Attachment B - Flood Impact Assessment Memorandum

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NL201088

19 May 2022

Maria Pennisi
Grindley Construction Pty Ltd
55 Grandview Street
Pymble, NSW 2073

Dear Maria,

Re: Memorandum – 51 Masons Parade, Point Frederick – Flood Impact Assessment

Introduction

Northrop Consulting Engineers have provided civil design and documentation to support the Development Application (DA) at 51 Masons Parade Point Frederick (Ref: DA21/14808). As part of the submission a Concept Stormwater Management Plan (CSMP) was prepared (revision B, dated 15/09/21) that outlined the conceptual stormwater design for the development. The report also detailed an overview of the flooding behaviour of the site, (including both local overland flow and inundation from Brisbane Water) as well as the flood mitigation measures required for the development.

The flood mitigation measures as detailed in the CSMP were proposed to meet Central Coast Council's Development Control Plan (DCP) requirements, in particular Chapter 6.7 Water Cycle Management. These measures were agreed in principle during a project meeting with Central Coast Council's Flood Engineer which was held on 05/03/21. These measures included:

- Minimum Floor Level to be set above the 1% Annual Exceedance Probability (AEP) + Sea Level Rise + 500mm freeboard or the Probably Maximum Flood (PMF) event (whichever was greater).
- Preparation of a qualitative flood impact assessment which includes:
    - Assessment of existing building footprints & comparison to the developed scenario.
    - Assessment of the cut & fill volumes of flood storage, and provision of equivalent offset storage volumes.
    - Assessment of the conveyance of floodwaters through the site, ensuring the proposed development does not reduce the conveyance capacity.
- The carpark area is to be above the 1% AEP flood level.

Following submission of the CSMP, a Request for Additional Information (RFI) was returned by NSW Department of Planning and Environment (DPIE) dated 25/03/22 which requested:

> *"Additional flood impact and risk assessment information reflecting the site's flooding hazard, which is to include (but is not limited to) details of:*

- *proposed evacuation and emergency response procedures during a flood event; and*
- *flood impacts on surrounding developments and/or land resulting from the proposal and impact on flood behaviour."*

In addition, further correspondence from DPIE was provided via email requesting:

> ***"Flood Impacts Modelling** – the Department considers further modelling necessary for the following reasons:*
>
> - *evidence of consultation with Council and Council's view has not been provided as indicated.*
> - *the qualitative assessment that the proposal will not increase flooding impacts (including impacts to adjoining land) due to an overall reduction in footprint on the site does not adequately consider impacts due to the change in footprint (consolidated towards the northern end of the site), provision of hardstand areas such as the carpark, any ground disturbance and does not consider impacts which may arise on the proposed allotment forming part of the proposal.*
> - *the development site contains an area mapped as high hazard, in the vicinity of the new consolidated footprint.*
> - *the location of the consolidated footprint is located in proximity to both the 5% and 1% AEP storm events and the PMF runs directly through the site and therefore quantitative modelling is appropriate for the Department to be able to adequately assess flood impacts*
>
> *Please provide further modelling of flood impacts on surrounding developments and/or land resulting from the proposal and impact on flood behaviour as a result in the change to development (i.e. footprint, hardstand areas and ground disturbance). This is required for the Department to complete an assessment of flooding impacts of the development."*

The purpose of this memorandum is to provide a summary of the Flood Impact Assessment and flood modelling that has been undertaken to provide the information as requested. Included herein is a summary of the methodology, assumptions and results as well as discussion of the 2D modelling performed.

This memorandum is to be read in conjunction with the Flood Figures appended to the rear of this correspondence.

Flood Modelling Methodology

Central Coast Council has an existing 2D flood study and model of the subject site and surrounding catchment area as detailed in the 'Gosford CBD Overland Flow Flood Study' (Cardno, 2013), herein referred to as the 'Existing Flood Study'. The Existing Flood Study utilises the SOBEK two-dimensional (2D) flood modelling software coupled with rainfall on grid hydrology.

For the purposes of this investigation a site specific TUFLOW 2D model has been prepared, coupled with inflows from both Rainfall on Grid and DRAINS hydrology. A breakdown of the catchments used for the DRAINS and Rainfall on Grid is presented in Figure 2 in Appendix A.

TUFLOW is considered one of the industry's leading 2D flood modelling packagers and is commonly used for the preparation of Flood Impact Assessment.

It is noted that whilst different software packages have the potential to produce slightly different results, the primary purpose of this investigation is to prepare a comparison of the flood behaviour to assess the flood impact, using like-for-like modelling methodology. As such, the modelling methodology is considered a reasonable approach.

A comparison of the Existing Flood Study and the existing case scenario prepared herein was undertaken and the results are discussed within the results section of this correspondence.

Hydrological Modelling & Rainfall Estimation

A hydrological model was developed using the runoff-routing software DRAINS utilising the initial and continuing loss hydrologic model as outlined by the ARR2019 procedures and using ARR2016 rainfall data obtained from the Bureau of Meteorology.

The upstream forested catchment area was divided into sub-catchments and modelled in DRAINS with the total run-off hydrograph applied to the TUFLOW model as an upstream boundary condition just upstream of Henry Parry Drive. An overview of the catchment delineation is provided in Figure 2.

The remaining 2D model extent utilised the Rainfall on Grid (RoG), which is consistent with the approach adopted from the Existing Flood Study. The model extent was based on the local catchment topography, which included a review of the Existing Flood Study results to ensure the full extent of the catchment contributing to the flood behaviour of the site was included. Figure 3 provides an overview of the 2D model extent along with assigned land use and surface roughness.

TUFLOW Model Development

A TUFLOW 2D hydraulic model was created using the same key assumptions and methodology outlined by the Existing Flood Study. Key assumptions adopted from the Existing Flood Study include:

- A constant tail water level at the Brisbane Water foreshore of 0.72m AHD.
- Only drainage infrastructure equal to or greater than 600mm diameter was included.
- Zero blockage factor applied to the drainage network (consistent with Scenario 3 of the Council model).

