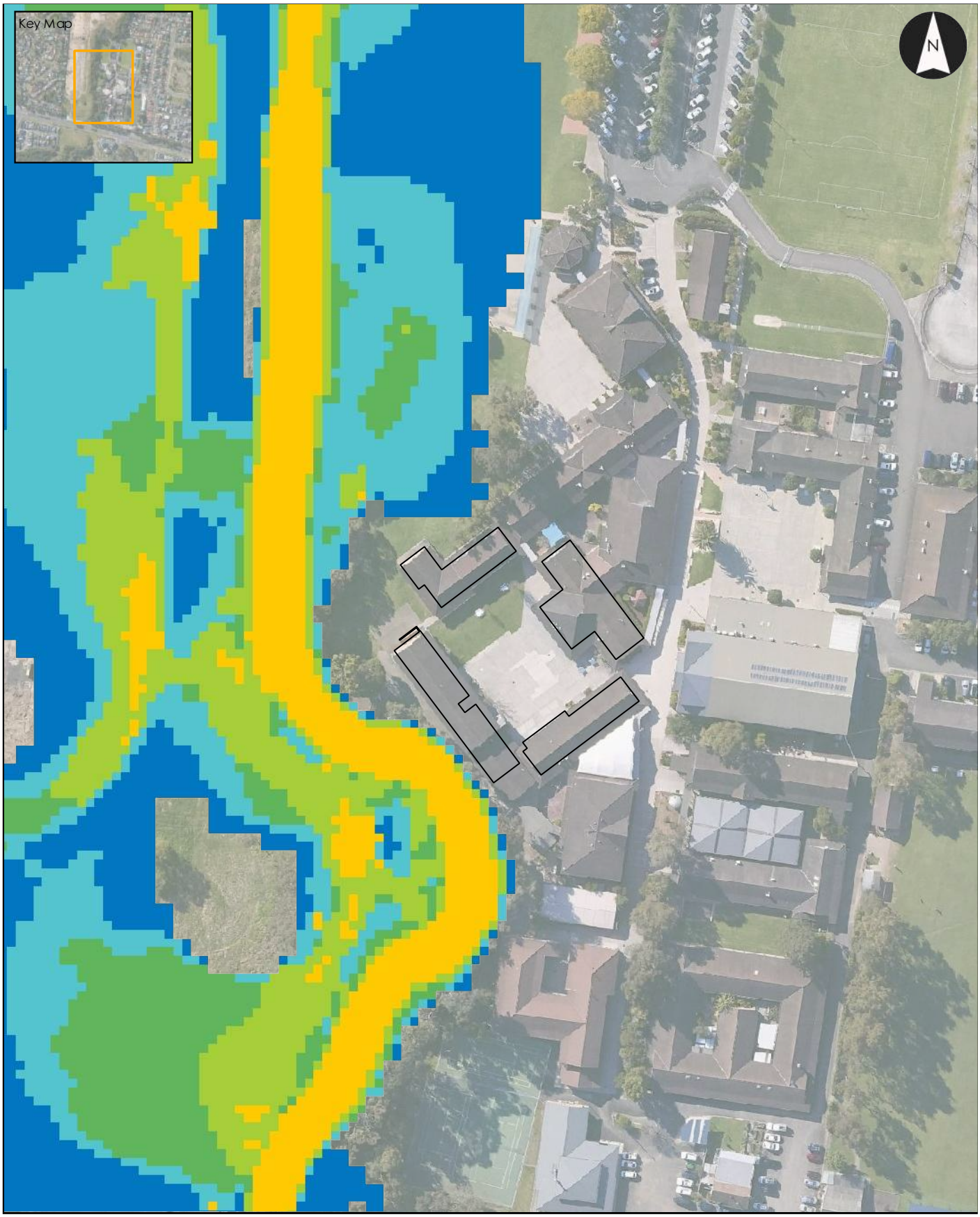

20 year ARI Existing Conditions Flood Hazard

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 4

Legend

Existing Buildings

Hazard Category (H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

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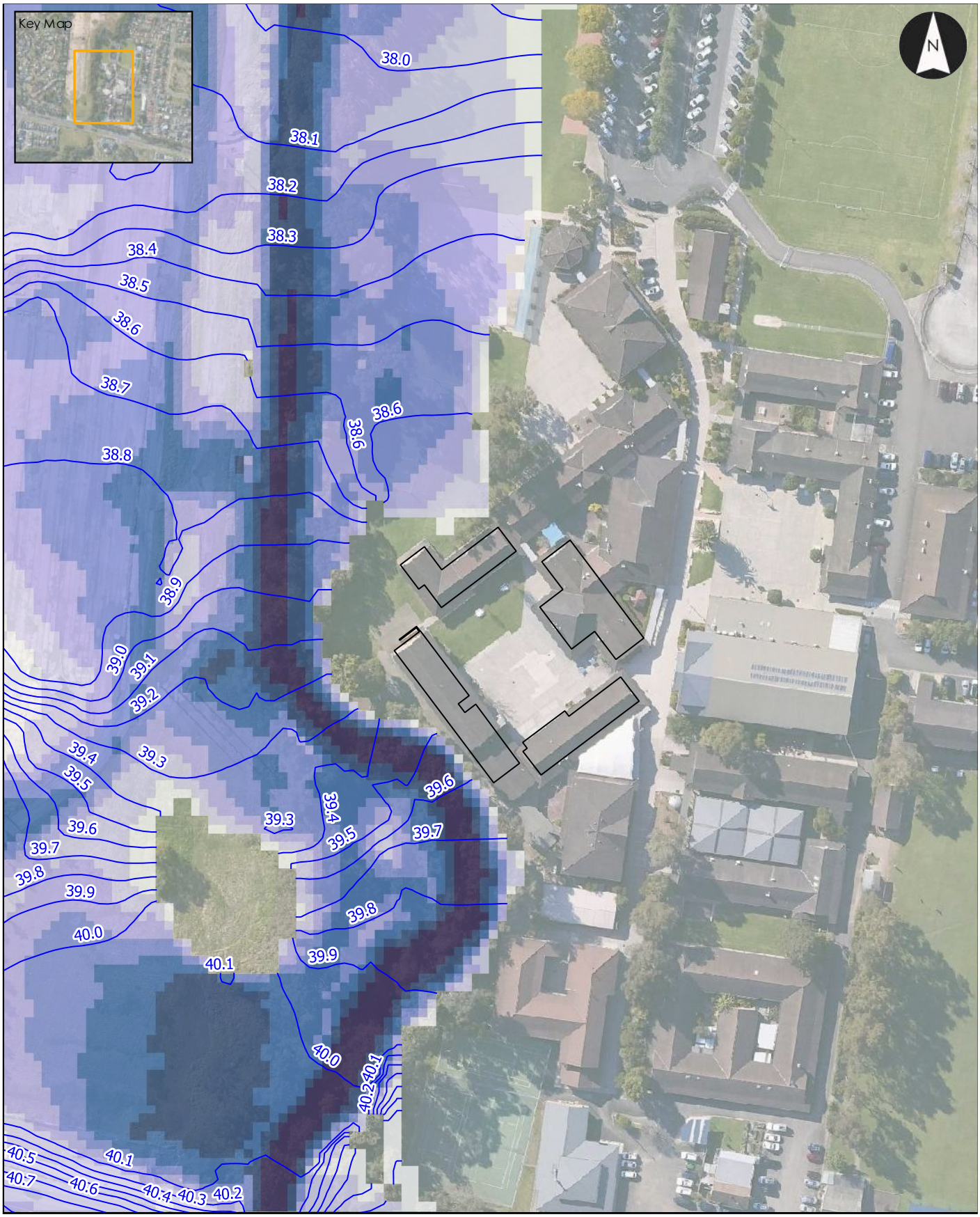


100 year ARI Existing Conditions Flood Depth and Extent

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

Figure No: 5

Legend

- Existing Buildings
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

Notes:
1. Map displayed in EPSG:28356

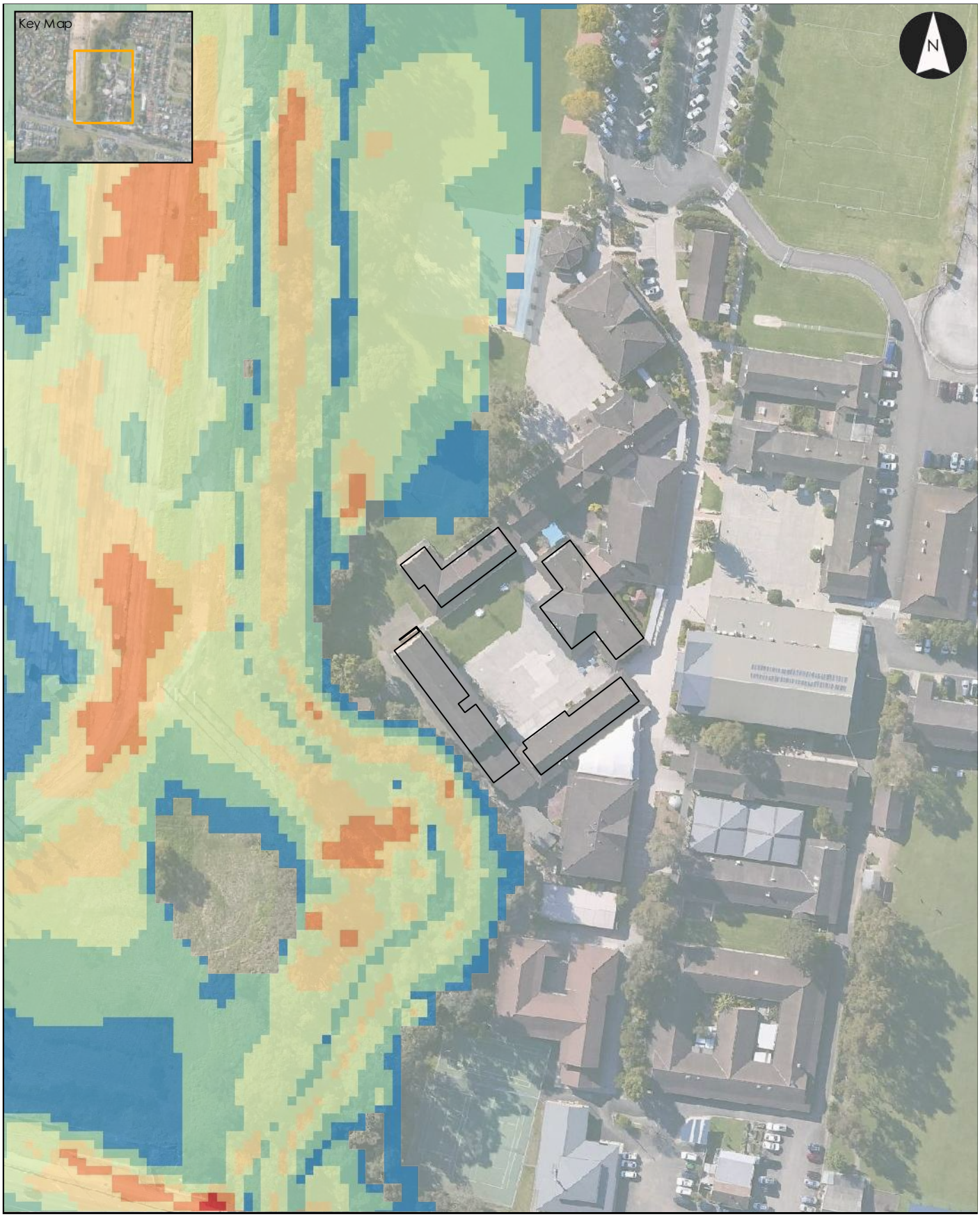
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