A 2D model cell size of 1.0m was adopted to balance the accuracy of the model with computation times, as well as the accuracy of the data available for the model (i.e. 1.0m DEM Lidar). The 1% AEP design storm event was modelled for a range of durations extending from the 20 minute to 1 hour durations.

It is noted that in developing the TUFLOW model, there were several key differences that were implemented due to updated or more accurate information that has become available since the preparation of the Existing Flood Study. These include:

- Use of the latest ARR2019 methodologies such as the initial and continuing losses model, additional storm durations and temporal patterns.
- Adopted the latest ARR2016 BOM rainfall data.
- Introduced the most recent Lidar data for surrounding area, obtained from ELVIS Elevation Website.
- Imported the available detailed survey over the subject site.
- Updated the assumed below ground stormwater to be consistent with the detailed survey information.
- Updated building footprints as well as surface roughness values based on detailed survey and recent aerial imagery.
- Used a finder grid size of 1.0m for increased accuracy (previously 2.0m cell size).

The developed case scenario was also prepared based on the latest civil DA design with a 3D surface modelled from the design levels and building layouts for the development. A number of flood mitigation measures were implemented into the developed scenario to minimise the impact on neighbouring properties.

These measures included:

- Maintaining existing levels for the exit driveway along the northern boundary.
- Providing additional flood storage volume within the open channel to offset the lost flood storage.
- Grading levels within the active space to maximise additional flood storage and conveyance.

The TUFLOW model definition, site topography and sub-catchments for the existing and developed case scenarios can be found in Figures 1 to 6 appended to the rear of this correspondence.

Results

It was determined that the critical duration for the site was the 45 min storm event. The modelled existing and developed case flood depth and elevation as well as the hydraulic hazard categories are presented in Flood Figures A1 to B2 whilst the 1% AEP flood depth difference is presented in Figure C1 appended to the rear of this correspondence.

The following elements were observed from the results:

- Figure B2 shows the majority of the subject site (outside the extent of the main channel) experiences flood conditions that are safe for pedestrians.
- Figure C1 shows there is a significant decrease in flood depth to the east of the subject site, which is attributed to the removal of the existing buildings that formed a barrier during the existing case, blocking the flow path.
- Figure C1 shows there is a decrease in flood depth within the open channel ranging from 10-100mm which is expected to be due to the additional flood storage introduced in the developed case.
- Figure C1 shows there is a small increase in flood depth of approximately 20mm within the open channel adjacent to an existing building.

A comparison of the Existing Flood Model to the existing case results was also undertaken. The flood level across the subject site varied, with an increased in flood elevation of between 20mm to 200mm typically observed. The flood level within the Masons Parade road frontage was approximately 10-20mm higher than the levels of Existing Flood Study.

The comparison indicates that the results of the TUFLOW model are generally consistent with the Existing Flood Study, with minor variations in flood levels attributed to the difference in modelling assumptions and additional detailed information utilised within the vicinity of the subject site.

Discussion

Central Coast Council's DCP, Chapter 6.7.7.6 *Flooding Targets* provides compliance requirements in relation to developments subject to flooding. In particular, it outlines the requirements for acceptable flood impact, which state that any proposed development may not:

- *Adversely affect flood behaviour by raising predevelopment flood level by more than 10mm.*
- *Significantly alter flow distributions and velocities to the detriment of other properties or the environment of the flood plain.*

An increase in excess of 10mm is observed within the open channel located adjacent to 63-65 Masons Parade. Northrop Consulting Engineers were engaged to provide the Structural and Civil design for the recent redevelopment of the affect lot which is now constructed. The floor level along the affected edge of the building is sited at a minimum of RL4.225m AHD with no openings present below the ground floor level. With a flood level of approximately 2.0m AHD in the channel is observed in Figure B1, the finished floor level remains approximately 2.2m above the 1% AEP floor level in this location, well above the typical 500mm freeboard requirement for residential buildings. As such, the minor increase of 20mm adjacent to this building is not expected to create a significant adverse impact to this property.

It is noted that there is generally an overall positive impact on other surrounding properties by reducing the flooding depths on adjacent lots.

Conclusion

A Flood Impact Assessment has been prepared to support the proposed development at 51 Masons Parade, Point Frederick.

The flood depth, elevations and hazard categories for the existing and developed case scenarios were provided, as well as a comparison of the flood depth. It was determined that there were no adverse impacts to the flood behaviour on adjacent properties as a result of the proposed development.

In addition, the flood hazard conditions within the proposed active space does not exceed H1 in the 1% AEP event, and that the higher hazard categories located onsite within the open channel and the driveway are consistent with the existing flood behaviour.

We submit our findings for your consideration, and if you require clarification on the above, please feel free to contact the undersigned on (02) 4365 1668.