100 year ARI Existing Conditions Flood Velocity

Legend

Existing Buildings

Flood Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- > 3.0

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 6

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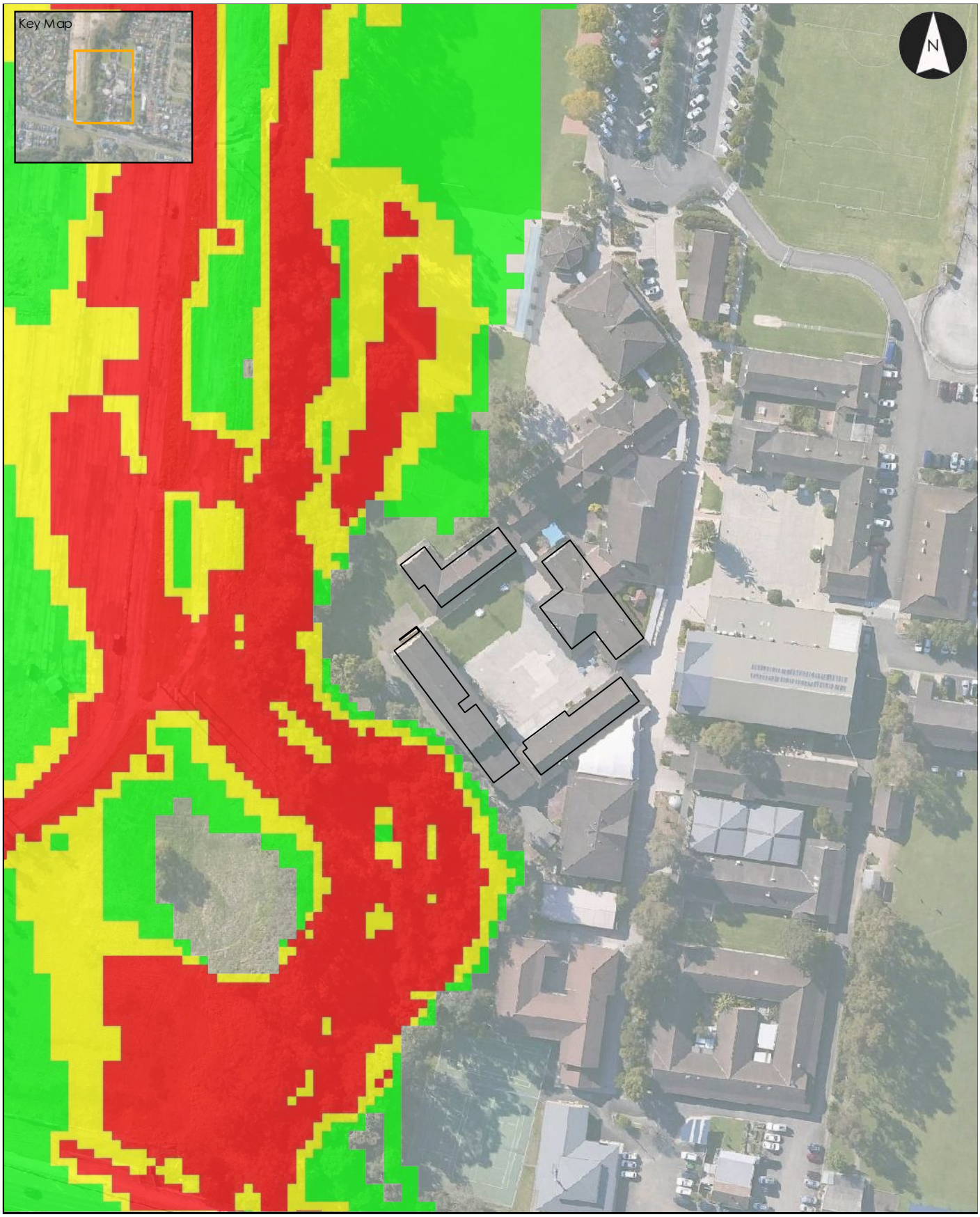

100 year ARI Existing Conditions Provisional Flood Hazard

Legend

Existing Buildings

Provisional Hazard

- Low
- Transitional
- High

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

Figure No: 7

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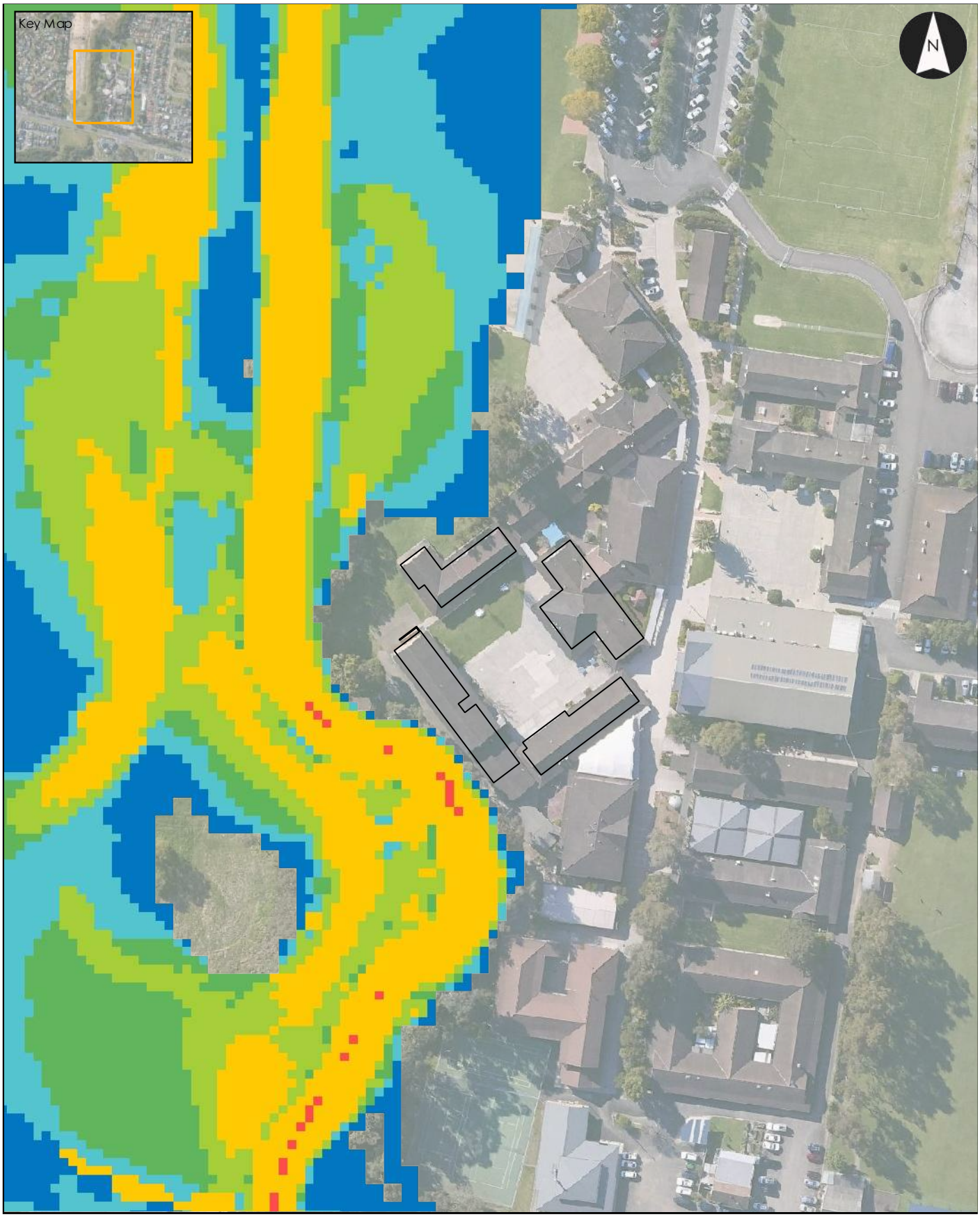


100 year ARI Existing Conditions Flood Hazard

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 8

Legend

Existing Buildings

Hazard Category (H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Notes:
1. Map displayed in EPSG:28356