Robert Suckling
Civil Engineer
BE Civil (Hons 1), MIE Aust

Appendix A - Flood Figures

Figure 1 – Locality Plan

Figure 2 – Terrain & Catchments

Figure 3 – Existing Case – TUFLOW Model & Land Use

Figure 4 – Developed Case – TUFLOW Model & Land Use

Figure 5 – Existing Case – Detailed Surface Elevation

Figure 6 – Developed Case – Detailed Surface Elevation

Figure A1 – Existing Case – 1% AEP Flood Depth & Elevation

Figure A2 – Existing Case – 1% AEP Hydraulic Hazard Category

Figure B1 – Developed Case – 1% AEP Flood Depth & Elevation

Figure B2 – Developed Case – 1% AEP Hydraulic Hazard Category

Figure C1 – 1% AEP Flood Depth Difference

Legend

Subject Site

0 100 200 Metres

1:10,000

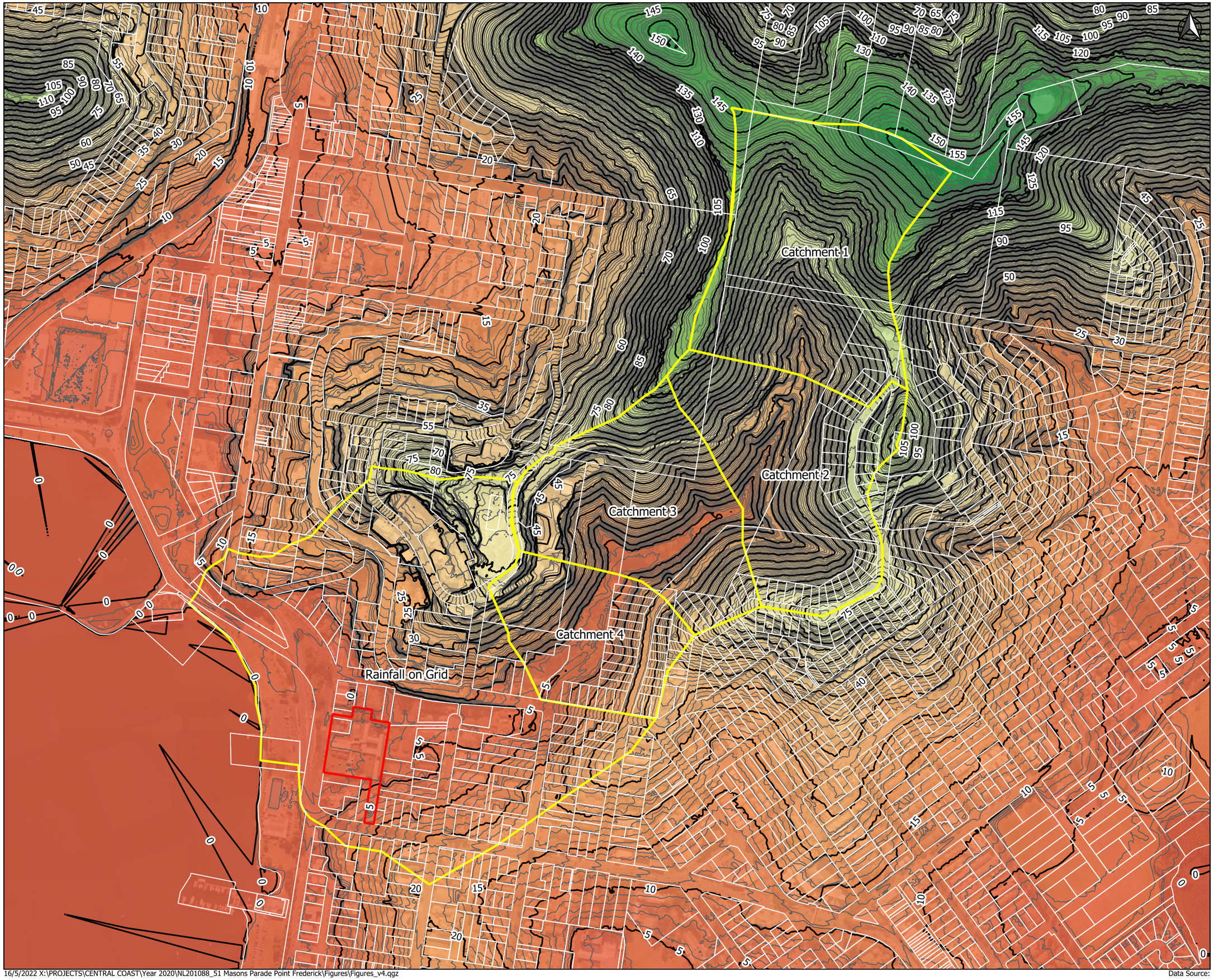
Figure 1 - [A]

Locality Plan

51 Masons Parade
Point Frederick
NL201088

NORTHROP

Data Source:



Legend

- Subject Site
- Sub-Catchment
- Major Contour (5m)
- Minor Contour (1m)

Elevation (m AHD)