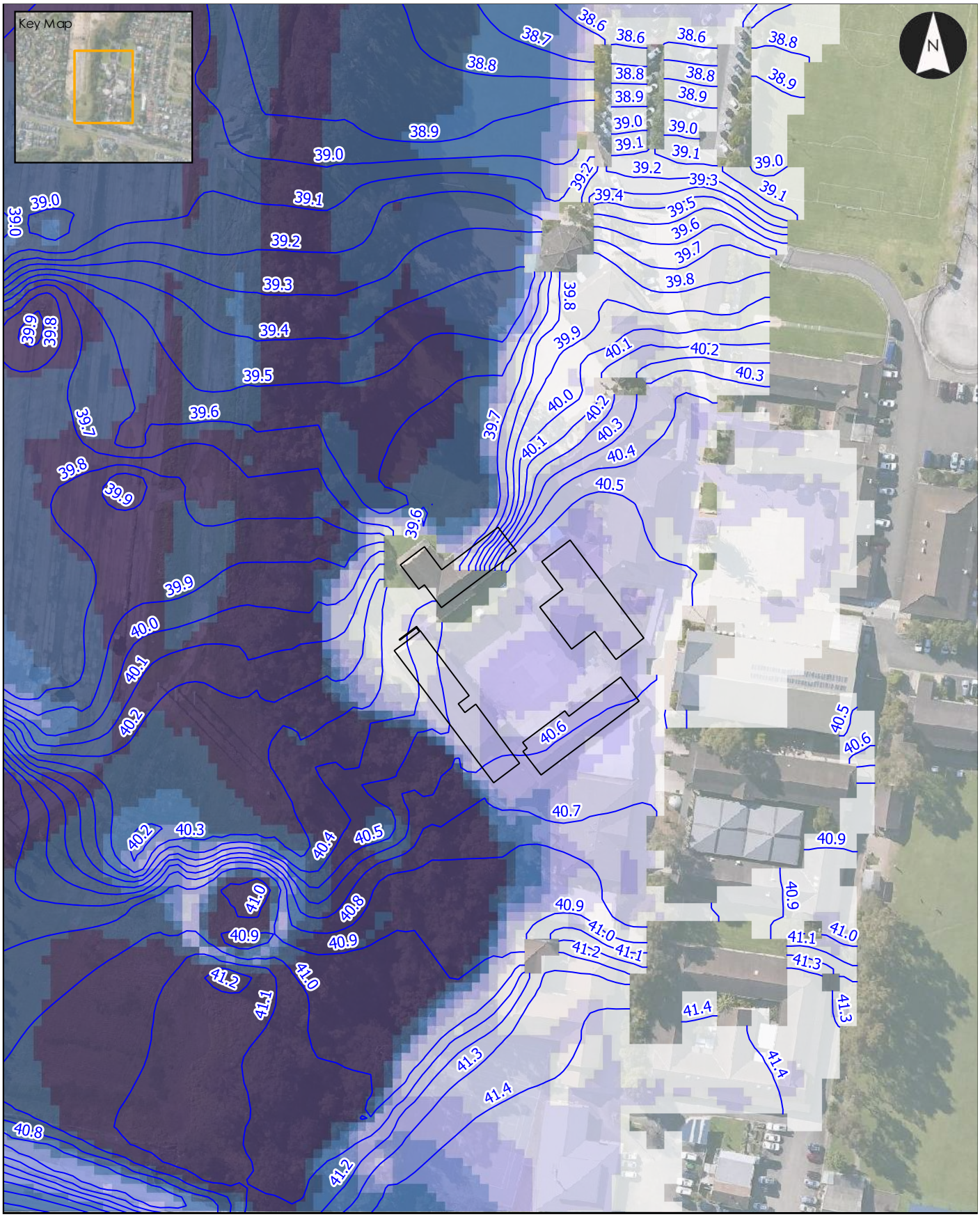
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



PMF Existing Conditions
Flood Depth and Extent

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 9

Legend

- Existing Buildings
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

Notes:
1. Map displayed in EPSG:28356

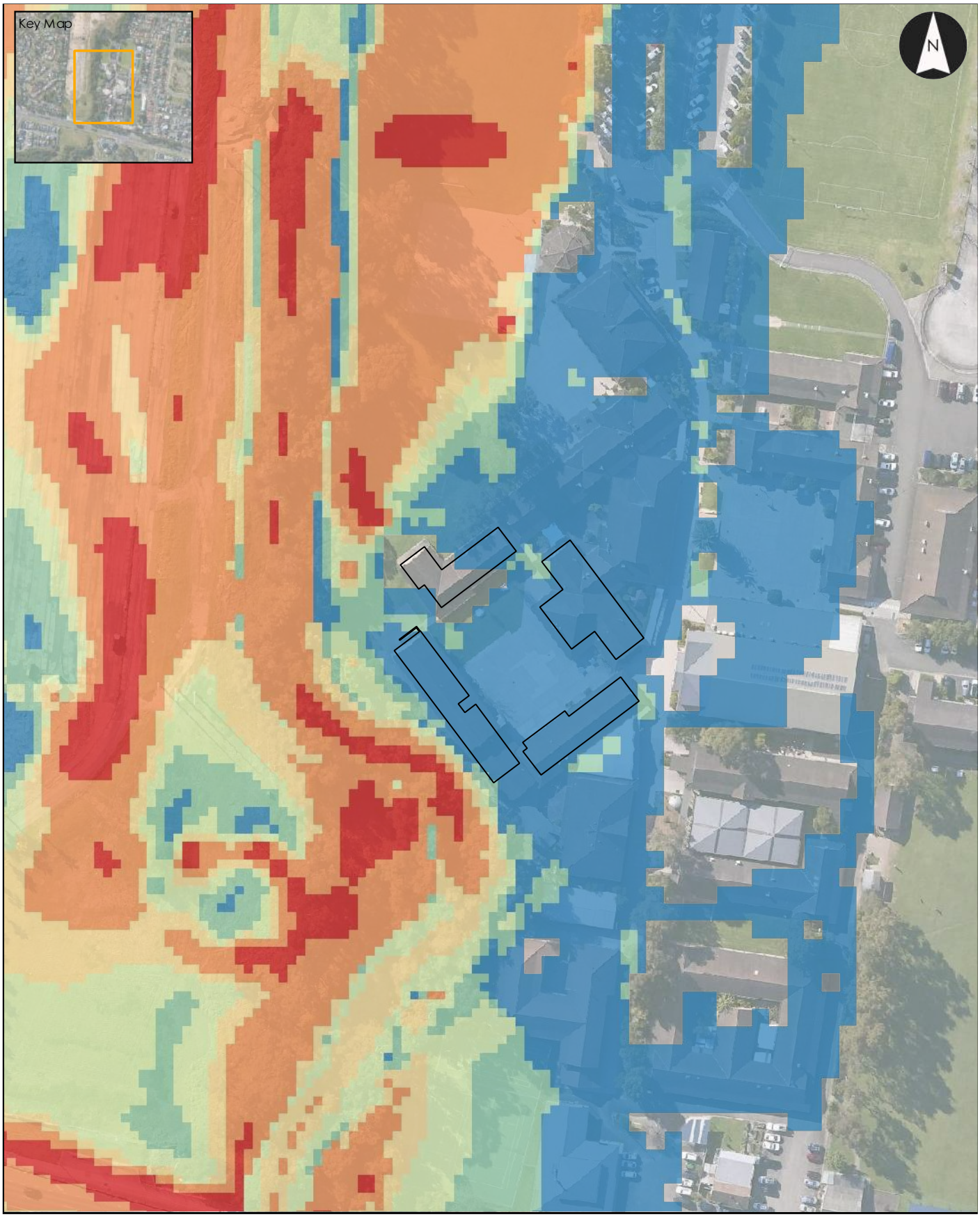
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



PMF Existing Conditions
Flood Velocity

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 10

Legend

Existing Buildings

Flood Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- > 3.0

Notes:
1. Map displayed in EPSG:28356

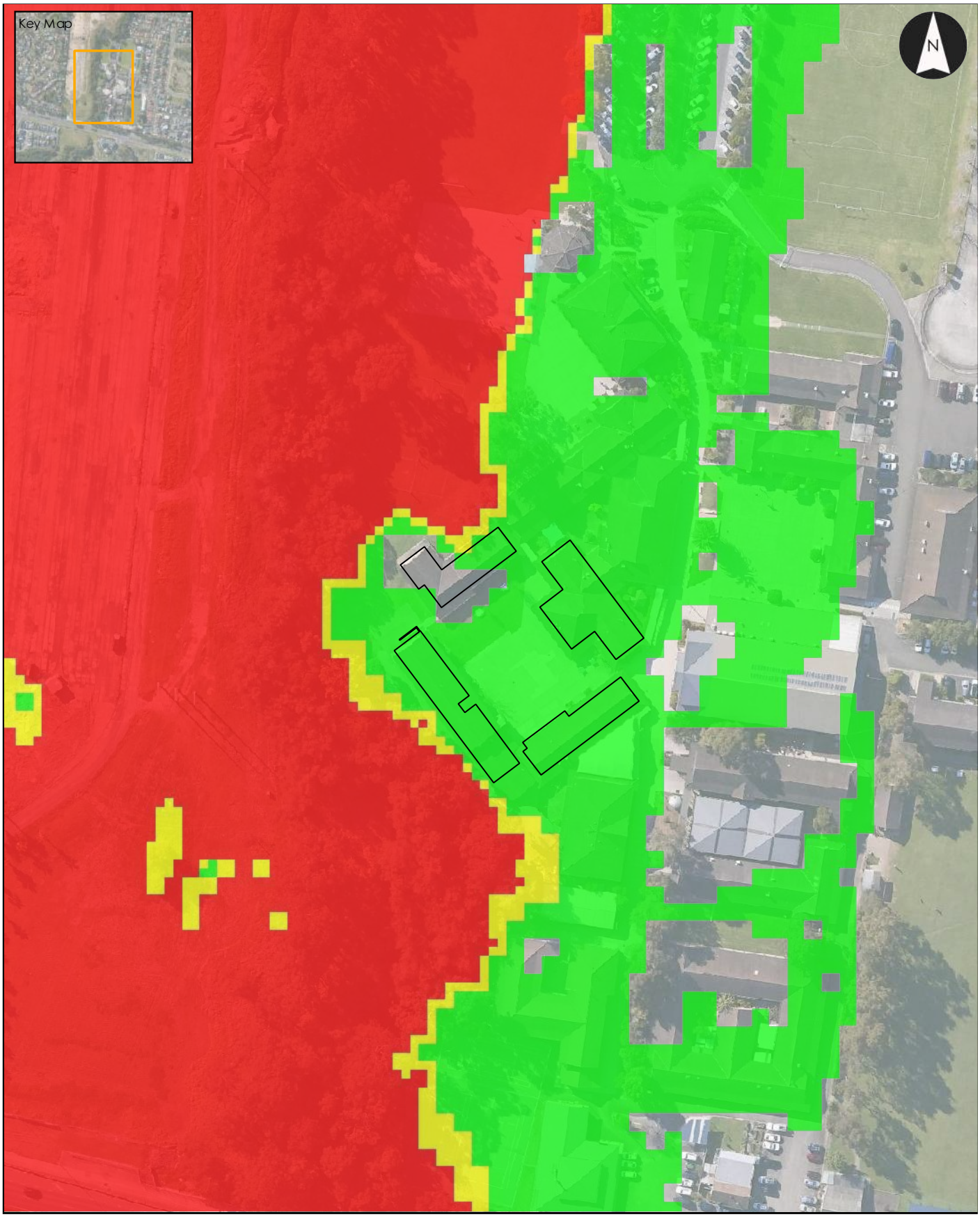
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