- -20
- 0
- 20
- 40
- 60
- 80
- 100
- 120
- 140
- 160

0 100 200 Metres

1:6,000

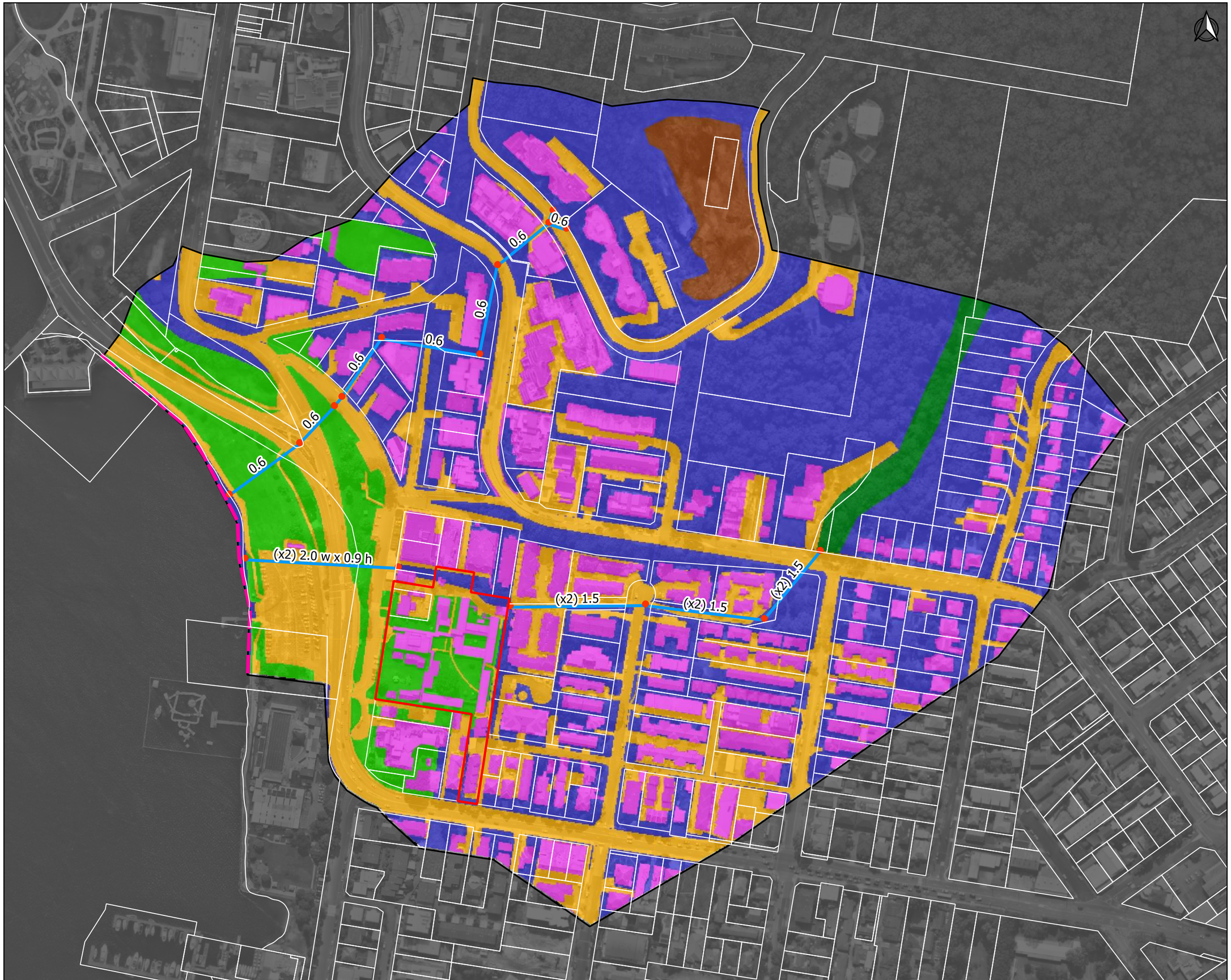
Figure 2 - [A]

Terrain & Catchments

51 Masons Parade
Point Frederick
NL201088

NORTHROP

Data Source:



Legend

- Subject Site
- 1d Network (Pipes)
- 1d Network (Pits)
- Model Outlet
- Model Extent

Land Use (Mannings n)

- Low//Medium Density Resi. & Veg. Areas (0.065)
- Road Pavement & Footpaths (0.020)
- Buildings & Roof Areas (0.020)
- Exposed Rock (0.040)
- Turf & Open Fields (0.030)
- Vegetated Creek/Dense Veg. (0.110)

0 50 100 Metres

1:3,000

Figure 3 - [B]

Existing Case
TUFLOW Model & Land Use

51 Masons Parade
Point Frederick
NL201088

NORTHROP

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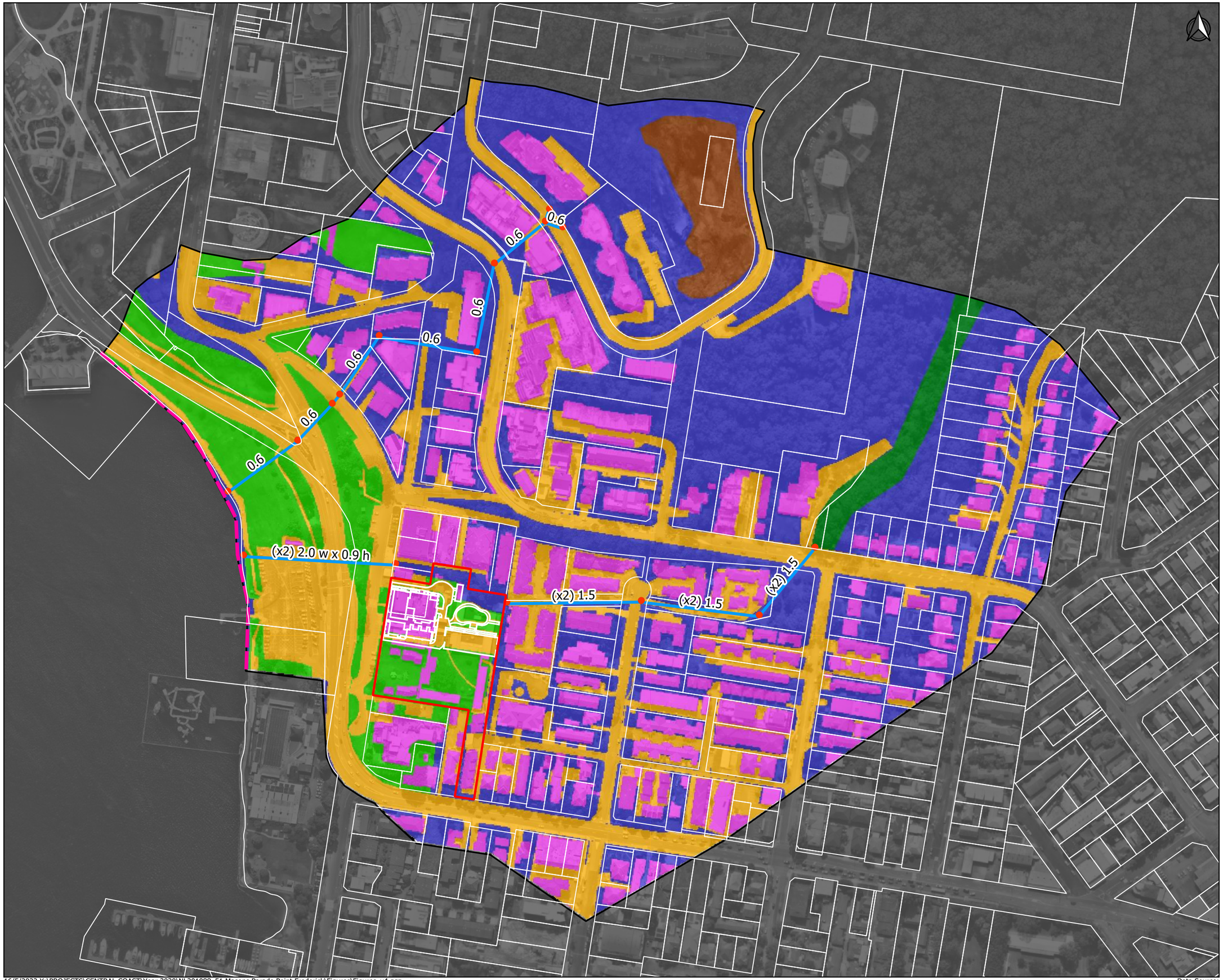