PMF Existing Conditions
Provisional Flood Hazard

Legend

Existing Buildings

Provisional Hazard

- Low
- Transitional
- High

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 11

DRAFT - Not For Construction

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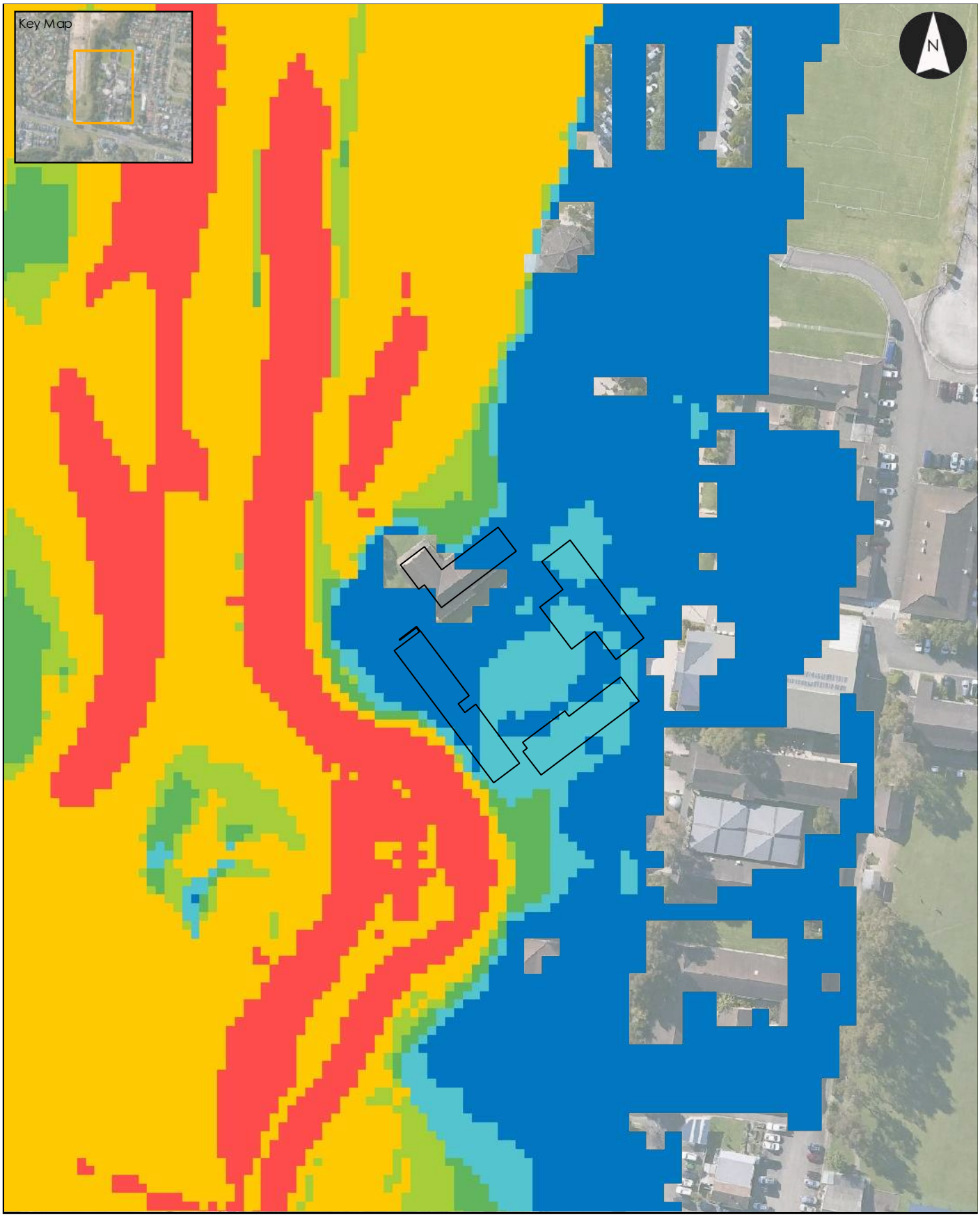


PMF Existing Conditions Flood Hazard

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 12

Legend

Existing Buildings

Hazard Category (H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Notes:
1. Map displayed in EPSG:28356

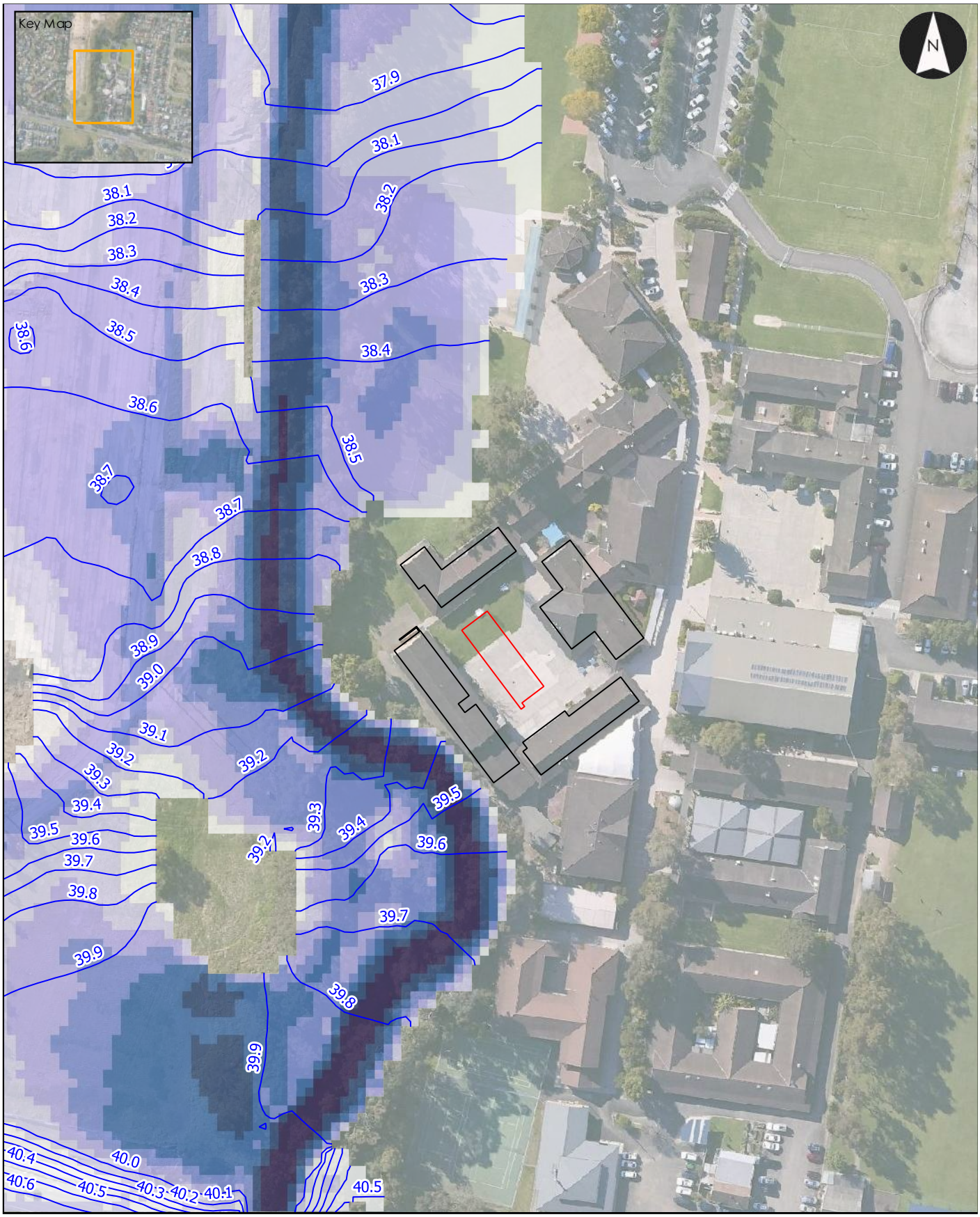
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



20 year ARI Proposed Conditions Flood Depth and Extent

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 13

Legend

- Proposed Buildings
- Existing Buildings
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

Notes:
1. Map displayed in EPSG:28356

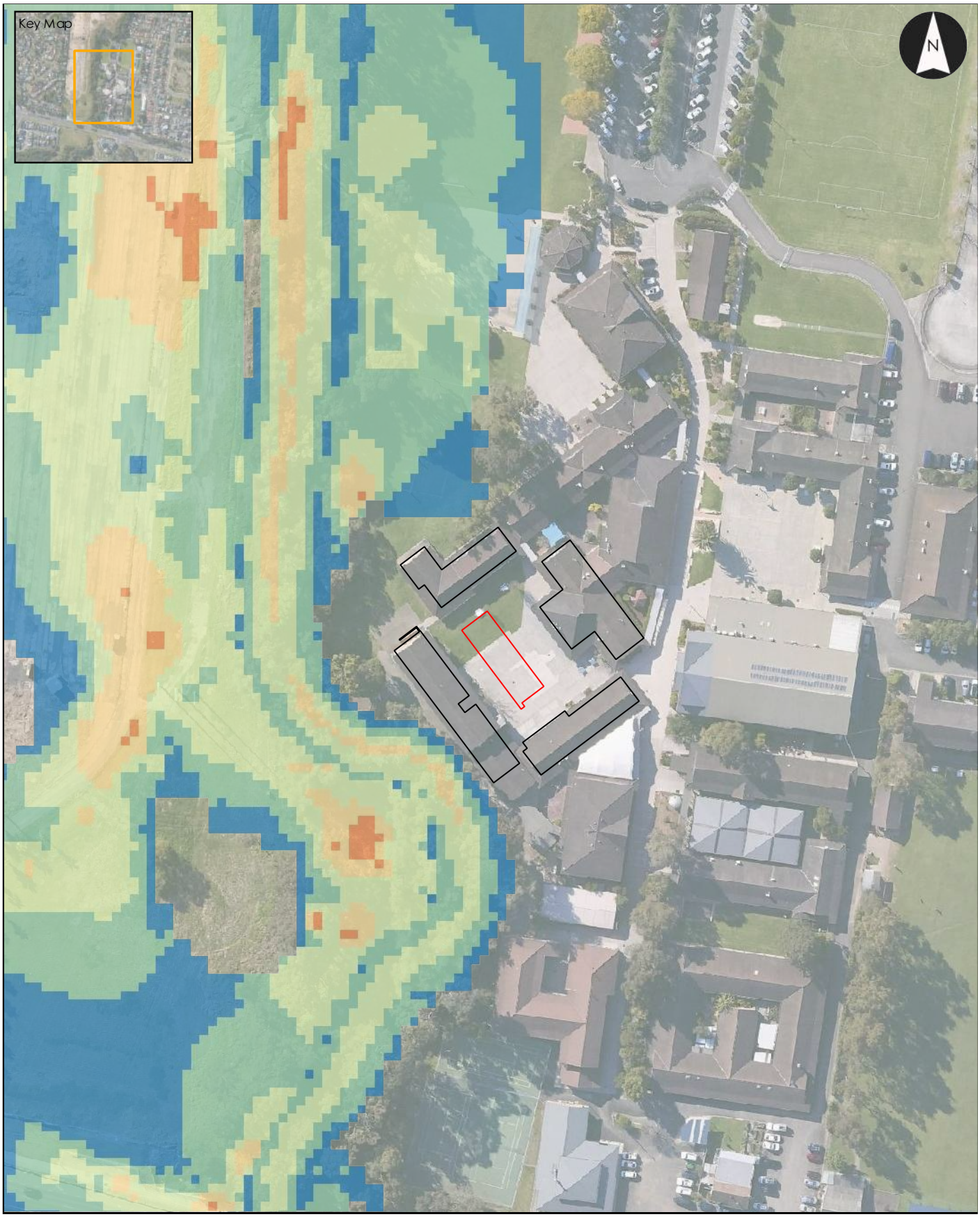
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



20 year ARI Proposed Conditions Flood Velocity

Legend

- Proposed Buildings
- Existing Buildings

Flood Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- > 3.0

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 14

DRAFT - Not For Construction

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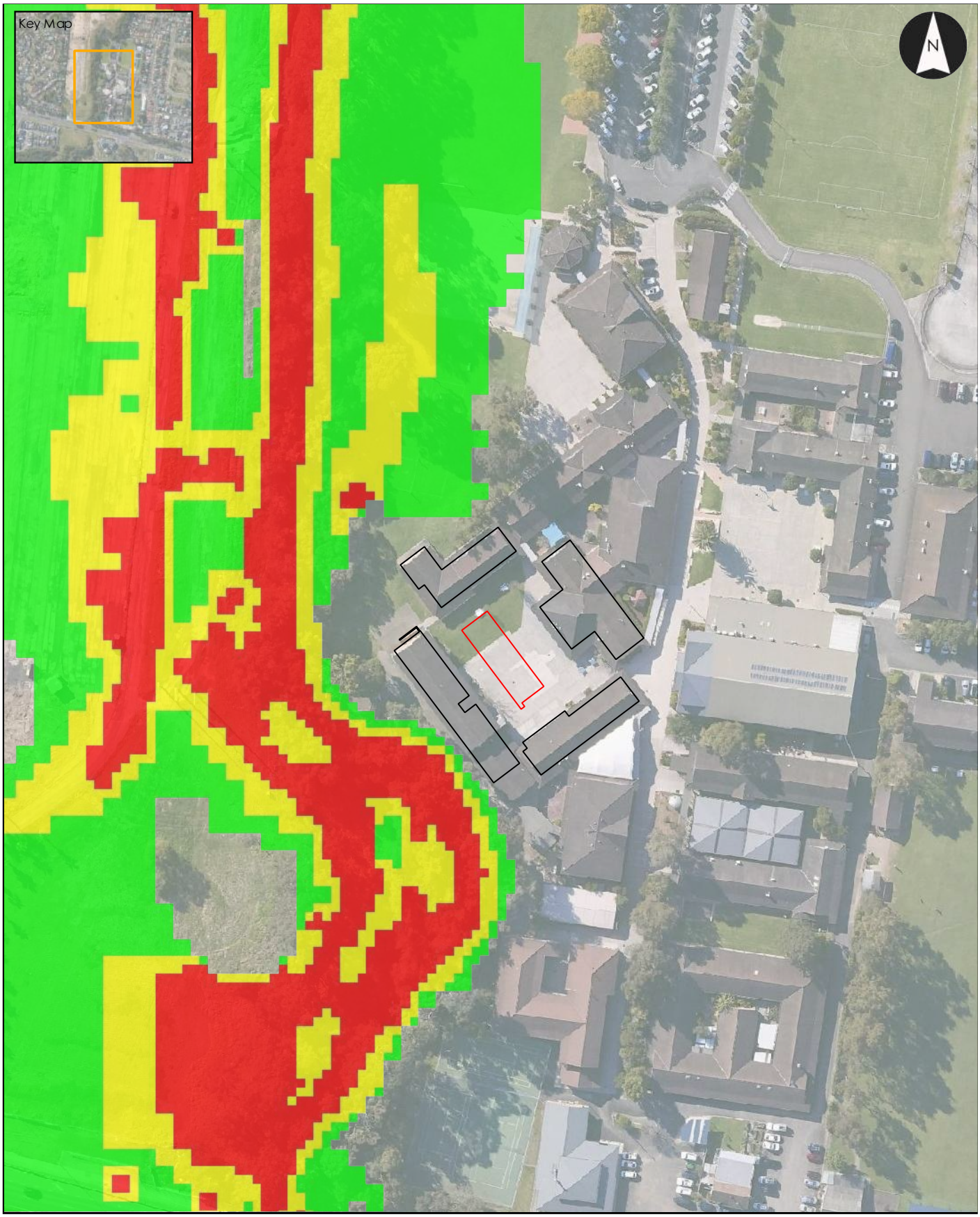

20 year ARI Proposed Conditions Provisional Flood Hazard

Legend

- Proposed Buildings
- Existing Buildings

Provisional Hazard

- Low
- Transitional
- High

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 15

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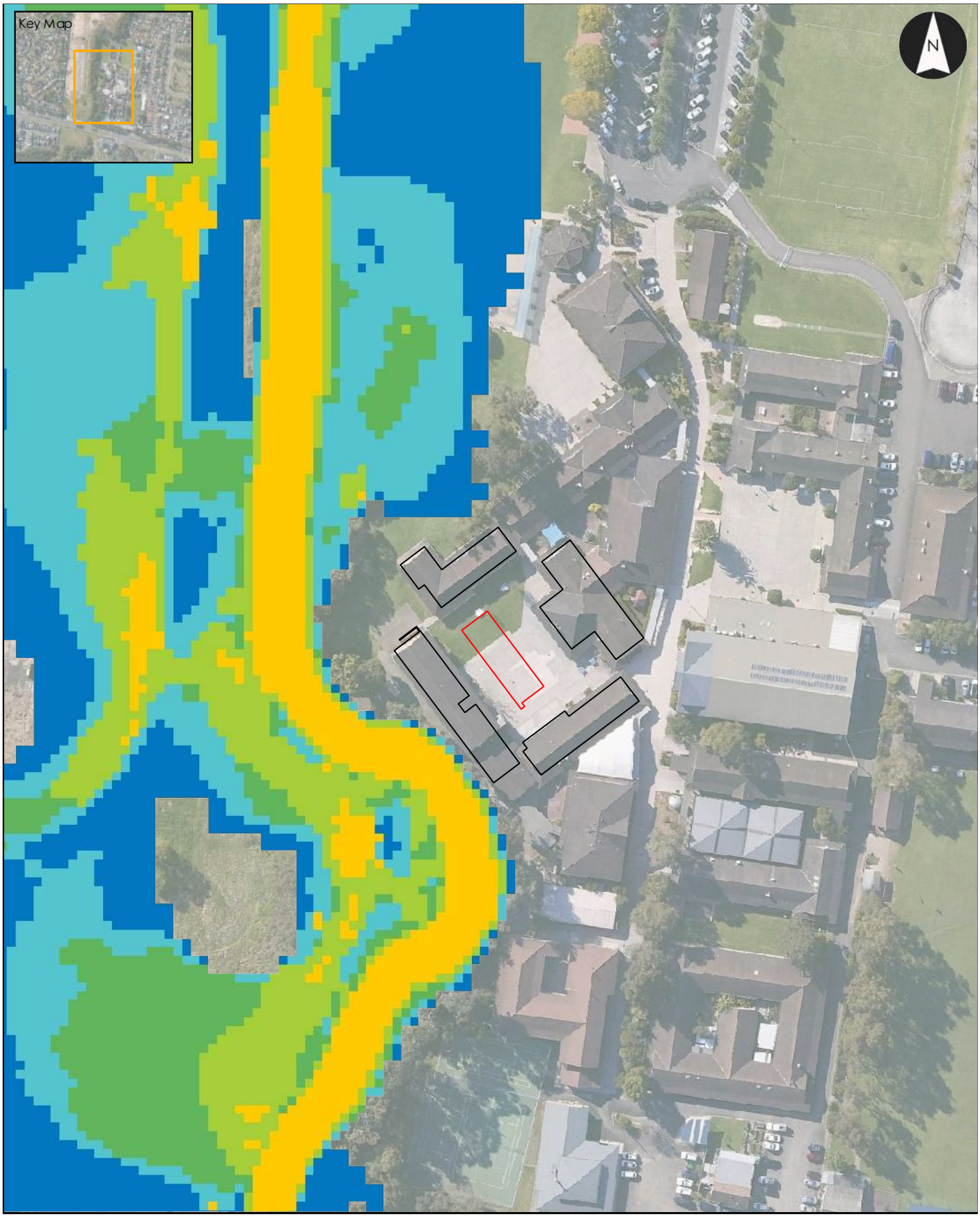
Stantec



20 year ARI Proposed Conditions Flood Hazard

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 16

Legend

Proposed Buildings
Existing Buildings

Hazard Category (H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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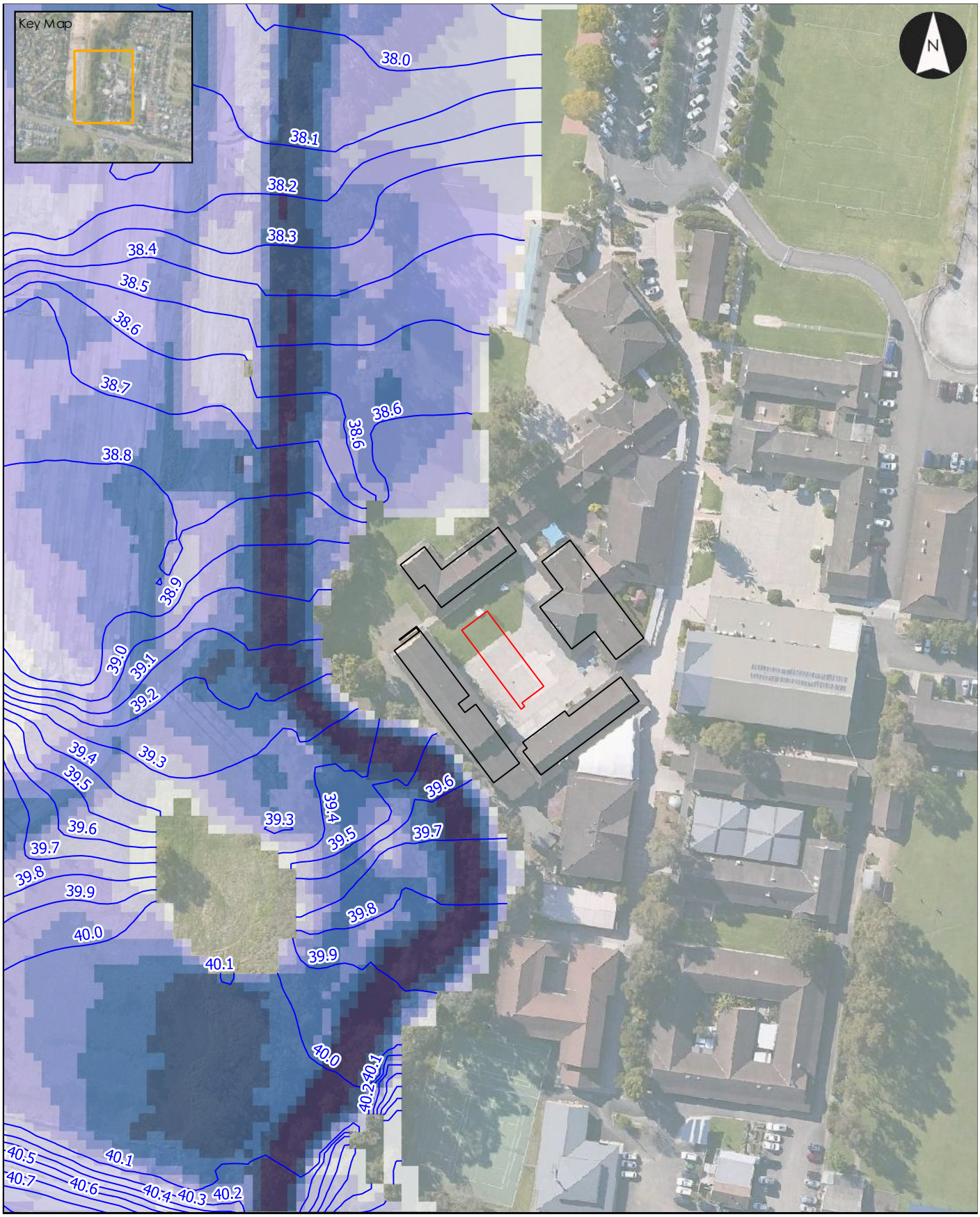
Stantec