Legend

- Subject Site
- 1d Network (Pipes)
- 1d Network (Pits)
- Model Outlet
- Model Extent

Land Use (Mannings n)

- Low//Medium Density Resi. & Veg. Areas (0.065)
- Road Pavement & Footpaths (0.020)
- Buildings & Roof Areas (0.020)
- Exposed Rock (0.040)
- Turf & Open Fields (0.030)
- Vegetated Creek/Dense Veg. (0.110)

0 50 100 Metres

1:3,000

Figure 4 - [B]

Developed Case
TUFLOW Model & Land Use

51 Masons Parade
Point Frederick
NL201088

NORTHROP

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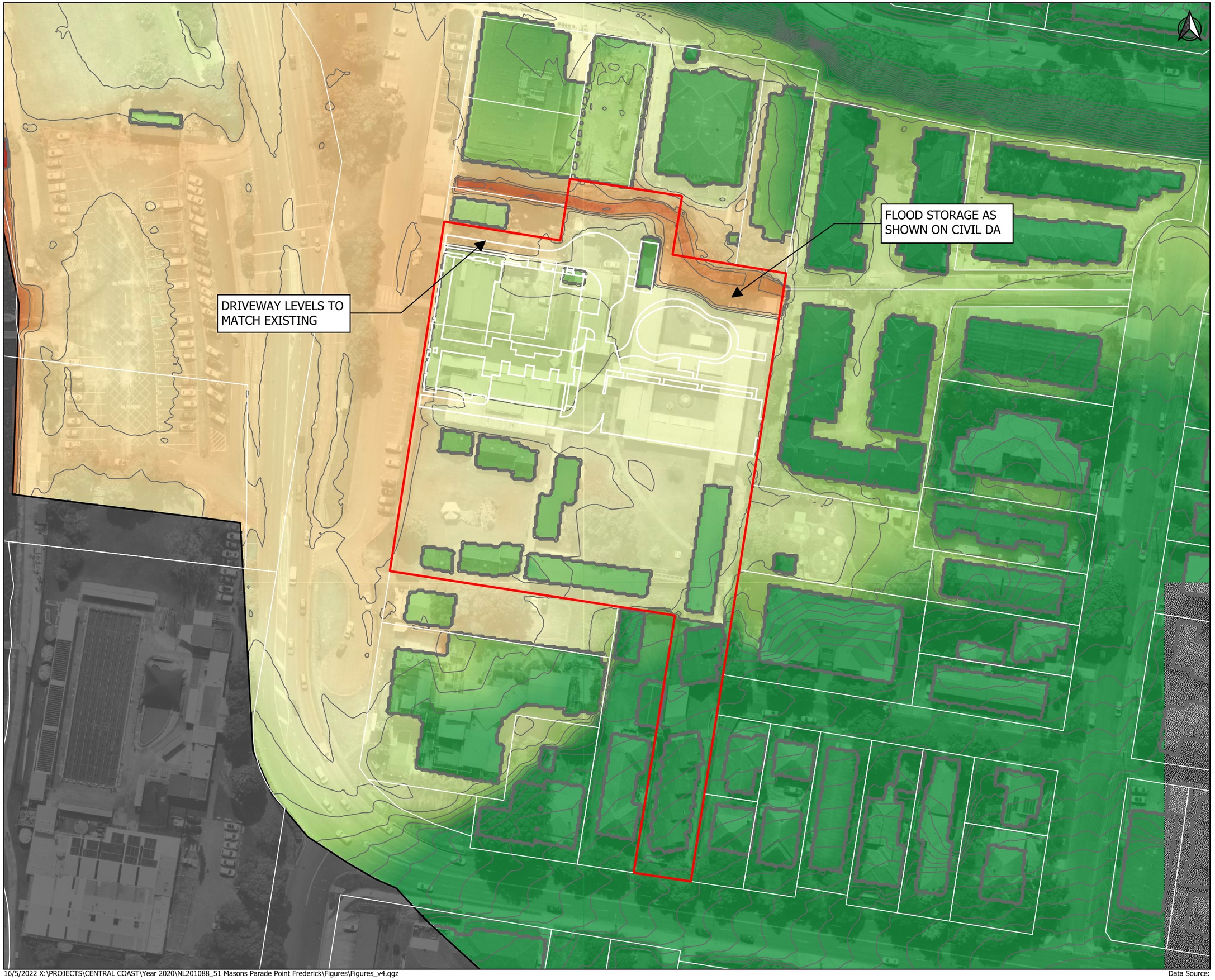
Data Source:

Figure 5 - [B]
Existing Case
Detailed Surface Elevation

51 Masons Parade
Point Frederick
NL201088

NORTHROP

Data Source:



Legend

- Subject Site
- Elevation Contour (0.5m)
- Model Extent

Developed Elevation (m AHD)

- < -1
- 0.5
- 2
- 3.5
- > 5

0 10 20 Metres

1:1,000

Figure 6 - [B]

Developed Case
Detailed Surface Elevation

51 Masons Parade
Point Frederick
NL201088

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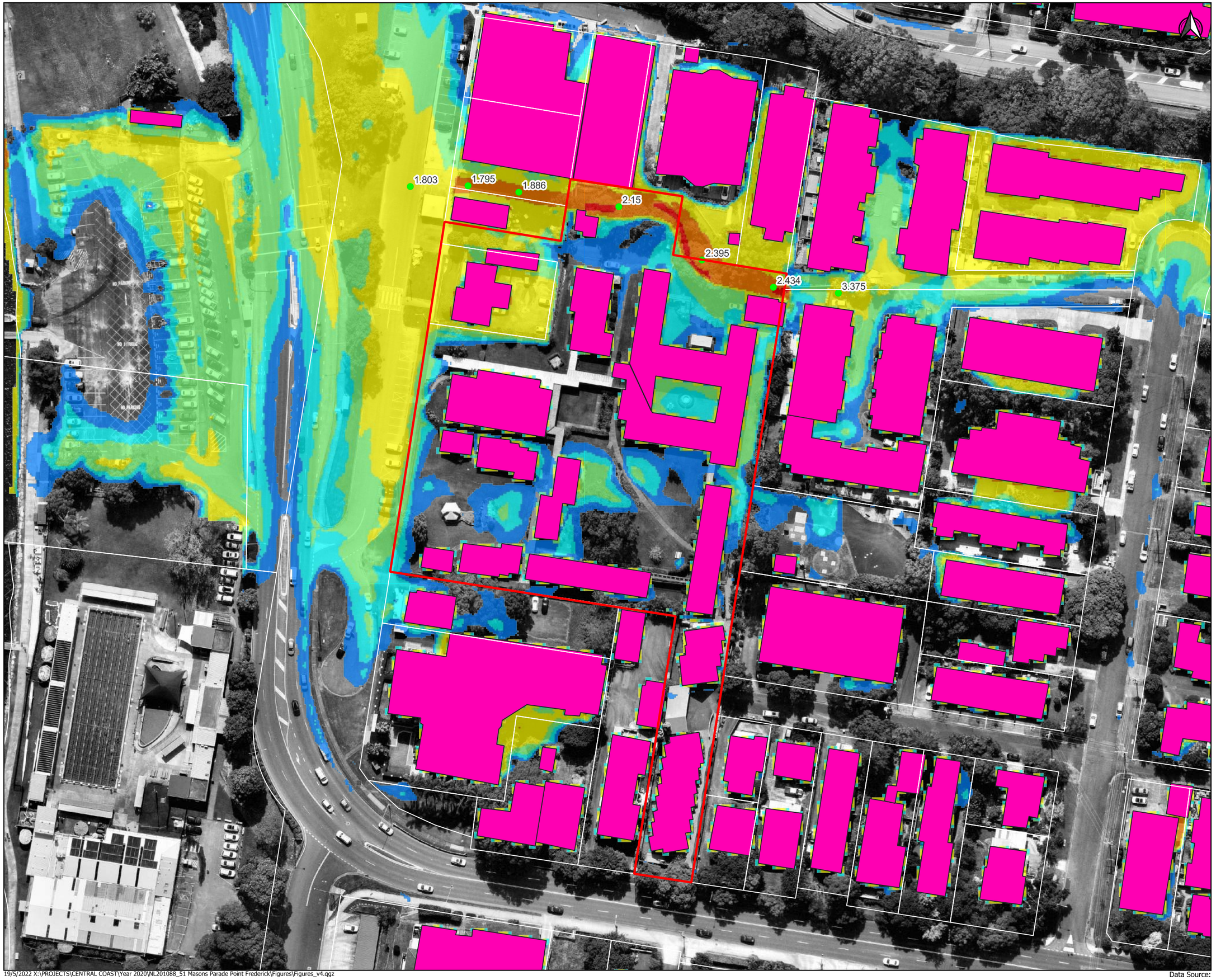


Legend

- Boundary
- Building Extent
- Flood Elevation (m AHD)