100 year ARI Proposed Conditions Flood Depth and Extent

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 17

Legend

- Proposed Buildings
- Existing Buildings
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

Notes:
1. Map displayed in EPSG:28356

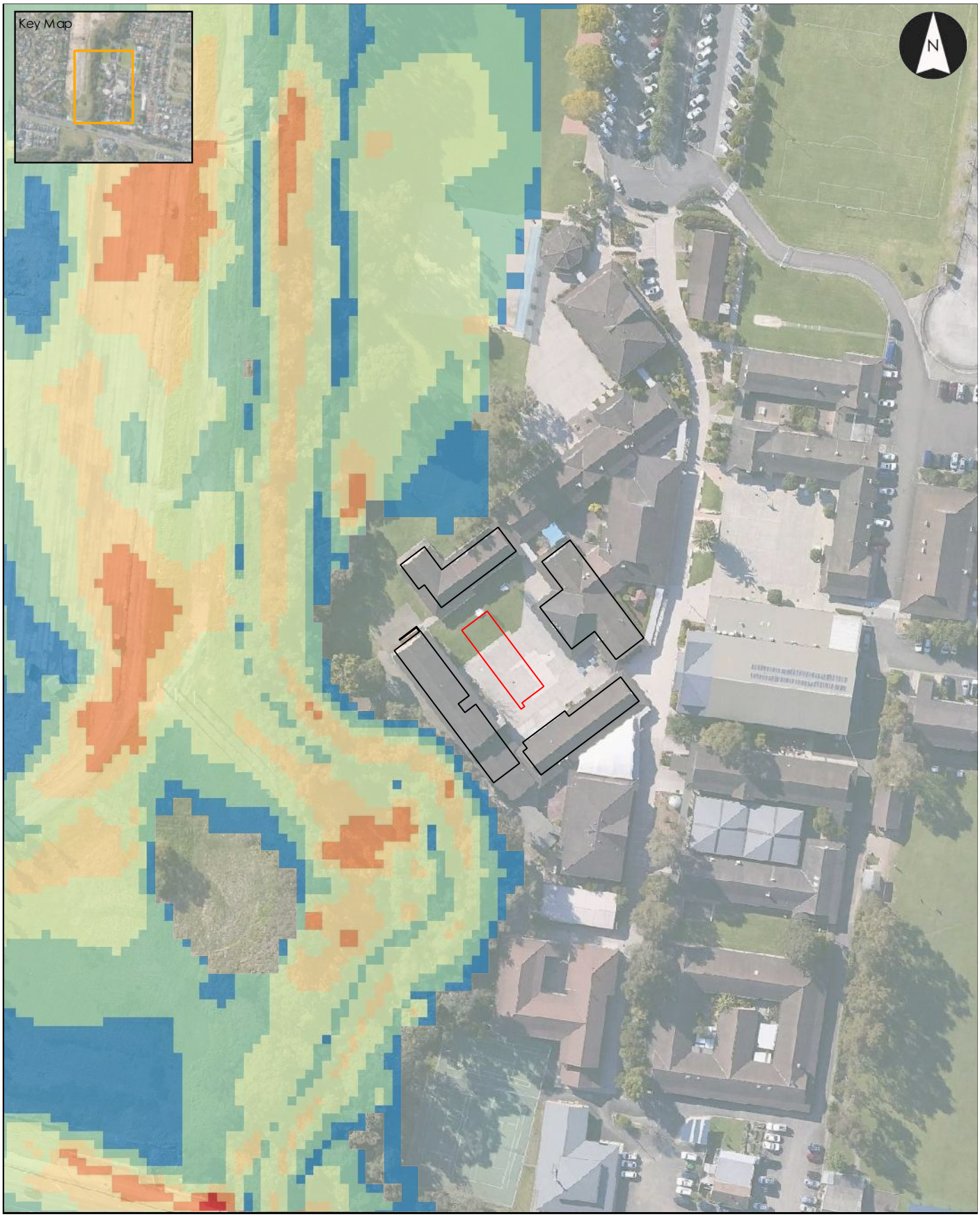
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



100 year ARI Proposed Conditions Flood Velocity

Legend

Proposed Buildings

Existing Buildings

Flood Velocity (m/s)

- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- > 3.0

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

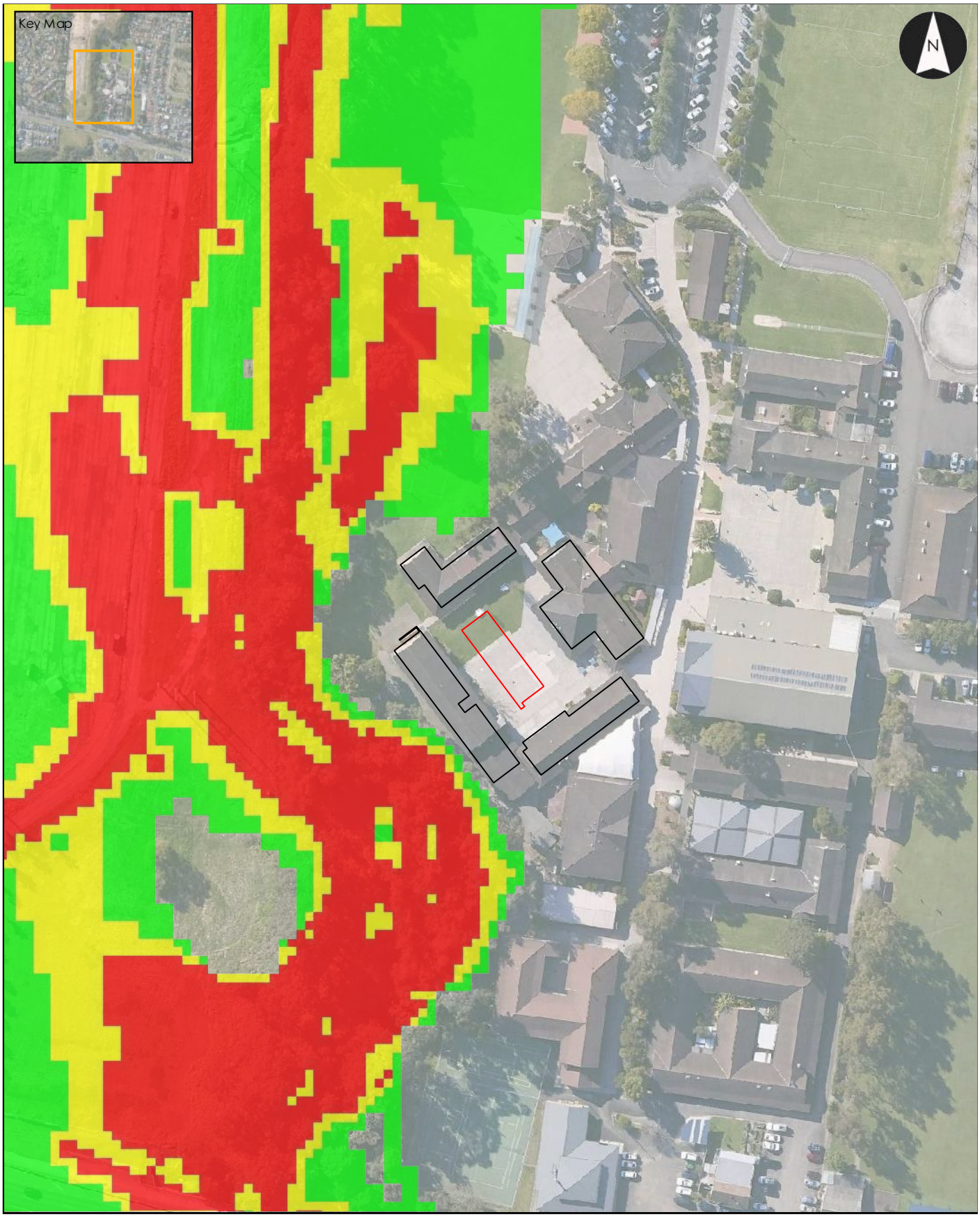
Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

Figure No: 18

DRAFT - Not For Construction

Stantec



100 year ARI Proposed Conditions Provisional Flood Hazard

Legend

- Proposed Buildings
- Existing Buildings

Provisional Hazard

- Low
- Transitional
- High

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

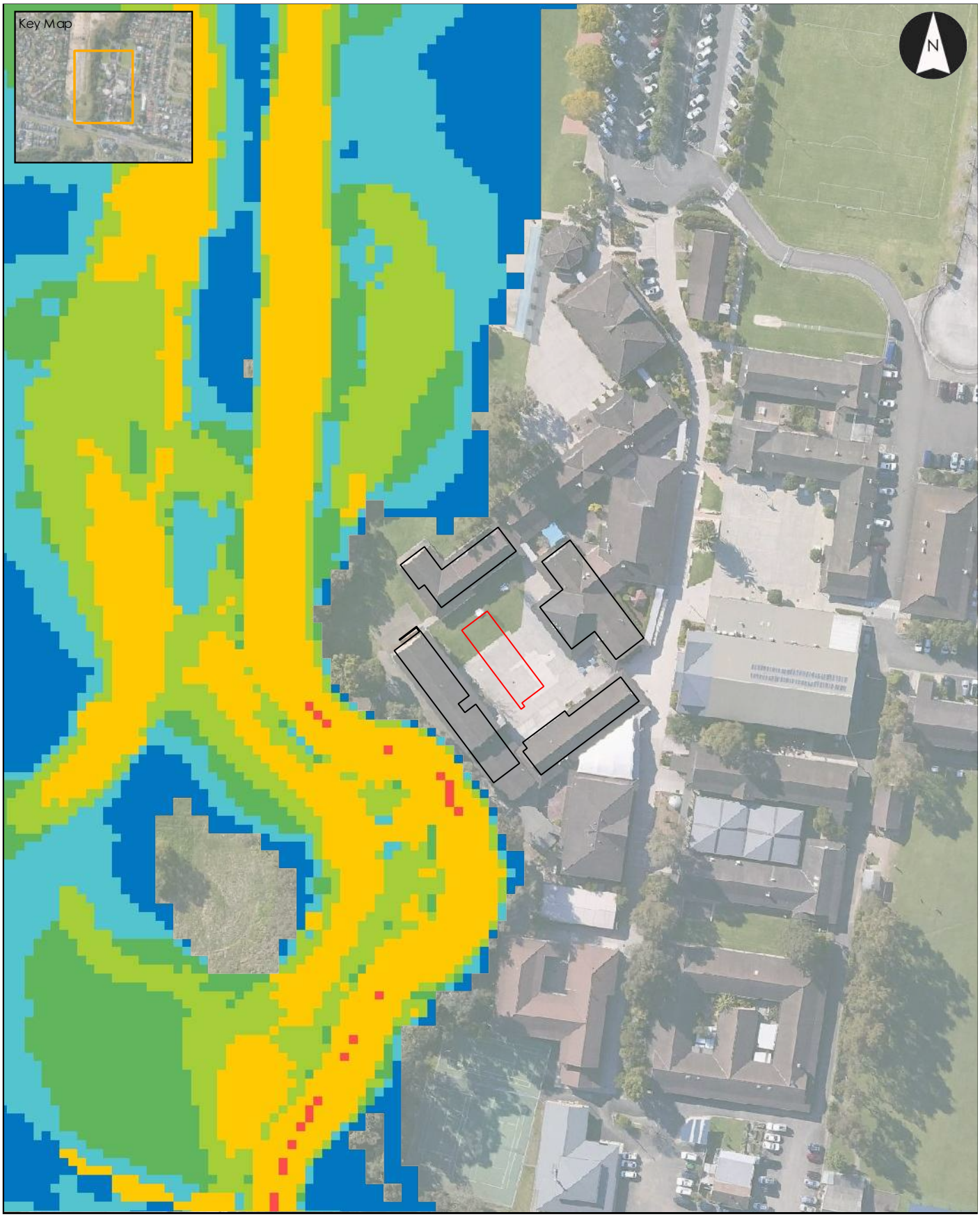
Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 19

DRAFT - Not For Construction

Stantec



100 year ARI Proposed Conditions Flood Hazard

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

Figure No: 20

Legend

Proposed Buildings

Existing Buildings

Hazard Category (H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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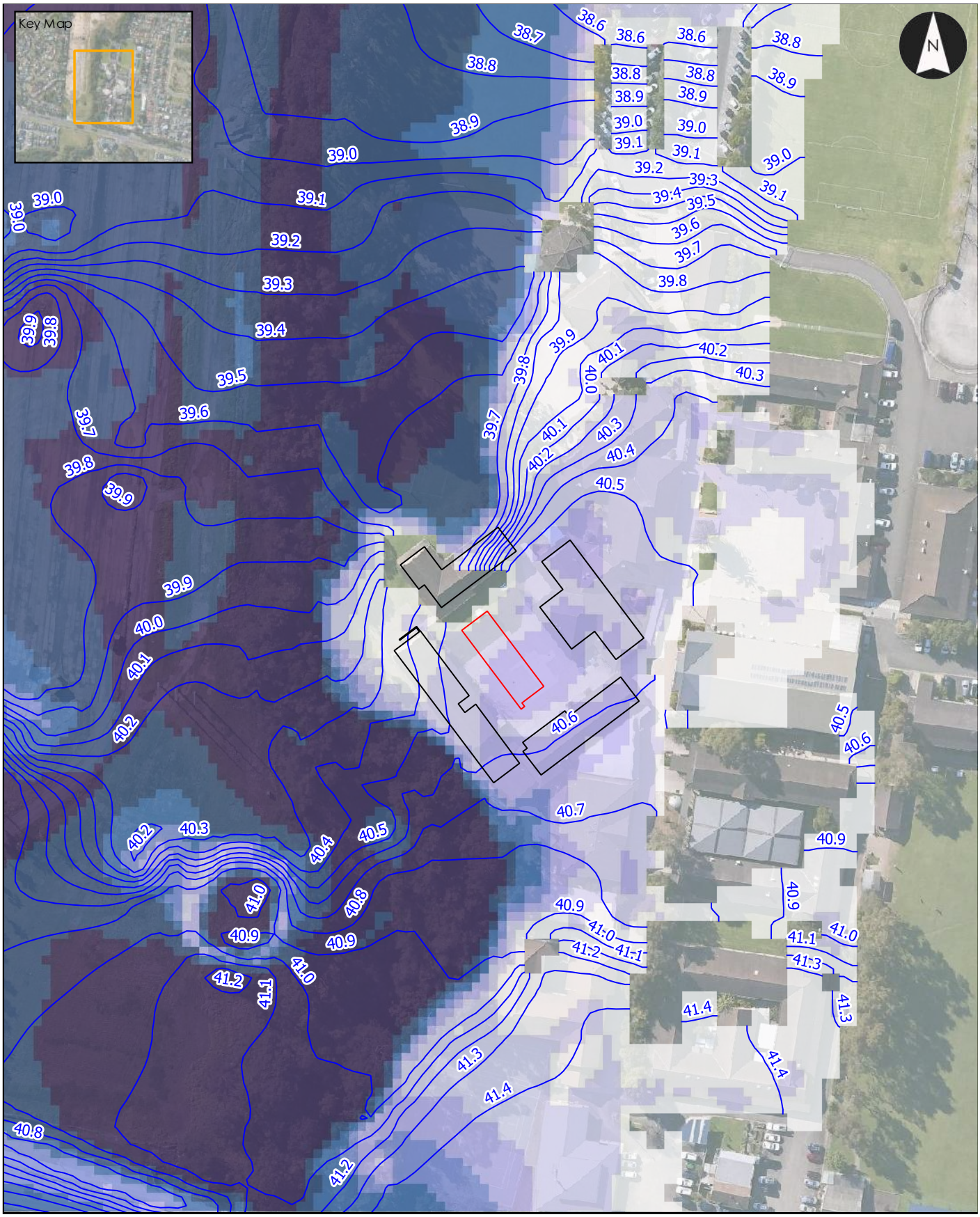
Stantec



PMF Proposed Conditions Flood Depth and Extent

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 21

Legend

- Proposed Buildings
- Existing Buildings
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

Notes:
1. Map displayed in EPSG:28356

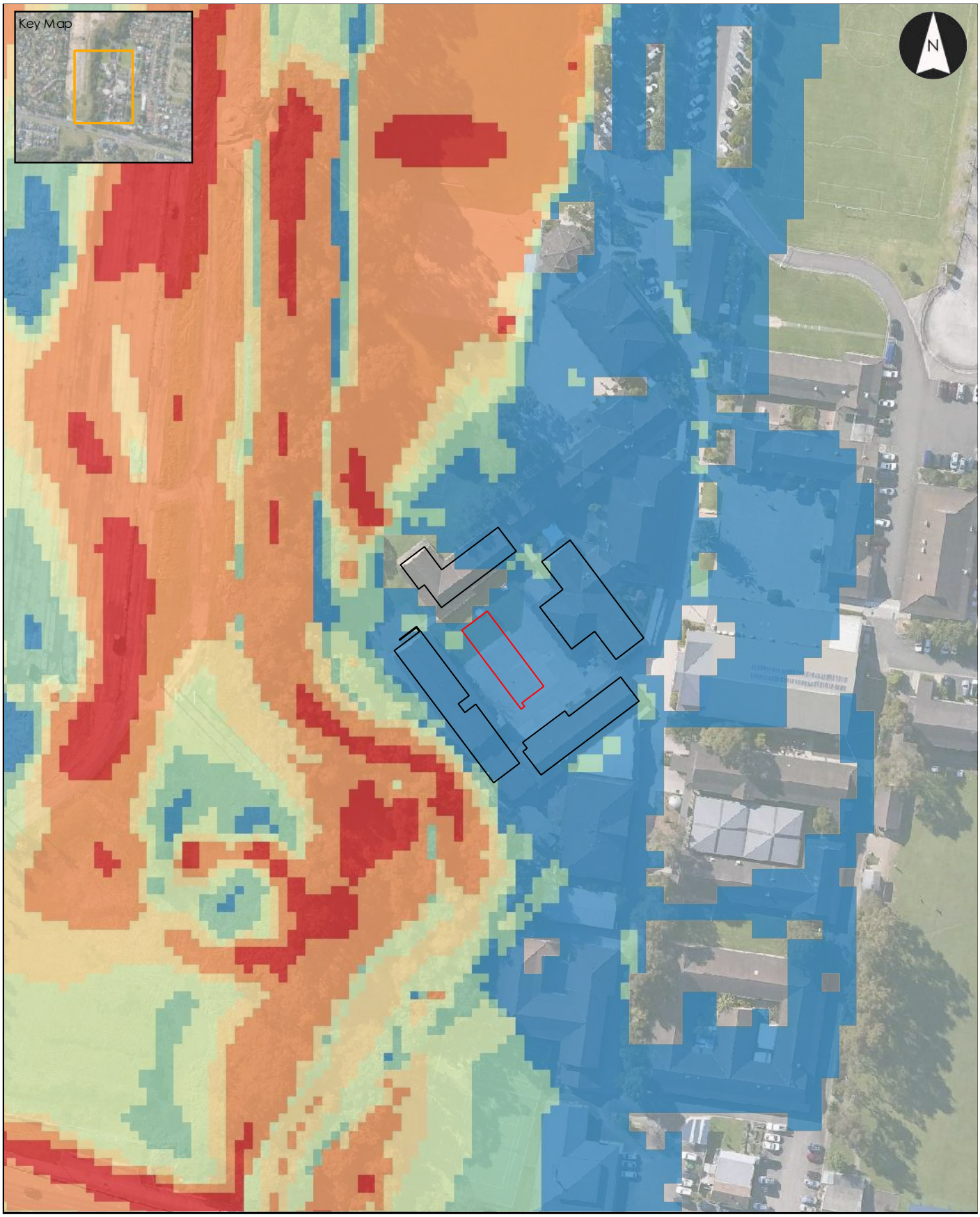
References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

DRAFT - Not For Construction

Stantec



PMF Proposed Conditions
Flood Velocity

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 22

Legend

Proposed Buildings
Existing Buildings

Flood Velocity (m/s)
- < 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- > 3.0

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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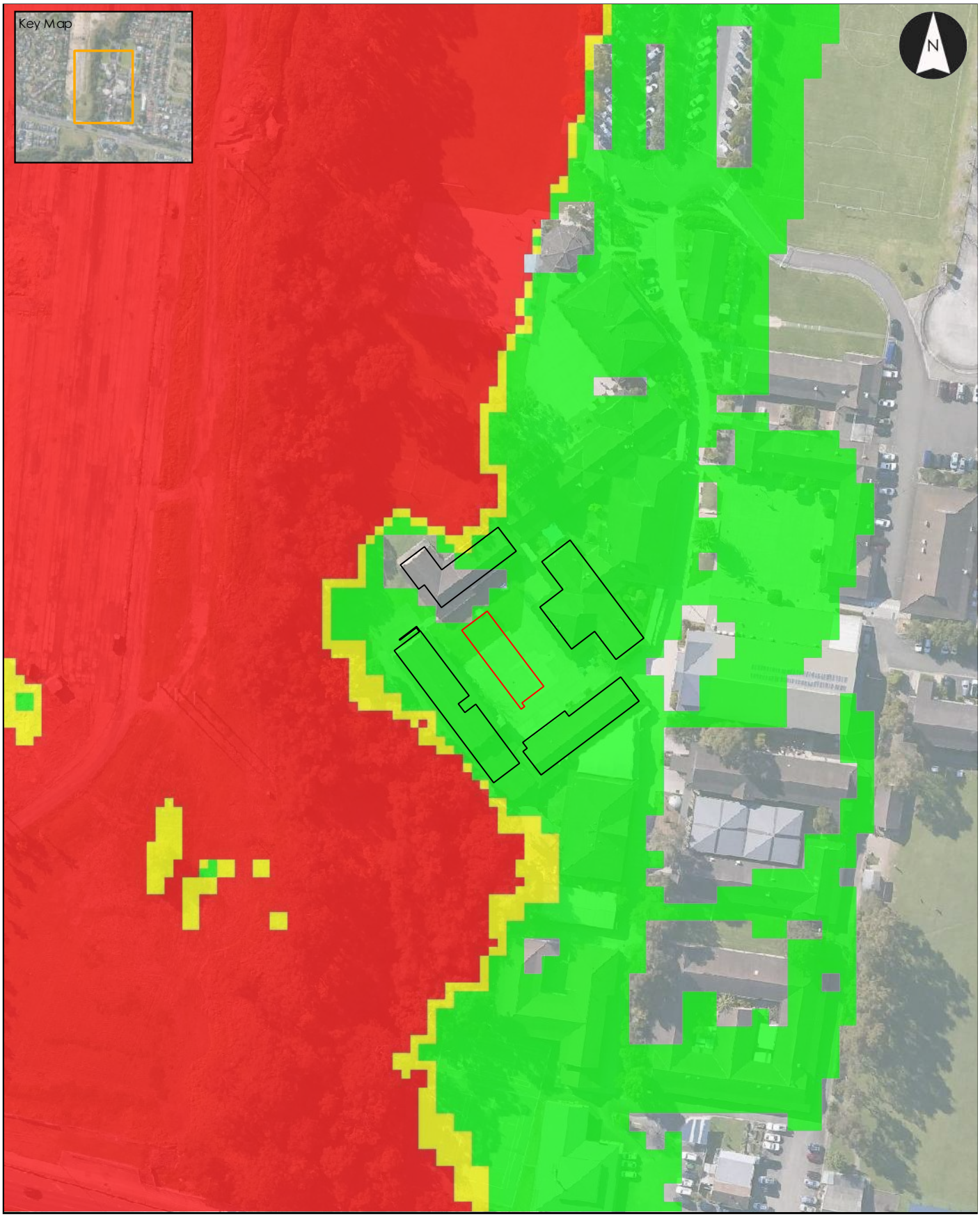
Stantec



PMF Proposed Conditions
Provisional Flood Hazard

Legend

Proposed Buildings

Existing Buildings

Provisional Hazard

Low

Transitional

High

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

Figure No: 23

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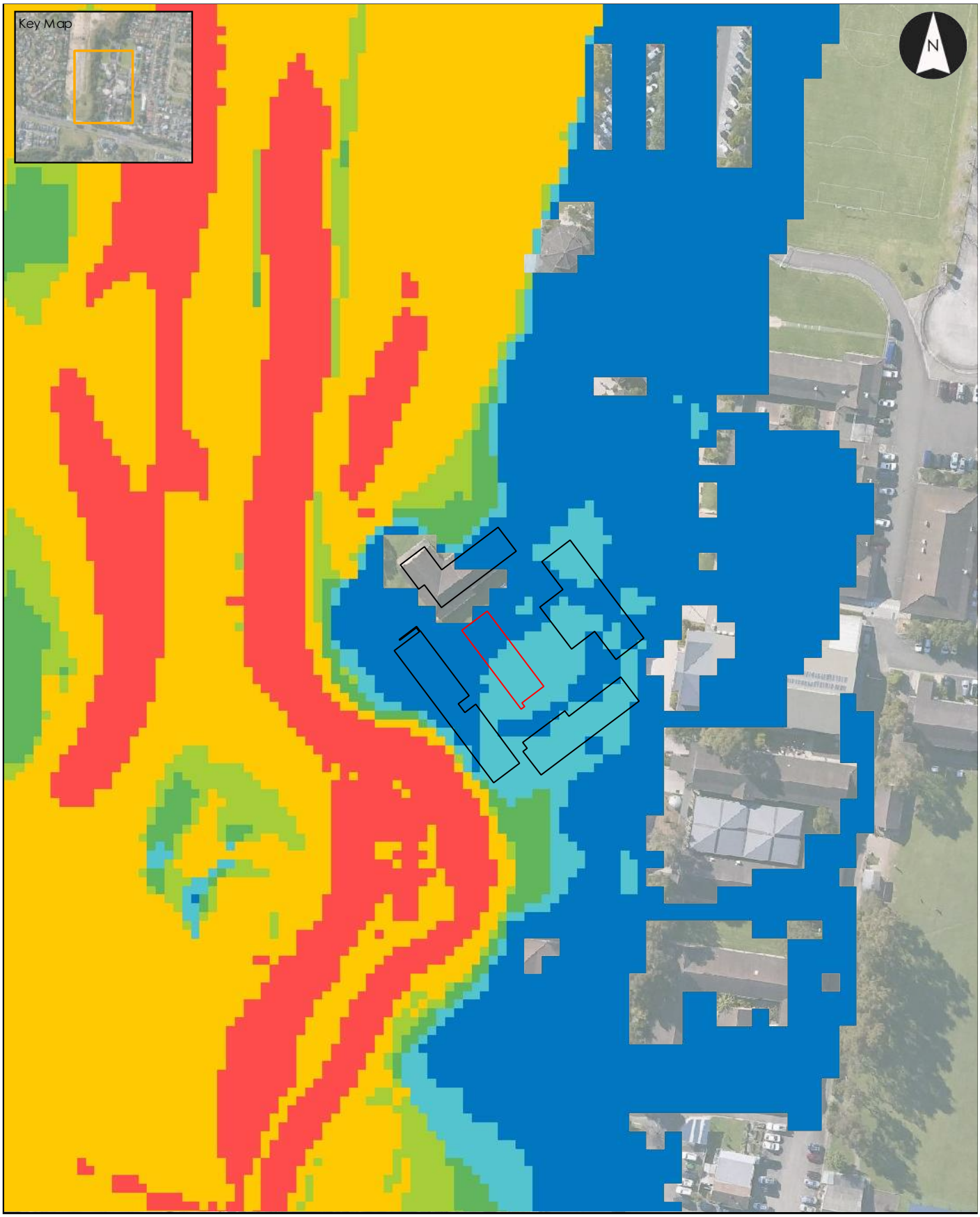

PMF Proposed Conditions Flood Hazard

Project: William Carey Christian School

Client: Gardner Wetherill

Project Code: 300203875

Drawn By: AC, Checked By: Yu, Stephen

Date: (2024-09-11)

Figure No: 24

Legend

Proposed Buildings

Existing Buildings

Hazard Category (H1-H6)

- H1 - Generally safe for vehicles, people and buildings.
- H2 - Unsafe for small vehicles.
- H3 - Unsafe for vehicles, children and the elderly.
- H4 - Unsafe for vehicles and people.
- H5 - Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
- H6 - Unsafe for vehicles and people. All building types considered vulnerable to failure.

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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20 year ARI Proposed Minus Existing Conditions Water Level Difference

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 25

Legend

Proposed Buildings
Existing Buildings

Change in Flood Extents (Wet/Dry)
Was Wet, Now Dry
Was Dry, Now Wet

Water Level Difference (m)
< -0.50
-0.50 to -0.20
-0.20 to -0.10
-0.10 to -0.05
-0.05 to -0.01
-0.01 to 0.01
0.01 to 0.05
0.05 to 0.10
0.10 to 0.20

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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100 year ARI Proposed Minus Existing Conditions Water Level Difference

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 26

Legend

Proposed Buildings
Existing Buildings

Change in Flood Extents (Wet/Dry)
Was Wet, Now Dry
Was Dry, Now Wet

Water Level Difference (m)
< -0.50
-0.50 to -0.20
-0.20 to -0.10
-0.10 to -0.05
-0.05 to -0.01
-0.01 to 0.01
0.01 to 0.05
0.05 to 0.10
0.10 to 0.20

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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PMF Proposed Minus Existing Conditions
Water Level Difference

Project: William Carey Christian School

Client: Gardner Wetherill
Project Code: 300203875
Drawn By: AC, Checked By: Yu, Stephen
Date: (2024-09-11)
Figure No: 27

Legend

Proposed Buildings
Existing Buildings

Change in Flood Extents (Wet/Dry)
- Was Wet, Now Dry
- Was Dry, Now Wet

Water Level Difference (m)
- < -0.50
- -0.50 to -0.20
- -0.20 to -0.10
- -0.10 to -0.05
- -0.05 to -0.01
- -0.01 to 0.01
- 0.01 to 0.05
- 0.05 to 0.10
- 0.10 to 0.20

Notes:
1. Map displayed in EPSG:28356

References:
1. Basemap: Metromap

0 25 50 75 100 m

Scale at A3: 1:1500

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Stantec

DESIGN WITH COMMUNITY IN MIND

Communities are fundamental. Whether around the corner or across the globe, they provide a foundation, a sense of place and of belonging. That's why at Stantec, we always design with community in mind.

We care about the communities we serve—because they're our communities too. This allows us to assess what's needed and connect our expertise, to appreciate nuances and envision what's never been considered, to bring together diverse perspectives so we can collaborate toward a shared success.

We're designers, engineers, scientists, and project managers, innovating together at the intersection of community, creativity, and client relationships. Balancing these priorities results in projects that advance the quality of life in communities across the globe.

Stantec trades on the TSX and the NYSE under the symbol STN.
Visit us at stantec.com or find us on social media.

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