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

0 10 20 Metres

1:1,000

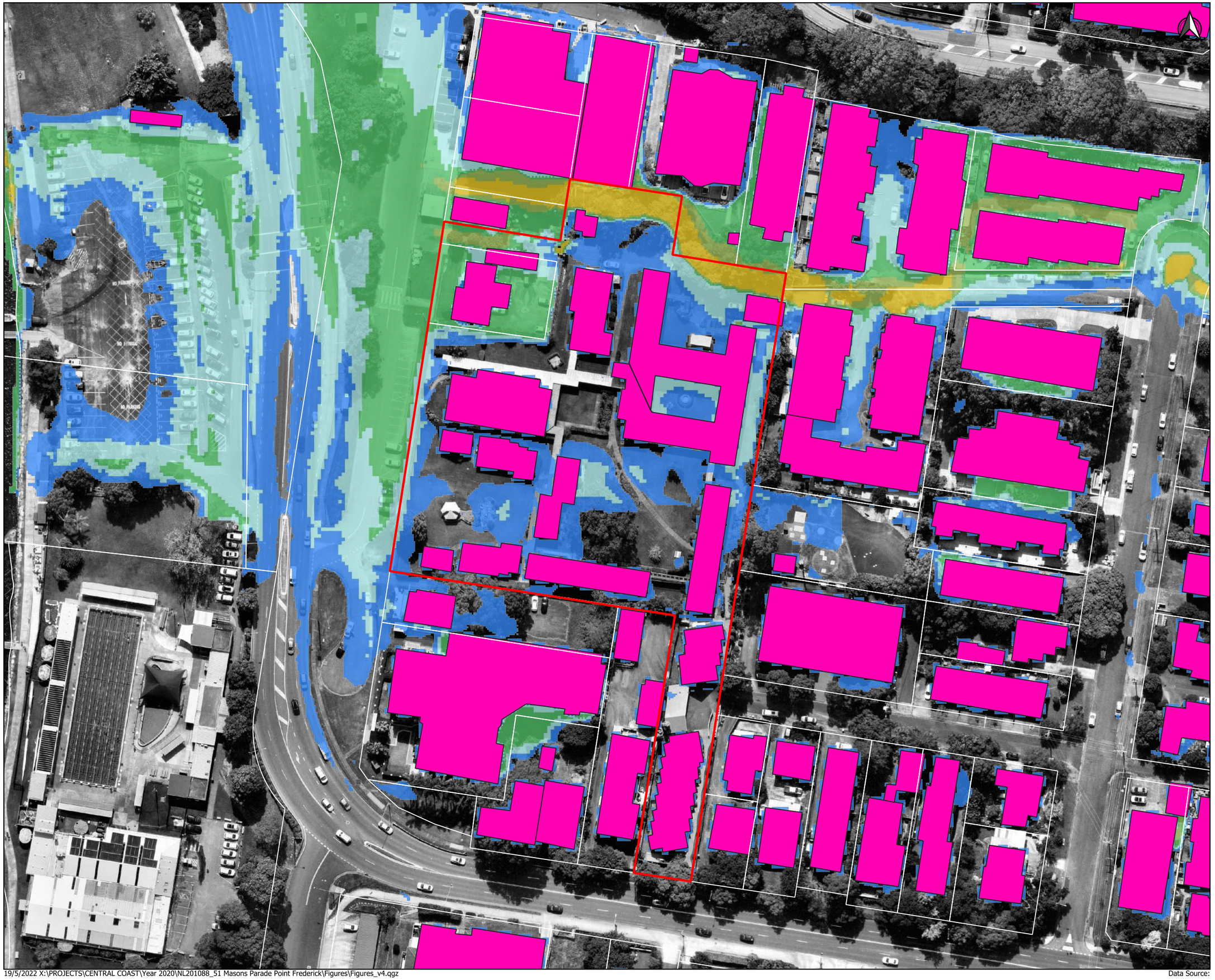
Figure A1 - [B]

Existing Case
1% AEP Flood Depth & Elevation

51 Masons Parade
Point Frederick
NL201088

NORTHROP

Data Source:



Legend

- Boundary
- Building Extent

Hydraulic Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

0 10 20 Metres

1:1,000

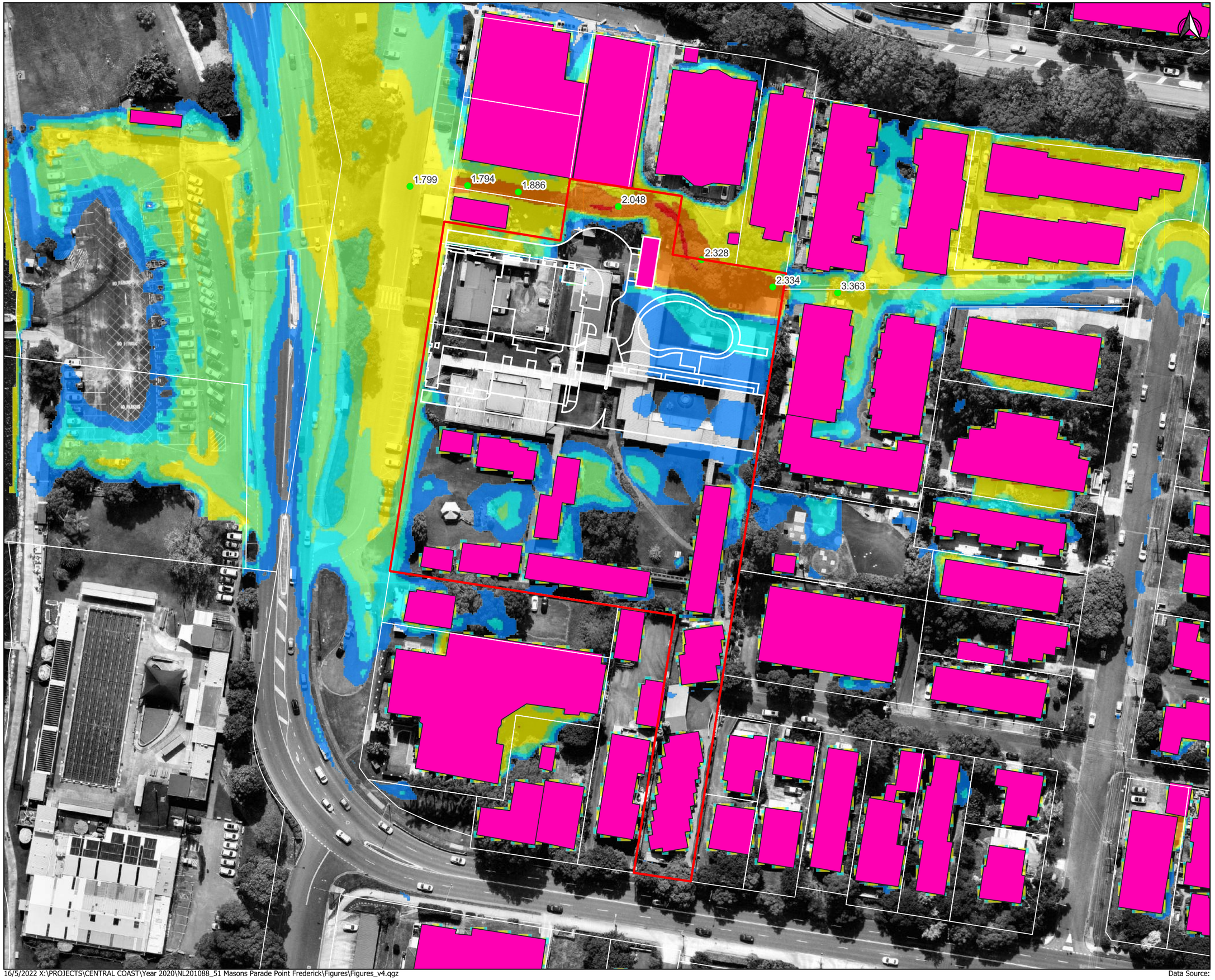
Figure A2 - [B]

Existing Case
1% AEP Hydraulic Hazard Category

51 Masons Parade
Point Frederick
NL201088

NORTHROP

Data Source:



Legend

- Boundary
- Building Extent
- Flood Elevation (m AHD)

Flood Depth (m)

- Less than 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- Greater than 2.0

0 10 20 Metres

1:1,000

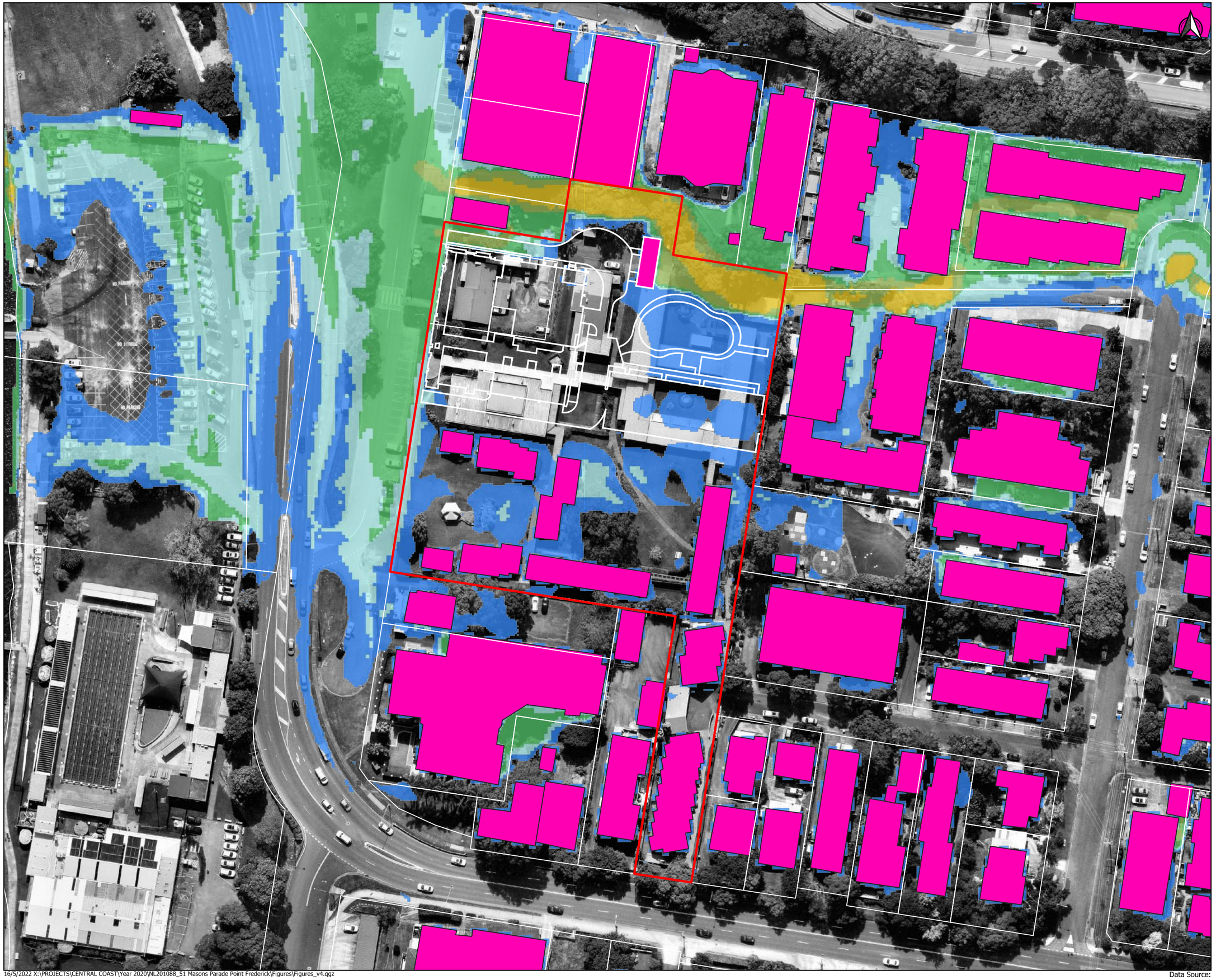
Figure B1 - [B]

Developed Case
1% AEP Flood Depth & Elevation

51 Masons Parade
Point Frederick
NL201088

NORTHROP

Data Source:



Legend

- Boundary
- Building Extent

Hydraulic Hazard Category

- H1
- H2
- H3
- H4
- H5
- H6

0 10 20 Metres

1:1,000

Figure B2 - [B]

Developed Case
1% AEP Flood Hazard Category

51 Masons Parade
Point Frederick
NL201088

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Data Source:

Legend

- Boundary
- Building Extent

Flood Depth Difference (m)

- <-0.10
- -0.10 - -0.05
- -0.05 - -0.01
- Less than +/-10mm
- 0.01 - 0.05
- 0.05 - 0.10
- >0.10

0 10 20 Metres

1:1,000

Figure C1 - [B]

1% AEP Flood Depth Difference

51 Masons Parade
Point Frederick
NL201088

NORTHROP

Data Source: